University of Reading

What determines and deters Innovation in the British and Omani Small and Medium-sized Enterprises

A Thesis submitted for the Degree of Doctor of Philosophy

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Dedication

Almighty Allah! All praise and gratitude to you. I dedicate this thesis to my beloved family!

Declaration

I confirm that this is my own work, and the use of all material from other sources has been properly and fully acknowledged.

Shamsa Mas’oud Nasser Al Sheibani

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List of Abbreviations and Acronyms

ASEAN	the Association of South East Asian Nations
BE	Business Environment
CATI	Computer Assisted Telephone Interviews
EU	The European Union
FDI	Foreign Direct Investment
FB	Firm Behaviour
FC	Firm Characteristics
FIPP	Formal Intellectual Property Protection
HM	His Majesty
ICT	Information Communication Technology
IDBR	Inter-Departmental Business Register
IN	Innovation
INVs	International New Ventures
IPRS	Intellectual Property Right System
FIPPR	Formal Intellectual Property Protection Rights
KE	Knowledge-based Economy
LKS	Local Knowledge Spillovers
LSBS	The Longitudinal Small Business Survey
MVPROBIT	Multivariate Probit
ODI	Outward Direct Investment
OECD	Organisation for Economic Cooperation & Development
OLS	Ordinary Least Square
OMR	Omani Rials
R&D	Research & Development

Riyada	The Public Authority for Small and Medium-sized Enterprises
SMEs	Small and Medium-sized Enterprises
WIPO	The World Intellectual Property Organisation
D&B	Dun & Bradstreet
CBR	Cambridge Center for Business Research
BIS	Business Innovation & Skills

Abstract

This research employs both quantitative and qualitative approaches in investigating the drivers and barriers of different types of innovations in the British and Omani small and medium-sized enterprises (SMEs). It follows the existing British Surveys on SMEs and develops a new dataset for the Omani SMEs. Although the Omani data sample is currently small, the framework can be used for future studies to establish larger data samples. An important contribution of this study is the design of the research that allows the findings relating to innovation among British SMES to be used to draw implications for innovation among Omani SMEs.

This research also contributes to the literature as it fills the gap of limited empirical studies that compare both the drivers and barriers of different types of innovation in SMEs, in a developed and a developing economy, in a single thesis. Investigating both the determinants and deterrents of innovation in SMEs is important to have a full understanding and insights on how to enhance SMEs' ability to innovate and respond to disruptions and challenges. Unlike all the previous studies, this study separates services innovation from product innovation, to make it clear that product innovation means goods innovation, and investigates the effect of different variables on product and service innovations separately.

This thesis asks the following four questions. What are the key specific firm characteristics that impact innovation outcomes in the British and the Omani SMEs? What are the key firm behavioural elements that matter for the British and the Omani SMEs in deciding on whether to innovate or not? What are the key specific business environment factors that influence the choice of innovation in the British and the Omani SMEs? What are the barriers that may prevent the British and the Omani SMEs from innovating and how to overcome them?

The first three questions are raised to understand the relationship of the firm characteristics, firm behaviour and the business environment with the innovation of products, services, processes and marketing methods at SMEs level in the UK and Oman. The fourth question is raised to identify the barriers to innovation in the British and Omani SMEs and propose suggestions to overcome them.

This research analyses three datasets, the Cambridge Centre for Business Research (CBR) SME Dataset 1997, the Department for Business Innovation & Skills (BIS) Dataset 2015 and the online Omani SMEs Survey 2018. These are used to test the products, services, operational processes,

organisational or managerial processes, and marketing methods models at the firm level. It also uses the datasets to find out the barriers to innovation in the British and Omani SMEs.

It employs three estimators: the probit, the logit, and the multi-variate probit to have a clear view of the effect of firm characteristics, firm behaviour and business environment factors on different types of innovation in the British and the Omani SMEs. For the Omani sample, the investigated direct relationship between the explanatory variables and the innovation outcomes showed quite sizable variables are insignificant. These are exports, family-owned businesses, firm age, executive founders, access to new exports markets, access to external finance, access to ICT, access to skilled labour and unskilled labour markets out of twenty-five tested explanatory variables. However, when additional tests were carried out, it is found that an indirect relationship between the explanatory variables and the innovation outcomes exist through the firm behaviour and business environment factors.

The British SMEs in the 1990s primarily innovated their products, followed by their processes and services. The marketing methods innovation was the least practised type of innovation by the British SMEs during that period. This finding reflects the British economy in the 1990s, as it was highly industrialised and starting to move towards a knowledge-based economy. Later, the British SMEs in the 2010s shifted their focus as they became more processes and services innovation-oriented, followed by marketing methods innovation. Product innovation is the least practised kind of innovation in the meantime. This finding also reflects the transfer of the British economy to the crypto- economy that requires innovative process solutions to protect privacy, sensitive information and wealth.

The situation with the Omani SMEs now is somewhere between the British SMEs in the 1990s and the British SMEs in the 2010s. This finding reflects the Omani economy's diversification initiatives aiming to leapfrog from a natural resources-based economy to a knowledge-based economy. The Omani SMEs are mostly service-oriented, followed by marketing methods and incremental product innovations. The processes innovations are the least practised among the different types of innovations at the firm level.

The results show that two common and key firm characteristics drive innovation in the British and the Omani SMEs: the 'firm size' and the 'updated equipment & high technology.' The 'firm age' matters for innovation with the British SMEs in and after the 1990s. There are also two common and key firm behaviour elements: the 'R&D' and the 'capacity for expansion.' The

presence of competition, access to local business networks, access to external R&D and government support are the four common and key business environment factors that drive innovation at the firm level.

The results also show that the common and key barriers to innovation in the British and the Omani SMEs are the bureaucratic hurdles of laws and regulations, the rigidities in organisational culture, the financial constraints and lack of proper finance vehicles devoted for innovation purposes. They may be prevented internally by adopting the culture of innovation, starting with the executive founders or both female and male entrepreneurs who may play a significant role in inspiring the team to innovate. The external barriers may be reduced by activating the well-harmonised entrepreneurship ecosystem that aims for economic transformation through innovative solutions.

This research uses cross-sectional datasets; hence there is an issue of causality and endogeneity which is difficult to be treated given that 5 innovation models are investigated with 25 explanatory variables. It would be useful to investigate the innovation model using panel data in future research. The panel dataset will enable the researcher to perform binary choice models for panel data such as the pooled estimation, the random effect, and the fixed effects. Also, it will enable the researcher to see the changes that happened in the SMEs over multiple years. Besides, this research did not cover the sectoral analysis as the models were already exhausted enough with explanatory variables. Therefore, it will be interesting to do an in-depth sectoral analysis with fewer explanatory variables in the model. Moreover, it will be interesting to perform clusters analysis to evaluate the behaviour and performance of the SMEs in each cluster.

Keywords: SMEs, firm, innovation, drivers, barriers, products, services, operational, organisational, managerial, processes, marketing, methods, characteristics, behaviour, business and environment.

Chapter 1: Introduction

1.1 Introduction

Innovation is an essential driver of economic growth as it does not benefit consumers and businesses only, but the economy as a whole. The purpose of this thesis is to investigate what determines different types of innovation in British and Omani small and medium-sized enterprises (SMEs) and to highlight the significant obstacles that may hinder their decision and choice to innovate.

This chapter establishes the research motivation (section 1.2) and sets out the research aims and objectives (section 1.3). It summarises concepts and definitions related to SMEs, knowledge-based economy (KE), and innovation (section 1.4). It also states the research questions and builds up the main hypotheses (section 1.5). It then sheds light on the research limitations (section 1.6), followed by the research contributions (section 1.7). Finally, it outlines the thesis structure (1.8).

1.2 Research Motivation

The research started with macro thoughts and with interest in exploring the knowledge-based economy (KE), followed by the question of how to convert Oman's economy to KE. Owing to the significant role of SMEs and innovation as a driving force for economic growth, productivity, and employment, I thought it would be more practical and beneficial to convert the topic to a micro-level. I also thought that a comparison study between a developed and an emergent economy would be more interesting for a PhD thesis. It will shed light to similarities and differences between the drivers and barriers of innovation in the British and the Omani SMEs. It will also determine where the Omani SMEs stand compared to the British SMEs in 1990s and 2010s. Therefore, I settled with studying the SMEs' transition to KE by investigating the determinants and deterrents of different types of innovation in British and Omani SMEs.

The main reasons for selecting the British SMEs to compare with the Omani SMEs are as follows:

Firstly, the fact that the United Kingdom is ranked No.3 out of 128 countries in terms of the Global Innovation Index, as per the Organisation for Economic Cooperation and

Development (OECD) report (2016). The UK scored 61.9% whereas Oman ranked 73 out of 128 countries, the last among the Cooperation Council for the Arab States of the Gulf (GCC), with a score of 32.2%, which raised the following question. What are the drivers of innovation in UK firms that may inspire firms in Oman to become among the top 20 global innovators in the future? According to the OECD report, this is justified by the high level of the education system reflected by the existence of at least 3 of the Top 10 Universities worldwide in the UK with a large scale of research and development (R&D), the most citable documents and access to information communication technology (ICT). Another essential feature is the large domestic market scale and e-government.

Secondly, the United Kingdom is among the advanced economies (all EU countries, USA, Malaysia, Taiwan, Australia and New Zealand) that adopt firm-based innovation surveys, which have transformed the innovation studies from theoretical to empirical researches.

Thirdly, the easier access to British SMEs datasets as compared to other developed economies since I am a student in a British University; which gives me the privilege to access the Online UK data services through my student ID.

Furthermore, this research study is important and will have an impact on Oman for the following main reasons:

Firstly, the slump in the oil prices that started in 2014 and continues today has prompted the urgency for Oman to diversify the resources of national income and continuous economic development. The key challenge facing Oman is the creation of good jobs for the nation. Oman's potential for growth and stability will be achieved if the desires and innovative forces of Omani youth can be put into action.

Secondly, the speech of His Majesty, the Sultan Qaboos bin Said, at the Saih Al Shamekhat's Symposium in 2013 inspired me to study more about SMEs. His Majesty stressed the fundamental role played by the SMEs in the national economy and considered them as the foundations of all national economies. Since SMEs' role is crucial in every economy, and our main concern is on how to convert Oman's economy to the KE, I focused on SMEs.

Thirdly, this study compares British SMEs with the Omani SMEs because the UK has been always ranked among the top five innovative economies worldwide by OECD, which raised

the following question. What are the drivers of innovation in UK firms that can inspire firms in Oman to become among the top 20 global innovators in the future?

1.3 Research Aims and Objectives

This research aims to:

- Contribute to finding ways of diversifying the economy and sources of income.
- Participate in discovering pathways for effective or successful SMEs' transition to KE.
- Help the policymakers in better understanding the barriers and drivers of innovation in Oman and the UK to limit or overcome the obstacles and invite or boost the determinants of innovation.

The objectives of this research are:

- To investigate the drivers and barriers of different types of innovation in the British SMEs in the 1990s and the 2010s.
- To explore the determinants and deterrents of different types of innovation in the Omani SMEs.
- To provide a comprehensive comparison study between the three different studied datasets and theories.

It is vital to understand some key concepts and definitions, as summarised in section 1.4 to achieve the research aims and objectives.

1.4 The Concepts and Definitions

1.4.1 Definition of the Small and Medium-sized Enterprises (SMEs)

Small and medium-sized enterprises may be defined differently from one country to another. For example, what is defined as SME in the UK and the USA is not the same definition in Asia. However, SMEs are mainly defined based on the total number of employees and total annual sales or turnover of the firm. According to Riyada (The Public Authority for Small and Medium-sized Enterprises) in Oman, the SMEs are those enterprises that fit with the following determined categories.

Table 1. 1 Definition of the SMEs in Oman

Firm Size	Micro	Small	Medium
Total Employees	1-5	6-25	26-99
Annual Sales (OMR)	Less than 100,000	100,000 to 500,000	500,001 to 3,000,000

In comparison, the SME definition as per the Organisation for Economic Cooperation & Development (OECD) is slightly different. The total number of employees is stretched to an upper limit of fewer than 250 employees which is applicable in the European Union. However, this is not the practice in the United States as it includes firms with less than 500 employees in the SME's categorisation. Financial assets are also included in SME's definition. The turnover of micro firms (less than 10 employees) should not exceed EUR 2 million (equivalently, around $2.3 million) while the turnover of small enterprises' (10-49) employees should not exceed EUR 10 million (equivalently, about $11.7 million) and that of the medium-sized enterprises' (50-249) employees should not exceed EUR 50 million (equivalently, around $58.7 million) (OECD, 2005, p. 17). This research follows the SMEs definition based on employment size of micro, small and medium as defined in Oman and UK.

1.4.2 Definition of the Knowledge-based Economy (KE)

The world economy has undergone a necessary structural change driven by both globalisation and the ICT revolution that led to introducing a new economic system in recent years. The increased usage of knowledge characterises the modern economic system via the fast circulation of ICT, productivity growth, and the aggressive trend in competition and globalisation. Henceforth, the role of knowledge has captured the attention of entrepreneurs and businesses at the international level.

Knowledge is either codified or tacit (Dasgupta & David, 1994). In other words, it is either embodied into machinery and equipment or disembodied through scientific and technological literature, consultancy, education systems, movement of personnel, etc.). Public spending on education, training, R&D, and ICT is referred to as an investment in knowledge. On the one hand, economists view knowledge as a public good produced from

R&D activities that cause knowledge spillover and hence increase returns (Grossman & Helpman, 1994; Romer, 1994). On the other hand, Langlois (2002) argued that knowledge, whether tacit or codified, is embodied in institutions and artefacts that make its transfer possible even in the absence of any codification.

There is a debate in the recent literature on the interaction between elements of KE and the impacts and opportunities they might develop in both developed and developing countries. R&D is the largest factor in knowledge and innovation expenditures. The R&D data usually either overstates the detection of technological innovations or discounts a wide range of activities that includes the creation or the use of new knowledge in innovation. Therefore, knowledge depends on R&D, learning, networking of the firm and non-R&D expenditures, such as training, market research, design, production, marketing, etc., as well as capital expenditure, which is a major mode of 'embodied' knowledge spillover.

Drucker (1998) argued that knowledge had become the key economic resource and the dominant or perhaps the only source of competitive advantage. He defined KE as an economy where wealth is generated primarily through the production of goods and services that have significant intellectual content. He popularised the term *'knowledge economy'* when he used the title 'The Knowledge Economy' in Chapter 12 of his book "The Age of Discontinuity" in 1969. He attributed the term to an economist named Frits Machlup (1962), who was inspired by Fredrick Winslow Taylor's post publishing his book '*The Principles of Scientific Management'* in 1911.

Powell and Snellman (2004) defined the KE as the production of goods and services based on knowledge-intensive activities that contribute to a faster pace of scientific and technological progress. The major characteristic of the KE is the higher dependence on intellectual competences than on the natural resources or the physical inputs. Furthermore, David and Foray (2002) pointed out that knowledge-based communities are agents of economic change. They argued that knowledge-based activities are generated when ICTs support people, and often interact to create and share new ideas, information, and technologies that are highly used to collect and spread the new knowledge. Hence, a

knowledge-intensive community is one wherein a large proportion of members are involved in the production and reproduction of knowledge.

In our opinion, KE can be defined as the latest stage of development in global economic restructuring. Thus, the developed countries such as the UK have transitioned from an agricultural economy (Pres-Industrial Age), mainly the agrarian sector, via the industrial economy (Industrial Age), primarily the manufacturing sector, and the post-industrial or mass production economy in the mid 1990 known as the service sector, to the knowledge economy in the late 1990s to 2000s, mainly the technology and human capital sectors. It is not the case with some developing countries such as Oman. Oman started with a natural resources-based economy and made a leapfrog to a services-based economy by overtaking the industrial sector. Figure 1.1 illustrates the stages of transitional economies, starting from the agrarian sector to the innovation sector.

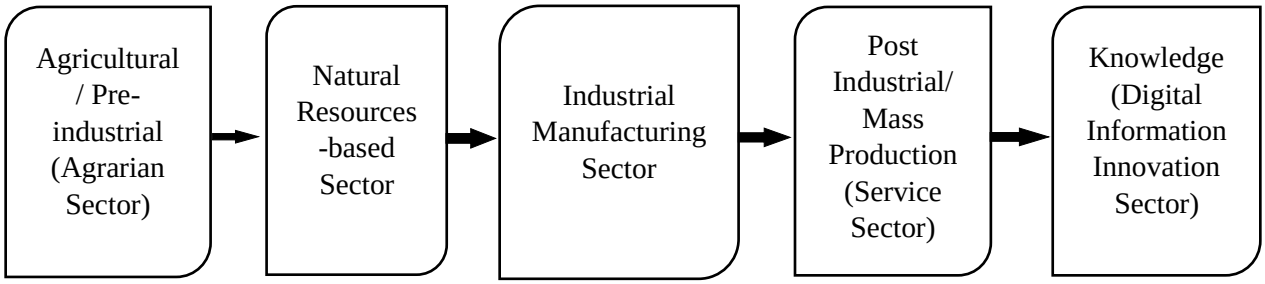

Figure 1. 1Transitions of economies

I also think that KE can be defined as the economy where the conventional factors of production – land, labour, capital, and technology – are utilized to maximize growth, employment, and productivity through processing the KE inputs: human capital (knowledge, education, training & development, work experience), Research & Development, Information Communication Technology, Infrastructure Support, and Innovation inputs, as illustrated in Figure 1.2.

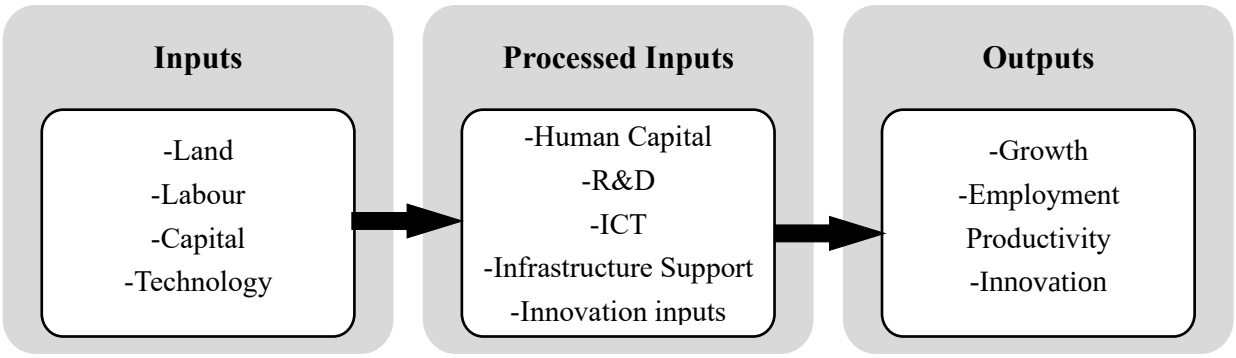

Figure 1. 2 KE conceptual framework

According to the Organisation for Economic Cooperation and Development Report (OECD, 1996), the term "knowledge-based economy" is widely used to describe the important role of knowledge and technology in economic growth. The OECD economies, including the UK, are more highly dependent on the production, distribution, and use of knowledge than ever before. Knowledge, as embodied in human capital and technology, has always been significant to economic development and its importance has further been recognised over the last few years in Oman.

I picked two theories that resonate with the concept of KE, as follows:

Firstly, ***"Modernization-emancipation theory"*** states that if economies develop continuously, then their course follows two stages: a transition from agrarian to industrial economies and from industrial to knowledge economies. The first transition increases the bureaucracy in the economy, whereas the second increases the individualisation (Welzel, 2007). Individualisation is used in the sense of an increasing desire for emancipation or freedom from domination (Welzel, 2013).

Secondly, ***"The modern economic theory of entrepreneurship"*** claims that influential entrepreneurs establish good judgement in making risky innovations based on their knowledge. They are compensated either through salaries or profits according to the role that they played as managers or employees or owners of their firms (Buckley & Casson, 1985).

1.4.3 Definition of the Innovation

Innovation is defined in dictionaries as "the introduction of something new." Innovation is a universal concept that can be applied in various areas. In the business world, innovation is defined as the process of transforming a new idea or invention into a good or service with

value addition for customers who will buy it. In practice, innovation is a result of a firm's application of business ideas that satisfy the needs and expectations of the customers. In short, the concept of innovation is commonly associated with the terms *"new," "significant change," "improvements," "enhancement,"* and *"creation."* Kuratko and Hodgetts (2004) defined innovation as the change and enhancement of comprehensive resources to create new wealth.

In Economics, innovation is an important driving force of economic development that pays back consumers, businesses, and the economy as a whole. In economic terms, innovation describes the creation and application of ideas and technologies that enhance goods and services or make their production more efficient. Therefore, the main advantage of innovation is its substantial contribution to economic growth and employment creation. The innovation can lead to higher productivity when the same inputs produce greater outputs. As productivity rises, more goods, services, and jobs are created; hence, the economy grows.

The most used definition of innovation today is the official OECD definition articulated by the *Oslo Manual*. It states that innovation is *"the implementation of a new or significantly improved product (goods or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations."* (OECD, 2005, p. 46).

The OECD categorises innovation into four types: product, process, organisational and marketing innovations. Based on OECD (2016), product innovation is the launch of a new product in the form of either a good or a service or a significantly improved one in terms of its characteristics or intended uses. Process innovation is the execution of a new or significantly improved operational process concerning either the production or delivery methods. Marketing innovation is the execution of a new marketing method or significantly improved marketing method such as product packaging or design, product placement, product pricing or promotion. An organisational innovation is the execution of a new or significantly enhanced organisational process such as business practices, firm organisation or external links and networks. This thesis employs four types of innovations as dependent variables. They are incorporated into five regression models, as the service innovation is

separated from the product innovation to investigate the effect of independent variables on them separately or individually.

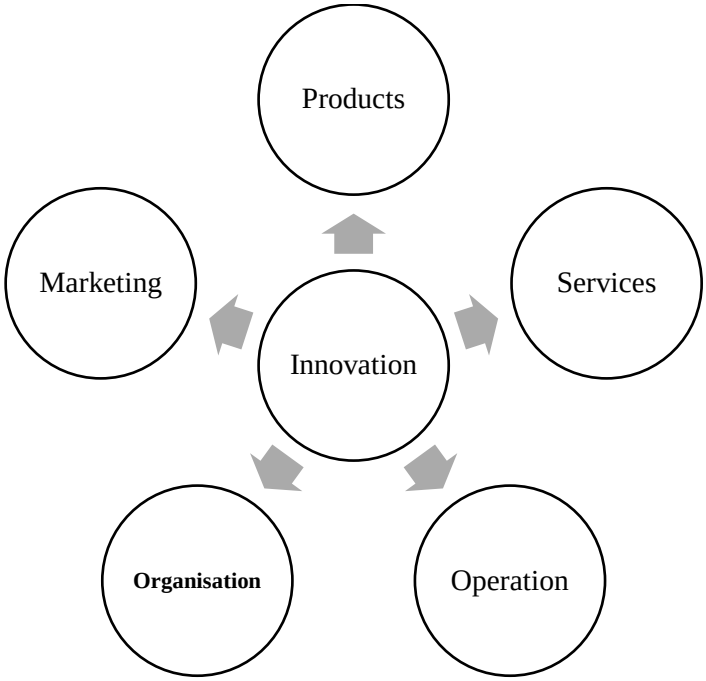

Figure 3. 1 Innovation outcomes

I believe that innovation is neither restricted to the most developed economies nor restricted to the high technology sectors. Innovation has transformed into a global vision, influencing all sectors of the economy. Schmookler (1966) argued that innovation is an economic phenomenon, which can be satisfactorily understood in terms of its familiar analytical challenge. Explaining such innovation phenomena has become the major issue in Economics towards improved competitiveness, higher standards of living and growth.

1.5 The Statement of Research Questions

This thesis sheds light on the Omani SMEs' transition to KE by focusing on the innovation pillar. It investigates the different types of innovation determinants and deterrents in Omani and British SMEs. The overall research raises four important questions, as follows:

1. What are the key specific firm characteristics that impact innovation outcomes in the British and the Omani SMEs?
2. What are the key firm behavioural elements that matter for the British and the Omani SMEs in deciding on whether to innovate or not?
3. What are the key specific business environment factors that influence the choice of innovation in the British and the Omani SMEs?
4. What are the barriers that may prevent the British and the Omani SMEs from innovating and how to overcome them?

The research examines four key hypotheses as follows:

The first and the second hypotheses suggest that there are **internal** determinants of innovation in the form of key specific *"SMEs' characteristics"* and key specific *"firms' behaviour elements"*. The third hypothesis suggests that there are **external** drivers of innovation and are related to *"business environment factors"*. Both types of drivers of innovation affect directly or indirectly SMEs' choice and decision to innovate.

The fourth hypothesis claims that barriers to innovation may also be internal or external to the SMEs. They may differ from one firm to another according to their belongingness to specific sectors and the development of countries and markets where they operate.

The hypotheses are then tested on whether the firm's characteristics, behaviour and business environment have an impact on the firm's different types of innovations. It is done by estimating five innovation outcomes at the firm level, using three estimation techniques: the probit, the logit and the multivariate probit (MVPROBIT).

1.6 The Research Limitation

The main research limitation pertains to the nature of cross-sectional datasets that raises causality and endogeneity concerns. This is difficult to be treated given the research investigates 5 innovation models with 25 explanatory variables. There are other issues related to the datasets as follows.

Firstly, the Cambridge Centre for Business Research (CBR) dataset covers only SMEs in the manufacturing and services sectors in the UK. SMEs in other industrial sectors which are

directly related to innovation are not in the dataset. Moreover, the dataset is cross-sectional as it covers data for a single year (1997). However, the sample size is good as it included 2,520 British SMEs.

Secondly, the Department for Business Innovation & Skills (BIS) dataset is also cross-sectional as it covers data for one year only (2015). However, the sample size is quite large, as it included 15,502 British SMEs.

Thirdly, the Omani SMEs Survey dataset is also cross-sectional as the online survey was conducted for a single year (2018). Also, the sample size is quite small relative to the previously investigated datasets as it includes just 200 Omani SMEs. However, the sample is satisfactory and representative of the population.

Therefore, it will be useful to study the model using panel datasets, to enable the researcher to perform binary choice models for panel data and see the changes that happened in the SMEs over multiple years. Besides, this research did not cover the sectoral analysis as the models were already exhausted enough with explanatory variables. Therefore, it will be interesting to do an in-depth sectoral analysis with fewer explanatory variables in the model. Moreover, it will be interesting to perform clusters analysis to evaluate the behaviour and performance of the SMEs in each cluster.

1.7 The Research Contribution

This empirical research adds value to the existing literature as follows.

Firstly, this research follows the current British surveys on SMEs and establishes a new dataset for the Omani SMEs. The framework can be used in future studies to establish larger data samples. More prominently, the findings pertaining to innovation among British SMEs can be used to draw implications for innovation among Omani SME's as the result of the research design.

Secondly, it fills the existing gap in the literature since SMEs' theories have only been applied in limited countries and rarely been applied to the Cooperation Council for the Arab States of the Gulf (GCC), including Oman. There is no published research on SMEs' drivers and barriers to innovation for any Arab country.

Thirdly, the research provides comparisons of the results of different types of innovation in three survey datasets: the British SMEs in the 1990s, the British SMEs in the 2010s and the Omani SMEs in the 2010s.

Last but not the least, unlike the previously published papers, it separates the service innovation from the product innovation to make it clear that product innovation means goods innovation and investigates the effect of different variables on product and services innovation separately.

Finally, unlike all the previous published papers on innovation models, it takes into consideration the clear effects of medium-sized and mid-aged firms by including the firm size squared and firm age squared.

1.8 The Structure of the Thesis

The remainder of the thesis paper is structured as follows. Chapter 2 presents the reviewed literature followed by the research methodology in Chapter 3. Chapters 4 and 5 investigate the drivers and barriers of innovation in the British SMEs in the 1990s and the 2010s, respectively. Chapter 6 explores the determinants and deterrents of innovation in the Omani SMEs in the 2010s. Finally, chapter 7 recaps the major findings and concludes with outlines of the implications for policy in the UK and the Sultanate of Oman.

Chapter 2: The Literature Review

2.1 Introduction

An extensive literature suggests that different firms innovate differently. For instance, some firms actively register patents post conducting internal research and development (R&D). Other firms collaborate with external partners who possess the expertise and the required competencies. Further, others through licensing, acquire the most updated technology or promote innovation, such as supporting best practices in design, staff training and marketing research.

However, although high costs and uncertainty are often associated with innovation, its advantages have been promoted by several authors, such as Crepon, Duguet, and Mairesee (1998), who suggested that a firm's efficiency and productivity are positively related with outputs of innovation. Moreover, Banbury and Mitchell (1995) also recognised a positive correlation between the rate at which firms can innovate new products and processes and long-term sustainability. Furthermore, the fact that innovative firms outperform non-innovative companies is considered as the key conclusion of Jin, Hewitt-Dundas, and Thompson's (2004) research.

This chapter sheds light on the literature related to the drivers and barriers of different types of innovation in small and medium-sized enterprises (SMEs). Section 2.2 presents background about some general theories relevant to SMEs. Section 2.3 summarises the key and most recent empirical studies related to innovation in SMEs. Section 2.4 discusses the main research theory. Section 2.5 examines the literature on barriers to innovation. Finally, section 2.6 provides a summary of the reviewed literature.

2.2 General Theories

As this study is located within an extensive body of literature dealing with SMEs' transition to a knowledge-based economy, it is important to start by discussing theories related to the firm, transition, growth and innovation to provide a comprehensive outlook for the research study.

2.2.1 Theories of the Firm

This subsection presents the static view of traditional theories as opposed to the dynamic view of new theories. While doing so, it also touches on some basic entrepreneurship

literature and discusses literature related to family-owned businesses and government support.

The Static View of Traditional Theories

Starting with "*The theory of the firm",* which links entrepreneurship with economic growth. This theory is the microeconomic concept that states the overall nature of firms is to maximise profitability by creating the greatest possible gap between revenue and costs. Profitability can be achieved through innovation. Also, the theory has been debated about whether a firm's goal is to maximise profits in the short term or long term.

Firms that target long-term profitability may choose to innovate radically rather than incrementally, which is more likely related to short term profitability. Moreover, the decision-making of a firm's executives is influenced by competition in the market. The higher the competition, the higher is the urge to maximise profits. Profit maximization can be fulfilled when the firm stays one step ahead of its competitors by adapting its offerings and reinventing itself. Therefore, a balance between short-term profits and investing in the future maximises the long-term profits.

Firms that focus on profit maximisation take risks in respect of public perception and a loss of goodwill between the company, consumers, investors, and the public. Therefore, focusing on stakeholders' satisfaction through providing innovative products, services, operational processes, organisational or managerial processes and marketing methods will mitigate such risks.

For larger firms, the economies of scale were the critical factor in dictating efficiency during the mass production age. According to the classical theories such as "*the free market economic theory*" of Adam Smith (1776), the prices of products are set based on free bargaining of the supply and demand in the market.

Later, Galbraith (1952) formulated a theory of political modification of markets. He argued in his *"theory of countervailing power"* that the power of large business is dependent on the size of its labour and government intervention, which contradicted the concept of the invisible hand or unobserved force in the market that equilibrates the supply and demand.

Unlike larger firms, smaller firms do not have such political and labour force countervailing powers, hence they need to be innovative and find alternative strengths, such as access to ICT, new export markets, skilled labour markets, unskilled labour markets, external finance, external R&D, strong business networks, and the local regulatory planning body and government support.

Moving to the entrepreneurship literature, Coase (1937) explained in his article *"The nature of the firm"* why individuals prefer to establish any form of business entities, such as companies and partnerships, rather than to trade in the markets via contracts. Since it is possible to carry out the production process without establishing or registering a firm, he raised a question of why and under what conditions should firm are expected to emerge?

He argued that a firm is established when an entrepreneur starts to recruit people. Then, he explored under what circumstances it is sensible for the entrepreneur to recruit individuals rather than choosing to make contracts in the market. *"The traditional economic theory"* assumed that it is cheaper to contract out than to hire employees because the market is efficient, as the producers who are best at offering each good or service at the lowest price are already doing so.

However, Coase (1937) found that transactions costs exist when contracting in the market, as the quoted price of the good or the service includes the cost of obtaining them through the market in addition to other costs such as search and information costs, bargaining costs, keeping trade secrets and enforcement costs. It implies that firms will emerge when they manage to produce such goods and provide such services at suitable prices that minimise or skip such additional transaction costs.

Moreover, Coase (1937) found that there is a countervailing cost to the firm due to the diminishing returns of the entrepreneur function. It includes the rise in overhead cost and misappropriation of resources. Coase (1937) also provided a breakthrough on the importance of intellectual protection property rights and transaction costs for the institutional structure, which is considered a managerial or organisational processes innovation.

Furthermore, the traditional economics literature on industrial organisation explained why more than one firm is required to exist in the industry. Additional profitability encourages a

firm's entry into the industry, and this is why the entry of new firms is interesting and important, as new firms equilibrate the market at competitive levels. Moreover, Audretsch (1995) provided another explanation for the entry of new firms by arguing that new firms are not established to be smaller clones of the larger incumbents. On the contrary, they exist to function as agents of change through innovation.

The Dynamic View of New Theories

The firm is the opening topic for most theories of innovation, where firms are exogenous, and the created technological change is endogenous. For instance, *'the Knowledge Production Function Model'*, which was developed by Zvi Griliches (1979), is the most common model found in the literature of technological change. Firms exist as an exogenous factor, and they engage in the new economic knowledge as an input into the process of producing innovative activity.

'New economic knowledge' is the most significant input in the knowledge production function. There are empirical studies that indicated a strong and positive relationship between the knowledge inputs, such as R&D, and the innovative outputs. For instance, Cohen and Klepper (1992) concluded that R&D contributes highly to generating new economic knowledge. Furthermore, Pfirrmann and Walter (2002) argued that the most innovative countries are those with the highest investment in R&D and the low innovative output is related to less developed countries, which rarely produce new economic knowledge.

Similarly, most innovative industries are known for their sizable investment in R&D and new economic knowledge. The industries which are highly investing in R&D, such as computers, pharmaceuticals and instruments, produce new economic knowledge and innovative high output. These differ from those with low investment in R&D, such as wood products, textiles and paper, which tend to generate only a minor amount of innovative output. Therefore, the Knowledge Production Model linking knowledge-generating inputs to outputs holds at more aggregated levels of economic activity (Audretsch, 1995).

The model of knowledge production function becomes even less convincing given the recent wave of studies revealing that SMEs are the engine of innovation in certain industries. These results are surprising, as Scherer (1991) observed that the greater share of industrial R&D is undertaken in the largest corporations. SMEs account only for a minor share of R&D inputs.

As the Schumpeterian hypothesis predicts, the knowledge production function implies that innovation favours those organisations with access to knowledge production, known as the large incumbent organisations. The recent evidence revealing the strong innovative activity raises the question: Where do new and small firms obtain the knowledge?

Audretsch (1995) answered the above question. He argued that although the model of knowledge production function may still be valid, the indirectly assumed unit of observation at the level of the firm may be less valid. The reason why the knowledge production function holds more closely for more aggregated degrees of observation may be that investment in R&D and other sources of new knowledge spills over for economic exploitation by third-party firms.

To sum up, unlike the traditional theories which suggest that entrepreneurship delays economic growth, new theories suggest that entrepreneurship stimulates and generates growth. The reason for these theoretical contradictions is explained in the context of the theory. The traditional theories are static and new knowledge has no role.

In the traditional theories, the firm's efficiency is determined merely by the ability to use economies of scale, which controls growth. However, new theories are dynamic, and new knowledge plays a big role, which is crucial in innovation. Since knowledge is characteristically indefinite, asymmetric and associated with high costs of transactions, discrepancies arise regarding the expected value of new ideas. Therefore, economic agents have no incentive to leave an incumbent firm and form a new firm in an attempt to commercialise the observed value of their knowledge.

Family-owned Businesses Theories

Many small firms are family-owned businesses, but not all family-owned businesses are small firms. Family-owned businesses are an important element in most economies and may constitute up to 65 percent of GDP. They are various and range from very small to very large firms with different structures of family engagement. They also exist within the context of societies which share various values, attitudes, laws, and business practices (Howorth et al., 2010).

According to Howorth et al. (2010), there are several kinds of family firms, such as founder-owned, small family-owned ones handed over by generations and large family-owned pyramidal firms. The last kind of family-controlled firm is unique and lower in risk-taking, unlike the former family business, which is more entrepreneurial and more open to innovation and taking risks. It uses cross-shareholding, super-voting shares, and centralised ownership to leverage family equity and to have control of multi-corporations.

Besides, Howorth et al. (2010) pointed out that family relationship allows family-owned firms to avoid institutional shortfalls at the commencement of industrialisation. The family frontier expresses the boundary of trust, merging of capital and managerial resources. Also, the owners of the family business can use protective strategies to develop a business culture. The authors then addressed the succession of family generations, stating its relationship with the advancement of ownership structure, and the significance of planning and preparation of successors for the evolution.

Moreover, they highlighted that culture is a key factor in influencing the development of family-owned firms. For instance, in the USA, the family firms' management is usually allocated to professional managers even when family equity ownership is large. However, this is not the case in Europe, Africa and in Asia, where the family members are in control of the business, as it is viewed as an advantage. For instance, Casson (2014) argued that the ownership advantage determines the management capability that governs the firm's potentiality and the attainment of this potential through overcoming growth obstacles. Therefore, ownership advantage in this sense complements management capabilities.

Finally, they pinpointed the need to value the roles played by family members in the family-owned businesses, particularly women who are neither owners nor managers, yet facilitate relationships between those who are directly engaged in the firm.

Firms' growth and survival may be derived by innovation; hence, it is important to also go through the growth theories, as summarised in section 2.2.2.

2.2.2 Theories of Growth

This subsection presents the traditional theories of growth as opposed to modern growth theories. It also discusses models related to SMEs' growth; in particular, the Stochastic

Model, Human Capital Model and Learning Model. Then, it sheds light on the determinants of firms' growth other than firm age and firm size that are also determinants of firms' innovation.

The traditional theories of growth

The firm's growth was the main research subject for the majority of economics studies in the 1950s and 1960s (Hart & Paris, 1956; Simon & Bonini, 1958). At that time, the firm's growth was thought to be regulated by Gibrat's Law, also known as the *"Law of Proportionate Growth"*. It suggests that the firm's growth does not depend on the firm's size. It holds for large firms, as at that time the dataset included only large firms, but after the inclusion of small firms, it was found that it doesn't hold for them. As a result, more theoretical and empirical studies were conducted on firms' growth and survival. These studies focused on both firm size and age in explaining firms' survival and growth patterns. For example, Simon and Bonini (1958) further showed that firm growth is unrelated either to the firm's size, prior growth or age. Also, based on comprehensive datasets, Geroski (1995) and Lotti et al. (1999) suggested that Gibrat's Law is not confirmed for new-born or established firms, as smaller firms proportionally grow faster than larger ones. Moreover, many other empirical studies have rejected Gibrat's Law due to the evidence that there is a negative relationship between firm size and growth (Dunne & Hughes, 1994; Dunne, Roberts, & Samuelson, 1989; Evans, 1987a; Liedholm, 2002; McPherson, 1996; Shiferaw, 2006; Storey et al., 1987).

The modern theories of growth

"The modern theory of small firm growth" is based on a few grounds and assumptions. Firstly, if the expected pay-off of entrepreneurship exceeds the pay-off of employment, individuals select entrepreneurship over being employed. Secondly, there is a positive relationship between a person's capabilities and the pay-off to becoming an entrepreneur. Thirdly, individuals are not certain of their capabilities, but they learn from their experiences. Finally, smaller firms have a greater failure rate, but the surviving ones grow faster than bigger firms.

The exact mechanism linking knowledge creation to growth is not understood fully, even though knowledge supports growth. Audretsch and Keilbach (2004) discussed that entrepreneurs play the role of transforming new knowledge that is not used by large firms into growth. They argued that much of the entrepreneurship literature consider

entrepreneurial opportunities as internal factors, whereas they are created externally. While large firms create much knowledge, they filter knowledge as they do not use all the knowledge created since its utilisation is contaminated with uncertainty. It provides opportunities for SMEs to always take up a large share in utilising and commercialising the new knowledge.

The authors elaborated that much of the commercialisation of innovation is based on knowledge spillovers to SMEs and is executed by individuals who are former employees of large firms. They argued that in general SMEs, which are mainly involved in knowledge-based industries, experience higher growth and also lower survival rates.

Audrestsch and Keilbach's (2004) arguments are consistent with a 'Lamarckian evolution'. Active Lamarckian evolution depends on the capital of entrepreneurship that includes a set of agents and institutions which support the creation of new firms. It requires social approval of entrepreneurial behaviour and the willingness of entrepreneurs to take the risk of creating new firms. It also includes the involvement of financing agents who are willing to share the risks.

Three key growth models are relevant to small and medium-sized firms: The Stochastic Model, Human Capital Model and Learning Model.

The Stochastic Growth Model

The Stochastic Model is closely associated with Gibrat's Law. It consists of three elements that influence the growth of SMEs. These are the constant growth rate of the market, which is common to all firms, the systematic tendency for the growth of the SMEs to be related to their initial size, and the random growth term. Many researchers have explained the Stochastic Model of growth (Dunne et al., 1989; Evans, 1987a, 1987b; Hall, 1987; O'Farrell & Hitchens, 1988). Since the Stochastic Model proposes that many factors influence the growth of the firm, O'Farrell and Hitchens (1988) conclude that there is no dominant theory in this model. It also does not have a suitable framework to test the firm's growth. However, other authors trust that there is a 'minimalistic' theoretical background behind the testing of Gibrat's Law in empirical studies (Coad, 2007).

The Human Capital Model

Lucas (1978) argued that entrepreneurs have a specific managerial capability that impacts the success of their business. He assumed that skills differ across employees. As a result, the size distribution of firms is based on the relative endowment of entrepreneurial talents and skills of employees.

Penrose (1959) explained that the Human Capital Model contains two different arguments: the resource push and the managerial limits to growth. *"The resource push argument"* views firms as a bundle of resources tied up together by a mix of administrative skills that deploy them most effectively (Geroski, 2002). *"The managerial limits to growth argument"* assume that there are limits to the expansion that existing managers can achieve. It also assumes that there are limits to the management capacity due to the constraint to the expansion of the number of managers (Penrose, 1959).

Human capital is related to the firm's 'internal' environment because the personal characteristics and leadership styles of the owner-manager are counted in this environment (Gibb & Scott, 1985). Plenty of literature has stressed factors related to human capital that affect the firm's growth, such as the owner's age, educational level, training, personal values, inspiration to growth, occupational background, personal objectives and managerial styles (O'Farrell & Hitchens, 1988: 1373).

The Learning Model

The Learning Model was developed by Jovanovic (1982). There is a considerable literature on growth that covers the Jovanovic Model (Liedholm & Mead, 1999; Storey, 1994; You, 1995). The Jovanovic Model suggested that management ability differs across entrepreneurs. This information is unknown to the firm's owner when a new firm is formed.

Besides, Jovanovic (1982) claimed that firms have different efficiencies. When the firms enter into production, they get to understand their real efficiency on a gradual basis. They may adjust their behaviour after learning about their real capabilities. Based on the imperfect information on firms' efficiency levels in each period, firms select output levels to maximise projected profitability. Then, based on the firms' efficiency levels, they update their expectations. The firms that review their capability upward tend to expand, and those who review them downward tend to contract or exit the market (Liedholm & Mead, 1999; Storey,

1994; You, 1995). This model has significant suggestions and shows that both firm age and firm size are critical for firms' dynamics. It estimates that firm failure and growth rates are negatively related to the age and size of the firm (Liedholm & Mead, 1999).

Jovanovic's model is entirely consistent where founders are quite heterogeneous; early failures are quite common, and entry mistakes can easily happen (Vivarelli, 2007a). However, the model does not take into account the progression of a firm's abilities. It assumes that firms are capable of birth with an unknown value of time-invariant characteristics. Therefore, it was called "*a passive learning model*" by Pakes and Ericson (1987, 1998).

Pakes and Ericson (1987, 1998) then developed an "*active learning model"* in which managerial abilities are improved through human capital development. This model is an extension of Jovanovic's basic model (Liedholm & Mead, 1999). However, in the active learning model, a firm is expected to know the future distribution of the industry structure, its characteristics, and the characteristics of its competitors (Vivarelli, 2007a).

To sum up, the early theories of growth, such as Gibrat's Law of Proportional Effect, were characterised to be statistical. Later theories, however, demonstrated entrepreneurship as a learning process, as the entrepreneur gains feedback information on the firm's performance post-formation. The three firm growth models summarise various factors of the growth of SMEs. Random factors, human resources, and learning ability all affect the firm's growth.

The driving force behind most of the empirical studies on firms' growth and survival is the strong positive relationship between efficiency and firm size that is supported by both the passive learning and active exploration models. However, the evolutionary learning framework has shown there is a significant impact of ownership structure on this relationship; hence the efficiency-size relationship is not supported in some firm's ownership structures, such as the labour-managed firm (Kamshad, 1994).

Other Determinants of Firm Growth

There is plenty of literature on factors affecting firms' growth other than *firm size* and *firm age*. Firstly, *firms' level of investment in innovation and R&D* is positively correlated with firms' growth and productivity (cf. Lööf & Heshmati, 2002). Knowledge capital, defined as

"the ratio of innovation sales to total sales," is a significant variable contributing to firms' innovative level and performance heterogeneity. Furthermore, the survival and growth amongst firms are dependent on differential rates of investment in knowledge such as R&D, as argued by Klepper and Simons (1997) or intersectoral differences in the firm's size and intensity of R&D, as argued by Levin et al. (1985). Moreover, the increasing codification of knowledge stock would increase firms' innovative performance, as suggested by Brusoni et al. (2001) and David and Foray (2002).

Secondly, firms' ICT and infrastructure support are positively correlated with firms' growth and productivity. For example, Zon (2001) extended Lucas's (1988) model by adding the effects of ICT on capital investment. He assumed that ICT has a positive effect on growth performance by improving both the total factor productivity and enhancing the efficiency of knowledge accumulation and the learning process.

Thirdly, firms' human capital is partially translated as the knowledge, skills, and abilities of the founder-entrepreneurs, which are regarded as key factors contributing to firms' success and growth (Storey, 1994). It implies that the founder-entrepreneurs' level of education and experience in terms of knowledge, skills, and training are part of firms' human capital. Moreover, the empirical literature shows that knowledge is positively related to human capital. For instance, Winter (1987) argued that tacit and codified knowledge are substitutes yet are seen as complements in the learning process. Brusoni et al. (2001) found a strong positive relationship between the industry's investment in skilled people (high tacit skills) and codified knowledge.

Subsection 2.2.3 discusses the evolvement of theories of innovation. It looks at other aspects relevant to SMEs as follows: innovation theories and government support to SMEs' innovation. It also presents intensive literature on strength of SMEs and large firms: their respective advantages and disadvantages, as well as their complementary and contradicting roles.

2.2.3 Theories of Innovation

Schumpeter (1934) discussed innovation in four aspects: product, process, organisation, and market. He argued that some industries focus more on product innovation while others focus on process innovation, depending on their product or market characteristics. Moreover,

intellectual property rights like patents and trademarks are more effective for product innovation than process innovation, which leads to varying patterns of innovation across industrial sectors depending on the firm size.

Schumpeter's earlier work (1912) considered the independent, small scale, entrepreneurial type of firm as the dynamo of innovation. However, post his research in *Capitalism, Socialism, and Democracy* for more than three decades, *Schumpeter* (1942) found that the real innovator was the large-scale establishment or unit of control that does not work under conditions of comparatively free competition. He did not explicitly differentiate between the effects of the size of the firm and the effects of the power of the market on innovation. He focused mainly on the effects of market power on innovative activity and the effect of innovation on the market structure in a dynamic process of creative destruction.

Scherer (1991) described the creative destruction process as an innovation that led not only to superior new goods and services. It simultaneously undermined the market positions of firms committed to old ways of doing business. It destroyed old monopolies while creating new economic value. To the extent that monopoly power accompanied the value-creating innovations, its processors had to exercise their power cautiously both in pricing and product policy in case they stimulate another wave of monopoly-eroding changes.

Galbraith (1952) indicated that innovation had become so costly to the point where it could only be done by firms that had the resources with substantial size. Berchicci and Tucci (2010) further developed the innovation's theme. They considered that new entrants are more effective innovators than longer-established incumbent firms. They argued that incumbents are often quite successful innovators. However, they may intentionally postpone the commercial utilisation of some of their inventions, which sends the wrong message to the market as if their innovation performance is weak.

Curran (2000) argued that despite the well-established support systems in Western economies, there is little evidence of any significant impact on the performance of SMEs that have accepted support. Later scholars investigated other aspects relevant to SMEs as follows: innovation, government support for innovation in SMEs and comparison between SMEs and larger firms.

Innovation

"Open innovation theory" states that firms must use internal and external ideas of innovation, as well as internal and external market channels to implement innovative strategies and boost their technology (Chesbrough, 2006). The theory implies that firms should not rely only on internal ideas and market channels, but must consider external ideas and pathways that could be equally important. In the process of adopting innovation, SMEs face obstacles that include lack of innovation resources, methods, and managerial competences. However, SMEs still demonstrate strong capabilities in achieving constant improvements and innovation. In short, open innovation provides an opportunity to SMEs for exploiting external innovation resources, exploring scientific innovation ideas and managerial capabilities (Chesbrough, 2006). Also, firms are motivated to innovate by facilitating their entrance into new markets, which will enable them not only to sustain their current market position but to expand, as argued by Shefer and Frenkel (2005) and Webster (2004).

Government Support for SMEs' Innovation

Like any firm, SMEs face financial barriers that may hinder their success. They need support to overcome capital constraints. Based on Giddens' theoretical framework, innovative SMEs can be built close to research institutions or universities with a high capacity of R&D.

Doh, S. & Kim, B. (2014) found there is a positive relationship between the governmental financial aids and regional South Korean SME innovations as a result of investigating the impact of governmental subsidy on innovation of regional SMEs. They also examined whether the governmental support policies enhance patent and new design registrations of SMEs. They found that a positive relationship exists among the technological development assistance by the government and patent acquisitions and new design registrations of regional SMEs. Also, they tested whether the networks with universities promote technological innovation of regional SMEs. They found that networks with universities also have a positive relationship with patent acquisitions and new design registrations of regional SMEs. More literature on government support to innovation in SMEs is available in subsection 2.4.3 of 'Business Environment'.

Strengths of SMEs

The relative strengths of SMEs rely on behavioural characteristics such as higher motivation in management and labour, more distinction and creativeness in workers' tasks, adequate knowledge in distinctive skills and flexibility in communication (Nooteboom, 1994; Rothwell & Dodgson, 1991). Overall, there are comparative advantages of SMEs and large firms concerning innovation. While the relative strengths of SMEs are 'the behavioural characteristics,' the large firms' advantages are 'the resources. However, it is neither the SMEs nor large firms which are the better innovators.

In the process of technical advance, SMEs and large firms are likely to have 'complementary' roles, as they are better at different types of innovation. Therefore, finding ways to combine large firms' resources with the behavioural characteristic of SMEs is the target of the management of both types of firms. It can be achieved by R&D cooperation and the development of networks (Vossen, 1998).

The advantages of large firms versus SMEs and their complementary roles are discussed next.

The Advantages of Large Firms

Market power and firm size are correlated; hence, economists find it difficult to separate their effects. It has been claimed that firms with the power of monopoly would be more likely to innovate as they have a higher ability to harvest the innovation rents. Also, firms earning monopoly profits are better able to utilise their internal resources in financing R&D, hence avoiding the disadvantages of external financing. External financing requires disclosure of at least some of the project's information and release of tangible collateral under lien in case of project failure.

It has been argued that the scale of economies in R&D does exist. To achieve such a comparative advantage, it requires a sizable firm with large volumes of sales that can captivate the fixed cost of innovation. It has also been suggested that there may be economies of scale in the R&D process itself. Unlike the advantage mentioned earlier which is financial, this latter benefit is purely technical as it relates to the higher quality of researchers who interact with their colleagues in similar disciplines or research groups to solve common

problems and collaborate to discover new inventions, as suggested by Kamien and Schwartz (1975).

Moreover, larger firms are in a better position to grasp the benefits of the innovation process since they tend to have larger output. Also, due to capital market imperfections, large firms can easily be granted external financing for risky R&D projects, as they are usually better in managing their risks by diversifying their portfolio of R&D projects. Furthermore, large firms are better able to exploit the results of their research efforts, either due to their ability to complement the R&D project with other activities such as exceptional marketing channels or due to their good market image and reputation, which grant them easy entry to new markets, as suggested by Nelson (1959).

Nooteboom (1994) and Rothwell and Dodgson (1991) view the relative advantages of large firms through a material lens. They listed, for example, economies of scale and scope, cheaper resources, risk diversification, and specialisation in terms of people and equipment.

The Advantages of SMEs

The disadvantages of large firms are viewed as advantages to SMEs. In contrast to what was mentioned in earlier literature, counterparties think that firms that possess monopoly power may be less motivated to innovate because they are rival free (Scherer, 1991) and sales of new products may be at the expense of the sales of existing products. Mansfield (1968) and Mansfield et al. (1971) argued that large firms might face inefficient managerial coordination and loss of flexibility due to the longer chain of command, as more people are involved in decision-making. Therefore, firms may become bureaucratic as they grow large. Furthermore, researchers may lose interest to innovate in large firms as their effort is not recognised as much as in small firms.

The relative strengths of SMEs depend on behavioural attributes. For example, there is higher motivation in labour and management due to ownership, flexibility and more variation in the scope and task of employees, in addition to the existence of diverse tacit knowledge in skills and communication (Nooteboom, 1994; Rothwell & Dodgson, 1991). Also, taking risks and accepting uncertainties are fundamental in entrepreneurship (Storey & Greene, 2010).

The Contradictory Characteristics of Large Firms and SMEs

The literature also suggests other characteristics of large firms and SMEs that can be an advantage and disadvantage at the same time. For example, the lower hierarchy in SMEs reduces bureaucracy, lowers filtering of proposals and increases flexibility on the one hand, but it limits career opportunities for their employees on the other hand. Moreover, less filtration of proposals may result in more original ventures or lack of rejections to unsuccessful business ideas. As another example, task specialisation in large firms may result in unique and scarce competencies, but it can lead to a lack of attention for marketing and financial planning (Vossen, 1998).

Rothwell and Dodgson (1991) argued that in SMEs, the technical human resources are well plugged into other departments while in large firms, the technical personnel are isolated from other corporate departments. However, Cohen and Levin (1989) suggested that complementarities between R&D and other non-manufacturing activities are developed better in larger firms.

Furthermore, it has been argued that large firms are better in attracting highly skilled specialised labour (Rothwell & Dodgson, 1991), while Zenger (1994) suggests that SMEs are better in offering contracts that reward performance management, which helps to retain engineers with outstanding capabilities. Rothwell and Dodgson (1991) argued that the shareholder pressures in larger firms could force a focus on short-term profits while Nooteboom (1994) claimed that in SMEs, the management is informal and lack strategic planning due to lack of managerial time and skills, which may result in a short-term perspective. Since the advantages of SMEs are in general, the disadvantages of large firms and vice versa, Figure 2.1 summarises the relative advantages of both types of firms.

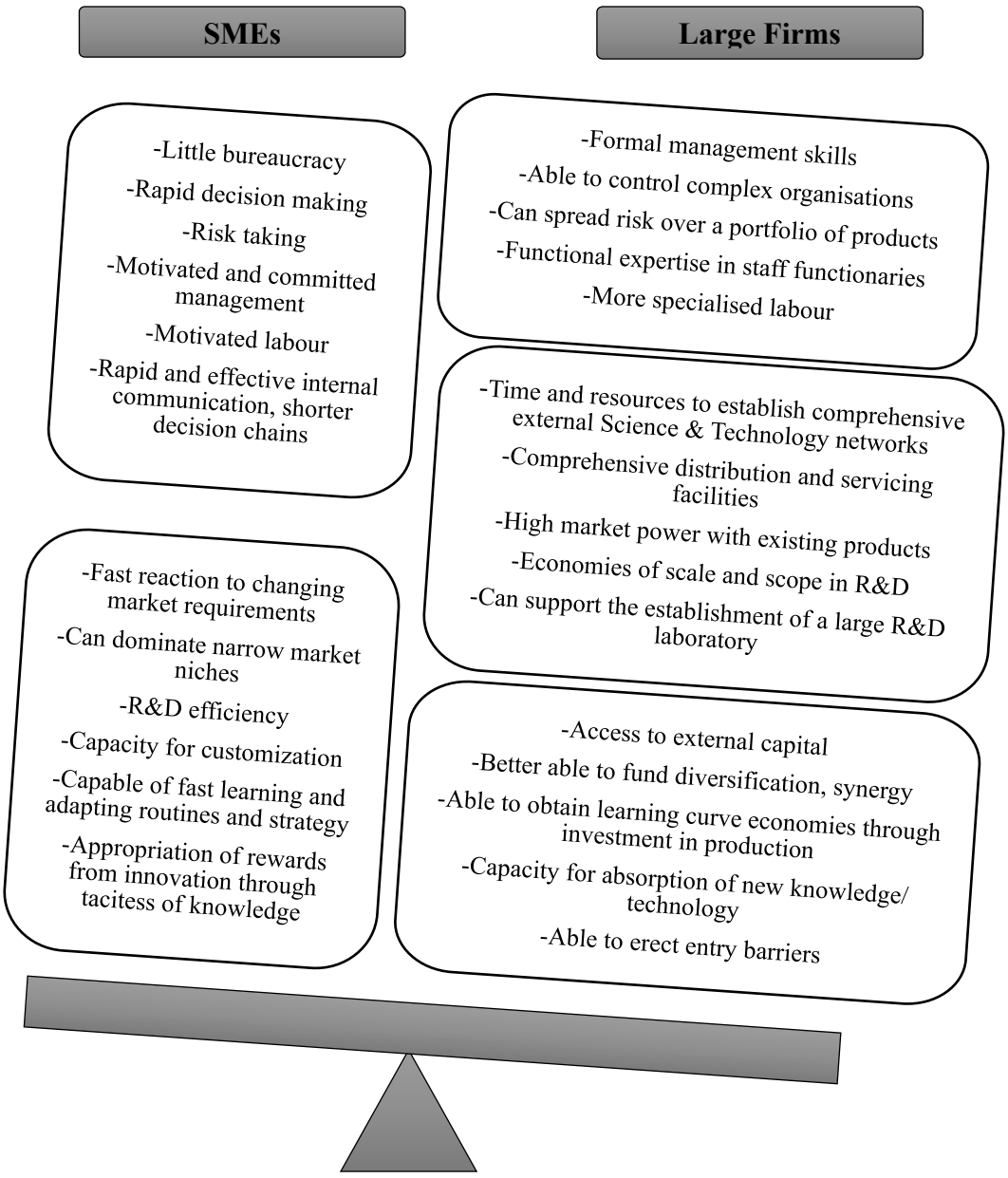

Figure 2. 1 Relative advantages of SMEs and large firms.

Content cited from Table 1 of Combining small and large firm advantages in innovation: Theory and examples (Vossen, 2016)

The complementary role of large firms and SMEs

The majority of empirical results show that SMEs conduct R&D more efficiently than large firms. Moreover, SMEs and independent inventors are disproportionately accountable for substantial innovations (Acs & Audretsch, 1990). It is reaffirmed by Vossen (1998), who found that SMEs are more profitable and cost-efficient in innovation. Other empirical studies indicated that SMEs have more innovative output than expected from their innovative input. Zenger (1994) concluded that organisational diseconomies of scale are greater than the technological economies of scale in R&D. It has been further argued that the R&D of SMEs is usually underestimated in many surveys because they do not have a formal and separate R&D department (Kleinknecht & Reijnen, 1991).

Also, studies of the components of innovation costs showed that larger firms do have higher spending in R&D activities than SMEs (Archibugi, Evangelista & Simonetti, 1995; Felder, Licht, Nerlinger & Stahl, 1996). Moreover, the findings of Acs, Audretsch and Feldman (1994) showed that SMEs are better in taking the knowledge spillovers' advantages from corporate R&D laboratories and universities. Besides, the economic value differs between SMEs and large firms. Also, on average large firms produce fewer innovations per dollar spent on R&D; but their innovations are on average of higher quality (Cohen & Klepper, 1992).

To conclude, it is neither SMEs nor large firms that are better innovators. SMEs and large firms are good at different kinds of innovation, and they play different roles in the industry cycle in a dynamic complementary approach (Nooteboom, 1994). For instance, large firms are better at science-based innovations with higher average economic value that use economies of scale and scope and require a large number of specialists (Cohen & Klepper, 1992). On the other hand, SMEs are relatively better in innovations with no effects of scale and where they can use their flexibility and efficiency in inventing new products. Besides, they can take over the knowledge spillovers from the corporate R&D departments of large firms (Acs, Audretsch & Feldman, 1994).

2.3 Key Recent Empirical Studies

Many studies have investigated the drivers of innovation in SMEs in different countries. Examples include Baldwin et al. (2001) and Raymond and St-Pierre (2010) for Canada;

Romijn and Albaladejo (2002) for the United Kingdom; Vega-Jurado et al. (2008) and Guadalupe et al. (2010) for Spain; de Jong and Vermeulen (2004) for the Netherlands; Bertschek (1995) for Germany; Hong, Oxley, McCann and Le (2016) for New Zealand; and Lee et al. (2010) for South Korea. Other studies on innovation in the Association of South-East Asian Nations (ASEAN) and other East Asian economies have been conducted by Hahn and Narjoko (2011), Intarakumnerd (2011), and Intarakumnerd and Ueki (2010).

This section presents in detail the most recent literature on gender and innovation. It also touches on internal, external R&D, and sectors and their impact on innovation. The extensive literature on drivers of innovation is discussed in section 2.4.

2.3.1 Gender and Innovation

Gender issues of innovation are rarely discussed because innovation research lacks analyses on where innovation takes place and who participates in it (Fagerberg et al., 2005). Moreover, the role of the innovator is rarely covered in the innovation literature (Brannback et al., 2012). Therefore, gender is almost invisible due to the lack of focus on individuals as actors (Alsos et al., 2013). This research includes two of the firm characteristics: "businesses led by female" and "businesses led by male" which are among the firm characteristics or among independent variables used to explain the different innovation models. The variable "businesses led by both female and male" is considered the dummy variable.

Gender and innovation have been addressed for the last two decades. However, the literature is still limited (e.g. Abrahamsson, 2002). The word gender here refers to gendered structures and processes that contribute to understanding innovation rather than women (Alsos et al., 2013). However, the existing literature highlights women's experiences and focuses on how gendering processes impact women. For example, Amble et al. (2014) discuss how the invisibility of innovation in the public sector impacts women as well as the ways innovation policies create a role for women as providers of different resources (Kvidal & Ljunggern, 2014).

The issue of gender and innovation is evolving as empirical research. On the one hand, Ostergaard et al. (2011) suggested that gender diversity is positive for innovation. On the other hand, other published researches overlooked the contribution of women in innovation

(e.g. Blake & Hanson, 2005; Kvidal & Ljunggren, 2013). This contradiction showcases the need for further research studies to clarify the role of gender in innovation.

Alsos and Ljunggren (2013) examined innovation in diverse cultural and geographical backgrounds: three countries in East Africa – Kenya, Tanzania and Uganda; three countries in Latin America – Colombia, Bolivia and Brazil; and two European countries – Germany and Portugal. They found that the barriers facing innovative women are unexpectedly similar throughout these selected countries, in spite of the different cultural and geographical settings. They also found that innovative business activities carried out by women are invisible or unseen participation.

Lindberg et al. (2013) investigated the organisational innovation in two Swedish firms in highly masculine sectors, mining and forestry, by monitoring the gender equality measures. They applied two different classifications on gender equality measures based on newness: traditional and innovative. They found that three of the measures can be viewed as organisational innovation: cooperation with gender researchers, creative workshops, and engaging in work to challenge masculinities.

Brink et al. (2014) examined gender and innovation in new and small businesses and found that women are less likely to innovate technologically-based products and processes compared to men. They explained that women and men have different role expectations and concluded that women are not less innovative than men. However, women, in general, face institutional constraints and traditional role models that limit their choices to female-typed occupations and working structures such as part-time work.

Amble et al. (2014) investigated innovation in the care sector in Norway. They demonstrated new methods of organising work hours. They carried out action research in two health care institutions. They presented an organisational process innovation in the form of a new rota system. They also introduced full-time care work and changed the norm of part-time employment. The new system introduced longer shifts and a new resource team for the nurses. It improved the quality of care services and the working arrangements at the workplace, as employees drove it.

Aidis (2016) interviewed three successful Latin American women entrepreneurs from Bolivia, Brazil and Colombia. She found them to be innovative in personal services and industrial services as well as in the recycling and manufacturing sectors. She also saw that compared to the US and Asian women entrepreneurs; Latin American women entrepreneurs score at a medium level in innovativeness. Aidis (2016) then looked at the government support extended to these three women entrepreneurs, their business networks, their access to global markets, and bureaucratic barriers that they face in their businesses. She found that international recognition grants them visibility, credibility and access to resources in their local countries.

There is a risk with theorising merely about women and their experiences as it strengthens the dominant image of men as the unmarked sex; hence, men and masculinities need not be challenged (Oudshoorn, 2004). Although men and masculinities are dominant to organisational analysis, they are not centred in the investigations. Moreover, ideas of femininity and masculinity when attached to women and men may invite gender sensitivities (Poutanen & Kovalainen, 2013; Remneland-Wikhamn & Knights, 2013).

Research on gender and innovation assumes that the male-dominated industries are perceived as sites for technological products innovation (Wajcman, 2010). However, the visibility of men in innovation may also be overstated if not examined. Therefore, the point is not about developing the technology; it is simply about renegotiating masculine identities. Oudshoorn (2004) argued that men are generally seen as important and highly visible agents when it comes to innovation. However, they are invisible to users of particular health care innovation. There are three implications for men working in these industries: positive, negative and mixed-effects (Holter, 2014), as will be discussed next.

Firstly, the view of the positive effects may promote the focus on innovation because being involved in innovation is rewarding and maximising job satisfaction for the male innovators. For example, Mellstrom (2004) demonstrated how Malaysian male motorbike repair shop workers and Swedish male engineers are passionate about machines. They experience self and job satisfaction when working closely with machinery and equipment.

Secondly, the view of the negative effects may advocate that with the pressure to be innovative sometimes comes also stress or bad health issues. Those who are not willing to

innovate may eventually have to leave the firm or the industry. However, since paid work continues to determine men's identity, the consequences of the exclusion of non-innovative men or men who fail in undertaking innovative activities may also be crucial (Catala et al., 2012).

Thirdly, the mixed-effects view may assume that the effects on men working in male-dominated industries will be different for different groups of men (Holter, 2014) and also that men exercise diverse masculinities in different situations. For example, Filteau (2014) showcased how men working in the oilfield can apply new dominant masculinity reflecting safety at the workplace.

Given this discussion of emerging gender and innovation issues, this research thesis also investigates the effect of businesses led by a female and businesses led by a male on different types of innovation as discussed in subsection 2.4.1.

2.3.2 Other factors

Internal and external R&D

Ceccagnoli et al. (2013) empirically found that SMEs use internal and external R&D activities to enhance innovation performance. Other studies show that SMEs undertake informal and non-permanent R&D by utilising the resources from various functions due to lack of financial and technological capabilities.

Moreover, Annique, Cuervo-Cazurra, and Asakawa (2010) found that R&D alliances with universities and suppliers have a positive impact on the firms' product innovation. However, R&D collaborations with competitors appear to influence product innovation negatively. It suggests that not all R&D partnerships have a positive impact on product innovation.

Furthermore, Hagedoorn and Wang (2012) and Berchicci (2013) found empirically that at higher levels of in-house R&D intensity, a complementary relationship between the internal and external R&D exists, while a substitutability relationship exists between them at lower levels of in-house R&D intensity.

Formal Training

There are few studies on formal training as a determinant of innovation at the firm level. Formal training is an important component of innovation. Bauernschuster, Falck, and Heblich (2009) argued that formal training increases the innovation propensity in the firm

through knowledge sharing; hence lack of access to the skilled labour market is often viewed as a barrier to innovation. They found that there is a positive and significant relationship between formal training and *incremental rather than radical* innovations in German firm over the period from 1997 to 2001.

Moreover, formal training on radical innovation is considered risky; hence, firms prefer training for incremental innovation to keep the employees up-to-date on major changes in high technology. Gonzàlez, Miles-Touya, and Pazò (2016) found that formal training has a positive impact on innovation at the firm level. They also found that formal training complements R&D, and both have a positive effect on product innovation.

The empirical studies on the relationship between training and innovation do not differentiate between formal and informal training. Dostie (2013), Zwick (2005), Barrett and O'Connell (2001), Black and Lynch (1996) found that the effect of classroom training (formal training) and the on the job training (informal training) is positive on innovation. Pischke (2005) argued that the amount of informal training conducted by firms are higher than the amount of formal training; hence, the informal training may have a larger influence on innovation than formal training at the firm level.

Besides, it is also vital to differentiate between different types of innovation. Becheikh, Landry, and Amara (2006), and Michie and Sheehan (2003) found that different types of innovation involve different types of inputs.

Dostie, and IZA (2018) found that both formal and informal training have a positive impact on innovation at the firm level. They found that informal training has a higher effect on several types of innovation than formal training. They considered this result as a surprise because formal training has a higher impact on a firm's productivity than informal training. They also found that the process innovation has the highest effect on the firm's productivity. Therefore, they concluded that informal training positively influences the productivity of the firm through the process's innovations.

2.4 Main Research Theory

The recent literature on innovation factors can be categorised into three groups: firm characteristics (FC), firm behaviour (FB) and business environment (BE). There are

'indirect' relationships between these categories. For example, the observed firm characteristics are the result of the firm's behaviour or strategy. Also, the business environment that the firm operates in influences both the firm characteristics and behaviour (Hong, Oxley, McCann, & Le, 2016).

In view of the conceptual framework (Figure 2.2), Hong, Oxley, McCann, and Le (2016) developed and tested the following part of innovation model on New Zealand SMES as a starting point.

Innovation indicator(s) = *f* (*fc, fb, be*)

Where: ***fc*** = firm characteristics, ***fb*=** firm behaviour, ***be*** = business environment and Innovation are 4 types: product, operational process, organisation or managerial process and marketing methods.

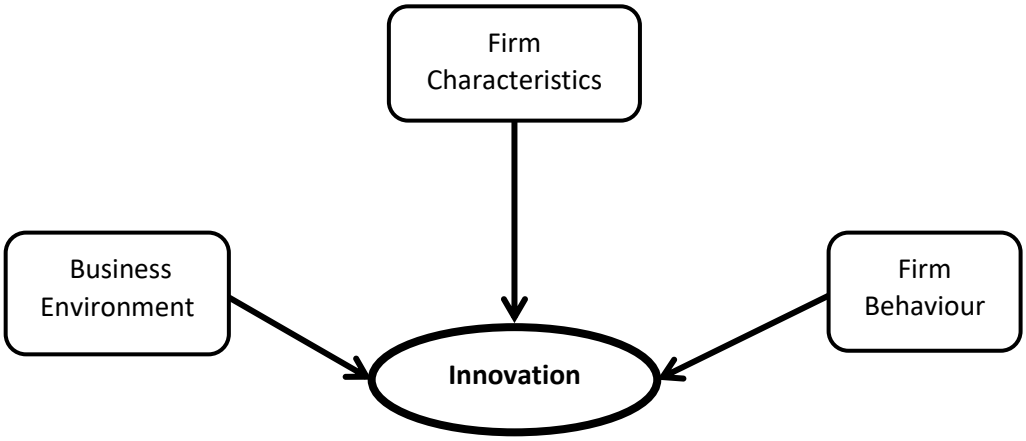

Figure 2. 2 Innovation Model

(Hong, Oxley, McCann, & Le, 2016)

This research adopts the empirical innovation model as a starting point for the British SMEs in the 1990s (ch.4), the British SMEs in the 2010s (ch.5) and the Omani SMEs in the 2010s (ch.6). However, the testing is done on 5 types of innovation models as service innovation is added.

There are three main limitations to this innovation model. Firstly, the existence of a non-linear relationship between innovation intensity and ***fc***, ***fb***, ***be*** is established. Secondly, the

causation is nowhere simple in the selected model: for instance, the impact of ***fc*** on innovation through ***fb and be*** and the impact of ***fb*** on innovation through ***be***. Therefore, assuming that ***fc*** and ***fb*** are independent is unrealistic. The third limitation is the lack of feedback loops in the innovation model.

Furthermore, the investigation in chapter 6went beyond the starting point by exploring the indirect impact of the firm characteristics, firm behaviour and business environment on different types of innovation as illustrated in dotted lines on figure 2.3, which is mentioned on the paper published by Applied Economics in 2016 as a conceptual framework. However, it was neither empirically tested nor published by the authors Shangqin Hong, Les Oxley, Philip McCann and Trinh Le. Therefore, testing the indirect impact of independent variables on innovation may be considered as a contribution in the current research.

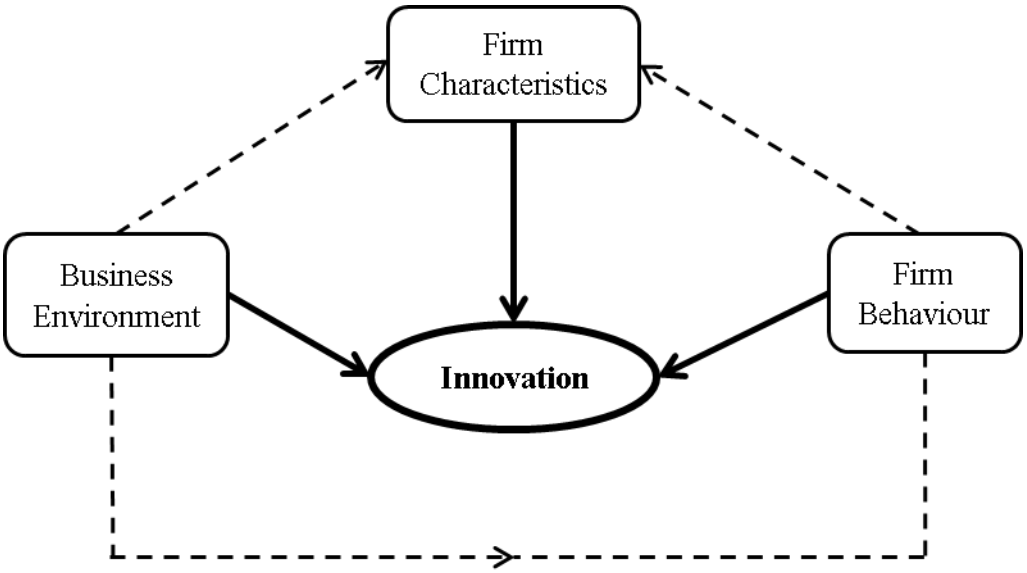

Figure 2. 3 Innovation Conceptual Framework

(Hong, Oxley, McCann, & Le, 2016)

There is a large literature on the firm and market characteristics that led the current generation to create the unit-record-based firm-level surveys on the determinants of innovation in several countries (Hong, McCann, & Oxley (2012). It is argued by Schmookler (1966) that innovation is a fundamental economics concept, which can be effectively understood as an analytical tool. Explaining such a concept becomes a principal issue in Economics for a higher standard of living, growth and competitiveness.

The first and the most well-known testable hypothesis of the drivers of innovation is the Schumpeterian hypothesis, which was initiated by Schumpeter (1942). It suggested the existence of a relationship between innovation, firm size and market structure. The argument presented in Schumpeter's primary work is quite different from that in his later writings, owing to changes in the modern economy.

Many authors, such as Phillips (1971), Freeman (1982) and Nelson (1959) referred to the 'two Schumpeter's' in their work. They argued that the 'early' Schumpeter or Schumpeter Mark I (1934) focused on the important role of start-ups and small entrepreneurs in innovation, whereas the 'later' Schumpeter Mark II (1942) leaned to large monopoly firms. However, Langlois (2003) defends Schumpeter's position by arguing that the authors' misunderstanding of Schumpeter's overall work resulted from their ignorance of the economic process, as the coexistence of the theories does not reflect a change of opinion. Entrepreneurs indeed bring innovation to life, but monopoly formalises the innovation process for competitive advantages.

Authors have identified a wide range of factors as potential drivers of innovation post the Schumpeter hypotheses. The firm's capability to innovate is the heart of SMEs' participation in production networks (Harvie et al., 2010); hence, a better understanding of the firms' innovation capability is worth exploring. Reviews of the drivers of technological innovation have been provided by Teece (2010) and Souitaris (2003).

The selected literature which is discussed in the next subsections provides the basis for the empirical research analysis aimed at highlighting the key determinants of innovation in the British and the Omani SMEs.

2.4.1 Firm Characteristics

The firm characteristics are examples of explanatory variables that highly influence the innovation at the firm level.

Firm Size

Schumpeter (1934) claimed that new and small enterprises are important for innovation. His hypothesis examined the relationship between innovation and firm size, where firm size is a typical example of a firm characteristic. The larger firms have more resources that are devoted to innovative activities and are decentralised in decision-making while the SMEs

may suffer from resource constraints which discourage engagement in innovative activities (Kamien & Schwartz, 1975).

Furthermore, Schumpeter (1942) focused on large monopoly firms and their tendency to innovate to maintain their leadership advantage. Kamien and Schwartz (1975) argued that larger firms have more resources and autonomy in decision-making, so more resources are allocated to innovation in larger firms than in SMEs. Armbruster et al. (2008) found the production capacity, which is related to firm size, is highly correlated with innovation.

Larger firms are more likely to have higher access to the financial resources required for investment in new technology. They are also more likely to attract the necessary human capital and other resources. Cohen and Levin (1989) and Hall and Khan (2002) argued that large firms produce economies of scale and spread the associated fixed costs across a greater number of units.

Pavitt, Robson, and Townsend (1987) observed that both large and small firms exhibit above-average innovation, but medium-sized firms innovate below-average intensity; hence creating a non-linear relationship between the firm size and innovation. Acs and Audrestsch (1990) found that small firms learn from knowledge spilt over from larger firms and tend to innovate radical innovations. Langlois (2003) focused on small entrepreneurial businesses and concluded that entrepreneurs bring innovations to life. Moreover, there is a high correlation between innovation and production capacity as related to firm size (Armbruster et al., 2008).

Both larger and smaller firms have above average innovation intensity, whereas medium-sized firms have below-average innovation intensity. Therefore, firm size can have a positive effect on innovation as larger firms are positively influencing innovation. It can also have a negative impact on innovation, as smaller firms are also positively influencing innovation.

Exports

Likewise, business makeup, which covers ownership, organisational structure, and export status, matters for innovation. Researchers pay closer attention to multinational corporations while testing the Schumpeterian hypothesis because of their larger size and dominancy as

compared to domestic-oriented firms, which are usually SMEs with monopolistic market competition (Hirschey, 1982).

The positive linkages between FDI by US multinational associates and labour-skill requirements, which was used as R&D proxy, was stressed by Baldwin (1979). This approach is based on the argument that multinational firms innovate more than domestic firms because of their known firm-specific advantages. For example, they have higher benefits to their innovative efforts as a result of their access to international market, higher internal resources to devote to innovation because of their higher knowledge-acquisition options due to their global and multi-sites structure (McCann & Acs, 2011).

Exposure to foreign trade improves firms' innovation capability through exports, imports and FDI. Keller (2009) found that technology spillovers have a positive impact on imports and firms' inward and outward FDI.

In addition to foreign direct investment, exports are a type of foreign expansion. Gruber, Mehta and Vemon (1967) and Horst (1972) suggested that firms that are engaged in innovative activities have higher export sales. However, Lin and Chen (2007) had the opposite thought in which they proposed that firms that export their products are more likely to be innovative. Furthermore, Hong, Oxley, McCann, and Le (2016) found that business makeup factors matters for innovation. It includes exports intensity.

Love and Ganotakis (2013) found a positive relationship between exports and British SME's capability to innovate in a high-technology sector. Moreover, Hall and Khan (2002) suggested that imports of high technology products from developed countries are usually associated with a high level of knowledge spillover and transfer.

Firms that export goods and services have a positive impact on innovation.

Also, firms' innovation is affected by further factors, such as firm age, product characteristics, firm locality, and stock of knowledge as follows.

Firm Age

In general, a firm age is measured in years. Based on the recent empirical evidence, there are different views on the relationship between firm age and innovation. On the one hand, Koberg et al. (1996) and Hurley and Hult (1998) suggested that younger firms are more

innovative, as they are more receptive to radical innovation due to the infusion of new members into the organisation who are receptive to new ideas and have a thirst towards winning a higher stock of market share and maximize their profits. Li (2001) also suggested that new firms rely on product innovation to gain a competitive advantage to survive and ensure sustainable growth. Avermaete et al. (2003) found that young firms tend to introduce innovations that have a larger impact on firm's turnover. Hausman (2005) states that younger micro firms are more innovative than their older counterparts. Craig and Moores (2006) concluded that younger firms are more likely to innovate radically.

On the other hand, Sorensen and Stuart (2000) argued that older firms are facing bureaucracy issues, but they possess knowledge accumulation and experience, which makes them engage more in incremental innovation. Avermaete et al. (2003) found that older firms are more likely to introduce products that are new to the market segment in which they compete.

The firm's age is positively related to its capability to innovate, as older firms usually have accumulated more experience in learning how to improve their efficiency than younger firms. However, the firm's age is also negatively related to its capability to innovate, as younger firms usually have infused new blood (new resources) who are fast in learning and have a thirst for capturing a market share through radical innovation. Shefer and Frenkel (2005) examined 209 industrial firms in the northern part of Israel. They found that younger firms were investing in research and development more than older firms. It is because it is more difficult for older firms to adjust to new technological changes than it is for younger firms. Younger SMEs are more flexible in taking advantage of breakthroughs in technology through start-ups or incubating centres than older SMEs. Moreover, Craig and Moores (2006) argued that innovation is related to the firm's life stage. They found that firms are more likely to innovate in the earlier stages of their life span.

In general, firms innovate regardless of their age. Younger firms are more likely to innovate radical products and operations, whereas it can have a positive effect on innovation as older firms are more likely to innovate incremental products, services and processes.

Sites

Leiponen (2006) argued that organisational structure is a component of business makeup where a firm could have a single location or headquarters and may have branches and

subsidiaries in which innovation gets effected according to how the firm is receptive to knowledge transfer and spillovers. Moreover, a business's structure is established based on a particular set of objectives and activities, where it has been proposed that the knowledge transfer between each unit is likely to influence the firm's innovation (Frenz & Letto-Gillies, 2009).

Foreign-owned firms have the advantage of employing assets owned by foreign partners, such as sharing technological know-how and financial support. Thus, foreign ownership is theorised to have a positive impact on SMEs' capability to innovate. However, the importance of foreign ownership may rely on the share of the ownership, as parent companies may restrict the sharing of resources to overseas firms if they do not hold a large controlling interest over those firms. Guadalupe et al. (2010) found that the parent companies of multinational firms acquire firms in foreign countries that are more likely to be adopting new technologies and innovating their products and processes.

Furthermore, McCann and Acs (2011) contend that multinational firms are more likely to innovate than domestic firms due to their higher internal resources that are devoted to innovation activities and knowledge acquisition opportunities.

The number of sites or branches or subsidiaries has an indirect relationship with innovation outcomes. Therefore, the impact of sites on innovation will depend on such factors as the firm's ability to share and transfer knowledge and resources within the main office, branches or subsidiaries. The higher the ability to share knowledge and resources among them, the more likely they innovate and vice versa. The firms with access to subsidiary resources are more likely to innovate if they have an incentive to innovate; otherwise, the effect may be insignificant.

Location

Brouwer, Budil-Nadvornikova, and Kleinknecht (1999) suggested that the unique specification of the location directly or indirectly influence the firm's innovation, as firms in urban agglomerations tend to invest more in R&D activities and product development compared to firms situated in rural areas. Audretsch (2003), Sedgley and Elmslie (2004), and Herrera, Munoz-Doyague, and Nieto (2010) found that agglomeration has a positive impact on innovation when considering human capital, R&D and the high technology sector as

controlled variables. Bell (2005) found that firms in clusters produce more innovation than firms located in remote places. Alegre and Chiva (2008) and Falk (2008) argued that location is usually used as a control variable in innovation empirical studies to fix the differences in inter-regional or inter-country samples.

The impact of location on innovation is insignificant or unclear unless the firm is investing in other activities that boost innovation such as R&D activities, human capital and technology, in which case the effect may be positive and significant.

High Quality Branded Product

The World Intellectual Property Organization (WIPO) published a report in 2011 about the changing face of innovation. Firms use branding as a strategy to control and manage consumers' perception of their products and image. In many cases, branding creates a sustainable competitive advantage for firms. A complementary relationship exists between branding and innovation because firms that invest in branding also invest in innovation.

Moreover, sometimes, firms face a choice between either branding or innovating. Branding complements innovation (WIPO, 2011). Kirner, Kinkel, and Jaeger (2009) suggested that product diversity or specialisation depends on how complex the products and services of the firm are. Hong, Oxley, McCann, and Le (2016) found that product characteristics also appear to be positively related to innovation.

There is a positive effect of the branded product on innovation when a complementary relationship exists and a negative effect of the branded product on innovation when a substitutability relationship exists.

Updated Equipment and High Technology

Johnston (1966) found that acquisition and usage of durable physical goods like machines, plants and buildings are positively related to innovation. Santamaria, Nieto, and Barge-Gil (2009) suggested the use of updated equipment and advanced technology such as automatic machinery and robots, is positively related to innovation, especially with the firms in the technology sector.

The investment of updated equipment and high technology in SMEs positively boost the firm's ability to innovate.

Executive Founders

Hong, Oxley, McCann, and Le (2016) found that business makeup factors matters for innovation. It includes organisational structure, business ownership, etc.

The effect of executive founders on innovation depends on the level of commitment extended by the executive founders towards innovation. The higher commitment may imply there is a positive effect; lack of commitment may have a negative impact on innovation, and a trivial commitment level may imply that there is an insignificant effect on innovation.

Family-owned Business

Laforet (2013) found that a dynamic environment positively affects young innovative family firms. She also found that environmental uncertainty, competition, long-term survival and sectoral trends positively affect old, innovative family firms. Moreover, she concluded that innovation has a higher impact on younger family firms' business financial performance than older family-owned firms.

The effect of family-owned firms on innovation outcomes varies according to the extent of changes in the business environment. Positive changes in the business environment may positively affect innovation outcomes of the family-owned firms. Negative changes in the business environment may negatively affect the innovation outcomes at family-owned firms. No changes in the business environment may imply an insignificant effect.

Business Led by Females

Akulava (2015) identified a small but positive effect of having a female owner on the propensity of the firm to implement a new product or service and to introduce a new business process or marketing strategy. Although there are differences between countries and regions, on average, female-led firms are consistently demonstrating more innovative behaviour than male-led firms. For example, in the developed world, women entrepreneurs are either more likely to introduce innovative products and services to the market than men entrepreneurs, or similar exhibit rates of innovation (Vanderbrug, 2013). However, in developing countries, a gap exists in the female entrepreneurs' contribution level of innovation in the market, which is mostly due to a lack of access to the basic resources necessary for innovation, such as skilled workforce, financial resources and education (Ighomereho et al., 2013). Furthermore, Smith-Doerr (2010) argued that the relationship between gender and innovation is negative.

It is because the innovation in its traditional form has negatively influenced women's participation in the male-dominated industry.

The effect of business led by Female on innovation varies from one innovation outcome to another. Females tend to innovate intangible products or ways of doing things, such as services, organisational processes and marketing methods, rather than physical products or manufacturing-related innovation, which are more male-dominated styles of innovation.

Business Led by Males

Other studies related to the effect of gender on innovation found that there is no difference between male and female business owners when taking into consideration the introduction of new products, new organisational structures and other forms of innovation (Kalleberg & Leicht, 1991). However, when innovation is measured using hard indicators, such as patenting activity and research and development expenses, male-owned firms outperform female-owned firms. Miller and Trian (2009) argued on the importance of gender diversity in the boardroom, which provides strategic human and social capital to firms; hence increasing innovation.

The businesses led by males are more likely to innovate products and manufacturing-related processes rather than innovating services and organisational structures, which is better achieved by women in business.

2.4.2 Firm Behaviour

Different types of innovation are more likely or less likely to be caused by different firm behaviours. Investment decisions are particularly critical to a firm's general operations. However, they are also important for a firm's innovation. This subsection covers behavioural aspects that are relevant to innovation as follows.

Capability of Expansion

Santamaria, Nieto, and Barge-Gil (2009) argued that the effect of expansion in terms of products and expertise is positive on innovation, as it is easier for expanding firms to develop and adopt new technologies that will improve their activities and processes.

The firms which can expand in terms of production and product ranges are more likely to engage in innovative activities.

Research & Development (R&D)

The importance of R&D to innovation has been well communicated over the years. The most popular measures of R&D effort as a kind of intangible investment are the R&D expenditure and intensity. Given the belief that internal and external R&D contribute differently to the innovation process, several types of research handle them separately in their research (Beneito, 2006; Frenz & Ietto-Gillies, 2009).

Moreover, many researchers regard R&D as the most important driver of innovation, particularly in the context of SMEs. Choi and Lim (2017) found that SMEs' innovation capacity related to R&D activities is positively associated with their innovation performance.

Stock, Greis, and Fischer (2001) found that the absorptive capacity, one measurement of firms' stock of knowledge, is associated with firms' ongoing in-house R&D activity. It suggests that R&D is positively related to innovation because the firm's absorptive capacity, which is the ability to convert new ideas or external information to a commercial product, as suggested by Cohen and Levinthal (1990), is a kind of innovation. Moreover, Harris and Moffat (2011) argued that not all innovation is supported by R&D, as some firms undertake R&D and do not innovate. However, Ganotakis and Love (2011) found that SMEs that have the collaboration of internal R&D and external efforts are more likely to produce product and processes innovations.

R&D has a positive relationship with innovation. However, in rare cases, the effect may be insignificant because not all firms that undertake R&D activities are innovators. Also, in rare cases, the effect of R&D is negative on innovation as a result of R&D collaboration with competitors.

Formal Intellectual Property Protection Rights (FIPPR)

Jong and Hippel (2009) found that using various types of intellectual property protection, such as patents, trademarks, brands, etc., have a positive effect on innovation. Davis (2006) concluded that patents and copyrights give firms the incentive to innovate, as they grant them temporary exclusive rights that guarantee them the associated rents. Trademarks have a positive effect on innovation as they provide incentives to innovation by motivating firms to engage in incremental innovation such as product differentiation. Incremental innovation helps firms to leverage trademarks indirectly to supplement other strategies, such as patents

secrecy, and time lead. However, trademarks may also have a negative effect on innovation, as they may block innovative firms from entering the market. Sometimes, the effect of trademarks is insignificant because some trademarks are not innovation incentive-oriented, as both innovative and non-innovative firms use trademarks. Patents protect individual inventions, but trademarks protect groups of inventions and mostly the firm in general.

An efficient and effective intellectual property rights (IPR) system is suggested to have a positive impact on firms' innovation. Hall and Lerner (2009) assumed that the weak implementation of IPR protection would delay the firm's investment to secure the returns from innovation. Allred and Park (2007) also found in their study of data for 706 firms in 29 countries that a strong and positive relationship exists between the enforcement of patent rights and innovation.

The effect of formal intellectual property protection rights (FIPPR) on innovation depends on the type of FIPPR – patents, copyrights, or trademarks – and also depends on the firm's incentive to innovate. It can, therefore, be positive or negative or insignificant.

Formal Training

Frenz and Ietto-Gillies (2009) suggested that the knowledge transfer between each unit is likely to affect the innovation in the firm. An extensive literature on the relationship between formal training and innovation at the firm level is available in subsection 2.3.2.

The effect of formal training on innovation is mostly positive as it includes the transfer of knowledge and skills to upgrade or enhancements. However, too much training may sometimes expose the rules of the game or the core knowledge to spread to rivals through vertical collaboration, staff turnover and movements to competitors. It will enable the competitors to learn from the well-trained staff who can be supported to convert the ideas gained from the formal training and knowledge spillover, which may negatively impact the innovation of the originated firm.

2.4.3 Business Environment

The firm's innovation is likely to be influenced by the environment it operates within. This subsection specifies the main business environmental factors that may matter for innovation at the firm level as follows.

Competition

According to Schumpeter (1942), large monopoly firms are more likely to innovate. Baumol (2002) suggested radical innovations allow a monopoly firm to increase its profits and maintain long-term rents as well as its market leadership over time. Substantial innovations may pay for a firm's long-term monopoly rents. However, in some remarkably successful innovation cases, more typically innovation outcomes tend to be related to more modest and important market gains and expansions.

In general, Baumol (2002) considered innovation as a 'life-and-death matter for a firm', as firms have no choice other than to innovate to survive and overcome the threats of competition. Langlois (2003) concluded that monopoly formalises the innovation process for greater benefit.

Schumpeter (1942) gave preference to imperfect competitive market over perfect competition and suggested that monopolistic firms are more innovative than other firms, as they have some degree of market power. However, this is not the case in the perfect competition scenario where firms are discouraged from innovating due to lack of barriers to entry and easy imitation of innovation by competitors.

Later reviewed literature showed that there is a link between market structure and innovation. For instance, the results in Arrow (1962) demonstrated that under certain assumptions competition is likely to incentivise innovation as a monopolist gains less from an innovation than a competitive firm which is also known as Arrow's replacement effect.

However, firms' incentives to innovate are determined not only by the existence of competition but also by the possibility of appropriating the results of their investment-which is associated with market power. If competition is too strong, appropriability is reduced, and so is the incentive to invest and innovate.

Moreover, the recent literature suggests that a "middle ground" environment, where there exists some competition but also high enough market power coming from the innovative activities, might be the most conducive to innovation efforts, a result which is found also in a theoretical framework (based on endogenous growth models) and is confirmed in empirical

studies that do find an inverted U relationship between competition and innovation (Aghion et al 2002, 2005).

The effect of monopolistic competition on innovation is positive.

Access to New Exports Market

The innovation outcomes can be highly influenced by substantial changes in market demand (Flaig & Stadler, 1994; Sadowski & Rasters, 2006). Modern trade and growth theories (Acemoglu, 2009; Aghion & Howitt, 2009; Grossman & Helpman, 1991b) suggested that firms' access to new export markets affects innovation, as it increases the size of markets that can be appropriated by innovators. Golovko and Valentini (2011) argued that *innovation and exports positively reinforce each other as they have a complementarity relationship*. They concluded that participating in export markets can promote firms' learning, and thus enhance innovation. Also, firms can enter new geographical markets through innovation.

Firms that have access to new exports markets are more likely to innovate.

Access to External Finance

SMEs that have larger internal financial resources or access to external sources of finance are assumed to be more likely to innovate than firms which do not have access to external finance. The relationship between the use of finance and the extent of firms' innovation capability is, therefore expected to be significant and positive. Access to external funds to acquire new machinery and equipment is important to every firm, as Hall and Khan (2002) suggest that capital goods and skilled workers are essential for the successful implementation of a new invention.

Moreover, Kim and Lee (2011) found that indirect external financing of bank loans has a negative impact on the technology innovation activity of Korean firms whereas direct external financing of security issues has a positive impact on innovation.

The effect of external finance on innovation is positive in the case of direct external financing and is negative in the case of indirect external financing.

Access to ICT

Higon (2011) found that ICT operates primarily as efficiency-enhancing technologies, although specific market-oriented applications such as websites development exhibit the

potential to create competitive advantage through product innovation. Frenz and Ietto-Gillies (2009) suggested that the knowledge transfer between each unit is likely to affect the innovation in the firm.

The adoption of ICT infrastructure can increase firms' efficiency and widen firms' access to the market. It replaces traditional channels of communication to manage business documentation and information, engage in business transactions or e-commerce, and to make business operations.

The ICT may boost the innovation process through the faster diffusion of information and the closer ties between suppliers and consumers. ICT may also increase communication efficiency and reduce geographical limitations. For example, Machikita et al. (2010) found that there is a positive relationship between ICT and business performance, particularly about the improvement of production management and the development of export markets. Also, Spiezia (2011) studied firms in eight OECD countries and found that ICT enables firms to adopt new practices and processes, especially those related to product and marketing innovations. I, therefore, expect SMEs that have access to ICT infrastructure are more likely to innovate.

The effect of access to ICT on innovation is mostly positive. However, in a rare situation, the effect may be negative, such as the case of access to external training, as information, thoughts and ideas get exchanged, and too much knowledge sharing might have a negative effect on innovation, as it exposes the innovative ideas of firms to competitors who may steal the idea and turn it into their innovation.

Access to Skilled Labour Market

Stock, Greis, and Fischer (2001) found that the absorptive capacity, one measurement of firms' stock of knowledge, is associated with firms' physical and human capital. It suggests that access to skilled labour is positively related to innovation because of the firm's absorptive capacity, which is the firm's ability to convert new ideas or external information to a commercial product, as suggested by Cohen and Levinthal (1990).

According to the survey conducted by Hall and Khan (2002), firms' access to skilled labour is found to be crucial to its ability to absorb and use new technology. They argued that

expensive, competent and skilled labour is required to have a successful implementation of any technology. Dewar and Dutton (1986) found that investment in human capital in the form of technical specialists facilitates the adoption of new technical processes. Therefore, firms with higher educated and technically qualified employees are more likely to be responsive and capable of strengthening the capacity to innovate.

The effect of access to the skilled labour market on innovation is positive.

Access to Unskilled Labour Market

Fajnzylber and Fernandes (2005) found that Chinese firms that engage in innovative activities have a higher demand for lower-skilled labour than the firms that do not innovate. Thus, in the case of Chinese firms, the unskilled labour is highly specialised in certain activities which grant them a comparative advantage in unskilled labour intense goods. However, Hong, Oxley, McCann, and Le (2016) found that access to unskilled labour has an insignificant impact on innovation at New Zealand SMEs.

The effect of access to the unskilled labour market on innovation is not clear.

Access to Local Business Networks

Eraydin and Armatli-Koroglv (2005) found that local and national business networking as well as global linkages, were important and confirmed the positive relationship between the intensity of local networking and innovativeness.

The effect of access to local business networks on innovation is positive.

Access to Universities and Research Institutions

Freel (2000) argues that university links enable SMEs to improve their innovative capacity or capabilities by gaining access to sophisticated technology and technical expertise. Beneito (2006) and Frenz and Ietto-Gillies (2009) found that internal R&D (from inside the firm) and external R&D (from universities or external research institutions) have a distinct influence on innovation. Kesidou and Romijn (2008) argued that the local knowledge spillovers (LKS) between agglomerated firms are viewed as key determinants of regional innovation in advanced economies. However, in developing economies, innovation research studies have highlighted the international linkages and ignored LKS. Therefore, they investigated empirically the significance of LKS for innovation of software firms in Uruguay. They found

that there is a positive and significant relationship between the LKS and firms' innovation performance via the company spin-offs, labour mobility, and informal networking channels.

Recent studies on open innovation models, as conducted by Spithoven, Vanhaverbeke, and Roijakkers (2013), suggest that SMEs' innovation can be achieved through internal or external knowledge and technologies. It indicates that internal R&D is not sufficient and that SMEs have also to seek external R&D to have a greater opportunity to have radical innovations. Other recent studies also highlighted the positive collaboration impact of internal and external R&D on product and process innovation output (Cohen & Levinthal, 1989; Hagedoorn & Wang, 2012; Higon et al., 2014; Stam & Wennberg, 2009). Moreover, Cohen and Levinthal's (1989) study suggested that internal R&D not only generates product and process innovation but also improve the firms' absorptive capacity. Likewise, Lane and Lubatkin (1998) suggested that external R&D increases the firm's innovative output and absorptive capacity.

The effect of access to the universities and research institution's R&D is positive on innovation. In rare cases, it can be insignificant if the research does not apply to the firm's operations and development stage.

Access to Government Support

As discussed by Abonyi (2005) and confirmed by Oum, Narjoko, and Harvie (2014), in general, government support is extended in six ways: training, counselling and advice, technology development and transfer, information, business linkages, financing and a healthy business environment.

Marcus (1981) found that government policies play a big role in shaping the environment of the firm and stressed that government regulations affect the innovation rate and substance. He focused on the major role that the non-technology-related policies play in shaping the environment of the firm. Sternberg (1996) argued that the unintended spatial impacts of technology policies are far higher than the intended impacts. Businesses are unable to correctly measure risk and opportunity without policy certainty, which can result in a reduction of investment in the innovative activity (Hong, Oxley, McCann, & Le, 2016). Choi

and Lim (2017) found that government and public policies that provide fiscal incentives and information are positively associated with SMEs' innovation performance through their internal innovation capacity.

Furthermore, there are robust and well-established systems in place to support SMEs in the developed economies. However, it is debatable whether these systems are effective and meet the demands of new ventures or SMEs. Bennett and McCoshan (1993) suggested that there is an overall form of division and overlaps, which is complicated and provides no guarantee that it can support quality networks. Curran (2000) argued that very few SMEs are willing to accept government support.

Mugler (2000) also argued that various forms of support originate from a position of privilege rather than the situation in the newly democratised transitional economies where their support system is often basic or does not exist. However, Doh and Kim (2014) reviewed the literature concerning the innovation and the government support policies of SMEs in regional industries. They found from the empirical studies that there is a positive relationship between government support or funding programmes and patent acquisitions or new design registrations of SMEs.

Furthermore, Smallbone and Welter (2001) discussed the government's role in developing SMEs in transition economies. They argued that a stable macroeconomic environment, sound legislation and regulations (easy registration, compliance to tax, social security, etc.), supportive government policies and programmes, as well as institutional arrangements (business support infrastructure, banks, and other financial intermediaries) have strong and positive effects on SME development.

Lall (2003) argued that it is important for governments to be proactive overcoming market failures that may delay firms building their capabilities that are needed for the development of the industry. Intarakumnerd and Virasa (2004) found that government policies may support firms' development of technological expertise and access to high technology. Kim and Lee (2011) studied firms in South Korea and found that government financial aid programmes positively impact products and processes innovations at the firm level and are insignificant at the market or industry level.

The effect of government support on innovation is mostly positive. However, this is also subject to the type of support and on whether the entrepreneurs accept it. If the support is accepted, then the effect may be positive, and if it is not, the effect is insignificant. Moreover, if the government support is in the form of rigid rules and regulations that may result in hindering the innovation activity in SMEs, then the effect would be negative on innovation.

2.5 Barriers to Innovation in SMEs

SMEs are the key driving forces for advanced economies because of their contributions in employment, exports and technological advancement. However, several quantitative and qualitative studies (Conte & Vivarelli, 2013; Love & Ropper, 1999; Subrahmanyam, 2012) have found SMEs are more constrained than large firms, both financially and non-financially. The lack of financial assets, absence of economies of scale, weaker competencies and absorptive capacity force SMEs to invest less in R&D activities. Similarly, Demirbas et al. (2011) argued that in developing countries, SMEs frequently face more obstacles than larger firms, such as lack of skilled labour and lack of investment in R&D and technology.

The global challenges for the survival and growth of the SMEs involve improving the quality standard of innovation and promoting the innovative culture in the firm. Such a culture supports radical innovations through R&D and encourages the patenting of innovated products to maximise the performance of SMEs.

Firms' innovativeness can be explored by investigating both approaches: the drivers and barriers of innovation. On the one hand, the internal drivers of innovation can be internal resources that are hard-to-copy such as strong branded product, unique experts and strong R&D department (Cohen & Levinthal, 1990; Conner & Prahalad, 1996; Eisenhardt & Martin, 2000), self-motivation and internal technological capability (Bala Subrahmanya, 2005), corporate culture and investment in skilled labour (Tellis, Prabhu, & Chandy, 2009) and appropriate organisation structure (O'Conner & Ayers, 2005).

On the other hand, the external drivers of innovation are recognised by Porter (1990) as strong competition, demanding customers and aggressive suppliers. The absence of internal and external drivers of innovation forms an unhealthy environment that can hinder and constrain innovation activities, or may, in short, present some barriers to innovation.

By explaining the effects of barriers to innovation in SMEs, it is possible to understand important questions such as: Why do SMEs not innovate? Why do they not innovate on a larger scale? Why do they not innovate with a particular type of innovation? Earlier contributions to the literature of barriers to innovation include the work of Piatier (1984) and later Hadjimanolis (1999, 2003). The recent literature on barriers to innovation includes Mohnen, Palm, van der Loeff, and Tiwary (2008), Galia, Mancini, and Morandi (2012), Iammarino, Sanna-Randaccio, and Savona (2007), and D'Este, Iammarino, Savona, and von Tunzelmann (2008).

Understanding barriers to innovation may explain why SMEs do not innovate. However, this is unexpectedly hard to explore. Piatier (1984) stressed that some real cases of barriers to innovation are not included in surveys because those firms stopped operating due to their inability to innovate; hence they did not take part in the survey. He argued that such closed firms are hard to identify and that non-innovators do not observe and face barriers to innovation.

Recent studies, such as Mohnen, Palm, Shim van der Loeff, and Tiwary (2008), show that innovators face barriers at a higher level than non-innovators. D'Este et al. (2008) drew attention to the importance of differentiating between non-innovators that show no effort to innovate at all, and non-innovators that aspire potential firms to innovate. This differentiation allows us to have more realistic conclusions on the different views about the barriers of innovation concerning innovators and non-innovators.

Furthermore, D'Este, Iammarino, Savona, and von Tunzelmann (2012) made an argument to differentiate between the truly revealed constraints that affect innovation activities experienced by innovative firms (e.g. insufficient amounts for financing R&D activities and lack of access to external finance) and general perceptual constraints that deter firms from innovation activities (e.g. lack of innovative personnel or lack of management support or aspiration for innovation). Furthermore, Carpenter and Nakamoto (1989) argued that innovators face several constraints and risks. However, they are motivated to overcome them by their strong profitability and sound market position, which may be achieved through innovation, as concluded by Cho and Pucik (2005).

Barriers and constraints to innovation, as categorised by Piatier (1984), can be internal and external, just like drivers of innovation. Hadjimanolis (2003) classified barriers to innovation as general versus relative barriers and objective versus perceptual barriers. General barriers affect all firms regardless of their sectors, unlike relative barriers which are rather sector-specific. Perceptual barriers are subjectively perceived as constraints to innovation, whereas the objective barriers are truly constraining innovation.

When barriers to innovation that originate from within firms are added to those caused by external circumstances, a complete picture is observed. Innovation activities are seriously inhibited with the absence of support inside the firm. Internal barriers to innovation are easier to overcome by the firms that seek change and superior market position with the sincere efforts from within the firms. However, external barriers are harder to overcome by firms, as they cannot isolate themselves and their innovation activities from the outside environment. Such barriers are not under control by firms.

The existing literature on innovation systems provides a clear view of how external factors may create barriers to the innovation of a specific sort. Lam and Lundvall (2007) argued that firms which operate within different innovation systems manage innovation differently, as they focus on different factors. Lundvall, Johnson, Andersen, and Dalum (2002), as well as Galia et al. (2012), studied the effects of the national innovation system on barriers to innovation. They found that firms operating within different innovation systems experience different barriers to innovation. In short, this group of authors agree on the importance of country-specific policies in overcoming barriers to innovation.

In general, SMEs face financial constraints that hinder their decision to innovate. There may be insufficient amounts allocated for R&D activities. Moreover, there may be difficulties in accessing finance outside the firm, which can seriously impact innovation performance. Access to finance is a major issue for firms engaged in innovation projects and activities (D'Este, Rentocchini, & Vega-Jurado, 2014). They are even strongly pronounced in young SMEs that engage in R&D activities (Segarra, Gracia-Quevedo, & Teruel, 2013). Therefore, the financial constraints highly reduce the probability of innovation opportunity (Savignac, 2008) and influence the investment in R&D (Tiwari, Mohnen, Palm, & van der Loeff, 2007).

R&D investment in SMEs is affected by the financial constraints, and sometimes SMEs are forced to abandon R&D projects due to lack of finance (Czarnitzki & Hottenrott, 2011). Mohnen et al. (2008) found that financial constraints are a common barrier to innovation, despite all the efforts taken to facilitate access to financial channels. Hyytinen and Tovianen (2005) provided evidence that public funding helps SMEs that depend on external financing to overcome their financial constraints and innovate.

2.6 Summary

As this study is located within an extensive body of literature dealing with small and medium-sized enterprises' (SMEs) transition to a knowledge-based economy (KE), it was essential to start by discussing the theories related to the firm, transition, growth, and innovation to provide a comprehensive outlook for the research study.

The literature review first presented the static view of traditional theories as opposed to the dynamic view of new theories. While doing so, it also touched on the basic entrepreneurship literature and discussed literature related to family-owned businesses and government support.

Next, it discussed the traditional and modern theories of growth, focusing on models related to SMEs' growth in particular: The Stochastic Model, Human Capital Model and Learning Model. Then, it highlighted the determinants of firms' growth other than firm age and firm size that are also determinants of firms' innovation.

After that, it discussed the evolvement of theories of innovation. It looked at further aspects relevant to SMEs, including innovation, employment generation, and support needs. It also drew a comparison between SMEs and large firms, discussing advantages and disadvantages as well as their complementary and contradicting roles.

It highlighted the most recent literature about gender and innovation. It also touched on internal and external R&D and their impact on innovation. After, it summarised the key and most recent empirical studies related to innovation in SMEs. Then, it discussed the main research theory. Finally, it presented literature on the barriers to innovation in SME.

Chapter 3: Research Methodology

3.1 Introduction

This chapter presents the research methodology and showcases the datasets of the Cambridge Centre for Business Research (CBR), the Department for Business Innovation & Skills (BIS) and the Omani SMEs Survey that I have used to investigate the innovation models in British and Omani SMEs. It demonstrates the research design and methodology, starting with the sampling strategy, followed by the data gathering, organisation and analysis techniques, validity, reliability, and ethical consideration. It also justifies the Econometrics methods employed as a way of addressing the research questions.

As this chapter is located within a wide literature on research design and methodology, it is important to start by discussing the background of the research design, style, techniques, and data collection methods.

3.1.1 Background

This research is mixed with exploratory, descriptive and analytical techniques. Firstly, it is exploratory because there are no published studies that investigate the determinants and barriers of innovation at small and medium-sized enterprises (SMEs) in Oman. Therefore, I aimed in this study to look for patterns from comparing results in two countries, the United Kingdom (before and after the 1990s) and Oman in 2010s, and also to test hypotheses or ideas that can be investigated to form the basis for further research. For this purpose, I have utilized datasets of previous studies, the Cambridge Centre for Business Research Dataset of 1997 [1] for studying British SMEs in the 1990s and the Longitudinal Small Business Survey Year 1 (2015)[2] conducted by the Department for Business Innovation & Skills (BIS) for studying the current outlook in British SMEs.

Secondly, the research is descriptive because it aims to identify the applicable innovation outcomes in British and Omani SMEs and classify the firms' characteristics, behaviour, and

[1] The dataset was used for the purpose of testing the workability of innovation models using econometrics models in STATA software. There was no access to proceeding datasets.
[2] The report was published in May 2016. The second-year report was published late in 2017 with strict and limited access.

business environment by using quantitative techniques to collect, analyse and summarise data. It is implemented by conducting an online survey for SMEs in Oman.

Thirdly, it is analytical because it compares and contrasts the results of SMEs' innovation outcomes in two countries, as mentioned above. The comparison study allowed me to locate and identify similar and different factors or variables that determine innovation outcomes in the two countries.

The research style is ***deductive reasoning*** (top-down approach). I used this approach to test whether the innovation model applies to the British and Omani SMEs and to what extent. I started with a broad research question on how to have a successful transition of SMEs to Knowledge-based Economy. Then, I narrowed down the study to cover the innovation pillar, which I think is very important, and few micro and empirical studies have shed light on it. Then, I agreed with the research questions and hypotheses. Deductive research is a process and can be summarised by several steps, as shown in Figure 3.1.

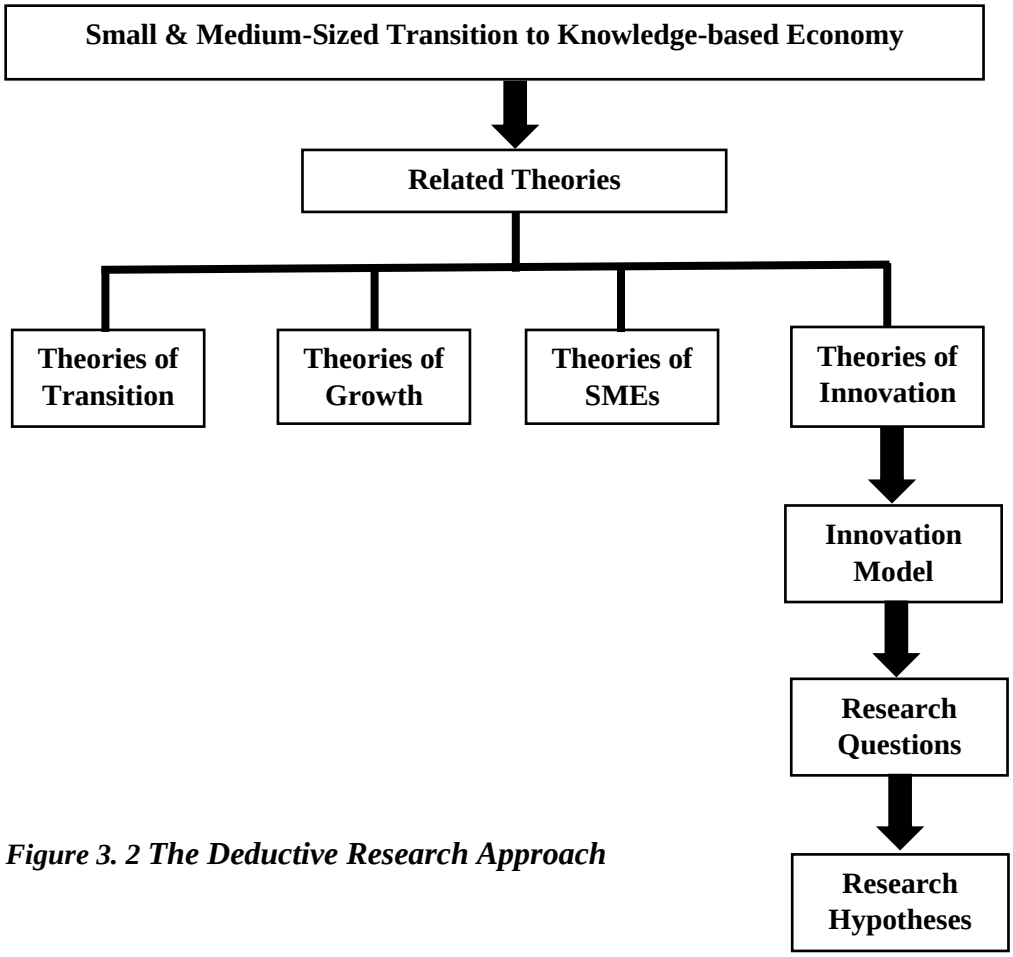

Figure 3. 2 The Deductive Research Approach

The deductive research process, as shown in Figure 3.2, consists of five stages. The theory is developed or improved at the first stage as a result of reviewing existing literature and gathering knowledge from various sources. The research questions are raised, and the research hypotheses are developed and tested in the second stage. A theory includes concepts. Concepts are units that a researcher uses to construct ideas and observations. The operational definitions and measurable indicators or variables need to be determined, which are then tested. The third stage in the deductive research process is data collection. Testing occurs after the collection of data by accepting or rejecting the expected causal relationship stated in the research hypotheses (David & Sutton, 2011). Then, the deductive model is analysed, and results are drawn into conclusions. Conclusions may be practical and may have implications for policy formulation, which is reviewed on a periodical basis to reflect any updates in theory.

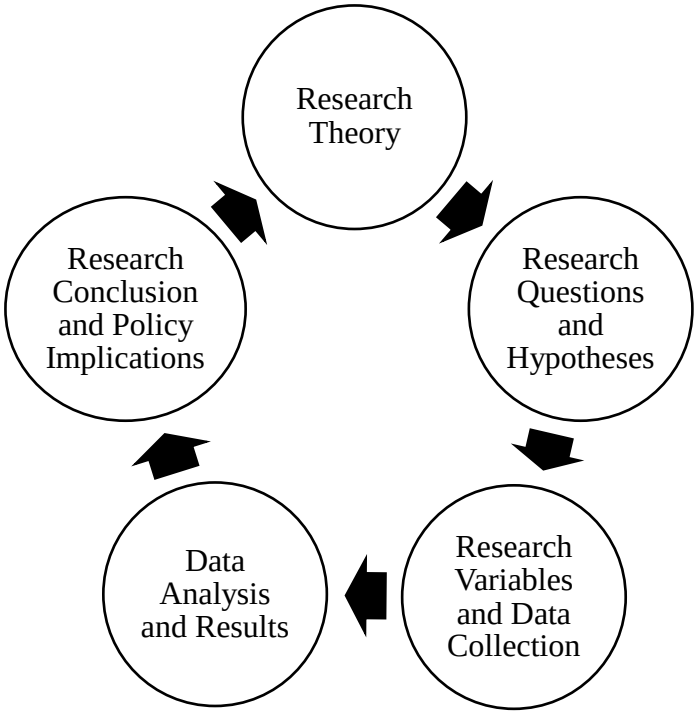

Figure 3. 3 The Deductive Research Process

The rigorous structure of the deductive research process is helpful in addressing the issues at each stage of the research process.

The following sub-section shows that the research question must be clearly stated to reflect what exactly is being researched. It is difficult for a new researcher to raise adequate research questions because it requires a level of focus that is not easy to be found at the initial stage of the research.

3.1.2 Research Questions

Clearly stating what the researcher wants to find out, is a key factor in formulating a research question. The research questions are usually raised from the theories, which are drawn from the literature review or constructive discussion with supervisors and experts in the area of the study or from the inquisitive mind of the researcher (David & Sutton, 2011).

The overall research raised the following important questions:

1. What are the key specific firm characteristics that impact innovation outcomes in British and Omani SMEs?
2. What are the key firm behavioural elements that matter for British and Omani SMEs in deciding on whether to innovate or not?
3. What are the key specific business environment factors that influence the choice of innovation in British and Omani SMEs?
4. What are the barriers that may prevent British and Omani SMEs from innovating and how to overcome them?

3.1.3 The Use of Secondary Data

The secondary data can be a valuable resource for a research project, depending on its nature. For example, a sample survey dataset can be the main focus of the study, or it can only provide background information for the research project, depending on the inclusion of the variables of interest. The utilisation of the sample survey dataset depends on the theoretical and conceptual framework of the research. There are three forms of secondary data, as categorised by Dale et al. (1988). These are aggregated data, sample surveys and cohort studies.

Firstly, the aggregated data is derived from more than one source and is presented in summary tables; hence, it is the most accessible form and the easiest to be incorporated in research. It can also be freely available on the internet for the public from government-

sponsored surveys and is considered as official statistics. The researcher who uses aggregated data may present it in the form of tables or charts.

Secondly, the sample survey dataset consists of data gathered, usually by the government or a specialised private institution, from long surveys conducted annually or semi-annually. Also, one-off surveys can be a sample survey dataset. The data collected can be accessed, downloaded and exported by the researcher to a statistical or an Econometrics data analysis package, such as R, MATLAB, EViews, and STATA. The researcher who uses a sample survey dataset can showcase a deep and genuine understanding of the models investigated by using various regressors and compare between the results output.

Thirdly, the cohort studies are used within a longitudinal research design. They are focused on taking repeated measures from individuals over a longer period. The data collected is multi-disciplinary and usually covers the demographic, social, economic and other aspects related to these individuals. The researcher who uses cohort studies can describe patterns of change over time, control for variables and provide a complex analysis of relationships between the variables studied.

Advantages of secondary data

The use of secondary data is well established in the social sciences. It allows the researcher to use mostly cost-free data that can easily be accessed. Moreover, the secondary data is subject to test and retest methods for reliability and validity. The dataset generally contains a much larger and broader sample than could be realistically obtained by researchers on their own, especially if the research is conducted by a government body or a specialised institution. Also, the financial costs related to the secondary data analysis are much less than for primary data collection, with no data collection, coding or data entry to be undertaken.

A tubular data has a robustness and reliability that is unmatchable by some of the primary data. Therefore, aggregated data is a resource that should not be neglected in the research process.

Although a dataset that exactly matches the research requirements may not exist, the researcher will frequently find datasets that provide a valuable and comprehensive base against which to compare primary research findings.

The one-off surveys contain focused and specific data. Therefore, when considering such types of secondary data in the research project, the researcher can take advantage of considering the sampling technique, sampling frame, research design and method of data collection with the conceptual framework of the original research.

Disadvantages of secondary data

The usage of secondary data is dependent on accessibility and the applicability of existing datasets to the area of the research project. Although catalogue search engines are easy to use, it takes time to locate the required data file, and sometimes it might be unavailable. Moreover, while it seems that time is saved in not collecting primary data, it is on the contrary spent on time-consuming tasks such as downloading, familiarisation and coding the dataset. Furthermore, the original data collection may use a different conceptual framework than the framework used in current research, which will require the use of more than one secondary dataset; hence the researcher should consider the differences between the studies. It may require a higher level of expertise in technical, statistical and data handling areas. For example, cohort studies usually require longitudinal analysis and issues such as missing observations need to be handled by the researcher (Atkinson, 1978).

3.1.4 The Use of the Internet for Primary Research

Market researchers widely use the internet to undertake online (e-mail and web-based) survey on consumers. Also, the academic community uses them extensively in their researches. Social researchers are increasingly exploring the use of the internet for primary research across subject disciplines.

The use of online social survey

Both social and market researchers have undertaken a huge stake of surveys distributed through the internet. The researchers use the internet to conduct both targeted surveys on specific social groups and larger surveys of multiple groups. There are advantages to online surveys. They are cheaper and easier to manage than postal surveys. They also have shorter periods between the commissioning of research and the reporting of survey findings, as the time spent in collecting and analysing data is reduced **(**David & Sutton, 2011).

Online surveys include e-mail or a contact number to provide support to the research participant. Although online surveys are cost-effective, there is a debate on the differences

between internet-based surveys and postal paper surveys on issues related to the validity of the data collection. Moreover, there are concerns raised about survey response rates, sample bias and the quality of responses. Dolnicar et al. (2009) concluded that online respondents had fewer incomplete data and a lower drop-out rate. The results also showed that the survey respondents complete an online survey faster than the mail survey. Sheehan (2001), however, provided evidence that the response rate for online surveys is decreasing in recent years, as the non-deliverable e-mails are increasing, as also concluded by McDonald and Adam (2003). Greenlaw and Brown-Welty (2009) concluded that the web-based survey costs on average lower than the paper-based survey. However, the use of the web requires to balance between the type of likely respondent and the suitability of the administration process for the specific research topic. A mixed-mode approach of both paper and online surveys may be adopted to balance between maximising the response rate and minimising the survey costs.

As mentioned earlier, the term "online survey" refers to both e-mail-based and web-based surveys. A questionnaire that is sent as an e-mail to a designated person who then replies with the completed survey is referred to as an e-mail-based survey. A questionnaire that is hosted on a website, where the respondent is invited to respond to the survey's questions and is directed to the website through a live link is called a web-based survey.

There are several disadvantages to using e-mail surveys. First, the researcher and the survey's respondent require to have some technical expertise to construct or respond to the simple text-based questions of an e-mail survey. Moreover, the simplicity of the e-mail survey is also one of its disadvantages, as the format of the survey questions is limited, whereas the respondents are free to respond in a format of their choice. Second, the data contained in the e-mail will require to be manually copied from the body of the message and pasted into a data file for further analysis. Third, it is difficult to track participation in an e-mail survey as the e-mail address needs to be known; besides, it is difficult to identify the reason for the non-response whether it is due to not being willing to participate in the survey or not reading the e-mail (Hewson et al., 2003).

A web-based survey needs more technical expertise than an e-mail survey. It also requires access to a website to host the survey and collect the responses of the survey. With some understanding of HTML (hypertext mark-up language), basic web surveys can be developed.

There are also survey development applications which enable the researcher with minimum technical expertise to create complex surveys, such as Google Forms, SurveyMonkey, KeySurvey, SuperSurvey, Zoomerang, SurveyCrafter and Cool Surveys. Such applications enable researchers to design a questionnaire template that is visually attractive to the respondents. The responses from the completed surveys are downloaded into a database file that can be uploaded into software analysis packages such as STATA, R, MATLAB and EViews.

It is easy to monitor the statistics of the site usage with a web-based survey. Site usage statistics are regularly viewed on websites and can provide useful information on how many times the site has been accessed. Phippen (2007) used the log files from websites in calculating the survey response rate.

3.1.5 Structure of the Chapter

This chapter sheds light on the research methodology. Section 3.2 presents the research database and sampling strategy, followed by section 3.3, which showcases the research quality. Then, section 3.4 summarises how the designed survey was administered. Section 3.5 discusses the four different types of research estimators. Finally, section 3.6 provides a summary of the reviewed literature.

3.2 Research Database and Sampling Strategy

It is difficult to define innovation and how empirically it is captured exactly. However, it can still be more easily identified than technological progress. The conceptual and theoretical understanding of innovation has increasingly promoted since the early 1980s. The main changes that have been found in empirically-oriented innovation research post the initiation of firm-level innovation surveys are more perceptible than the non-empirical innovation researches. Several countries, such as Canada, the United States, Malaysia, Taiwan, Australia, and almost all EU countries, share a common practice of collecting innovation-related data through firm-based surveys. These survey-lead approaches have transformed the understanding of the nature and drivers of innovation. As a result, the rest of innovation-related research has increasingly become a combination of both quantitative and qualitative approaches and moved from theoretical to merely empirical research (Hong, Oxley, McCann, & Le, 2016).

3.2.1 The CBR Dataset

The present researcher used and analysed three datasets in this research at different stages, as follows:

Phase 1: British SMEs in the 1990s

This research uses the Cambridge Centre for Business Research (CBR) small and medium-sized enterprises (SMEs) dataset of 1997 (2nd Panel) for the pilot study purpose as it contains the majority of variables required in investigating the innovation model. The dataset consists of 2,520 SMEs in the manufacturing and business services sectors across all the United Kingdom. The questionnaire consists of five parts: general characteristics of the business, workforce and training, commercial activity and competitive situation, innovation, factors affecting expansion and efficiency and acquisition activity, capital expenditure and finance. Fifty questions resulted in 414 variables. I used only 30 variables that are related to my research topic, innovation. Please refer to ***Appendix A3.1,*** which shows the mapping of the variables I used to test the innovation model with the questions taken from the CBR survey. The responses of the CBR survey formed a dataset. The dataset has been downloaded from the UK Online Data Services website and then exported to STATA software to run the regression models using probit, logit, and multivariate probit estimators, as explained in detail in Chapter 4. The results of the regression analysis are then compared with the results of recent empirical studies.

Sampling Strategy

This research adopts the sampling framework of CBR because the innovation model is tested using the full sample of 2,520 firms. The sample is extracted from the Dun & Bradstreet UK Marketing Database. The benefit of using the D&B database is that it provides information about employment activity, legal status, and other business information in addition to providing the names and functions of executives, the telephone number and addresses. It is really helpful in assessing sample response bias using these characteristics.

The CBR targeted at the beginning for a sample of 2,500 of SMEs that have less than 500 employees in England, Wales and Scotland, with a split of 1,000 workers from the business services sector and 1,500 workers from the manufacturing sector. They aimed for a higher proportion of participants from the manufacturing sector to achieve practical numbers of firms in the conventional and hi-tech sectors.

Moreover, the survey sample targeted for more of the medium-sized firms within both the manufacturing and the business services sectors. As noticed from their previous surveys, the medium-sized firms are reluctant to fill in questionnaires compared to other segments. Also, CBR chose to do so because 81.6% of the British firms in the manufacturing and business sectors were micro firms and 96.2% were small firms, as per DTI SME Statistics for the United Kingdom in 1996. It implies that if the CBR did not target for higher numbers of medium firms, their survey would have lower useable numbers of respondents from this segment.

Besides, the CBR used a stratified sample design. They set targets to have a stratification ratio of 60:30:10 (micro: small: medium) across the three employment bands 1-49, 50-199 and 200-499 of the manufacturing sample. However, they targeted for a 75:20:5 split (micro: small: medium) for the business services sector because the D&B sampling framework and the business population as a whole contained relatively few larger SMEs in the business services sector compared to the manufacturing sector.

The survey was conducted from June to October 1997 by the CBR members. The questionnaire was sent to 12,640 SMEs across the UK after dividing them into two groups: 8,000 firms were telephoned to confirm their size, independence and sector and 4,640 firms were sent questionnaires without checking on their eligibility. This split was implemented to consider the cost-effectiveness of the two approaches and to help the CBR team to analyse the impact of telephoning on item and unit response rates for use in their future survey designs. A reminder letter was sent to both groups after two weeks from the first attempt, and another reminder with a copy of the questionnaire was sent to them two weeks later.

From the sample of 8,000 firms that were telephoned, 2,570 were removed (1,123 for refusing to participate in the survey and 1,447 for not meeting eligibility criteria). Moreover, 1,618 firms out of the 5,430 eligible participants have returned useable questionnaires with a response rate of 29.8%. From the sample of 4,640 firms that were not telephoned, 161 were removed for not meeting the eligibility criteria. Also, 902 firms out of 4,479 eligible participants have returned useable questionnaires with a response rate of 20.1%.

Table 3.1 compares the proportion of firms in the achieved sample of different employment size bands with the targeted sample. The table shows that the target for the business services

and manufacturing sectors for the band (1-49 employees) was achieved, but this was not the case with the targets for the larger bands, which was broadly achieved with the business services sector only.

Table 3. 1 Sample Size

Employment Size	Targeted Sample		Respondents Sector-wise		
	Business Services %	Manufacturing %	Business Services %	Manufacturing %	Total Respondents %
1-49	75	60	78	72	75
50-199	20	30	19	24	22
200-499	5	10	3	4	4

Note: the source is CBR Survey Dataset, 1997.

Table 3.2 shows a comparison of employment size between the Dun & Bradstreet (D&B) total sample base, the SMEs of the manufacturing and business services sectors in the Inter-Departmental Business Register (IDBR[3]) and the CBR survey respondents. The table indicates that the D&B and the IDBR data are almost the same. The CBR survey has a larger proportion of firms in the 50-199 size band than the other two because the sample was stratified to cover more medium and larger SMEs contrasting to micro and small firms.

Table 3. 2 Employment Size Distribution

Employment Size	CBR %	D&B %	IDBR %
1-49	74.5	92.3	96.2
50-199	21.6	6.7	3.1
200-499	4.0	1.0	0.7
Total	100	100	100

Note: the source is CBR Survey Dataset, 1997.

Table 3.3 illustrates the distribution of enterprises by their legal form in the manufacturing and business services sectors. It compares the firm's legal status among the three datasets: the CBR, the VAT registered[4] and the D&B. The proportions of the CBR survey broadly

[3] The IDBR includes records of all businesses operating a PAYE scheme and that are registered for VAT.

[4] The VAT-based data is taken from Business Monitor PA 1003, where they have filtered all data relating to manufacturing, business services, other services, post & telecommunications, property and public administration.

match those on the D&B dataset. The proportions of sole proprietorship and partnership firms in the VAT registered dataset is higher than in the CBR and D&B, whereas the proportion of companies is lower in the VAT registered dataset compared to the other two datasets.

Table 3. 3 British SMEs by Legal Form

Legal Form	CBR %	VAT Registered %	D & B %
Sole Proprietorship	15.2	34.6	14.1
Partnership	13.8	17.2	12.2
Companies	71.0	48.2	73.7

Note: the source is CBR Survey Dataset, 1997.

Table 3.4 shows the distribution of SMEs by their date of formation. It compares the age of the CBR survey firms with the Company Register as a whole. The proportions of all respondents in the CBR survey in all age bands are higher than the ones in the company register except for the >=1986 band as it takes time for new firms to get included in the D&B dataset from which the CBR dataset is extracted.

Table 3. 4 Date of the Business Formation

Date of Register	CBR Survey			Company Register
	Manufacturing %	Services %	All Respondents %	All Companies %
<1900	4.4	2.3	3.5	0.2
1900<1930	3.5	2.4	3.1	1.2
1930<1950	5.7	2.8	4.5	2.4
1950<1975	21.2	11.7	17.3	11.7
1975<1986	30.6	23.6	27.7	16.7
>=1986	34.6	57.2	43.9	67.8

Note: the source is CBR Survey Dataset, 1997.

The CBR team systematically analysed the respondents by comparing response rates in terms of age, employment turnover, pre-tax profit and legal status to have a formal analysis of response bias. Therefore, they used the data available in these fields in the D&B database for

different groups of firms in the overall sampling frame. They conducted this analysis for the business services and manufacturing sectors separately, as well as for the telephoned and not telephoned samples discretely.

They analysed the unit of non-response bias according to a combination of parametric and nonparametric tests. They used the parametric test called the **Bonferroni test**, about the one-way Analysis of Variance (ANOVA). This test is a multiple comparison procedure across groups to check whether there are differences in the mean characteristics of the firms in those groups. For instance, the test can determine if the firms that refused to participate in the survey are different from the firms that did not return questionnaires.

The Bonferroni test corrects for a potential bias that may occur in the multiple comparisons when a sequence of pairwise comparisons was made between each of the possible pairs of groups. It has two assumptions as follows: each of the groups is an independent random sample from a normally distributed population, and the variances within the groups are the same in the population. The CBR survey team suspected that the two requirements might not hold. Therefore, they also conducted a nonparametric test called the **Kruskal-Wallis test**.

The Kruskal-Wallis test is an extension of the two-sample **Mann-Whitney test** based on ranks to a multiple comparison framework. It is a one-way analysis of variance by ranks that tests if k independent samples are from different populations. Therefore, the null hypothesis is tested and whether k samples come from the same population. It suggests that only the variables tested have the same continuous distribution, which requires at least ordinal measurement of the variables (Siegel & Castellan, 1988).

The analyses are summarised as follows. In the manufacturing sector sample, there was no significant response rate difference between those who responded to the survey and those who refused to take part in the survey, except those who refused to participate at the telephone screening stage. The sample group who refused to take part in the survey when they were telephoned are older and larger in terms of employment and turnover compared to those who returned useful surveys or did not return the survey. It explains the lower than targeted response rates in the larger size groups due to the refusal of the firms to participate at the telephone screening stage.

In the business services sector, no significant differences were using Bonferroni and Kruskal-Wallis tests, except in one case, but the target ratios were broadly achieved. The case occurred differently with the telephoned sample where the smaller firms in terms of employment were the ones less likely to participate in the survey, but the differences in means across the groups were smaller compared to the difference in the means of groups across the manufacturing sample.

There was only a two-group comparison involved in the blind sample; hence, they used the nonparametric Mann-Whitney test. The test showed no response bias in business services and the usual lower response rates from the larger manufacturing firms.

To sum up, the analysis revealed that there is only a size-based response bias in the manufacturing sample. However, there is no evidence of systematic bias in terms of age, profit margin or legal status. Overall, the achieved sample of the CBR reflects the characteristics of the D&B sampling framework in all categories except in the employment band of larger firms in the manufacturing sector.

The CBR team's approach to spatial response patterns is based on comparing the achieved sample with the VAT business register. Table 3.5 compares the regional distribution of the CBR survey sample with that of VAT-registered firms in the sectors of manufacturing and business services. The table reveals that the CBR survey sample is similar in regional spread to the VAT registered enterprises, and also reflects the differences between the manufacturing and business services sectors in VAT registered firms.

Table 3. 5 Regional Distribution of VAT Registered and Survey Enterprises

Region	Manufacturing		Business Services	
	Survey %	VAT registered %	Survey %	VAT registered %
South East	31.8	34.6	45.8	49.8
East Anglia	5.3	3.9	5.3	3.7
South West	6.9	8.3	8.5	7.9
West Midlands	11.7	12.5	5.7	7.3
East Midlands	8.7	9.3	5.4	5.5
Yorkshire & Humberside	10.0	8.5	5.5	5.7
North West	12.9	10.4	8.8	8.0
North	4.5	3.2	4.2	2.8
Wales	3.5	3.6	3.5	2.9
Scotland	4.7	5.7	7.3	6.4

Note: the source is CBR Survey Dataset, 1997.

Shangqin Hong, Les Oxley, Philip McCann, and Trinh Le (2016) investigated four types of innovation at firm level: product, operational processes, organisational or managerial processes, and marketing methods in New Zealand SMEs, whereas this research thesis adds a fifth type, i.e. service innovation, which is perceived as part of product innovation in all the existing researches. Moreover, this thesis covers additional variables that were not investigated by Oxley and McCann, such as family-owned business, business-led by women, business-led by men, executive founders, formal training, capability for accessing external finance, access to universities and research institutions and access to government support. However, this thesis did not include some variables that were present in Oxley and McCann. These explanatory variables are sufficient product capacity, inward direct investment (FDI) intensity, outward direct investment (ODI) indicator, transport, water & waste, and labour productivity. Also, Oxley and McCann segregated the variable competition into three sub-variables: monopoly, oligopoly, and monopolistic competition, whereas this thesis covers the monopolistic competition only, due to limitations in the CBR & BIS datasets.

Table 3.6 describes the selected variables. It consists of five innovation outcomes at the firm level (the dependent variables). It also includes a total of 25 independent variables: twelve

variables categorised under “firm characteristics”, four variables under “firm behaviour” and nine variables under “business environment”.

Table 3. 6 Description of Variables

Variables	Definition
Innovation Variables	
Model 1: Product Innovation	
Product Innovation	A binary variable that takes the value of 1 if the firm launched a new or significantly improved product at the firm level during the last three financial years, 0 otherwise.
Model 2: Service Innovation	
Service Innovation	A binary variable that takes the value of 1 if the firm launched a new or significantly improved service at the firm level during the last three financial years, 0 otherwise.
Model 3: Operational Processes Innovation	
Operational Processes Innovation	A binary variable that takes the value of 1 if the firm used a new significantly improved service operational processes at the firm level during the last three financial years, 0 otherwise.
Model 4: Organisational or Managerial Processes Innovation	
Organisational or Managerial Processes Innovation	A binary variable that takes the value of 1 if the firm launched a new significantly improved organisational or managerial processes at the firm level during the last three financial years, 0 otherwise.
Model 5: Marketing Methods Innovation	
Marketing Methods Innovation	A binary variable that takes the value of 1 if the firm launched a new significantly improved marketing method at the firm level during the last three financial years, 0 otherwise.
Explanatory Variables	
A) Firm Characteristics	
1. Firm Size	Log of the total average number of employees in the firm for the latest financial year.
2. Firm Size Square	Log of the square of the total average number of employees in the firm for the latest financial year.
3. Exports	1 if the firm has exported goods and services, 0 otherwise.
4. Sites/Branches/Subsidiaries	1 if the firm has one or more than one site/branches/subsidiaries and has access to the resources, 0 otherwise.
5. Updated Equipment & High Technology	1 if the firm has up-to-date equipment and high technology, 0 otherwise.
6. Business Led by Women	1 if the firm is led by the female, 0 otherwise.
7. Business Led by Men	1 if the firm is led by the male, 0 otherwise.
8. Firm Age	Log of the total number of years since the firm started its operations.
9. Firm Age Square	Log of the square of the total number of years since the firm started its operations.

10.	Location	1 if the firm's headquarters is located in the urban area, 0 otherwise.
11.	Branded Product	1 if the firm considered the brand and quality of the product a priority in their innovation activities during the last three years, 0 otherwise.
12.	Executive Founders	1 if the firm's Chief Executive or Senior Partner or Proprietor are founders of the business, 0 otherwise.
	B) Firm Behaviour	
13.	Expansion	1 if the firm has arranged to expand its range of expertise or products, 0 otherwise.
14.	R&D Indicator	1 if the firm has engaged in R&D activities in the last financial year, 0 otherwise.
15.	Formal IP Protection Disclosure	1 if the firm considered patents disclosures important for their innovation activities during the past three years, 0 otherwise.
16.	Formal Training	1 if the firm provided formal training, 0 otherwise.
	C) Business Environment	
17.	Competition	1 if the firm has one or more competitors, 0 otherwise.
18.	Access to New Export Market	1 if the firm considered accessing to new exports market important during the last three years, 0 otherwise.
19.	Access to External Finance	1 if the firm had access to external finance in the last two years, 0 otherwise.
20.	Access to Information and Communication Technology (ICT)	1 if the firm considered ICT important in the past three years, 0 otherwise.
21.	Access to Skilled Labour Market	1 if the firm has access to the skilled labour market, 0 otherwise.
22.	Access to Unskilled Labour Market	1 if the firm has access to the unskilled labour market, 0 otherwise.
23.	Access to Local Business Networks	1 if the firm considered the local business networks are good at its location, 0 otherwise.
24.	Access to Universities and Research Institutions	1 if the firm considered access to universities and higher education institution resources is important during the past three years, 0 otherwise.
25.	Access to Government Support	1 if the firm considered access to government support is important during the past three years, 0 otherwise.

Table 3.7 summarises the innovation outcomes at the firm level. It lists the dependent and independent variables of the innovation models. All the variables are binary except for firm size and firm age. The number of SMEs that have participated in the CBR survey is 2,520, which is equal to the number of observations. At the firm level, the mean shows that 27% of the British SMEs innovated their products, 24% innovated their operational processes, 20%

innovate their organisational or managerial processes, 15% innovated their services, and 10% innovated their marketing methods.

Table 3. 7 Innovation Outcomes at Firm Level

Innovation outcome at Firm Level	Yes	No	Total	Yes %	No %	Total %
Product Innovation	683	1,837	2,520	27	73	100
Service Innovation	371	2,149	2,520	15	85	100
Operational Processes	615	1,905	2,520	24	76	100
Organisational or Managerial Processes	504	2,016	2,520	20	80	100
Marketing Methods	246	2,274	2,520	10	90	100

Table 3.8 provides a summary of sample statistics as per the CBR survey responses. The dataset included firms with minimum zero employees and a maximum of 485 employees, which were all categorised under SMEs at that time. *It also covered SMEs below 1 year and up to 278 years old. Post running the regression model, the resulting coefficients for both firm size and firm age were very small. Therefore, I have taken the log of firm size and got values with a minimum of 0 and maximum of 6.18. I have also taken the natural log of the total number of years since business started operations and got values with a minimum of 0 and maximum of 5.63.*

Table 3. 8 Summary of Statistics

Variables	Mean	Std. Dev.	Min	Max
Dependent Variables				
Products Innovation	0.271	0.445	0	1
Services Innovation	0.147	0.354	0	1
Operational Processes Innovation	0.244	0.430	0	1
Organisational or Managerial Processes Innovation	0.200	0.400	0	1

Marketing Methods Innovation	0.098	0.297	0	1
Independent Variables				
Firm Size	36.737	61.915	0	485
Exports	0.346	0.476	0	1
Sites/Branches/Subsidiaries	0.117	0.321	0	1
Updated Equipment and New Technology	0.310	0.463	0	1
Female Led Businesses	0.076	0.265	0	1
Male Led Businesses	0.901	0.298	0	1
Firm Age	22.425	27.958	1	278
Location	0.815	0.388	0	1
Branded Product	0.528	0.499	0	1
Executive Founders	0.735	0.442	0	1
Capability for Expansion	0.242	0.428	0	1
R&D	0.328	0.470	0	1
Formal Intellectual Property Rights	0.063	0.242	0	1
Formal Training	0.550	0.498	0	1
Competition	0.788	0.409	0	1
Access to New Exports Markets	0.549	0.498	0	1
Access to External Finance	0.378	0.485	0	1
Access to ICT	0.243	0.429	0	1
Access to Skilled Labour Market	0.454	0.498	0	1
Access to Unskilled Labour Market	0.308	0.462	0	1
Access to Local Business Networks	0.488	0.500	0	1
Access to Universities and Research Centres	0.135	0.342	0	1
Access to Government Support	0.101	0.302	0	1

Firm Characteristics

In general, the size of the British firm in the 1990s was small, as on average the number of employees per firm was 37, and the average firm age was 22 years old since starting operations. 31% of the firms had updated equipment and high technology. Also, 52.8% of the firms produced high quality branded products, and 34.6% of them exported their products and services. 11.7% of them had more than one site, branch and subsidiary and had access to their resources. 81.5% of them were located in urban areas. Women managed only 7.6% of the British SMEs and men managed 90.1% of them. It implies that only 2.3% of the British firms had both women and men in their top management team. Also, 73.5% of them had executive founders.

Firm Behaviour

24.2% of the British SMEs in the 1990s had the capability for expansion. 32.8% of them invested in R&D activities or had proper R&D function and budget. Only 6.3% of them acquired formal Intellectual Property protection rights. 55% of them provided formal training to their employees.

Business Environment

66.2% of the British SMEs in the 1990s operated in a monopolistic competition market. 37.8% of them had access to external finance. 54.9% of them had access to new exports markets. 24.3% of them had access to ICT. 30.8% of them had access to the unskilled labour market. 45.4% had access to the skilled labour market. 48.8% of them had access to local business networks. 13.5% of them had access to universities and research institutions, and 10.1% of them had access to government support.

3.2.2 The BIS Dataset

Phase 2: British SMEs in the 2010s

Survey Method

The Department for Business Innovation & Skills (BIS) commissioned 15,500 Computer Assisted Telephone Interviews (CATI) for the longitudinal small business survey (LSBS) Year 1 (2015) survey conducted with owners or proprietors and managing directors or other

senior managers of small and medium-sized enterprises in the United Kingdom. This survey was conducted between July 2015 and January 2016 by BMG Research Ltd, and the average interview length was 30 minutes. It is considered the largest small businesses survey ever undertaken in the UK, and it is repeated annually to establish a panel dataset.

Sampling Strategy

There were no quotas imposed at the stage of interviews according to Office for National Statistics guidelines other than on overall target, the number of interviews in Northern Ireland, and the number of IDBR[5] and Dun & Bradstreet[6] sourced interviews. A sample stratification strategy was implemented in each of the four UK nations (England, Wales, Scotland and Northern Ireland). The targets were based on the size of the enterprise of registered and unregistered businesses as follows:

- 12% of interviews with unregistered businesses with zero employees.
- 11% of interviews with registered businesses with zero employees that were companies.
- 5% of interviews with registered businesses with zero employees that were not companies.
- 10% of interviews with registered micro-businesses with between one and four employees that were companies.
- 7% of interviews with registered micro-businesses with between one and four employees that were not companies.
- 9% of interviews with registered micro-businesses with between five and nine employees.
- 26% of interviews with registered small businesses with between ten and 49 employees.
- 20% of interviews with registered medium-sized businesses with between 50 and 249 employees.

[5] [5] IDBR is a record of all UK enterprises that pay VAT or PAYE. It has approximately 2.3 million enterprises.

[6] Dun & Bradstreet is a source for businesses with zero employees. These businesses do not pay VAT or PAYE. It has approximately 3.1 million businesses.

The logic behind setting these targets for these size bands is that they are broadly in line with the proportion of total employment and turnover among SMEs in the UK. This logic is also followed in other previous small business surveys.

The targets substantially overrepresented businesses with 5 and 249 employees compared to their real numbers within the business population. It is not the case with the target set for businesses with zero employees. However, the proportion of targeted businesses with zero employees (28%) was still higher than was the case in the previous small business survey (17%).

The BIS dataset consists of 405 variables, and I have used only 30 variables that are related to innovation outcomes in British SMEs. Please refer to ***Appendix A3.2***, which shows the mapping of the variables I used to test the innovation model with the questions taken from the BIS survey. The responses of the BIS survey formed a dataset. The dataset has been downloaded from the UK Online Data Services website and then exported to STATA software to run the regression models using probit, logit and multivariate probit estimators, as explained in detail in Chapter 5. The results of the regression analysis are then compared with the results of the British SMEs in the 1990s.

Tables 3.9 to 3.11 summarise the demographics of the BIS sample in terms of firm size, firm age, and sector type.

Table 3. 9 British SMEs by Employment Category

Category Base No.	**Firm Size**	**Freq.**	**%**
1	No Employees	4,355	28.09
2	Micro 1-9	4,102	26.46
3	Small 10-49	4,066	26.23
4	Medium 50-249	2,979	19.22
Total		**15,502**	**100**

Table 3. 10 British SMEs by Sector Type

Category Base No.	Sector	Freq.	%
1	Production and construction	3,530	22.77
2	Transport, retail and food services	3,858	24.89
3	Business services	4,858	31.34
4	Other services	3,256	21
Total		**15,502**	**100**

Table 3. 11 British SMEs by Age

Category Base No.	Firm age	Freq.	%
1	<=1 year	153	0.99
2	1 year	171	1.1
3	2 years	310	2
4	3 years	416	2.68
5	4 years	384	2.48
6	5 years	511	3.3
7	6-10 years	2,005	12.93
8	11-20 years	2,733	17.63
9	>= 20 years	8,819	56.89
Total		**15,502**	**100**

Table 3.12 describes the selected variables. It consists of five models of innovation outcomes at the firm level. It also includes a total of 25 independent variables: 12 variables categorised under “firm characteristics”, four variables under “firm behaviour” and nine variables under “business environment.”

Table 3. 12 Description of Variables

Variables	Definition
Innovation Variables	
Model 1: Product Innovation	
Product Innovation	A binary variable that takes the value of 1 if the firm launched a new or significantly improved product during the last two financial years, 0 otherwise.

Model 2: Service Innovation	
Service Innovation	A binary variable that takes the value of 1 if the firm launched new or significantly improved service during the last two financial years, 0 otherwise.
Model 3: Operational Process Innovation	
Operational Processes Innovation	A binary variable that takes the value of 1 if the firm used new or significantly improved operational processes during the last two financial years, 0 otherwise.
Model 4: Organisational or Managerial Process Innovation	
Organisational or Managerial Processes Innovation	A binary variable that takes the value of 1 if the firm launched new or significantly improved organisational or managerial processes during the last two financial years, 0 otherwise.
Model 5: Marketing Methods Innovation	
Marketing Methods Innovation	A binary variable that takes the value of 1 if the firm launched new or significantly improved marketing methods during the last two financial years, 0 otherwise.
Explanatory Variables in all the five models	
A) Firm Characteristics	
1. Firm Size	Log of the total number of employees in the firm for the latest financial year.
2. Firm Size Square	Log of the square of the total number of employees in the firm for the latest financial year.
3. Exports	1 if the firm exports products and services, 0 otherwise.
4. Sites/Branches/Subsidiaries	1 if the firm has one or more than one site/branches/subsidiaries and has access to the resources, 0 otherwise.
5. Updated Equipment & High Technology	1 if the firm has up-to-date equipment and high technology, 0 otherwise.
1. Firm Age	Log of the total number of years since the firm started its operations.
2. Firm Age Square	Log of the square of the total number of years since the firm started its operations.
3. Location	1 if the firm is located in an urban area, 0 otherwise.
4. Family-owned business	1 if the firm is owned by a family, 0 otherwise.
5. Business-led by women	1 if the firm is led by women, 0 otherwise.
6. Business-led by men	1 if the firm is led by men, 0 otherwise.
7. Executive Founders	1 if the firm has executive founders, 0 otherwise.

B) Firm Behaviour	
13. Capability for Expansion	1 if the firm has the capability for expansion in terms of expertise and product lines, 0 otherwise.
14. R&D Indicator	1 if the firm has R &D activities or function for the creation of new products and services, 0 otherwise.
15. Formal IP Protection	1 if the firm acquired Intellectual Property rights in the last 12 months, 0 otherwise.
16. Formal Training	1 if the firm has formal training programmes, 0 otherwise.
C) Business Environment	
17. Competition	1 if the firm has one or more competitors, 0 otherwise.
18. External Finance	1 if the firm has an average and above-average capability for accessing external finance, 0 otherwise.
19. Access to New Export Market	1 if the firm has new exports markets, 0 otherwise.
20. Access to Information and Communication Technology (ICT)	1 if the firm has ICT infrastructure, 0 otherwise.
21. Access to Skilled Labour Market	1 if the firm has access to the skilled labour market, 0 otherwise.
22. Access to Unskilled Labour Market	1 if the firm has access to the unskilled labour market, 0 otherwise.
23. Access to Local Business Networks	1 if the firm has access to local business networks, 0 otherwise.
24. Access to Universities and Research Centres	1 if the firm has access to universities or other higher education institutions, 0 otherwise.
25. Access to Government Support	1 if the firm has access to government support, 0 otherwise.

The outlook of British SMEs' innovation outcomes in the 1990s according to the responses gathered in the CBR dataset showed that 27% of the British SMEs innovated their products, 24% innovated their operational processes, 20% innovated their organisational or managerial processes, 15% innovated their services, and 10% innovated their marketing methods. These concentrations have changed, as illustrated in Table 3.7, and *the focus has shifted to internal and external services and marketing methods innovations rather than products and operational processes innovations, as follows.*

Table 3.13 shows the responses of British SMEs in the 2010s to the questions whether they innovate or not innovate any of the five types of innovation. In general, *the number of firms that innovate is lower than the number of firms that do not innovate.* This observation applies

to all types of innovation. Also, firms tend to innovate their organisational or managerial process more than any other type of innovation (47%). It is followed by service innovation (36%), marketing methods (32%) and operational process (26%) innovations, respectively. Although product innovation is most popular in terms of definition, it seems to be currently the least practised type of innovation according to the results (22%).

Table 3. 13 Responses of Firms on Innovations

Innovation outcome	Yes	No	Total	Yes %	No %	Total %
Product Innovation	3,362	12,140	15,502	22	78	100
Service Innovation	5,530	9,972	15,502	36	64	100
Operational Processes	4,095	11,407	15,502	26	74	100
Organisational or Managerial Processes	7,252	8,250	15,502	47	53	100
Marketing Methods	5,004	10,498	15,502	32	68	100

Overall, Table 3.14 shows that the majority of British firms are permanently non-finance seekers. Small and medium firms have higher access to finance than micro and firms with no employees. However, micro and zero employees' firms have higher future intentions to seek for finance than SMEs, which are perhaps already burdened or satisfied with their borrowings level.

Table 3. 14 British SMEs based on Employment and Finance

SME Finance Segmentation	Zero Employees	Micro (1-9)	Small (10-49)	Medium (50-249)	Total
Had a borrowing event	843	1,221	1,562	1,325	4,951
Would be seekers	144	127	81	33	385
Happy non-seekers	102	138	104	95	439
Permanent non-seekers	2,935	2,234	1,932	1,256	8,357
Other	331	382	387	270	1,370
Total	4,355	4,102	4,066	2,979	15,502

Furthermore, Table 3.15 indicates that 57% of the British SMEs were established more than 20 years ago. It also shows overall that as the firm ages, it expands in terms of the number of employees. In general, the total number of firms with zero employees is the highest in the British market, followed by micro and small firms.

Table 3. 15 British SMEs based on Employment and Firm Age

SME Age Segmentation	1-5 Years	6-10 Years	11-20 Years	> 20 Years	**Total**
Zero Employees	690	748	917	2,000	4,355
Micro (1-9)	641	546	695	2,220	4,102
Small (10-49)	442	466	750	2,408	4,066
Medium (50-249)	172	245	371	2,191	2,979
Total	1,945	2,005	2,733	8,819	15,502

Table 3.16 presents the tabulation of British SMEs' employment segments and types of sectors. In general, the British firms invest in the business services sector a bit higher (31%) than the rest of the sectors, which constitute less than 25% each. However, small firms favour the transport, retail and food services sector. Also, medium firms invest more in the other services sector than in the business services sector.

Table 3. 16 British SMEs based on Employment and Sector

SME Sector Segmentation	Production & Construction	Transport, Retail and Food Services	Business Services	Other Services	Total
Zero Employees	1,124	742	1,687	802	4,355
Micro (1 - 9)	922	1,234	1,344	602	4,102
Small (10 - 49)	909	1,218	1,045	894	4,066
Medium (50 - 249)	575	664	782	958	2,979
Total	3,530	3,858	4,858	3,256	15,502

Table 3.17 summarises the variables statistics of the innovation model. It lists the dependent and independent variables used to measure five innovation outcomes. The total number of observations is 15,502 of British firms. The means of the five types of innovation support the tabulation of innovation outcomes presented in Table 3.13, as the British firms innovate more of their organisational or managerial processes (46.8%), followed by services (35.7%) and marketing methods (32.2%). Only 21.7% of the British firms innovate their products, and 26.4% of the firms introduce major changes to their operational process.

Table 3. 17 Summary of Statistics

Variables	***Mean***	***Std. Dev.***	***Min***	***Max***
Dependent Variables				
Products Innovation	0.217	0.412	0	1
Services Innovation	0.357	0.479	0	1
Operational Processes Innovation	0.264	0.441	0	1
Organisational or Managerial Processes Innovation	0.468	0.499	0	1
Marketing Methods Innovation	0.323	0.468	0	1
Independent Variables				
Firm Size	23.983	39.759	0	249
Exports	0.215	0.411	0	1
Sites/Branches/Subsidiaries	0.994	0.075	0	1
Updated Equipment and New Technology	0.787	0.409	0	1
Firm Age	11.210	14.642	1	145
Location	0.722	0.448	0	1
Family-owned Businesses	0.668	0.471	0	1
Businesses Led by Female	0.206	0.404	0	1
Business Led by Male	0.050	0.217	0	1
Executive Founders	0.835	0.371	0	1
Capability for Expansion	0.802	0.398	0	1
R&D	0.464	0.499	0	1
Formal Intellectual Property Rights	0.001	0.025	0	1
Formal Training	0.323	0.468	0	1

Competition	0.107	0.310	0	1
Access to External Finance	0.538	0.499	0	1
Access to Exports Markets	0.125	0.330	0	1
Access to ICT	0.563	0.496	0	1
Access to Skilled Labour Market	0.219	0.413	0	1
Access to Unskilled Labour Market	0.286	0.452	0	1
Access to Local Business Networks	0.714	0.452	0	1
Access to Universities and Research Centres	0.065	0.247	0	1
Access to Government Support	0.033	0.179	0	1

The dataset includes firms with zero employees (the entrepreneur is not counted) and a maximum of 249 employees, which are all categorised under SMEs. It also covers SMEs between 1 year and more than 20 years old. In general, the size of the British firm in the 2010s is small, as on average the number of employees per firm is 24 and the average firm age is 11 years old since starting operations.

I have taken the log of firm size and got values with a minimum of 0 and a maximum of 5.52. I have also taken the log of the total number of years since business started operations and got values with a minimum of 0 and a maximum of 2.30.

Table 3.17 also provides a summary of sample statistics as per the BIS survey responses, as follows:

Firm Characteristics

66.8% of British SMEs are family-owned businesses. In general, the size of the British firm is small, as on average the number of employees per firm is 24 and the average firm age is between 11 to 20 years old since starting operations. Also, 21.5% of the firms export their products and services. 99.4% of them have more than one site or branch. 78.7% of them use updated equipment and high technology. 72.2% of them are located in urban areas. 20.6% of the British SMEs are managed by women and is. 83.5% of them have executive founders.

Firm Behaviour

80.2% of the British SMEs have the capability for expansion. 46.4% of them invest in R&D activities or have proper R&D function and budget. Only 0.1% of them acquire formal Intellectual Property protection rights. It supports the lower attention in innovating products. 32.3% of them provide formal training to their employees.

Business Environment

10.7% of the British SMEs operate in a monopolistic competition market. 53.8% of them have access to external finance. 12.5% of them have access to new exports markets. 56.3% of them have access to ICT. 28.6% of them have access to the unskilled labour market. 21.9% have access to the skilled labour market. 71.4% of them have access to local business networks. 6.5% of them have access to universities and research institutions, and 3.3% of them have access to government support.

3.2.3 The Omani SMEs Dataset

Phase 3: Online (web-based) Omani SMEs Survey

Sampling Strategy

I have used a ***snowball technique*** in distributing ***a web-based survey,*** which is a type of non-probability sampling method in analysing the Omani SMEs. I shared a link of the online Omani SMEs survey to Riyada (The Public Authority for Small and Medium-sized enterprises), who in turn shared it with their list of registered SMEs, totalling 30k firms, through short text messages, e-mail, and via social platforms networks such as WhatsApp messenger. The text messages were sent against a commission of approximately 500 British Pounds to encourage participation in the survey. Also, the link was shared to the SMEs that are active in social media channels, such as Twitter, Facebook and LinkedIn. I chose this technique because the population is huge and it is sometimes difficult to have access to the firms as they are located across Oman, which in terms of area is larger than the United Kingdom (309,501 square kilometres against 242,495 square kilometres). A snowball sampling depends on social networking and provides an informal method of accessing the required population (Atkinson & Flint, 2001). The sample is self-selecting and will reflect the business networks of those SMEs that choose to participate (Griffiths et al., 1993). Therefore, the response rate is undefined.

Usually, snowball sampling is used when the population is hidden and difficult to identify. In this case, part of the population is hidden as there are small businesses that are not registered. Moreover, not all the population characteristics are known. I have the name of the companies, commercial registration no., address, number of employees, firm age and type of business activity. I made a judgment on whether the sample is representative or not based on the firm size category. The SMEs' classification based on the firm size in Oman is (0-5) for micro, (6-25) for small, and (26-99) for medium firms. According to the business population estimates, the split ratio is 72:24:4 (micro: small; medium) whereas the collected sample of 200 Omani SMEs has the split ratio of 52:34:14 (micro: small; medium). Although the sample size is just 200 firms, which is small compared to the sample sizes of the previous two British datasets, I gave great attention to the accuracy of the sampling frame and technique to get high-quality responses.

Survey Design

The online Omani SMEs survey is a web-based questionnaire. I decided to develop a web-based questionnaire for several reasons. Firstly, the data can be easily placed in a database file and then be imported into an appropriate statistical analysis package which is called STATA. Secondly, the data collection period is quite short compared to e-mail and postal surveys. Thirdly, the online survey can be designed in a way that prevents a failure to respond to a compulsory research question or the accidental selection of an inappropriate number of categories. For instance, failure to fill all compulsory questions in the survey is brought to the attention of the respondent by showing an alert message that directs them to the unattended questions, and when a question states to tick one response only, this can be confirmed.

Furthermore, respondents can be invited to fill the survey at a website via a link, and questionnaires can be easily shared via e-mail to reach a wider geographical coverage. However, the respondents will be those who have access to the internet and are willing to participate in the online survey. Moreover, the researcher has to consider the technical expertise needed in developing a web-based survey and managing the survey database. Also, the researcher has to consider the internal technical support extended at the university or research unit, as well as the external technical support offered by the survey software

developer. However, there is also a concern of not including certain businesses from the sample if they do not have access to the internet or the relevant software (David & Sutton, 2011).

Survey Questions

The process of developing the survey questions requires sufficient time and effort. In the beginning, it seems simple and easy. However, as time passes, it turns out to be such a complex process. As the survey is conducted, there will be no chance of reviewing the questions that failed to collect data. Therefore, to successfully collect the data required, the survey questions are well thought out and are developed in a systematic order. They are then piloted, reviewed and edited before the survey is conducted. It has helped in successfully testing the research hypotheses.

The two surveys reused in this research (the CBR and the BIS) and the survey that the researcher has developed included both open-ended and closed-ended questions. The open-ended questions allow the respondents to write their responses, whereas the closed-ended questions provide the respondents with a list to select from categories or options. The given categories are based on knowledge about the topic which is obtained from the review of the literature and the existing British surveys on SMEs from the Cambridge Centre Research Business and Department for Business Innovation and Skills.

As a full-time PhD student in one of the esteemed British universities, I am given limited access to existing archives that contain details of previous relevant studies to my research. These surveys are usually from large governmental institutions which are subject to quality testing and responses. They were a very good source to replicate questions that I used, some of them in the Omani SMEs survey, and they also inspired me to develop new questions.

Types and Format of Survey Questions

There are three common different types and formats of survey questions. The first type is factual questions that focus on behaviour or knowledge, such as a firm's capability to expand, to export in new markets, to invest in R&D, etc. Secondly, there are attribute questions that collect respondents' attributes, such as firm age, firm size, legal status, etc. These questions are helpful at the data analysis stage for clustering and comparison purposes. The third type

of questions focuses on collecting data on opinions, beliefs and attitudes. All these types of questions are used in the three surveys (the CBR, the BIS and the Omani SMEs Survey).

The development of survey questions needs to be understood by the survey respondents. To develop logical questions that are direct to the point and easy to understand by the survey participants, background information on the topic area needs to be researched carefully. I, therefore, translated the survey on Omani SMEs into the Arabic language to give another option to the respondents who prefer to participate using their mother-tongue.

Questions have two formats: either open-ended or closed-ended. Open-ended questions are unstandardized questions. They allow the respondents to write their response using their own words. Closed-ended questions are standardised questions. They provide the respondents with options to select to indicate their responses.

The advantages of closed-ended questions are that they allow the respondent to give a fast response to a clear question. In general, respondents are more likely to complete a questionnaire if it demands lower effort and response time. However, this practice may expose the researcher to false data collection. Another advantage of closed-ended questions is that they are easier for the researcher to deal with at the stages of data entry and analysis. Standardised responses are easier to code, and pre-coding them saves time at the data entry and analysis stages.

There are disadvantages of both closed-ended and open-ended questions. On the one hand, closed-ended questions can force the respondent to choose one of the given answers when they would not have impulsively selected either any answer or that particular answer. Such false answers that may be raised in closed-ended questions could influence the researcher to make use of open-ended questions. Open-ended questions allow the respondents to provide responses using their own words and enable the respondents to express their opinion or raise issues that are not covered by the researcher.

On the other hand, open-ended questions rely on the respondent being interested in or knowledgeable of the subject to express the response in writing. Open answers are time-consuming for the researcher as they require pre and post coding of the responses.

According to the data type or the measurement level of the data to be collected, the format of the closed-ended questions is decided to be nominal or ordinal or interval or ratio. Moreover, the standardised responses should be exhaustive, exclusive and balancing categories (de Vaus, 2001).

This section outlines the formats used for closed-ended question responses in the Omani SMEs survey.

Firstly, a dichotomies question format is a question that has only two response categories. It is used to obtain basic factual information or to have a structural questionnaire by directing respondents to fill specific questions. However, the researcher should use dichotomies carefully, as such questions may force the respondent to exaggerate or underestimate their real opinion. A1 is an example of dichotomies question.

A1) Are you a family-owned business?

- ☐ Yes
- ☐ No

Secondly, there are questions with a list of responses, including responses in the form of categories to be selected by a respondent. Such questions should come with clear instructions on whether one, or more than one, of the given answers, can be selected. The researcher should consider a comprehensive list of given answers and should pilot the survey questions to find out any additional unforeseen responses that can be added to the final survey version. It is wise to include an "Other" category at the end of the given responses, followed by an open request of "Please state" to meet the exhaustiveness requirement. A3 is an example of a question with a list of responses.

A3) What is your firm's business sector?
Please select the sectors that apply to your business

- ☐ Production or Manufacturing
- ☐ Construction
- ☐ Transportation
- ☐ Retail Trade & Food Services
- ☐ Business Services
- ☐ Others, please specify in the below box:

Thirdly, multiple response questions are questions that require the respondent to select more than one answer. The researcher should understand that when using multiple response questions, it will later influence how the data will be coded and analysed. D4 is an example of multiple response questions.

D4) Which of these, if any, are reasons why you do not currently provide any formal training? (please tick what applies)

- ☐ All staff are sufficiently trained already
- ☐ Training not necessary in your type of business
- ☐ Too expensive
- ☐ Do not know where to find the right training
- ☐ Lack of time
- ☐ Employee turnover
- ☐ Others, please specify in the below box:

Fourthly, routing questions are questions that direct or funnel respondents to particular sections of questions. They are used when some questions are not applicable to certain respondents. Such directing respondents away from completing some questions that are not applicable to them will reduce the time required to finish the overall questionnaire. Routing questions normally consist of a 'Yes/No' followed by clear direction to answer a specific set of questions.

F2) Did your firm receive any form of government support in **the last three years**?

- ☐ Yes
- ☐ No
- ☐ I don't know

F2a) If yes, please specify the form of government support? (please select all that applies)

- ☐ Finance of venture
- ☐ Subsidy
- ☐ Tax exemption
- ☐ Being an incubator for some time
- ☐ Others, please specify in the below box:

Finally, attitudinal or opinion question responses collect data on a respondent's opinion by making use of a rating scale. Various rating scales can be used to create formal scales to measure concepts by combining responses from a series of statements. This section presents some of the commonly used rating categories and the application of Likert scales.

Rating question responses are simply response categories that are presented in rank order between extreme positions, normally positive, negative and neutral effect. The number of categories varies, but the most popular questions have either three or five categories. E5 is an example of a rating question.

E5) How do you describe your firm's growth in the last 12 months?

- Substantial Growth
- Significant Growth
- Moderate Growth
- Growth, don't know how much
- No change
- Minor Shrinkage

Semantic differential scales are used to assess individuals' responses to one statement or more by circling the numerical position on the scale that indicates the respondent's feelings, attitude or belief towards the item under study. G1a is an example of a semantic differential scale that assesses a single statement.

G1a) By approximately what percentage do you aim to increase your sales?

- 1-9%
- 10-24%
- 25-49%
- 50-74%
- 75-99%
- 100% or more

The use of Likert scales is a way of collecting data on a concept from different approaches (Oppenheim, 1992). They also provide the researcher with more information about a respondent's opinion or feelings on a topic that is more than just a disagree/agree or yes/no response.

Likert scales consist of positive and negative statements or scale items. Each scale item has the same standard set of responses. The responses would be on a rating scale with three

extreme positions, positive, negative and neutral. One of the common formats of Likert scales is the matrix question structure. It is used when there are a large number of rating questions which are organised into a matrix structure. The advantage of matrix questions is that all the large numbers of statements are put together in one question of the survey.

A standard Likert scale consists of five points with a given score from 1 to 5. C10 is an example of a matrix question structure.

C10) Given a **scale from 1 to 5**, where 1 indicates a very weak barrier and five a very strong barrier, kindly rank the following **barriers to innovation** in your firm. Please do not select more than one answer per row.

	Very Weak	Weak	Average	Strong	Very Strong
The financial constraints (high cost of innovation and lack of finance).	□	□	□	□	□
The bureaucratic hurdles (laws & regulations).	□	□	□	□	□
Intellectual Property management, project management, and organisational culture.	□	□	□	□	□
Lack of technological and market information	□	□	□	□	□
Lack of R&D activities or inadequate R&D investment	□	□	□	□	□
Lack of cooperation with universities and other relevant partners	□	□	□	□	□
Others	□	□	□	□	□

Survey Layout

The presentation and layout of the self-completion questionnaire need to be considered carefully. Failure to allow time for this in the researcher's planning schedule could result in a poor completion rate. Therefore, the survey must be professionally presented to encourage the respondents to participate in it.

For the online Omani SMEs Survey, a personal customised theme has been used in Google Forms that reflects SMEs using an innovative background or layout. The organisation and order of the questions are carefully considered, as they are organised in sections using different questions formats (see ***Appendix A3.4***).

3.3 Research Quality

3.3.1 Reliability and Validity of the Survey

The reliability and validity of the survey are important controls that should be in place to ensure the interpretation of the results is valid. Reliability indicates whether the survey participant will give the same response at a different time. It is judged by consistency in response and the limitation of the error measure, as it is not possible to completely remove the error. It is a crucial aspect, as unreliability will influence the analysis of relationships between the variables. When a measure has low reliability, the results produced are false or do not reflect the real picture (Punch, 2005).

Assessing the reliability of the survey questions is possible by employing the test-retest approach. This method asks the respondent the same questions at different time intervals. Then, the consistency in the given answers is assessed via correlation techniques. A correlation coefficient equal to or greater than 0.8 indicates that the question is reliable (de Vaus, 1996). However, the test-retest method is complicated, as it is not practical to ask the same questions to the same sample on two or more occasions. It is because the survey participants may remember their previous responses. Therefore, the test-reset method may not be an ideal test of the questionnaire's reliability; instead, it may become a measure of the respondents' memory.

Validity is the degree to which the questionnaire describes and measures the concept it was designed to. Validity can be internal or external. Internal validity assumes that there is no evidence that other variables plus the error term are responsible for the variation in the

dependent variable. The sampling technique and the measurement tools used for data collection can compromise internal validity. External validity is the degree to which the research findings can be generalised to larger populations. It is dependent on the extent of representativeness and the sample size on which the findings are based.

I have ensured the reliability and validity of the online Omani SMEs survey by the careful construction of the survey questions, as follows: (1) the questions' types and formats have been inspired from existing questionnaires from reputable surveys (CBR & BIS) to ensure criteria validity; (2) some questions were asked twice but phrased slightly differently; (3) the questionnaire has been reviewed by my supervisors to ensure content validity; and (4) the piloting of the questions has been performed and the participants were active entrepreneurs from family and friends who provided constructive feedback to improve the questionnaire. Hence, the clarity of statements was checked, and any ambiguous wording was changed. It has also enhanced the content validity. Cronbach's alpha, a measure of internal consistency (Pallant, 2005), was employed and showed good reliability. The α coefficient for the entire questionnaire is 0.84, which is sufficiently large.

3.3.2 Piloting the Survey

Piloting the questionnaire allows the researcher to evaluate the elements of the data collection process. It ensures that the respondents understand the questionnaire, and it returns meaningful and usable data in addressing the research questions. The survey questions should be piloted on a test group from the actual sample or from the targeted population to provide the researcher with useful feedback.

The feedback received from piloting of the questionnaire allows the researcher to gather information on the questions' appropriateness, on the categories of standardised responses, and the format and structure of the overall survey. Aldridge and Levine (2001) suggest that there are "warning signals" that may indicate that the surveys are problematic, as follows:

- Very long completion time
- Unanswered questions
- Uncompleted ranking question

- Multiple answers are given to questions where only one answer was required
- Only one response given to multiple response questions
- The same answers provided by all respondents.

The instructions for completing questions are perhaps insufficient if the respondents have incorrectly completed the questions. It is even more challenging if the questions were rooting questions. The inappropriate questions might require rewording if the respondents failed to answer them.

3.3.3 Ethical Considerations

As new technologies are adopted, the ethical concerns related to e-research are emerging. Research connecting to the internet needs to follow the same ethical values as all social research, such as informed consent, anonymity and confidentiality.

Researchers have ethical obligations and responsibilities to protect the rights and interests of the participants in any study that deals with people (Denscombe, 2014; Yin, 2014). However, the Omani SMEs survey is not an interventional study as it doesn't investigate sensitive human and confidential personal data. It investigates the drivers and barriers of innovation in Omani SMEs. Few of the survey questions request personal data, but they are not considered sensitive and may be available in the public domain, such as gender, age and the highest level of education. These types of questions are optional. The survey is confidential, and the results will be reported at the aggregate level without mentioning the name of the company. The respondents of the questionnaire are either the founders or owners or a senior executive of the company.

Since the survey does not investigate individuals, but SMEs instead, no consent forms and information letters were distributed to participants. Only one official letter was addressed to Riyada, the Public Authority for Small and Medium-sized Enterprises in Oman, to provide the researcher with the SMEs dataset and also to obtain their help in distributing the survey link to the Omani SMEs. Also, the questionnaire starts with a brief explanation about who is conducting the survey and from which university. It demonstrates to the participants the purpose of the survey and assures them about the confidentiality of their responses.

I have obtained the ethical approval of the Ethics Committee from the School of Politics, Economics and International Relations (see ***Appendix A3.5***).

3.4 Administering the Survey

Administering a survey post the questionnaire development is important, and arrangements need to be made for their distributions, such as attaching cover letters and statements, as well as allocating a form of incentive if needed to motivate the participants of the survey.

A covering letter or message at the beginning of the survey is important, as it identifies who is undertaking the research and conveys the aim and purpose of the study. Also, it explains the importance of the respondents' participation in the survey and gives them assurances of confidentiality and anonymity. It confirms that the study has been approved by an ethical clearance protocol and gives contact details if additional information is needed.

This research has employed an online web-based questionnaire. It was distributed to Omani SMEs through a shared link of an online survey tool, Google Forms, to the Public Authority for Small and Medium Enterprises (Riyada) in Oman. Riyada helped in sharing the web link with their list of registered firms which are stored in their database, totalling 30k. The participants of the survey are either firm founders or owners or senior executives.

The responses are saved automatically to Google spreadsheets that can be easily converted to Excel files. The Excel file is exported to STATA software to perform regression analysis. Please refer to ***Appendix A3.3***, which shows the mapping of the variables I used to test the innovation model using 31 variables selected from the Omani SMEs survey.

The innovation outcomes are regressed using probit, logit and multivariate probit estimators, as explained in detail in Chapter 6. The results of regression analysis are then compared with the results of British SMEs in the 1990s and 2010s.

3.4.1 Developing a Code Book

A codebook provides the framework for how the responses given to survey questions are coded for analysis in a statistical or econometrics package. It is developed for quantitative data collection methods. It is possible to put the codes next to the response categories on the actual survey itself for the closed-ended question to reduce data entry errors. Moreover, the

coding of closed-ended questions before administering the survey allows the researcher to check the appropriateness of the data measurements. See ***Appendices A3.1, A3.2 and A3.3***.

Table 3.18 describes the selected variables. It consists of five models of innovation outcomes at the firm level. It also includes a total of 25 independent variables: 13 variables categorised under "firm characteristics", four variables under "firm behaviour" and nine variables under "business environment".

Table 3. 18 Description of Variables

Variables	**Definition**
Innovation Variables	
Model 1: Product Innovation	
Product Innovation	A binary variable that takes the value of 1 if the firm launched the new or significantly improved product during the last three financial years, 0 otherwise.
Model 2: Service Innovation	
Service Innovation	A binary variable that takes the value of 1 if the firm launched new or significantly improved service during the last three financial years, 0 otherwise.
Model 3: Operational Process Innovation	
Operational Processes Innovation	A binary variable that takes the value of 1 if the firm used new or significantly improved operational processes during the last three financial years, 0 otherwise.
Model 4: Organisational or Managerial Process Innovation	
Organisational or Managerial Processes Innovation	A binary variable that takes the value of 1 if the firm launched new or significantly improved organisational or managerial processes during the last three financial years, 0 otherwise.
Model 5: Marketing Methods Innovation	
Marketing Methods Innovation	A binary variable that takes the value of 1 if the firm launched new or significantly improved marketing methods during the last three financial years, 0 otherwise.
Explanatory Variables in all the five models	
A) Firm Characteristics	
1. Firm Size	Log of the total number of employees in the firm for the latest financial year.
2. Firms Size Square	Log of the square of the total number of employees in the firm for the latest financial year.

3. Exports	1 if the firm exports products and services, 0 otherwise.
4. Sites/Branches/Subsidiaries	1 if the firm has one or more than one site/branches/subsidiaries and has access to the resources, 0 otherwise.
5. Updated Equipment & High Technology	1 if the firm has up-to-date equipment and high technology, 0 otherwise.
6. Firm Age	Log of the total number of years since the firm started its operations.
7. Firm Age Square	Log of the square of the total number of years since the firm started its operations.
8. Location	1 if the firm's headquarters is located in the urban area, 0 otherwise.
9. Family-owned business	1 if the firm is owned by a family, 0 otherwise.
10. Business-led by women	1 if the firm is led by women, 0 otherwise.
11. Businesses led by men	1 if the firm is led by men, 0 otherwise.
12. Branded Product	1 if the firm's product is branded, 0 otherwise.
13. Executive Founders	1 if the firm has executive founders, 0 otherwise.
B) Firm Behaviour	
14. Capability for Expansion	1 if the firm has the capability for expansion in terms of expertise and product lines, 0 otherwise.
15. R&D Indicator	1 if the firm has R &D activities or function for the creation of new products and services, 0 otherwise.
16. Formal IP Protection	1 if the firm acquired Intellectual Property rights in the last 12 months, 0 otherwise.
17. Formal Training	1 if the firm has arranged or funded any formal training programmes over the past 12 months, 0 otherwise.
C) Business Environment	
18. Competition	1 if the firm has one or more competitors, 0 otherwise.
19. Access to External Finance	1 if the firm has an average and above-average capability for accessing external finance, 0 otherwise.
20. Access to New Export Market	1 if the firm has new exports markets, 0 otherwise.
21. Access to Information and Communication Technology (ICT)	1 if the firm has access to ICT, 0 otherwise.
22. Access to Skilled Labour Market	1 if the firm has access to the skilled labour market, 0 otherwise.
23. Access to Unskilled Labour Market	1 if the firm has access to the unskilled labour market, 0 otherwise.

24. Access to Local Business Networks	1 if the firm has access to local business networks, 0 otherwise.
25. Access to Universities and Research Centres	1 if the firm has access to universities or other research centres in the last three years, 0 otherwise.
26. Access to Government Support	1 if the firm has access to government support in the last three years, 0 otherwise.

Table 3.19 illustrates the responses of 200 Omani SMEs to the questions whether they innovate or not innovate any of the five types of innovation. In general, *the number of firms that innovate is lower than the number of firms that do not innovate except for services innovation.* The outlook of Omani SMEs' innovation outcomes according to the responses gathered from our survey shows that 57% of the Omani SMEs innovated their services, 49% innovated their marketing methods, 46% innovated their products, 42% innovated their operational processes and 40% innovated their organisational or managerial processes. *It indicates that Omani SMEs focus more on innovating their services and marketing methods without neglecting other innovation outcomes, as the ratios are close. It resonates more with the current outlook of British SMEs.*

Table 3. 19 Responses of Firms on Innovations

Innovation outcome of Omani SMEs	**Yes**	**No**	**Total**	**% Yes**	**% No**	**% Total**
Product Innovation	92	108	200	46	54	100
Service Innovation	113	87	200	57	44	100
Operational Processes	84	116	200	42	58	100
Organisational or Managerial Processes	79	121	200	40	61	100
Marketing Methods	98	102	200	49	51	100

Overall, Table 3.20 shows that the majority of Omani firms that participated in the online survey are micro (1 to 5 employees) and small (6 to 25 employees). The Omani SMEs are mostly concentrated in the survival, success, and start-up stages.

Table 3. 20 Omani SMEs based on Firm's Life Stage and Employment

Firm Life Stage by Firm Size	Closed	The existence (Startups)	Maturity	Success	Survival	Takeoff	Total
Zero Employees	0	6	0	1	1	1	9
Micro	0	31	4	18	37	6	96
Small	1	8	5	23	26	5	68
Medium	0	1	2	8	4	3	18
Upper Medium	0	0	1	5	2	1	9
Total	1	46	12	55	70	16	200

Furthermore, Table 3.21 indicates that 55% (110 out of 200) of the Omani SMEs that participated in the online survey are newly established in the market (aged between 1 year and five years); 20% (40 out of 200) of the firms are aged between 11 to 20 years. It also shows that 19% (37 out of 200) of the firms are aged between 6 to 10 years and only 7% (13 out of 200) of them are aged more than 20 years old.

Table 3. 21 Omani SMEs based on Firm Age and Firm Size

Firm Age by Firm Size	1-5 years	6-10 years	11-20 years	> 20 years	Total
Zero Employees	9	0	0	0	9
Micro (1-5 employees)	68	15	12	1	96
Small (6-25 employees)	29	20	14	5	68
Medium (26-99 employees)	2	2	11	3	18
Upper Medium (100+)	2	0	3	4	9
Total	110	37	40	13	200

Table 3.22 presents the tabulation of Omani SMEs' employment segments and types of sectors. It indicates that the proportion of Omani firms in the production or manufacturing sector is 29% and, in the business, the services sector is 28%. It is followed by firms in retail trade and food services (21%) as well as firms in construction (13%). However, only 6% of the firms invest in the other services sectors, and only 4% of them invest in the transportation sector.

Table 3. 22 Omani SMEs based on Employment and Sector

Firm Sector by Firm Size	Business Services	Construction	Other Services	Production or Manufacturing	Retail Trade & Food Services	Transportation	Total
Zero employees	5	1	0	2	1	0	9
Micro	32	9	7	20	24	4	96
Small	12	14	3	25	11	3	68
Medium	2	2	0	8	5	1	18
Upper medium	5	0	1	2	1	0	9
Total	56	26	11	57	42	8	200

Table 3.23 summarises the variables statistics of the innovation model. It lists the dependent and independent variables used to measure five innovation outcomes. The total number of observations is 200 Omani firms. The means of the five types of innovations support the tabulation of innovation outcomes presented in Table 3.19, as the Omani firms innovate 56.5% of their services, followed by marketing methods at 49% and product innovation at 46%. They also innovate 42% of their operational processes and 39.5% of their organisational or managerial processes.

Table 3. 23 Summary of Statistics

Variables	**Mean**	**Std. Dev.**	**Min**	**Max**
Dependent Variables				
Product Innovation	0.460	0.500	0	1
Service Innovation	0.565	0.497	0	1
Operational Process Innovation	0.420	0.495	0	1
Organisational or Managerial Process Innovation	0.395	0.490	0	1
Marketing Methods Innovation	0.490	0.501	0	1
Independent Variables				
Firm Size	14.813	23.278	0	100
Exports	0.180	0.385	0	1
Sites/Branches/Subsidiaries	0.955	0.208	0	1
Updated Equipment and High Technology	0.500	0.501	0	1
Firm Age	7.425	8.077	1	38

Location	0.720	0.450	0	1
Family-owned Businesses	0.435	0.497	0	1
Business Led by Female	0.340	0.475	0	1
Branded Product	0.395	0.490	0	1
Employees of Different Gender	0.450	0.499	0	1
Executive Founders	0.655	0.477	0	1
Capability for Expansion	0.310	0.464	0	1
R&D	0.280	0.450	0	1
Formal Intellectual Property Rights	0.435	0.497	0	1
Formal Training	0.365	0.483	0	1
Competition	0.445	0.498	0	1
Access to ICT	0.645	0.480	0	1
Access to New Exports Markets	0.155	0.363	0	1
Access to Local Business Networks	0.435	0.497	0	1
Access to Skilled Labour Market	0.580	0.495	0	1
Access to Unskilled Labour Market	0.275	0.448	0	1
Access to External Finance	0.490	0.501	0	1
Access to University and Research Centre	0.270	0.445	0	1
Access to Government Support	0.160	0.368	0	1

The online survey dataset included firms with minimum zero employees (entrepreneur is not counted) and maximum 100 (entrepreneur is counted) employees, which are all categorised under SMEs. It also covered SMEs between 1 year and more than 20 years old (maximum of 38 years old). In general, the size of the Omani firm in the 2010s is small, as on average the number of employees per firm is 15 and the average firm age was eight years old since starting operations.

I have taken the log of firm size and got values with a minimum of 0 and maximum of 1.61. I have also taken the natural log of the total number of years since business started operations and got values with a minimum of 0 and maximum of 3.64.

The table also provides a summary of sample statistics as per the Omani SMEs' online survey responses, as follows.

Firm Characteristics

43.5% of Omani SMEs are family-owned businesses. In general, the size of an Omani firm is small, as on average the number of employees is 11 employees and the average firm age

is seven years old since starting operations. Also, 18% of firms export their products and services. 95.5% of them have more than one site or branch. 50% of them use updated equipment and high technology. 72% of them are located in urban areas. Women manage 34% of the Omani SMEs, and 45% of them have employees of different genders. It implies that the rest, 55%, of Omani SMEs have only a single gender (either all of the employees are male, or all are female). 39.5% of the Omani SMEs produce branded products. 65.5% of them have executive founders.

Firm Behaviour

31% of the Omani SMEs have the capability for expansion. 28% of them invest in R&D activities or have proper R&D function and budget. 43.5% of them acquire formal Intellectual Property protection rights. 36.5% of them provide formal training to their employees.

Business Environment

44.5% of the Omani SMEs operate in a monopolistic competition market. 49% of them have access to external finance. 15.5% of them have access to new exports markets. 43.5% of them have access to ICT. 58% of them have access to the skilled labour market. 27.5% have access to the unskilled labour market. 43.5% of them have access to local business. 27% of them have access to universities and research institutions, and 16% of them have access to government support.

3.5 Research Estimators

Given the conceptual framework discussed in section 2.4, the following model will be used as the starting point for the regression analyses.

Innovation indicator(s)= *f* (*fc, fb, be*)

Where:

fc = firm characteristics

***fb*=** firm behaviour

be = business environment.

It is a challenge for any innovation-related research to measure the variable of interest, innovation. Usually, the innovation is measured by proxies, such as R&D or patent-based indicators (Holland & Spraragen, 1933; Schmookler, 1950). These indirect measures are relatively narrow, as they induce large firm bias and potentially weak linkages with firm innovation.

Since the late 1970s, the introduction of firm-based innovation surveys has enabled researchers to measure innovation directly. This paper uses five dependent variables to capture different innovation outcomes at the firm and industry levels: product, service, operational processes, organisational or managerial processes, and marketing methods.

The hypotheses are tested on whether the firm's characteristics, behaviour and business environment have an impact on the firm's different types of innovation by estimating five innovation outcomes at firm level, using three estimation techniques: the probit, the logit and the multivariate probit (MVPROBIT), as follows.

3.5.1 Probit Estimator

Since the explained variables are binary, it is more appropriate to use beyond ordinary least square estimators, especially those related to discrete choice modelling. The PROBIT estimator is used, as shown in the equation below:

$$y_{vi}^{*} = x_{hi}'\beta_{vn} + \varepsilon_{vi} \qquad (1) \quad \text{Probit}$$

$$y_{vi} = 1 \; if \; y_{vi}^{*} > 0, and \; 0 \; otherwise,$$

Where i = 1, …, 2,520 firms, v =1, …, 5 $models$, h=1,…, 25 for the British SMEs in 1990s.

i = 1, …, 15,502 firms, v =1, …, 5 $models$, h=1,…, 25 for the British SMEs in 2010s.

i = 1, …, 200 firms, v =1, …, 5 $models$, h=1,…, 26 for the Omani SMEs in 2010s.

In other form $y_{vi} = 1(x_{hi}'\beta_{vn} + \varepsilon_{vi} > 0)$ to indicate a variable that equals one when the condition in parentheses is true and zero when it is not.

3.5.2 Logit Estimator

Thirdly, the LOGIT estimator, which is one of the common estimators for binary choices models, is used. It is easier to interoperate its results than those that are generated by probit estimator.

$$y_{vi}^{*} = \propto + \sum_{h=1}^{N} \beta_{vn} x_{hi} + \varepsilon_{vi} \ , \qquad (2) \quad \text{Logit}$$

Where i = 1, …, 2,520, h=1, …, 25, v =1, …, 5, for the British SMEs in 1990s.

i = 1, …, 15,502, h=1, …, 25, v =1, …, 5, for the British SMEs in 2010s.

i = 1, …, 200, h=1, …, 26, v =1, …, 5, for the Omani SMEs in 2010s.

$$If \ \ y_{vi}^{*} > 0, \qquad y_{vi} = 1$$

$$If \ \ y_{vi}^{*} < 0, \qquad y_{vi} = 0$$

In logistic regression, the errors are assumed to have a standard logistic distribution. Logit is a nonlinear specification that ensures the predicted probability is (0,1) for all values of x. The cumulative distribution function of the logit model is as follows:

$$E(Y)^{v} = \mathrm{P}\frac{\exp(\beta_0 + \beta_i \ x_i \ )}{1 + \ \exp(\beta_0 + \beta_i \ x_i \ )}$$

Logit estimator has slightly flatter tails. Probit estimator is a conditional probability P_i Approaches 0 or 1 at a faster rate. Basis of the Logit model is standard logistic distribution, whereas the basis of probit model is a standard normal distribution. Logit variance =π^2 /3 whereas probit variance =1. Logit requires mathematics, while probit requires sophisticated mathematics. Both estimators give the same result, preference of the method usually depends on the researcher's choice, but logit as a regressor is mostly preferred (Wooldridge, 2017).

3.5.3 Multivariate Probit Estimator

One form of innovation may lead to the generation of another type(s) of innovation(s), and the firm may introduce more than one type of innovation at a time. To avoid misspecification bias issues that may result from ignoring such assumptions, I agreed with the point raised by Shangqin Hong, Les Oxley, Philip McCann, and Trinh Le (2016) that it is perhaps inappropriate to assume independence between various innovation variables, whereas there is a correlation between various innovation outcomes. Therefore, I used the MVPROBIT to estimate the five innovation models at the firm level in one shot, using equation 3. The MVPROBIT estimator uses the Geweke-Hajivassiliou-Keane (GHK) simulator to evaluate the *M*-dimensional Normal integrals in the likelihood function.

$y^*_{mi} = x'_{hmi}\beta_{mi} + \varepsilon_{mi,}\ y_{mi} = 1\ if\ y^*_{mi} > 0, 0\ otherwise$ (3)

MVPROBIT

Where i = 1, …, 2,520, h=1, …, 25, m =1, …, 5, for the British SMEs in 1990s.

i = 1, …, 15,502, h=1, …, 25, m =1, …, 5, for the British SMEs in 2010s.

i = 1, …, 200, h=1, …, 26, m =1, …, 5, for the Omani SMEs in 2010s. $E[\varepsilon_m\ |x_{1,} \dots, x_M]$ =0,

Var$[\varepsilon_m\ |x_{1,} \dots, x_M]$ =1.

3.6 Summary

This chapter presented the research methodology in detail. It provided a recap of the research questions, then it discussed the use of secondary data and covered its advantages and disadvantages. It also discussed the use of the internet for primary research and focused on the online survey.

Then it described in detail the three research datasets: CBR, BIS and Omani SMEs survey. It clarified the three different sampling strategies for the datasets used and data collection adopted techniques. It is followed by the survey design and layout. It highlighted and provided examples of different types of survey questions used.

After that, it covered the research quality aspects, such as the reliability and validity of the survey. It described the piloting of the Omani SMEs survey, and it set out the key ethical considerations underpinning the study. Last but not least, it touched on how the Omani SMEs survey is administered and developed a codebook. Finally, it presented the three different types of research estimating techniques: PROBIT, LOGIT and MVPROBIT.

The next three chapters present the results from investigating the three datasets on the British SMEs in the 1990s, the British SMEs in the 2010s and the Omani SMEs in the 2010s.

Chapter 4: What determined and deterred innovation outcomes in the British SMEs in the 1990s?

4.1 Introduction

The objective of this chapter is to investigate what determined different types of innovations in British small and medium-sized enterprises (SMEs) in the 1990s. It also highlights the major barriers that hindered British SMEs' decision and choice to innovate their products, services, operational processes, organisational or managerial processes and marketing methods.

This chapter studies British SMEs in the 1990s because I think the situations and challenges faced by British SMEs at that time might be similar to the circumstances and challenges in Oman now as the UK is matured developed country and Oman is still developing. Therefore, this chapter aims to investigate the drivers of innovation of British SMEs and find out a way in which Omani firms may benefit from the experience of UK firms. It can happen by highlighting the innovation factors that might work in Omani firms or get inspired to innovate in different ways in the nearest future to diversify the sources of income in the Omani economy. It also can happen by understanding the different types of barriers to innovation besides getting prepared to deal with similar barriers if they also exist in Oman.

This chapter examines four research questions as follows:

Q1: What were the key specific firm characteristics that impacted innovation outcomes in the British SMEs in the 1990s?

Q2: What were the key firm behavioural elements that mattered for the British SMEs in the 1990s in deciding on whether to innovate or not?

Q3: What were the key specific business environment factors that influenced the choice of innovation in the British SMEs in the 1990s?

Q4: What were the internal and external barriers to innovation for the British SMEs in the 1990s?

This chapter examines the drivers and barriers of innovation in small and medium-sized enterprises (SMEs) in the UK at firm using the Cambridge Centre for Business Research (CBR) dataset of manufacturing and service sectors in 1997. The regression techniques used in this chapter are the probit, the logit and the multivariate probit (MVPROBIT) estimators, as mentioned in details in chapter 3.

Moreover, the determinants of innovations are many and may vary from country to another. Therefore, this chapter adopts the innovation model used in a recently published paper (Shangqin Hong, Les Oxley, Philip McCann and Trinh Le, 2016) in Applied Economics Journal on SMEs in New Zealand and applies it to CBR dataset. The dataset includes 2,520 British SMEs in the manufacturing and service sectors across England, Scotland, and Wales.

This innovation model is also applied to a more recent dataset of British SMEs in chapter 5 and Omani SMEs in chapter 6 for comparison purposes. It will help in understanding the changes and progress of different types of innovation in British SMEs. It will also be useful for Omani SMEs to learn from the UK experience in innovation at the firm level.

The adopted conceptual framework in this research and the recent literature on the drivers and barriers of innovation are discussed earlier in details in chapter 2. This chapter is outlined as follows to reflect on the research questions and hypotheses; Section 4.2 summarises the research dataset and methodology. Section 4.3 discusses research analysis and results. Then section 4.4 covers the different types of barriers faced by the British SMEs in the 1990s. Finally, the conclusion is summarised in section 4.5.

4.2 Research Data and Methodology

This chapter employs the data of small and medium-sized enterprises (SMEs) in the manufacturing and business service sectors in England, Scotland, and Wales. The dataset is downloaded from the UK online data service to investigate the drivers and barriers of innovation in the British SMEs. The source of the dataset is the Cambridge Centre for Business Research (CBR). The CBR dataset of 1997 has a total of 2,520 firms. It consists of a wide range of 396 financial and non-financial variables that are not available in normal companies' book accounts. These variables are collected merely from the national postal survey. They are about general business characteristics, innovation, commercial activities and competitive situations, workforce and training, as well as factors affecting efficiency,

acquisition activity, capital expenditure and finance. This research utilises a total of 45 variables: 30 variables are applied in the innovation models, and 15 variables reflect the barriers of innovation in British SMEs in the 1990s. For more information about the CBR dataset and sampling strategy or methodology, please refer to chapter 3.

Given the conceptual framework discussed in chapter 2, the following model will be used in this chapter and the following two chapters.

Innovation indicator(s)= *f* (*fc, fb, be*)

Where:

fc = firm characteristics, ***fb*****=** firm behaviour, ***be*** = business environment

It is a challenge for any research on innovation to measure the variable of interest, innovation. Usually, the innovation is measured by proxies such as R&D or patent-based indicators (Holland and Spraragen 1933; Schmookler 1950). These indirect measures are relatively narrow as they induce large firm bias and potentially weak linkages with firm innovation.

Since the late 1970s, the introduction of firm-based innovation surveys enabled researchers to measure innovation directly. This chapter uses five dependent variables to capture different innovation outcomes at the firm level: product, service, operational processes, organisational or managerial processes, and marketing methods.

The hypotheses are tested on whether firm characteristics, firm behaviour and business environment have an impact on different types of innovation in the British SMEs in the 1990s. It is done using three estimation techniques: the probit, the logit and the multivariate probit (MVPROBIT).

Firstly, since the explained variables are binary, it is more appropriate to use beyond ordinary least square estimators, especially those related to discrete choice modelling. Therefore, the PROBIT estimator is used.

The five innovation models are estimated separately, as shown in table 4.1. The pseudo-r-squared is approximately 0.2 in every innovation outcome at the firm level, which suggests that all the five models are good fits.

Table 4. 1 Probit Estimator on Innovations in British SMEs in the 1990s

VARIABLES	(1) Products Innovation	(2) Services Innovation	(3) Operational Processes Innovation	(4) Organisational or Managerial Processes Innovation	(5) Marketing Methods Innovation
Firm Size	0.082	-0.227***	0.092	-0.039	-0.070
	[0.067]	[0.074]	[0.070]	[0.069]	[0.085]
Firm Size Square	-0.018	0.043***	-0.004	0.009	0.015
	[0.012]	[0.013]	[0.012]	[0.012]	[0.015]
Exports	0.116*	-0.073	0.034	-0.082	0.172*
	[0.070]	[0.081]	[0.073]	[0.075]	[0.088]
Sites/Branches/Subsidiaries	-0.007	0.163*	-0.224**	0.130	0.216**
	[0.087]	[0.092]	[0.089]	[0.089]	[0.099]
Updated Equipments and High Technology	0.073	0.097	0.229***	0.182***	0.074
	[0.066]	[0.073]	[0.067]	[0.067]	[0.080]
High Quality Branded Product	0.482***	0.143	0.994***	0.398***	0.824***
	[0.117]	[0.130]	[0.135]	[0.123]	[0.180]
Firm Age	0.062	0.094	0.006	-0.118	0.016
	[0.107]	[0.125]	[0.110]	[0.107]	[0.136]
Firm Age Square	-0.002	-0.041	0.008	0.018	-0.007
	[0.021]	[0.026]	[0.021]	[0.021]	[0.026]
Location	-0.126	0.001	-0.072	0.071	-0.010
	[0.077]	[0.089]	[0.081]	[0.083]	[0.098]
Businesses Led by Female	0.012	-0.195	-0.326	0.038	-0.009
	[0.244]	[0.267]	[0.254]	[0.247]	[0.337]
Businesses Led by Male	0.034	-0.123	-0.093	0.021	0.243
	[0.218]	[0.235]	[0.221]	[0.221]	[0.295]
Executive Founders	-0.090	0.075	0.033	-0.110	-0.112
	[0.087]	[0.102]	[0.091]	[0.091]	[0.107]
Capability for Expansion	-0.047	0.211***	-0.206***	0.059	-0.068
	[0.071]	[0.076]	[0.073]	[0.073]	[0.087]
R&D	0.132*	0.180**	0.018	-0.066	-0.007
	[0.070]	[0.079]	[0.072]	[0.074]	[0.087]
Formal IP Protection Rights	0.213*	-0.249*	0.007	-0.517***	-0.198
	[0.118]	[0.133]	[0.120]	[0.130]	[0.143]
Formal Training	-0.127*	0.287***	-0.081	0.043	0.159*
	[0.069]	[0.080]	[0.071]	[0.072]	[0.089]
Competition	0.027	0.027	-0.083	-0.112	-0.204**
	[0.083]	[0.095]	[0.086]	[0.084]	[0.102]
Access to New Exports Market	0.707***	0.512***	0.524***	0.583***	0.118
	[0.129]	[0.145]	[0.143]	[0.135]	[0.185]
Access to External Finance	-0.043	-0.045	0.134**	0.047	-0.057
	[0.064]	[0.072]	[0.065]	[0.066]	[0.080]
Access to ICT	-0.202***	0.339***	-0.087	0.485***	0.081
	[0.075]	[0.081]	[0.076]	[0.076]	[0.089]
Access to Skilled Labour Market	0.117*	-0.303***	0.286***	-0.147**	0.064

	[0.069]	[0.083]	[0.071]	[0.074]	[0.088]
Access to Unskilled Labour Market	-0.083	0.083	-0.041	0.086	0.076
	[0.073]	[0.086]	[0.074]	[0.077]	[0.090]
Access to Local Business Networks	0.435***	0.257**	0.064	0.124	0.159
	[0.093]	[0.108]	[0.096]	[0.098]	[0.121]
Access to Universities and Research Center	0.080	0.025	-0.038	-0.139	0.086
	[0.097]	[0.106]	[0.099]	[0.102]	[0.113]
Access to Government Support	-0.110	0.141	0.049	0.101	0.047
	[0.107]	[0.116]	[0.108]	[0.110]	[0.125]
Constant	-1.737***	-1.725***	-1.958***	-1.455***	-2.263***
	[0.268]	[0.292]	[0.276]	[0.271]	[0.365]
Observations	2,520	2,520	2,520	2,520	2,520
Log likelihood	-1159	-858.1	-1079	-1042	-688.4
LR Chi2	626.5	389.8	641.9	438.8	235
pseudo r-squared	0.213	0.185	0.229	0.174	0.146

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Also, when regressing the models using probit estimator and excluding the firm age squared, the firm age becomes significant with the service innovation model, as demonstrated in Table A4.1 in the appendix.

Secondly, the LOGIT estimator, which is one of the common estimators for binary choices models, is used. Researchers find it easier to interoperate logit results than those that are generated by probit estimator.

The five innovation models are regressed separately, as shown in table 4.2. The pseudo-r-squared is also approximately 0.2 in every innovation outcome at the firm level, which suggests that all the five models are good fits.

Table 4. 2 Logit Estimator on Innovations in British SMEs in the 1990s

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	0.136	-0.379***	0.176	-0.067	-0.163
	[0.115]	[0.134]	[0.123]	[0.121]	[0.159]
Firm Size Square	-0.030	0.075***	-0.010	0.014	0.032
	[0.020]	[0.024]	[0.021]	[0.021]	[0.027]
Exports	0.198*	-0.160	0.058	-0.147	0.322*
	[0.119]	[0.145]	[0.124]	[0.130]	[0.165]

Sites/Branches/Subsidiaries	-0.009	0.260*	-0.377**	0.220	0.379**
	[0.141]	[0.158]	[0.149]	[0.148]	[0.176]
Updated Equipments and High Technology	0.117	0.164	0.371***	0.294**	0.114
	[0.110]	[0.130]	[0.113]	[0.116]	[0.149]
High Quality Branded Product	0.822***	0.263	1.823***	0.733***	1.746***
	[0.207]	[0.246]	[0.256]	[0.227]	[0.386]
Firm Age	0.102	0.118	0.077	-0.195	0.086
	[0.183]	[0.224]	[0.194]	[0.189]	[0.262]
Firm Age Square	-0.004	-0.064	-0.001	0.028	-0.023
	[0.036]	[0.047]	[0.038]	[0.038]	[0.051]
Location	-0.202	-0.010	-0.133	0.150	0.002
	[0.132]	[0.160]	[0.138]	[0.147]	[0.184]
Businesses Led by Female	-0.001	-0.309	-0.532	0.021	-0.085
	[0.418]	[0.486]	[0.446]	[0.435]	[0.642]
Businesses Led by Male	0.031	-0.204	-0.127	0.000	0.379
	[0.370]	[0.425]	[0.386]	[0.388]	[0.554]
Executive Founders	-0.167	0.172	0.015	-0.197	-0.185
	[0.148]	[0.186]	[0.154]	[0.158]	[0.199]
Capability for Expansion	-0.076	0.364***	-0.368***	0.117	-0.138
	[0.118]	[0.133]	[0.124]	[0.124]	[0.161]
R&D	0.213*	0.320**	0.039	-0.126	-0.021
	[0.116]	[0.140]	[0.121]	[0.126]	[0.160]
Formal IP Protection Rights	0.353*	-0.415*	0.008	-0.873***	-0.335
	[0.191]	[0.227]	[0.197]	[0.226]	[0.255]
Formal Training	-0.209*	0.495***	-0.127	0.095	0.307*
	[0.118]	[0.148]	[0.123]	[0.127]	[0.170]
Competition	0.044	0.034	-0.128	-0.198	-0.372*
	[0.144]	[0.175]	[0.151]	[0.149]	[0.194]
Access to New Exports Market	1.327***	1.043***	0.956***	1.103***	0.330
	[0.236]	[0.294]	[0.263]	[0.254]	[0.373]
Access to External Finance	-0.074	-0.075	0.218**	0.098	-0.103
	[0.107]	[0.129]	[0.110]	[0.115]	[0.148]
Access to ICT	-0.325***	0.577***	-0.142	0.806***	0.130
	[0.123]	[0.141]	[0.126]	[0.128]	[0.161]
Access to Skilled Labour Market	0.201*	-0.539***	0.467***	-0.286**	0.105
	[0.118]	[0.148]	[0.122]	[0.129]	[0.164]
Access to Unskilled Labour Market	-0.144	0.138	-0.063	0.133	0.119
	[0.123]	[0.153]	[0.126]	[0.135]	[0.166]
Access to Local Business Networks	0.710***	0.459**	0.081	0.212	0.288
	[0.158]	[0.204]	[0.160]	[0.171]	[0.231]
Access to Universities and Research Center	0.112	0.043	-0.077	-0.239	0.191
	[0.159]	[0.181]	[0.163]	[0.171]	[0.202]

Access to Government Support	-0.168	0.246	0.088	0.157	0.035
	[0.174]	[0.194]	[0.178]	[0.184]	[0.223]
Constant	-2.998***	-3.099***	-3.551***	-2.557***	-4.301***
	[0.465]	[0.536]	[0.496]	[0.480]	[0.699]
Observations	2,520	2,520	2,520	2,520	2,520
Log likelihood	-1162	-861	-1080	-1043	-689.3
LR Chi2	621.6	384	640.3	436.3	233.3
pseudo r-squared	0.211	0.182	0.229	0.173	0.145

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Also, when firm age squared is removed from the model, the firm age became significant at service innovation model, as shown in Table A4.2 in the appendix.

Thirdly, since one form of innovation may lead to the generation of another type(s) of innovation(s). Also, the firm may introduce more than one type of innovation at a time. To avoid misspecification bias issues that may result from ignoring such assumptions, I agree with Shangqin Hong, Les Oxley, Philip McCann and Trinh Le (2016) that it is perhaps inappropriate to assume independence between various innovation variables whereas there is a correlation between various innovation outcomes. Therefore, the MVPROBIT estimator is used to estimate the five innovation models at the firm level in one shot, as illustrated in table 4.3. The MVPROBIT estimator uses the Geweke-Hajivassiliou-Keane (GHK) simulator to evaluate the *M*-dimensional Normal integrals in the likelihood function. Table 4.3 presents a moderate correlation between different innovation outcomes value ranging from -0.360 to 0.575 at the firm level. Table A4.3 in the appendix shows that the firm age is significant at services innovation model when firm age squared is removed. It presents a moderate correlation between different innovation outcomes value ranging from -0.358 to 0.576 at the firm level.

Table 4. 3 MVPROBIT Estimator on Innovations in British SMEs in the 1990s

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	0.085	-0.213***	0.102	-0.032	-0.064
	[0.067]	[0.074]	[0.070]	[0.069]	[0.083]
Firm Size Square	-0.018	0.041***	-0.005	0.007	0.013
	[0.012]	[0.013]	[0.012]	[0.012]	[0.014]
Exports	0.109	-0.069	0.030	-0.088	0.180**
	[0.070]	[0.080]	[0.072]	[0.075]	[0.087]
Sites/Branches/Subsidiaries	-0.007	0.159*	-0.210**	0.127	0.212**
	[0.087]	[0.093]	[0.089]	[0.088]	[0.097]
Updated Equipments and High Technology	0.059	0.096	0.224***	0.172**	0.052
	[0.066]	[0.073]	[0.066]	[0.067]	[0.079]
High Quality Branded Product	0.509***	0.119	1.003***	0.422***	0.814***
	[0.117]	[0.130]	[0.130]	[0.122]	[0.168]
Firm Age	0.028	0.120	-0.000	-0.105	0.011
	[0.106]	[0.125]	[0.108]	[0.107]	[0.132]
Firm Age Square	0.004	-0.045*	0.010	0.016	-0.006
	[0.021]	[0.026]	[0.021]	[0.021]	[0.026]
Location	-0.126	-0.001	-0.095	0.067	-0.028
	[0.077]	[0.089]	[0.080]	[0.083]	[0.097]
Businesses Led by Female	0.051	-0.191	-0.283	0.049	0.076
	[0.247]	[0.265]	[0.255]	[0.250]	[0.332]
Businesses Led by Male	0.076	-0.112	-0.070	0.011	0.279
	[0.221]	[0.232]	[0.223]	[0.225]	[0.292]
Executive Founders	-0.084	0.066	0.067	-0.110	-0.106
	[0.086]	[0.101]	[0.089]	[0.090]	[0.105]
Capability for Expansion	-0.032	0.217***	-0.201***	0.071	-0.045
	[0.070]	[0.076]	[0.072]	[0.072]	[0.085]
R&D	0.122*	0.184**	0.022	-0.069	-0.039
	[0.070]	[0.078]	[0.072]	[0.074]	[0.086]
Formal IP Protection Rights	0.210*	-0.238*	-0.000	-0.530***	-0.228
	[0.118]	[0.132]	[0.118]	[0.130]	[0.139]
Formal Training	-0.124*	0.286***	-0.080	0.045	0.187**
	[0.069]	[0.080]	[0.071]	[0.072]	[0.088]
Competition	0.022	0.022	-0.047	-0.104	-0.182*
	[0.083]	[0.094]	[0.085]	[0.084]	[0.102]
Access to New Exports Market	0.691***	0.532***	0.516***	0.576***	0.198
	[0.129]	[0.146]	[0.138]	[0.134]	[0.175]
Access to External Finance	-0.041	-0.049	0.161**	0.049	-0.060
	[0.064]	[0.072]	[0.064]	[0.066]	[0.079]
Access to ICT	-0.207***	0.340***	-0.089	0.485***	0.076
	[0.075]	[0.081]	[0.075]	[0.076]	[0.086]
Access to Skilled Labour Market	0.121*	-0.300***	0.275***	-0.152**	0.071

	[0.069]	[0.082]	[0.070]	[0.074]	[0.086]
Access to Unskilled Labour Market	-0.088	0.088	-0.025	0.089	0.069
	[0.072]	[0.086]	[0.073]	[0.077]	[0.088]
Access to Local Business Networks	0.441***	0.235**	0.087	0.157	0.239**
	[0.092]	[0.108]	[0.094]	[0.097]	[0.117]
Access to Universities and Research Center	0.090	0.028	-0.013	-0.146	0.101
	[0.097]	[0.106]	[0.097]	[0.101]	[0.110]
Access to Government Support	-0.117	0.124	0.032	0.107	0.042
	[0.107]	[0.116]	[0.108]	[0.110]	[0.121]
Constant	-1.754***	-1.754***	-2.070***	-1.503***	-2.428***
	[0.271]	[0.290]	[0.278]	[0.275]	[0.360]
Observations	2,520	2,520	2,520	2,520	2,520

rho21	rho31	rho41	rho51	rho32
-0.213***	0.576***	0.143***	0.337***	-0.360***
[0.042]	[0.041]	[0.038]	[0.046]	[0.045]

rho42	rho52	rho43	rho53	rho54
-0.034	-0.058	0.228***	0.425***	0.487***
[0.042]	[0.047]	[0.038]	[0.045]	[0.050]

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

4.3 Research Analysis and Discussion

Tables 4.3 and 4.3A of multivariate probit at firm level showed that there are moderate correlations between the innovation outcomes. The statistically significant tests give the MVPROBIT models superiority over the Probit and Logit estimators. The results and conclusions are as follows:

Who were the Products Innovators?

The product innovators at the firm level are influenced by <u>one</u> out of twelve firm characteristics tested in the model. The *'high-quality branded product'* which is positive and statistically significant at 1%.

They are affected by <u>three</u> out of four firm behavioural factors investigated in this model. These are the *'R&D'* and the *'formal intellectual property protection'* which are positive and statistically significant at 10% and the *'formal training'* which is negative and statistically significant at 10%.

They are also influenced by <u>four</u> out of the nine business environment elements included in this model. These are the *'access to new exports markets'* and the '*access to local business*

networks' which are positive and statistically significant at 1% as well as the *'access to skilled labour market'* which is positive and statistically significant at 10%. In addition to that, the *'access to ICT'* is negative and statistically significant at 1%.

The product innovators at the firm level were the British SMEs in the 1990s. They produced high quality branded products and were sold to new exports markets. Those products were protected from imitation using formal intellectual property rights. Product innovators maintained the higher quality standards of their products by investing in internal R&D and utilising their highly skilled labour. Moreover, they were less likely to conduct formal training for their employees as they were already highly skilled and specialised. They had strong local business networks which offset their lower investment in ICT.

Who were the Service Innovators?

The service innovators at the firm level are influenced by four out of twelve firm characteristics. These are the *'firm size squared'* and the *'access to sites or branches or subsidiaries'* resources which are positive and statistically significant at 1% and 10% respectively. In addition to the *'firm size'* and the *'firm aged square'* which are negative and statistically significant at 1% and 10% respectively.

They are also affected by four out of four firm behaviour elements. These are the *'formal training'* and the *'capability for expansion'* which are positive and statistically significant at 1% as well as the *'R&D'* which is positive and statistically significant at 5%. Also, the *'formal intellectual property protection rights'* has an impact on service innovation at the firm level, which is negative and statistically significant at 10%.

The service innovators at the firm level are influenced by four out of nine business environment variables. These are the *'access to new exports market'* and the *'access to ICT'* which are positive and statistically significant at 1% as well as the *'access to local business networks'* which is positive and statistically significant at 5%. In addition to the *'access to the labour market'* which is negative and statistically significant at 1%.

The service innovators at the firm level in the 1990s were the younger and small and medium-sized British firms with branches across the country. They had access to subsidiary resources in international markets. They also could expand their products and services through their

investment in internal R&D activities. They were less likely to have access to the skilled labour market as they may choose to work for larger firms or they might be costly; hence, the British SMEs took so many efforts in providing formal training to their employees to excel in the quality standards of the services provided. Since they were service-oriented, they were less likely to acquire formal intellectual property rights. They instead focused their investments on their ICT and in building stronger local business networks.

Who were the Operational Processes Innovators?

The operational process innovators at the firm level are affected by three out of twelve firm characteristics elements. These are the *'high quality branded product'* and the *'updated equipment and high technology'* which are both positive and statistically significant at 1% as well as the access to *'sites/branches/subsidiaries'* resources which is negative and statistically significant at 5%.

They are influenced by one out of four firm behaviour variables, the *'capability for expansion'* which is negative and statistically significant at 1%.

Three out nine of the business environment factors also impact them. These are the *'access to new exports markets'* and the *'access to skilled labour market'* which are positive and statistically significant at 1% as well as the *'access to external finance'* which is positive and statistically significant at 5%.

The operational processes innovators at the firm level in the 1990s were the British SMEs with few sites or branches. They produced high quality branded products through highly skilled labour, updated equipment and higher technology. This made them attractive to have access to new exports markets and external finance facilities.

Who were the Organisational or Managerial Processes Innovators?

Two out of twelve firm characteristics influence the organisational or managerial processes innovators at the firm level. These are *'high-quality branded products'*, *'updated equipment and higher technology'* which are positive and statistically significant at 1%.

They are affected by one out of four firm behaviour variables. It is the *'formal intellectual property protection rights'* which is negative and statistically significant at 1%.

They are influenced by four out of nine business environment factors. These are the *'access to ICT'* and the *'access to new exports markets'* which are positive and statistically significant at 1% as well as the *'access to local business networks'* which is positive and statistically significant at 10%. In addition to the *'access to skilled labour market'* which is negative and statistically significant at 5%.

The organisational or managerial processes innovators at the firm level in the 1990s were the British SMEs. They were less likely have access to the skilled labour market, but they had updated equipment and advanced technology which supported them to produce high quality branded products. It attained a competitive edge that made them less likely to acquire formal intellectual property protection rights. It also enabled them to have access to new exports markets, strong ICT and local business networks.

Who were the Marketing Methods Innovators?

The marketing methods innovators at the firm level are affected by three out of twelve firm characteristics. They are the 'exports', the *'high-quality branded products'* and the access to resources of *'subsidiaries'* which are positive and statistically significant at 5%.

They are influenced by two out of four firm behaviour elements. They are the 'formal training' which is positive and statistically significant at 5% and the *'formal intellectual property protection rights'* which is negative and statistically significant at 10%.

They are also impacted by two out of nine business environment variables. One is the *'access to local business networks'* which is positive and statistically significant at 5%. Another is the *'competition'* which is negative and statistically significant at 5%.

The marketing methods innovators at the firm level in the 1990s were the British SMEs with good access to branches and subsidiaries' resources. They operated in a monopolistic competition where they exported high quality branded products, which were produced by well-trained employees. They were less likely to acquire formal property protection rights and rather were more likely to focus on strong local business networks.

A detailed comparison between the results of innovation outcomes at the firm level using the three estimators the PROBIT, the LOGIT and the MVPROBIT, with the results of the recent

empirical literature is undertaken to find out similarities and differences on the effects of explanatory variables on innovation outcomes as follows:

What were the Firm Characteristics that mattered for Innovation at the Firm Level?

The summary 4.1 shows the results of the four estimators are the same except for *'firm age squared'*. The variable 'firm age squared' is insignificant with all the estimators except with the MVPROBIT, where it is negative and statistically significant at 10% on service innovation. *It implies that younger British SMEs in the 1990s were more likely to innovate their services.*

Moreover, the more specialised or niche British firms in the 1990s, the fewer offices they had due to fewer customers in each locality. A less specialised firm, such as a firm of accountants, might have offices in several locations. Also, it might be that some types of firms needed more frequent face-to-face interactions with their customers.

Besides, the British SMEs that exported their high-quality branded products to new exports markets were more likely to innovate *both* their products and marketing methods. All estimators support this finding except with the MVPROBIT estimator that confirms that *'exports'* has a positive impact on marketing methods innovation only.

Summary 4. 1 Comparison of Impact of FCs on Innovations by Estimators

Variables	**PROBIT**	**LOGIT**	**MVPROBIT**
Firm Size	(-) ** on Services Innovation	(-) *** on Services Innovation	(-) *** on Services Innovation
Firm Size Squared	(+) *** on Services Innovation	(+) *** on Services Innovation	(+) *** on Services Innovation
Exports	(+) * on Products Innovation and Marketing Methods Innovation	(+) * on Products Innovation and Marketing Methods Innovation	(+) ** on Marketing Methods Innovation
Sites/Branches/ Subsidiaries	(+) * on Services Innovation and (+) ** on Marketing Methods Innovation	(+) ** on Marketing Methods Innovation	(+) * on Services Innovation and (+) ** on Marketing Methods Innovation

	(-) ** on Operational Innovation	(-) ** on Operational Innovation	(-) ** on Operational Innovation
Updated Equipments and High Technology	(+) *** on Operational Innovation and Organisational Innovation	(+) *** on Operational Innovation and Organisational Innovation	(+) *** on Operational Innovation and Organisational Innovation
High Quality Branded Product	(+) *** on Products Innovation, Operational Innovation, Organisational Innovation and Marketing Methods Innovation	(+) *** on Products Innovation, Operational Innovation, Organisational Innovation and Marketing Methods Innovation	(+) *** on Products Innovation, Operational Innovation, Organisational Innovation and Marketing Methods Innovation
Firm Age	(-) ** on Services Innovation	(-) ** on Services Innovation	(-) ** on Services Innovation
Firm Age Squared	Insignificant	Insignificant	(-) * on Services Innovation
Location	Insignificant	Insignificant	Insignificant
Businesses Led by a Female	Insignificant	Insignificant	Insignificant
Businesses Led by a Male	Insignificant	Insignificant	Insignificant
Executive Founders	Insignificant	Insignificant	Insignificant

The summary 4.2 provides a comparison of the impact of firm characteristics on innovation outcomes at the British SMEs in the 1990s and the results of the recent empirical studies. Overall, the results show that the '*exports', 'high quality branded products', 'updated equipment and high technology'* have a positive effect on different types of innovation. It is

supported by Lin and Chen (2007), Kirner, Kinkel, and Jaeger (2009) & Santamaria, Nieto, and Barge-Gil (2009), respectively.

Also, four of the firm characteristics: the *'location', the 'businesses led by a female'*, the *'businesses led by male'* and the *'executive founders'* are insignificant. However, this is not the case with previous empirical studies as there is a debate on the effect of these four variables on different types of innovation. The recent literature has shown controversy in the impact of gender on innovation at the firm level. On the one hand, Akulava (2015) identified a small, but the positive effect of having a female owner on the propensity of the firm to implement a new product or service and to introduce a new operational process or marketing methods. On average, female-led firms are consistently demonstrating more innovative behaviour than male-led firms, although there are differences between countries and regions. However, Kalleberg and Leicht (2001) argued that when innovation is measured using hard indicators such as patenting activity and research and development expenses, male-owned firms outperform female-owned firms. On the other hand, Smith-Doerr's (2010) argued that the relationship between gender and innovation is negative. It is because the innovation in its traditional form has negatively influenced women's participation in the male-dominated industry. The impact of 'location' on innovation may be insignificant as stated by Alegre and Chiva (2008) and Falk (2008) or may be positive as concluded by Bell (2005). Also, the executive founders' matter for innovation as Hong, Oxley, McCann and Le (2016) found that business makeup factors matters for innovation.

Summary 4. 2 Comparison of Impact of FCs on innovations against the Literature

1. Firm Characteristics		
Variables	**MVPROBIT**	**Previous Empirical Studies**
Firm Size	(-) *** on Services Innovation	(-) *** on Innovation Outcomes (+) *** on Operational Processes and Organizational or Managerial Processes Innovations
Firm Size Squared	(+) *** on Services Innovation	Previously not tested
Exports	(+) ** on Marketing Methods Innovation	(+) * on Operational Process Innovation

Sites/Branches/Subsidiaries	(+) * on Services Innovation and (+) ** on Marketing Methods Innovation (-) ** on Operational Processes Innovation	(+) *** on Product Innovation
Updated Equipment and High Technology	(+) *** on Operational Processes and Organisational or Managerial Processes Innovations	(+) *** on Products, Operational Processes, Organisational or Managerial Processes and Marketing Methods Innovations
High Quality Branded Product	(+) *** on Products, Operational Processes, Organisational or Managerial Processes and Marketing Methods Innovations	(+) *** on Products, Operational Processes, Organisational or Managerial Processes and Marketing Methods Innovations
Firm Age	(-) ** on Services Innovation	(+) ** on Innovation Outcomes (-) ** on Products, (-) *** on Organisational or Managerial Processes and Marketing Methods Innovations
Firm Age Squared	(-) * on Services Innovation	Previously not tested
Location	Insignificant	Insignificant (+) * on Innovation Outcomes
Businesses Led by a Female	Insignificant	(+) * on Innovation Outcomes Insignificant
Businesses Led by a Male	Insignificant	(+) * on Innovation Outcomes Insignificant
Executive Founders	Insignificant	(+) * on Innovation Outcomes Insignificant

Furthermore, the results indicate that the effect of accessing the resources of firm's *'sites/ branches/ subsidiaries'* on innovation outcomes is positive on services and marketing methods innovation and has a negative effect on operational processes innovation. The literature supports it. Leiponen (2006) argued that organisational structure is an element of business makeup where a firm could be a single-location firm or a subsidiary of another firm or a headquarter or a branch establishment in which innovation get effected according to how the firm is receptive to knowledge transfer and spillovers. Therefore, the positive effect may

indicate that the sharing of resources and the knowledge transfer existed between the head office and its branches or between the firm and its subsidiaries whereas the negative effect may reflect lack or inability of sharing knowledge or resources between branches and head office and the firm and its subsidiaries.

To sum up, five key firm characteristics derived different types of innovations at the British SMEs in the 1990s: the firm size, the firm age, the exports extensity, the brands and the updated equipment and high technology. The location did not matter and there was no specific gender dominating the innovation initiatives in the management team, and the executive founders were not active enough in making the innovation choices at the firm level. The sites, branches and subsidiaries were helpful in boosting services and marketing methods innovation, but they were less likely to drive the operational processes innovation.

What were the Firm Behaviour Elements that mattered for Innovation at the Firm Level?

The summary 4.3 demonstrates the effect of the firm behaviour elements on innovation outcomes using different types of estimators. The three estimators generated the same output. The effect of the *'R&D'* on innovation is positive all times at the firm level, whereas the rest of the variables showed two controversial effects on different types of innovation.

Summary 4. 3 Comparison of Impact of FBs on Innovations by Estimators

Variables	**PROBIT**	**LOGIT**	**MVPROBIT**
Capability for Expansion	(+) *** on Services Innovation (-) *** on Operational Innovation	(+) *** on Services Innovation (-) *** on Operational Innovation	(+) *** on Services Innovation (-) *** on Operational Innovation
R&D	(+) * on Products Innovation, (+) ** on Services Innovation	(+) * on Products Innovation, (+) ** on Services Innovation	(+) * on Products Innovation, (+) ** on Services Innovation
Formal IP Protection Rights	(+) * on Products Innovation	(+) * on Products Innovation	(+) * on Products Innovation

	(-) * on Services Innovation and (-) *** on Organisational Innovation	(-) * on Services Innovation and (-) *** on Organisational Innovation	(-) * on Services Innovation, (-) *** on Organisational Innovation
Formal Training	(+) *** on Services Innovation and (+) * on Marketing Methods Innovation (-) * on Products Innovation	(+) *** on Services Innovation and (+) * on Marketing Methods Innovation (-) * on Products Innovation	(+) *** on Services Innovation and (+) ** on Marketing Methods Innovation (-) * on Products Innovation

The summary 4.4 provides a comparison of the impact of behavioural elements on innovation outcomes at the firm level of the British SMEs in the 1990s and the results of the recent empirical studies.

In general, the positive effect of the firm behaviour elements on different types of innovation is supported by the recent literature such as Santamaria, Nieto, and Barge-Gil (2009) on the *'capability to expansion'*, Choi, Y. and Lim, U. (2017) on the 'R&D', Bauernschuster et al. (2009) on the *'formal training'*, Jong and Hippel (2009) and Davis Lee (2006) on the *'formal intellectual property protection rights'*.

However, the negative effect of firm behaviour elements on innovation is a surprising finding and is not supported by the previous or existing literature, as shown in summary 4.4.

Summary 4. 4 Comparison of Impact of FBs on innovations against the Literature

2. Firm Behaviour		
Variables	**MVPROBIT**	**Previous Empirical Studies**
Capability for Expansion	(+) *** on Services Innovation	(+) *** on Products, Operations, Organisational or Managerial Processes and Marketing Methods Innovations
	(-) *** on Operational Innovation	
R&D	(+) * on Products Innovation, (+) ** on Services Innovation	(+) *** on Products, Operational Processes, Organisational or

Formal IP Protection Rights	(+) * on Products Innovation (-) *** on Organisational Innovation, (-) * on Services Innovation.	Managerial Processes and Marketing Methods Innovations (+) *** on Products, Operational Processes, Organisational or Managerial Processes and Marketing Methods Innovation
Formal Training	(+) *** on Services Innovation and (+) ** on Marketing Methods Innovation (-) * on Products Innovation	(+) ** on Innovation Outcomes

The possible explanations for the negative effects of the firm behaviour elements on innovation outcome are as follows.

Firstly, the British SMEs in the 1990s that had the *'capability to expand'* their products and services were more likely to innovate their services but were less likely to innovate their operational processes. It might be due to the nature of their specialised sectors in manufacturing and business services which motivated them to focus more on improving products and services rather than processes to expand their products lines or reach and serve higher stake of customers by being closer to them through their unique services.

Secondly, the British SMEs in the 1990s that used *'formal intellectual property protection rights'* were more likely to innovate their products and were less likely to innovate their services, organisational or managerial processes and their marketing methods. It might be due to the high cost of additional innovations as well as to the rigid laws and regulations. Moreover, since the British SMEs have already secured their rents from launching new products through patents and trademarks, they might not have invested in additional innovation due to their uncertainty and excessive perceived risks.

Thirdly, the British SMEs that have conducted *'formal training'* in the 1990s were more likely to innovate their services and marketing methods but were less likely to innovate their products. It may be due to the limited budget and the high cost of formal training. Bauernschuster et al. (2009) found that formal training has a positive impact on innovation. Also, Frenz and Ietto-Gillies (2009) suggested that the knowledge transfer between each unit

is likely to affect the innovation in the firm. I, therefore, think the effect of formal training on innovation is mostly positive as it includes the transfer of knowledge and skills upgrade or enhancements. However, the exaggeration in providing formal training may sometimes expose the rules of the game to spread to competitors who will gain from the knowledge spillover when the key employees resign to move to competitors or establish their firm. Consequently, some indirect negative effect may be established on products innovation.

To sum up, the investment in the R&D was the key firm behaviour that mattered the most for innovation with the British SMEs in the 1990s. Moreover, the expansions, formal training and FIPPRs also boosted innovation at the firm level but to a certain extent.

What were the Business Environment factors that mattered for Innovation at the Firm Level?

The summary 4.5 presents the effect of business environment factors on different types of innovation. The results are the same as all the three estimators. However, the MVPROBIT estimator shows that the *'access to local businesses networks'* is significant in products, services, organisational or managerial processes and marketing methods innovations whereas the other three estimators show the same variable is significant only on products

Summary 4. 5 Comparison of Impact of BEs on Innovations by Estimators

Variables	**PROBIT**	**LOGIT**	**MVPROBIT**
Competition	(-) ** on Marketing Methods Innovation	(-) * on Marketing Methods Innovation	(-) * on Marketing Methods Innovation
Access to New Exports Market	(+) *** on Products Innovation, Services Innovation, Operational Innovation and Organisational Innovation	(+) *** on Products Innovation, Services Innovation, Operational Innovation and Organisational Innovation	(+) *** on Products Innovation, Services Innovation, Operational Innovation and Organisational Innovation

Access to External Finance	(+) ** on Operational Innovation	(+) ** on Operational Innovation	(+) ** on Operational Innovation
Access to ICT	(+) *** on Services Innovation and Organisational Innovation (-) *** on Products Innovation	(+) *** on Services Innovation and Organisational Innovation (-) *** on Products Innovation	(+) *** on Services Innovation and Organisational Innovation (-) *** on Products Innovation
Access to Skilled Labour Market	(+) * on Products Innovation, (+) *** on Operational Innovation (-) *** on Services Innovation and (-) * on Organisational Innovation	(+) * on Products Innovation, (+) *** on Operational Innovation (-) *** on Services Innovation and (-) ** on Organisational Innovation	(+) * on Products Innovation, (+) *** on Operational Innovation (-) *** on Services Innovation and (-) ** on Organisational Innovation
Access to Unskilled Labour Market	Insignificant	Insignificant	Insignificant
Access to Local Business Networks	(+) *** on Products Innovation, (+) ** on Services Innovation	(+) *** on Products Innovation, (+) ** on Services Innovation	(+) *** on Products Innovation, (+) ** on Services Innovation and Marketing Methods Innovation, (+) * on Organisational Innovation
Access to Universities and Research Centre	Insignificant	Insignificant	Insignificant
Access to Government Support	Insignificant	Insignificant	Insignificant

Overall, the results demonstrate that all the business environment factors have a positive impact on innovation except with the *'access to unskilled labour market'*, the *'access to*

universities and research centres' and the *'access to government support'* which are insignificant. Moreover, the *'access to skilled labour market'* and the *'access to ICT'* have shown controversial effects (positive and negative) on different types of innovation. The impact of the *'competition'* was negative on marketing methods innovation. *It may indicate that the British SMEs in the 1990s that chose to innovate different types of innovation were operating in a monopoly business environment with proper access to markets, network channels, external finance which did not require them less likely to innovate their marketing methods. However, they had lack of external R&D collaborations and government support.*

The summary 4.6 illustrates a comparison of the impact of business environment factors on innovation outcomes with the previous empirical studies.

The monopolist British SMEs in the 1990s were less likely to innovate their marketing methods as their products were branded with a high-quality standard. Arrow (1962) found that under certain assumptions, competition is likely to incentivise innovation as a monopolist gains less from an innovation than a competitive firm which is also known as Arrow's replacement effect. For the *'monopolistic competition'*, Baumol (2002) found that the threat of competition and the resilience for survival motivates firms to innovate. Schumpeter (1942) gave preference for the imperfectly competitive market over perfect competition and suggested that monopolistic firms are more innovative than other firms as they have some degree of market power. However, this is not the case in perfect competition scenario where firms are discouraged from innovating due to no barriers to entry and easy imitation of innovation by competitors.

Summary 4. 6 Comparison of Impact of BEs on innovations against the Literature

3. Business Environment		
Variables	**MVPROBIT**	**Previous Empirical Studies**
Competition	(-) ** on Marketing Methods Innovation	(+) *** on Products, Operational Processes, Organisational or Managerial Processes and Marketing Methods Innovations (-) *** on Innovation in case of monopoly competition.
Access to New Exports Market	(+) *** on Products, Services, Operational Processes and Organisational Processes Innovations	(+) *** on Products and Marketing Methods Innovations, (+) ** on Organisational or Managerial

		Processes Innovation
Access to External Finance	(+) ** on Operational Processes Innovation	(+) ** on Innovation Outcomes in case of direct external finance. (-) ** on Innovation Outcomes in the case of indirect external finance
Access to ICT	(+) *** on Services and Organisational Processes Innovations (-) *** on Products Innovation	(+) *** on Innovation Outcomes
Access to Skilled Labour Market	(+) * on Products Innovation, (+) *** on Operational Processes Innovation (-) *** on Services Innovation and (-) ** on Organisational Innovation	(+) ** on Innovation Outcomes Insignificant
Access to Unskilled Labour Market	Insignificant	Insignificant
Access to Local Business Networks	(+) *** on Products Innovation, (+) ** on Services and Marketing Methods Innovations, (+) * on Organisational Innovation	(+) ** on Operational Processes, (+) * on Organisational or Managerial Processes, (+) *** on Marketing Methods Innovations
Access to Universities and Research Centre	Insignificant	(+) *** on Innovation Outcomes
Access to Government Support	Insignificant	(+) *** on Innovation Outcomes

The positive effect of the business environment factors on different types of innovation is supported by the empirical literature as follows:

For the *'access to new exports markets'*, Flaig and Stadler (1994), Sadowski and Rasters (2006) suggested that changes in market demand locally, regionally, and internationally may positively affect innovation outcomes. Also, Acemoglu (2009) and Aghion & Howitt (2009) suggested that firm's access to new export markets may positively affect innovation as it increases the size of markets that can be appropriated by innovators.

For the *'access to external finance'*, Kim, S., Lee, H. and Kim, J (2016) found that indirect external financing like bank loans makes a negative impact on technology innovation activity of the Korean firms whereas direct external financing of security issues has a positive impact on innovation.

The literature supports the positive impact of the 'access to ICT' on innovation as Higon, (2011) found that ICT has a positive impact on different types of innovation, including the products innovation. He argued that some websites development exhibits the potential to create competitive advantage through product innovation.

However, the negative effect of the *'access to ICT'* on products innovation may be explained as it is similar to the case of the *'formal training'*. They both have a negative impact on products innovation and positive impact on services and processes innovations. They are both open channels for sharing knowledge and sometimes without restrictions to social media; hence, they may invite competitors to imitate their innovative products.

Besides, summary 4.6 shows that the *'access to skilled labour market'* has a positive effect on products and operational processes innovations. Gumbau-Albert and Maudos (2009) found that there is a positive relationship between levels of human capital and the number of patent applications. It suggests that skilled labour have a positive influence on products innovation. Moreover, the results show that the 'access to skilled labour market' also has a negative impact on services and organisational or managerial processes innovations. It is a surprising result and is not supported by the literature. *It indicates that British SMEs in the 1990s that had access to skilled labour were more likely to innovate their products and operational processes and less likely to innovate their services and managerial processes perhaps because too many innovations are costly for the firm.*

Moreover, since the firm has already developed a competitive advantage over their competitors, they may choose to be products and operational processes oriented. Also, the British SMEs in the 1990s that had access to skilled labour were less likely to innovate their services and organisational processes. It may be due to the existence of a rigid organisational culture that does not welcome change. Moreover, since skilled staff are specialised in specific skills and change will invite learning new skills, this may take a longer time to realise the fruits of exercising a new type of innovation.

The effect of *'access to unskilled labour market'* is insignificant. It may be due to the lower level of the absorptive capacity of unskilled labour. Stock, Greis and Fischer (2001) found that the absorptive capacity, one measurement of the firm's stock of knowledge is associated with the firm's physical and human capital. It may suggest that the *'access to skilled labour market'* is positively related to innovation due to their higher absorptive capacity or their ability to convert new ideas or external information to a commercial product as claimed by Cohen and Levinthal (1990).

The results show that *'access to universities and research institutions'* or what is called "external R&D" is insignificant at the firm level. Freel (2000) argues that university links enable SMEs to improve their innovative capacity or capabilities by gaining access to sophisticated technology and technical expertise. Beneito (2006), Frenz and Ietto-Gillies (2009) found that internal R&D (from inside the firm) and External R&D (from universities or external research institution) have a separate influence on innovation. Therefore, the effect of external R&D usually is positive on innovation. However, the effect can be insignificant if the external R&D does not serve or improve the firm's capacity or capability to become innovative.

The results show that the impact of *'access to government support'* is insignificant. Marcus (1981) found that government policies play a big role in shaping the environment of the firm and stressed that government regulations affect the innovation rate and substance. Therefore, the impact of 'access to government support' on innovation is usually positive. However, it may be insignificant if the support extended is trivial or not enough to motivate the firms to innovate.

To sum up, the key business environment factors that affected innovation at the British SMEs in the 1990s were the presence of monopolistic competition and access to new exports markets, external finance and local business networks. There was a lack of access to unskilled labour markets, the government support and research of universities; hence, they did not matter for innovation at the firm level. The access to skilled labour market boosted the products and operational processes innovations, but not the services and organisational processes innovations. The access to ICT enhanced the services and organisational processes innovations, but not the products innovation.

Section 4.4 answers the fourth research question of What were the internal and external barriers to innovation for the British SMEs in the 1990s?

4.4 Barriers to Innovation

The firm behaviour and business environment factors that had a negative impact on innovation outcomes maybe by default were the internal and external barriers to innovation in the British SMEs in the 1990s. The regression results revealed some of the possible barriers that faced the British SMEs at that time as follows:

Firstly, *there were some **internal** barriers derived from the negative impact of some firm behaviour elements on specific innovation outcomes*. For example, the presence of FIPPRs such as patents boosted the products innovation, but at the same time made some of the British SMEs in the 1990s to less likely innovate other types of innovations such as their services, processes and marketing methods. It is due to the guaranteed profits generated from their protected products and the attained competitive advantage in the market. Therefore, *the British SMEs in the 1990s did not innovate other types of innovations due to earlier innovation. It may also be due to the rigid laws and regulations accompanied by the higher costs of maintaining the patents.*

Furthermore, some of the British SMEs in the 1990s that have involved in expansions were less likely to innovate their operational processes and focused only on innovating their services. Those firms might not have invested in additional innovations due *to their uncertainty and excessive perceived risks.* Moreover, the over access to the firm's subsidiary resources made some British SMEs in the 1990s more reluctant to innovate their operational processes because it was cheaper for them to use the subsidiary 's processes or procedures rather than innovating new ones since they belonged to the same group especially if they were located in the same region and undergo the same rules and regulations.

Besides, over investing in formal training discouraged some British SMEs in the 1990s from innovating their products *because formal training and innovation are expensive. Moreover, the extremely excessive formal training could sometimes directly or indirectly lead to higher knowledge spillover to competitors who may copy the innovative ideas and launch similar products*.

It is also worth noting that one of the strong internal barriers in the British SMEs in the 1990s was *the uncompleted innovation culture* due to the inactive role of the businesses led by the female, businesses led by the male, and the executive founders in making innovation decisions and choices.

Secondly, there were some **external** barriers derived from the negative influence of some business environment factors on different innovation outcomes. For instance, some British SMEs in the 1990s that had unlimited and non-restricted access to ICT became less likely to innovate their products perhaps due to knowledge spillover to competitors through the free access to ICT and shared business networks. Moreover, the limited access to the unskilled labour market and the proper types of external finance facilities, lack of access to relevant external R&D and lack of government support were also important barriers that discouraged some of the British SMEs in the 1990s to innovate.

Furthermore, the CBR dataset revealed from the responses of the survey participants three major types of barriers to innovations that were faced by the British SMEs in the 1990s, as shown in figure 4.1. Those were the *economic barriers, the barriers at the firm level and the other barriers* as follows.

Firstly, the British SMEs in the 1990s faced ***economic barriers***. The results show that 65% of the survey participants mentioned that they did not innovate due to *the too high costs of innovation*. 63% of the participants thought that *excessive perceived risk* is a barrier to innovation. 62% of them found that *the lack of appropriate sources of finance* rendered the firm's innovation. Also, 62% of the survey participants mentioned that they did not innovate due to *the longer payoff period of innovation*.

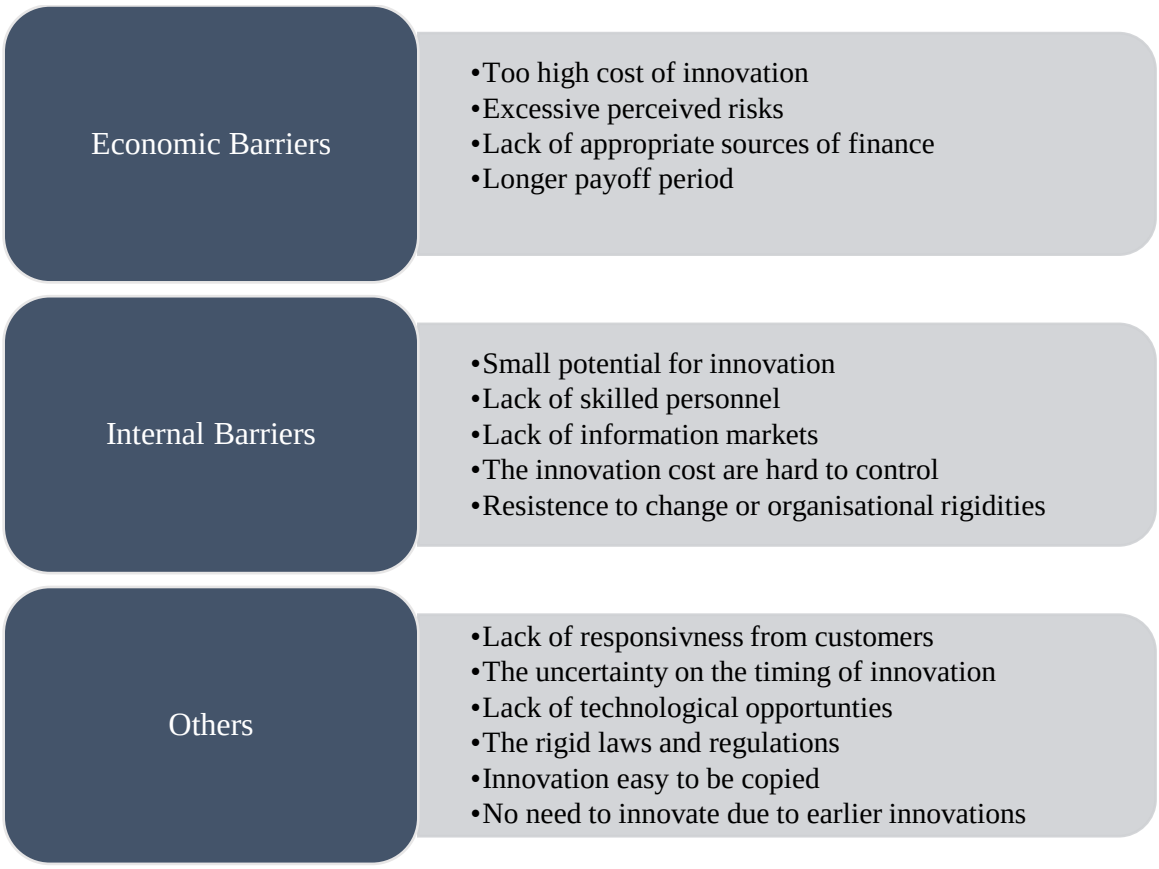

Figure 4. 1 The Barriers to Innovation in the British SMEs in the 1990s

Secondly, they faced ***barriers at the firm level***. The results reveal that 60% of the participant said that their *firms had a small potential for innovation*. 57% of them said they did not innovate due to *lack of skilled personnel*. 52% of the participants mentioned that due to *lack of information on markets*, they did not innovate. 51% of them said that *innovation costs are hard to control*, which discouraged them from innovating. 48% of them mentioned that they did not innovate because of *lack of information on technology*. Only 34% of them thought that *the resistance to change or organisational rigidities* renders them from innovating.

Thirdly, they faced ***other barriers***. 50% of the survey participants did not innovate due to *the lack of responsiveness from customers*. 44% of the participants mentioned that they did not innovate due to *the uncertainty on the timing of innovation*. 41% of the participants thought that *the lack of technological opportunities* was a barrier to innovation. Also, 41% of them considered *the rigid laws and regulations* were barriers to innovation. 38% of them said that

innovation was easy to be copied. 33% of the participants mentioned that there was no need to innovate due to *the earlier innovations*.

The summary of this chapter is provided in section 4.5 as follows.

4.5 Conclusion

This chapter aimed to provide insights on the drivers and barriers of innovation in the British SMEs in the 1990s using the Cambridge Centre for Businesses Research dataset of manufacturing and service sectors in England, Scotland, and Wales.

It investigated the impact of firm's characteristics, firm's behaviour and business environment on different types of innovation in the British SMEs in the 1990s using the innovation model developed by Hong, Oxley, McCann and Le (2016). Three estimators were used to test this relationship, PROBIT, LOGIT and MVPROBIT. Since the different types of innovation are correlated and one innovation my lead to another innovation, the MVPROBIT estimator was selected as a superior regression method in explaining the innovation model.

At firm level, the summary of statistics revealed that 27% of the British SMEs in the 1990s innovated their ***products***, 24% innovated their ***operational processes***, 20% innovated their ***organisational or managerial processes***, 15% innovated their ***services***, and 10% innovated their ***marketing methods*** as illustrated in table 3.7 (chapter 3). This chapter provided answers to the four research questions as follows.

C1: Five key firm characteristics derived the different types of innovation at the British SMEs in the 1990s: the firm size, firm age, exports extensity, brands, updated equipment and high technology. The younger British SMEs in the 1990s were more likely to innovate their services. The SMEs that exported their products and services were more likely to innovate their marketing methods to sell them. The SMEs that produced higher quality and branded products innovated all types of innovation except their services. Firms that had updated equipment and high technology were more likely to innovate their processes. There was no specific gender dominating the innovation initiatives in the management team, and the executive founders were not active enough in making the innovation choices at the firm level. There was also no clear role for the location in boosting different type of innovation.

However, the sites, branches and subsidiaries had a positive impact on services and marketing methods innovation.

C2: The investment in the R&D was the key firm behaviour that mattered the most for product and services innovations with the British SMEs in the 1990s. It is followed by the FIPPRs that protected the firm's product innovation and gave them the impulse to innovate more products, but not the services, organisational processes and marketing methods innovations. The firm's capability for expansion boosted the services innovation, but not the operational processes. The formal training helped the firms to innovate their services and marketing methods, but not their products.

C3: 5 key business environment factors affected innovation at the British SMEs in the 1990s. Those were the access to local business networks, access to new exports markets, the presence of the monopoly competition and the access to external finance. The access to local business networks helped the British SMEs in the 1990s to innovate all types of innovations except their operational processes. However, the presence of the monopolistic competition and access to external finance made it possible for them to innovate their operational processes. Also, the access to new exports market boosted the firms to innovate their products, services and processes. There was a lack of access to unskilled labour markets, the government support and research of universities; hence, they did not matter for innovation at the firm level. Access to skilled labour market boosted the products and operational processes innovations, but not the services and organisational processes innovations. Access to ICT enhanced the services and organisational innovations, but not the products innovation.

C4: Firstly, there were internal barriers that derived from the negative impact of some firm behaviour elements on specific innovation outcomes. For example, the presence of FIPPRs such as patents made some of the British SMEs less likely to innovate their services and processes as they have guaranteed the profits generated from their protected products and achieved a competitive advantage in the market; hence they did not innovate due to earlier innovations and other reasons. Also, the exaggeration of free accessed formal training acted as a barrier for some British SMEs from innovating more products because too much formal training could sometimes directly or indirectly lead to higher knowledge spillover to

competitors who may copy the innovative ideas and launch similar products. Furthermore, the over access to firm's subsidiary resources made some British SMEs in the 1990s more reluctant to innovate their operational processes because it was cheaper for them to use the subsidiary's processes or procedures rather than innovating new ones since they belonged to the same group and especially if they were located in the same region and undergo the same rules and regulations. Furthermore, one of the strong internal barriers in the British SMEs in the 1990s was *the uncompleted innovation culture* due to the inactive role of the businesses led by the female, businesses led by the male, and the executive founders in making innovation decisions and choices.

Secondly, there were external barriers derived from the negative influence of some business environment factors on specific innovation outcomes. For instance, some British SMEs that have over access to ICT became less likely to innovate their products perhaps due to knowledge spillover to competitors using the unlimited access to ICT especially the social media through their shared business network. However, access to ICT influenced them to innovate other innovations related to their services and organisational or managerial processes. Moreover, the limited access to the unskilled labour market and the proper types of external finance facilities, lack of access to relevant external R&D and lack of government support were also critical barriers that discouraged some of the British SMEs in the 1990s to innovate.

Thirdly, the responses of the survey participants divided the barriers to innovation in the British SMEs in the 1990s into three key groups: economic, internal and other factors as follows. First comes the economic barriers: too high costs of innovations, excessive perceived risk of innovation, lack of appropriate sources of financing innovations, and longer payoff period of innovations. Second, comes the barriers at the firm level (internal barriers): firms have a too-small potential for innovation, lack of skilled personnel, lack of information on markets, innovation costs are hard to control, lack of information on technology and resistance to change or organisational rigidities. Third comes the others barriers: Lack of responsiveness from customers, uncertainty on the timing of innovation, lack of technological opportunities, rigid laws and regulations, innovation is easy to be copied, and there is no need to innovate due to earlier innovations.

At this stage of the research, it is necessary to identify some limitations which need to be considered in further work. Firstly, the dataset covers only SMEs in the manufacturing and services sectors in the UK. SMEs in other industrial sectors which are directly related to innovation is not in the dataset. Secondly, the dataset is old as the survey was conducted in 1997. However, this limitation is treated as an opportunity. It is assumed that drivers and barriers of innovation in the British SMEs in the 1990s may match the existing scenario in Oman, which may allow for better contrasts and comparisons. There are available recent datasets in UK online data service, but they have secured access which is if employed in this research, they may provide better results. Thirdly, some potential explanatory variables were not available in the dataset such as oligopoly, sufficient production capacity, inward direct investment, labour productivity and transport. However, new variables were added to the model to test their effects on various innovation outcomes such as sites, business-led by women, business-led by men, executive founders, formal training, access to external finance, access to universities and other research institutions, and access to government support.

As a learning lesson for Oman from the experience of SMEs in UK, Oman may imply in the policies and reflect on the strategic plans the importance of diversifying the exports and emphasising on skilled labour, product diversity, new technology, up to date equipments, and investments in R&D, ICT, local business networks for the firms in order to innovate products, services, processes, and marketing methods. Also, Oman may encourage small firms who are in the same business activities to merge to gain market share and cooperate to increase opportunities for innovations.

This research can be extended in several directions. A first direction will be to test the innovation model in British SMEs using recent dataset and compare the results of SMEs in the 2010s with the results in the 1990s (chapter 5). A second direction would be to test the innovation model using Omani SMEs dataset and compare the results with the findings from studying the British SMEs in and after the 1990s (chapter 6).

Chapter 5: Investigating the recent drivers and barriers of Innovation in the British SMEs

5.1 Introduction

The United Kingdom is ranked No. 3 (2016), No. 5 (2017) and No. 4 (2018) out of 128 countries in terms of the Global Innovation Index as per OECD reports. It scored 61.9%, which is not far from Switzerland and Sweden that are ranked the first and the second respectively, with a score of 66.3% and 63.6%. The USA is ranked the fourth with a score of 61.4%, followed by Finland and Singapore with a score of 59.9% and 59.2% correspondingly as of 2016.

The British SMEs in the 1990s primarily innovated their products, followed by their processes and services. The marketing methods innovation was the least practised type of innovation by the British SMEs during that period. This finding reflects the British economy in the 1990s, as it was highly industrialised and starting to move towards a knowledge-based economy. So, what has been changed in the British SMEs in the 2010s with respect to the type of innovation, drivers, and barriers? Have they changed their focus in terms of types of innovation as the British economy has become a crypto- economy that requires innovative process solutions to protect individuals 'privacy, sensitive information and wealth? Have they experienced different types of barriers to innovation?

Therefore, this chapter investigates the innovation model using the SMEs dataset of the Department for Business Innovation & Skills (BIS-2015) in the UK. It compares the findings of the previous chapter that resulted from employing Cambridge for Business Research Database (CBR-1997) with the findings of this chapter.

This chapter also raises the following research questions:

Q1: What are the key specific firm characteristics that impact innovation outcomes in the British SMEs in the 2010s?

Q2: What are the key firm behavioural elements that matter for the British SMEs in the 2010s in deciding on whether to innovate or not?

Q3: What are the key specific business environment factors that influence the choice of innovation in the British SMEs in the 2010s?

Q4: What are the barriers that may prevent the British SMEs in the 2010s from innovating and how to overcome them?

The key empirical literature relating to innovation model is not covered in this chapter to avoid duplication, but it is available in chapter 2. The remaining of this chapter is structured as follows. Section 5.2 presents the dataset and research methodology. Section 5.3 covers the results and discussions. Section 5.4 investigates the recent barriers of innovation in the British SMEs in the 2010s, and section 5.6 recaps the results followed by the conclusion.

5.2 Data and Research Methodology

The Department for Business Innovation & Skills (BIS) commissioned 15,500 Computer Assisted Telephone Interviews (CATI) for the Longitudinal Small Business Survey (LSBS) conducted in 2015 with owners or proprietors and managing directors or other senior managers of small and medium-sized enterprises in the United Kingdom. This survey took place between July 2015 and January 2016 by BMG Research Ltd, and the average interview length was 30 minutes. It is considered the largest small businesses survey ever undertaken in the UK, and it is intended to be repeated on an annual basis to establish a panel dataset.

There were no quotas imposed at the stage of interviews according to Office for National Statistics guidelines other than on overall target, the number of interviews in Northern Ireland, and the number of IDBR[7] and Dun & Bradstreet[8] sourced interviews. A sample stratification strategy was implemented in each of the four UK nations (England, Wales, Scotland and Northern Ireland). The targets were based on the size of the enterprise of registered and unregistered businesses. They were broadly in line with the proportion of total employment and turnover among SMEs in the UK. This logic is also followed in other previous small business surveys.

[7] IDBR is a record of all UK enterprises that pay VAT or PAYE. It has approximately 2.3 million enterprises.

[8] Dun & Bradstreet is a source for businesses with zero employees. These businesses do not pay VAT or PAYE. It has approximately 3.1 million businesses.

The responses of the survey formed a dataset. The dataset has been downloaded from the UK Online Data Services website and then exported to STATA software to run the regression tests. The results of the regression are compared with the results of the British SMEs in the 1990s and will be compared with the results of the Omani SMEs dataset in the next chapter.

For more information about the BIS dataset and sampling strategy, please refer to chapter 3. This chapter uses the innovation model mentioned in chapter 4. It uses five dependent variables to capture different innovation outcomes: product innovation, service innovation, operational process innovation, organisational or managerial processes innovation, and marketing methods innovation at the firm level.

The hypotheses are tested on whether firm's characteristics, behaviour and business environment have an impact on the firm's innovation by estimating five innovation outcomes at the firm level using three estimation techniques: PROBIT, LOGIT and the multivariate probit (MVPROBIT).

Firstly, since the explained variables are binary, it is more appropriate to use beyond ordinary least square estimators, especially those related to discrete choice modelling.

The five innovation models are estimated separately, as shown in table 5.1. The pseudo-r-squared is approximately equal to 0.2 in every innovation model at the firm level, which suggest that all the five models are good fits. As Hensher and Johnson (1981) suggest that values between 0.2 and 0.4 are good model fits.

Table 5. 1 Probit Estimator on Innovations in British SMEs in the 2010s

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	-0.193**	-0.207**	0.308***	1.060***	-0.256***
	[0.090]	[0.082]	[0.082]	[0.080]	[0.080]
Firm Size Squared	0.055	0.045	-0.143***	-0.402***	0.180***
	[0.050]	[0.046]	[0.046]	[0.046]	[0.044]
Exports	0.237***	-0.062	0.142***	-0.135***	-0.003
	[0.041]	[0.040]	[0.040]	[0.039]	[0.039]
Sites/Branches/Subsidiaries	-0.091	-0.134	-0.181	0.173	0.024
	[0.165]	[0.152]	[0.155]	[0.153]	[0.162]
Updated Equipments and High Technology	0.161***	0.232***	0.159***	0.285***	0.905***

	[0.037]	[0.033]	[0.035]	[0.031]	[0.039]
Firm Age	0.192	1.724***	1.136***	-0.464	-0.504
	[0.427]	[0.397]	[0.418]	[0.372]	[0.390]
Firm Age Squared	-0.105	-1.437***	-0.828**	-0.027	0.544*
	[0.335]	[0.311]	[0.325]	[0.293]	[0.306]
Location	-0.104***	0.032	-0.022	0.015	0.001
	[0.028]	[0.026]	[0.026]	[0.024]	[0.026]
Family-Owned Businesses	0.139***	0.013	-0.044	-0.302***	0.193***
	[0.034]	[0.032]	[0.032]	[0.030]	[0.032]
Businesses Led by a Female	-0.123***	0.012	-0.032	0.100***	-0.058**
	[0.032]	[0.029]	[0.030]	[0.028]	[0.029]
Businesses Led by a Male	-0.147**	0.077	0.065	0.122**	0.174***
	[0.058]	[0.052]	[0.053]	[0.050]	[0.053]
Executive Founders	0.016	-0.042	0.172***	-0.104***	-0.127***
	[0.044]	[0.040]	[0.041]	[0.040]	[0.040]
Capability for Expansion	0.394***	0.327***	0.217***	0.127***	0.121***
	[0.039]	[0.032]	[0.034]	[0.029]	[0.032]
R&D	0.709***	0.660***	0.513***	0.224***	0.277***
	[0.027]	[0.024]	[0.025]	[0.024]	[0.025]
Formal IP Protection Rights	0.022	0.174	-0.252	0.704	-0.320
	[0.457]	[0.455]	[0.439]	[0.490]	[0.427]
Formal Training	-0.005	0.216***	0.216***	0.404***	-0.110***
	[0.029]	[0.027]	[0.027]	[0.026]	[0.027]
Competition	0.487***	0.950***	0.706***	0.150***	0.133***
	[0.036]	[0.038]	[0.035]	[0.037]	[0.036]
Access to New Exports Market	0.286***	-0.038	0.095**	0.227***	0.090*
	[0.048]	[0.048]	[0.048]	[0.047]	[0.047]
Access to External Finance	-0.053**	-0.120***	0.001	0.189***	-0.022
	[0.025]	[0.023]	[0.024]	[0.022]	[0.023]
Access to ICT	0.067**	0.145***	0.074***	0.215***	0.715***
	[0.028]	[0.025]	[0.026]	[0.024]	[0.025]
Access to Skilled Labour Market	0.068**	0.021	0.026	0.058**	0.190***
	[0.030]	[0.028]	[0.028]	[0.027]	[0.027]
Access to Unskilled Labour Market	-0.028	0.168***	0.086***	0.027	-0.091***
	[0.028]	[0.025]	[0.026]	[0.025]	[0.026]
Access to Local Business Networks	0.150***	0.052*	0.155***	0.039	0.015
	[0.030]	[0.027]	[0.028]	[0.025]	[0.026]
Access to Universities and Research Centre	0.377***	0.682***	0.360***	0.241***	0.049
	[0.046]	[0.050]	[0.046]	[0.049]	[0.046]
Access to Government Support	0.254***	0.510***	0.444***	0.335***	0.006
	[0.063]	[0.069]	[0.062]	[0.068]	[0.063]
Constant	-1.948***	-1.744***	-1.982***	-0.664***	-1.906***
	[0.214]	[0.196]	[0.204]	[0.191]	[0.204]
Observations	15,502	15,502	15,502	15,502	15,502
Log likelihood	-6794	-8242	-7682	-9058	-8329
LR Chi2	2624	3715	2536	3311	2842
pseudo r-squared	0.162	0.184	0.145	0.155	0.146

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Secondly, the LOGIT estimator, which is one of the common estimators for binary choices models, is used. It is easier to interoperate its results than those that are generated by the probit estimator.

Table 5. 2 Logit Estimator on Innovations in British SMEs in the 2010s

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	-0.311**	-0.344**	0.529***	1.776***	-0.419***
	[0.155]	[0.138]	[0.140]	[0.133]	[0.132]
Firm Size Squared	0.086	0.072	-0.247***	-0.675***	0.294***
	[0.087]	[0.077]	[0.079]	[0.076]	[0.073]
Exports	0.410***	-0.112*	0.228***	-0.223***	-0.000
	[0.071]	[0.068]	[0.068]	[0.064]	[0.065]
Sites/Branches/Subsidiaries	-0.180	-0.204	-0.300	0.295	0.020
	[0.290]	[0.257]	[0.267]	[0.256]	[0.275]
Updated Equipments and High Technology	0.297***	0.405***	0.289***	0.476***	1.604***
	[0.068]	[0.057]	[0.063]	[0.052]	[0.074]
Firm Age	0.317	2.927***	1.984***	-0.740	-0.832
	[0.749]	[0.673]	[0.729]	[0.615]	[0.649]
Firm Age Squared	-0.159	-2.427***	-1.445**	-0.078	0.900*
	[0.588]	[0.527]	[0.567]	[0.485]	[0.511]
Location	-0.185***	0.055	-0.032	0.025	0.001
	[0.048]	[0.044]	[0.046]	[0.041]	[0.043]
Family-Owned Businesses	0.250***	0.028	-0.072	-0.495***	0.315***
	[0.060]	[0.053]	[0.054]	[0.050]	[0.052]
Businesses Led by a Female	-0.227***	0.016	-0.054	0.169***	-0.098**
	[0.058]	[0.049]	[0.052]	[0.046]	[0.048]
Businesses Led by a Male	-0.248**	0.122	0.112	0.207**	0.297***
	[0.102]	[0.089]	[0.091]	[0.084]	[0.088]
Executive Founders	0.015	-0.068	0.307***	-0.178***	-0.213***
	[0.077]	[0.068]	[0.071]	[0.066]	[0.066]
Capability for Expansion	0.725***	0.567***	0.388***	0.211***	0.211***
	[0.074]	[0.057]	[0.062]	[0.049]	[0.055]
R&D	1.259***	1.102***	0.874***	0.368***	0.464***
	[0.049]	[0.041]	[0.044]	[0.039]	[0.041]
Formal IP Protection Rights	0.060	0.299	-0.425	1.129	-0.539
	[0.802]	[0.732]	[0.777]	[0.831]	[0.718]
Formal Training	-0.013	0.360***	0.366***	0.663***	-0.184***
	[0.051]	[0.045]	[0.046]	[0.042]	[0.044]
Competition	0.802***	1.639***	1.172***	0.251***	0.219***
	[0.061]	[0.067]	[0.059]	[0.061]	[0.059]
Access to New Exports Market	0.467***	-0.058	0.158**	0.382***	0.141*
	[0.081]	[0.081]	[0.080]	[0.078]	[0.078]
Access to External Finance	-0.085*	-0.207***	0.000	0.313***	-0.035

	[0.044]	[0.040]	[0.041]	[0.037]	[0.039]
Access to ICT	0.110**	0.243***	0.120***	0.353***	1.192***
	[0.049]	[0.043]	[0.045]	[0.039]	[0.044]
Access to Skilled Labour Market	0.121**	0.033	0.039	0.094**	0.323***
	[0.052]	[0.047]	[0.048]	[0.045]	[0.045]
Access to Unskilled Labour Market	-0.061	0.284***	0.148***	0.044	-0.153***
	[0.048]	[0.043]	[0.044]	[0.041]	[0.042]
Access to Local Business Networks	0.277***	0.080*	0.268***	0.067	0.030
	[0.054]	[0.045]	[0.049]	[0.042]	[0.045]
Access to Universities and Research Centre	0.621***	1.206***	0.600***	0.400***	0.075
	[0.078]	[0.089]	[0.077]	[0.083]	[0.076]
Access to Government Support	0.422***	0.980***	0.755***	0.577***	0.016
	[0.107]	[0.127]	[0.107]	[0.116]	[0.104]
Constant	-3.387***	-2.982***	-3.416***	-1.106***	-3.260***
	[0.376]	[0.334]	[0.355]	[0.318]	[0.346]
Observations	15,502	15,502	15,502	15,502	15,502
Log likelihood	-6802	-8231	-7693	-9056	-8338
LR Chi2	2608	3737	2514	3314	2824
pseudo r-squared	0.161	0.185	0.145	0.155	0.145

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Thirdly, since one form of innovation may lead to the generation of another type(s) of innovation(s), a nonlinear relationship exists. Also, the firm may introduce more than one type of innovations at a time. To avoid misspecification bias issues that may result from ignoring such assumptions, I agree with Shangqin Hong, Les Oxley, Philip McCann and Trinh Le (2016) that it is perhaps inappropriate to assume independence between various innovation variables whereas there is a correlation between various innovation outcomes. Therefore, the MVPROBIT estimator is used to estimate the five innovation models at the firm level in one shot, as illustrated in table 5.3. This table also presents a low correlation between different innovation outcomes value ranging from 0.104 to 0.389 at the firm level.

Table 5. 3 MVPROBIT Estimator on Innovations in British SMEs in the 2010s

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	-0.182**	-0.213***	0.302***	1.057***	-0.257***
	[0.089]	[0.081]	[0.082]	[0.080]	[0.080]
Firm Size Squared	0.052	0.050	-0.138***	-0.400***	0.180***
	[0.050]	[0.046]	[0.046]	[0.046]	[0.044]

Exports	0.242***	-0.063	0.138***	-0.135***	-0.002
	[0.041]	[0.040]	[0.040]	[0.038]	[0.039]
Sites/Branches/Subsidiaries	-0.104	-0.164	-0.171	0.176	0.020
	[0.165]	[0.151]	[0.155]	[0.153]	[0.162]
Updated Equipments and High Technology	0.158***	0.240***	0.160***	0.287***	0.906***
	[0.037]	[0.033]	[0.035]	[0.031]	[0.039]
Firm Age	0.212	1.755***	1.168***	-0.453	-0.495
	[0.429]	[0.398]	[0.418]	[0.372]	[0.390]
Firm Age Squared	-0.108	-1.460***	-0.849***	-0.038	0.538*
	[0.337]	[0.311]	[0.325]	[0.293]	[0.306]
Location	-0.104***	0.033	-0.022	0.015	0.001
	[0.028]	[0.026]	[0.026]	[0.024]	[0.026]
Family-Owned Businesses	0.136***	0.010	-0.047	-0.302***	0.192***
	[0.034]	[0.031]	[0.032]	[0.030]	[0.032]
Businesses Led by a Female	-0.123***	0.015	-0.026	0.100***	-0.058**
	[0.032]	[0.029]	[0.030]	[0.028]	[0.029]
Businesses Led by a Male	-0.148**	0.082	0.065	0.124**	0.174***
	[0.058]	[0.052]	[0.053]	[0.050]	[0.053]
Executive Founders	0.012	-0.036	0.178***	-0.103***	-0.127***
	[0.044]	[0.040]	[0.041]	[0.040]	[0.040]
Capability for Expansion	0.389***	0.322***	0.213***	0.128***	0.121***
	[0.039]	[0.032]	[0.034]	[0.029]	[0.032]
R&D	0.713***	0.660***	0.512***	0.223***	0.277***
	[0.027]	[0.024]	[0.025]	[0.024]	[0.025]
Formal IP Protection Rights	-0.063	0.159	-0.409	0.689	-0.319
	[0.470]	[0.471]	[0.456]	[0.495]	[0.425]
Formal Training	-0.001	0.219***	0.222***	0.403***	-0.109***
	[0.029]	[0.027]	[0.027]	[0.026]	[0.027]
Competition	0.507***	0.902***	0.711***	0.148***	0.135***
	[0.035]	[0.037]	[0.034]	[0.037]	[0.036]
Access to New Exports Market	0.281***	-0.037	0.096**	0.227***	0.090*
	[0.048]	[0.048]	[0.047]	[0.047]	[0.047]
Access to External Finance	-0.054**	-0.124***	-0.003	0.189***	-0.023
	[0.025]	[0.023]	[0.024]	[0.022]	[0.023]
Access to ICT	0.065**	0.149***	0.076***	0.215***	0.715***
	[0.028]	[0.025]	[0.026]	[0.024]	[0.025]
Access to Skilled Labour Market	0.067**	0.021	0.025	0.058**	0.190***
	[0.030]	[0.028]	[0.028]	[0.027]	[0.027]
Access to Unskilled Labour Market	-0.031	0.161***	0.082***	0.026	-0.091***
	[0.028]	[0.025]	[0.026]	[0.025]	[0.026]
Access to Local Business Networks	0.152***	0.054**	0.156***	0.039	0.014
	[0.030]	[0.026]	[0.028]	[0.025]	[0.026]
Access to Universities and Research Centre	0.386***	0.638***	0.362***	0.238***	0.049
	[0.045]	[0.048]	[0.044]	[0.049]	[0.046]
Access to Government Support	0.265***	0.477***	0.444***	0.334***	0.007
	[0.062]	[0.066]	[0.060]	[0.068]	[0.063]
Constant	-1.951***	-1.734***	-2.014***	-0.669***	-1.906***
	[0.213]	[0.196]	[0.204]	[0.191]	[0.204]
Observations	15,502	15,502	15,502	15,502	15,502

rho21	rho31	rho41	rho51	rho32
0.322***	0.241***	0.018	0.055***	0.389***
[0.015]	[0.015]	[0.014]	[0.015]	[0.015]
rho42	rho52	rho43	rho53	rho54
0.104***	0.019	0.106***	0.014	0.007
[0.014]	[0.014]	[0.014]	[0.014]	[0.014]

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

5.3 Research Analysis and Discussion

Table 5.4 of the multivariate probit at firm level showed that there are correlations between the innovation outcomes. The positive and statistically significant test statistics give the MVPROBIT model superiority over the Probit and Logit estimators. The results and conclusions are as follows:

Who are the Product Innovators?

According to the MVPROBIT estimator, the product innovators at the firm level are influenced by seven firm characteristics out of twelve total variables included in the model. The *'exports'*, the *'family-owned businesses'*, the *'updated equipment and higher technology'* are positive and statistically significant at 1%. The *'location'* and the *'businesses led by a female'* are negative and statistically significant at 1%. The *'firm size'* and the *'businesses led by male'* are negative and statistically significant at 5%.

The product innovators are also influenced by two firm behaviour elements out of four total variables included in the model. These are the *'capability to expansion'* and the *'R&D'* which are all positive and statistically significant at 1%.

Moreover, they are affected by eight business environment factors out of nine total variables included in the model. The '*monopolistic competition'*, the *'access to new exports markets*', the *'access to local business networks'*, the *'access to universities and research centres'* and the *'access to government support*' that are positive and statistically significant at 1%. The *'access to ICT'* and the *'access to skilled labour market'* which are positive and statistically significant at 5%. The *'access to external finance'* which is negative and statistically significant at 5%.

The product innovators are smaller British family-owned firms. They are less likely to be located in urban areas as a major part of their operations obliged them to be far from cities to reduce pollution. They use updated equipment to produce their products which are exported in new exports markets. The management of such businesses is more likely to be the kind of mixed genders with no specific gender dominating the management team.

They can expand through their product lines by investing in internal R&D activities as well as external R&D activities through their access to universities and research centres. Besides, they operate in a monopolistic competitive business environment that is supportive of innovating their products. For example, they have access to skilled labour markets and ICT. They are less likely to endure external finances through banks and finance companies as they are supported by the government and have strong local business networks.

Who are the Service Innovators?

The service innovators at the firm level are influenced by four out of twelve firm characteristics. The *'updated equipment and high technology'* and the *'firm age'* are positive and statistically significant at 1% whereas the *'firm size'* and the *'firm age squared'* are negative and statistically significant at 1%.

They are also affected by three out of four firm behaviour elements. These are the *'formal training'*, the *'R&D'*, and the *'capability for expansion'* which are positive and statistically significant at 1%.

The service innovators at the firm level are influenced by seven out of nine business environment variables. The *'monopolistic competition'*, the *'access to ICT'*, the *'access to unskilled labour market'*, the *'access to universities and research centres'* and the *'access to government support'* which are positive and statistically significant at 1%. The *'access to local business networks'* is positive and statistically significant, at 5%. The *'access to external finance'* is negative and statistically significant, at 1%.

According to the findings, the service innovators are smaller-sized and mid-aged British firms where their effect on service innovation reduces as the firm grow older. They can grow and expand through the monopolistic competition and collaboration of both internal and external R&D. To ensure that they maintain high-quality service standards, they focus on

extending formal training periodically to their unskilled labour team and guide them on how to use the updated equipment and high technology as well as to access different channels of ICT to extend their services to larger stakeholders. They are also less likely to undergo external finance through banking and finance options due to their smaller size as they have access to government support and strong local business networks.

Who are the Operational Processes Innovators?

The operational processes innovators at the firm level are affected by seven out of twelve firm characteristics elements. The *'firm size'*, the *'exports'*, the *'firm age'*, the *'updated equipment and high technology'* and the *'executive founders'* are positive and statistically significant at 1%. The *'firm size squared'* and the *'firm age squared'* are negative and statistically significant at 1%.

Three out four firm behaviour variables influence them: the *'capability for expansion'*, the *'R&D'* and the *'formal training'* which are positive and statistically significant at 1%.

Eight out of nine business environment factors also impact them. The *'monopolistic competition'*, the *'access to ICT'*, the *'access to unskilled labour market'*, the *'access to local business networks'*, the *'access to universities and research centres'* and the *'access to government support*', which are positive and statistically significant at 1%. The *'access to new exports markets'* is positive and statistically significant at 5%.

The results show that the operational processes innovators are more likely to be medium-sized and mid-aged British firms by which their effect on operational processes innovation reduces as they grow larger and older. They have strong exports that explore new markets locally, regionally and internationally. They have executive founders on board, and they extend formal training to their unskilled labour on a periodical basis to learn how to utilise their updated equipment and new technology well. They can expand further with the collaboration of both internal and external R&D. They operate in a monopolistic competitive business environment with strong business networks and government support.

Who are the Organisational or Managerial Processes Innovators?

The organisational or managerial processes innovators at the firm level are influenced by eight out of twelve firm characteristics. The *'firm size'*, the *'updated equipment and high technology'* and the *'businesses led by a female'* are positive and statistically significant at 1%. Also, the *'business led by male'* is positive and statistically significant at 5%. The *'firm size squared'*, the *'exports'*, the *'family-owned businesses'* and the *'executive founders'* are negative and statistically significant at 1%.

They are affected by three out of four firm behaviour variables. These are the *'formal training'*, the *'R&D'* and the *'capability for expansion'* which are positive and statistically significant at 1%.

They are influenced by seven out of nine business environment factors. These are the *'monopolistic competition'*, *the 'access to new exports markets'*, the *'access to external finance'*, the *'access to ICT'*, the *'access to universities and research centres'* and the *'access to government support'* which are positive and statistically significant at 1% as well as to the 'access to skilled labour market' which is positive and statistically significant at 5%.

The organisational or managerial processes innovators are medium-sized British firms where the effect of firm size on organisational processes innovation is lessoned as it grows larger. They are less likely to have exports activities. They are also less likely to be family-owned businesses, and they do not have executive founders on board. They are professionally managed as they have a balanced female and male leadership in the firm. They have updated equipment and technology, which is highly utilised by the skilled labour force who are conducting formal training to educate other employees in the firm. They can expand through the strong collaboration between the internal R&D department and the access to universities and research centres. They operate in a highly competitive healthy environment where there is proper access to new exports markets, ICT, financial channels and government support.

Who are the Marketing Methods Innovators?

The marketing methods innovators at the firm level are affected by eight out of twelve firm characteristics. The *'firm size squared'*, the *'updated equipment and high technology'*, the *'family-owned businesses'* and the *'businesses led by male'* are positive and statistically

significant at 1% as well as *'firm age'* is positive and significant at 10%. The *'firm size'* and the *'executive founders'* are negative and statistically significant at 1% as well as the *'businesses led by a female'* is negative and statistically significant at 5%.

They are influenced by three out of four firm behaviour elements. The *'capability to expansion'* and the *'R&D'* are positive and statistically significant at 1%, but the *'formal training'* is negative and statistically significant at 1%.

They are also impacted by five out of nine business environment variables. The *'monopolistic competition'*, the *'access to ICT'*, and the *'access to skilled labour market'* are positive and statistically significant at 1%. The *'access to new exports markets'* is positive and statistically significant at 10%. The *'access to unskilled labour market'* is negative and statistically significant at 1%

The marketing methods innovators are ageing small and medium-sized British family-owned firms. The effect of the firm size on marketing methods increases as the firm grow further. They have more males and fewer females in the management team. They are less likely to have executive founders on the board. They have access to the skilled labour market that fully utilises the updated equipment and high technology. They are less likely to have access to the unskilled labour market; hence, they are less likely to conduct formal training. They have the capability for expansion through the competition and access to ICT, strong local business networks, access to internal and external R&D and formal training.

The results of investigating the relationship of 'firm characteristics', 'firm behaviour' and 'business environment' on innovation outcomes are compared using the three estimators (the PROBIT, the LOGIT and the MVPROBIT). Also, the results of studying the British SMEs in the 2010s are compared with the results of the British SMEs in the 1990s using the MVPROBIT estimator as follows:

What are the Firm Characteristics that matter for Innovation at the Firm Level?

The summary 5.1 shows the effect of 'firm characteristics' on different types of innovation. The results are the same using the four estimators except in one case where the logit estimator has shown that the *'exports'* at the firm level has a negative impact on 'services innovation'. It is in addition to the negative impact of the 'exports' on 'organisational or managerial

processes innovation' as well as its positive impact on 'products and operational processes innovations' using the four estimators. Therefore, the British SMEs that export their products are more likely to innovate their products and operational processes. However, they are less likely to innovate their organisational or managerial processes and services, perhaps because the innovation is costly, and they already have the product and production-related processes innovations in place.

The effect of the *'firm size'* on innovation is diverse. *On the one hand, the* ***smaller*** *British firms innovate their products and services. On the other hand,* ***medium-sized*** British firms *tend to innovate their operational processes*. The effect of the firm size on innovation is, however, lessening as they employ more staff. Moreover, the **small and medium-sized** British firms innovate their marketing methods, but their effect on marketing methods innovation is strengthening as they employ more staff.

The number of the *'sites/branches/subsidiaries'* are insignificant on all types of innovation using the four types of estimators whereas the utilisation of *'updated equipment and high technology'* has a positive effect on all types of innovation. It may imply that *it does not matter whether the British firm has one or several branches to innovate, but their utilisation of high technology and updated equipment boost different types of their innovations*.

The results also indicate that the *'British family-owned businesses'* tend to innovate their products and marketing methods. However, they are less likely to innovate their organisational or managerial processes perhaps due to the adapted strategy of recruiting family members and existence of family work politics or traditions which may result in hesitations to make changes and improvements in the firm structure. It is also common with the British firms that have *'executive founders'* on their board of directors as they are less likely to innovate organisational processes, perhaps due to the same reasons. However, they differ from the family-owned businesses as they are less likely to innovate their marketing methods and may lean more to use the traditional marketing methods like word of mouth. They are instead more likely to focus on innovating their operational processes.

The ***mid-aged*** British firms tend to innovate their services and operational processes, but the effect on such innovations is lessening as the firm ages. The ***ageing*** firms innovate their marketing methods to reach to larger customer base. Besides, the firms that are '*located*' in

urban areas are less likely to innovate their products. It may be related to sector type as firm in the manufacturing sector are restricted to manufacture their products in industrial areas far from residential or inhabitants to reduce the level of pollution and to comply with corporate responsibility code of ethics.

Both the British *'businesses led by a female'* or the *'businesses led by male'* are more likely to innovate their organisational or managerial processes and are less likely to innovate their products. It could be a general trend with the British SMEs. As according to the sample statistics, *the recent innovations are processes and services-oriented rather than products oriented.* Also, results show that the British 'businesses led by male' are more likely to innovate their marketing methods than the 'businesses led by a female'. It could be due to male's higher business networks and interest in information technology and logistics sectors.

Summary 5. 1 Comparison of Impact of FCs on Innovations by Estimators

Variables	**PROBIT**	**LOGIT**	**MVPROBIT**
Firm Size	(+) *** on Operational Innovation and Organisational Innovation (-) ** on Products Innovation, Services Innovation and (-) *** on Marketing Methods Innovation	(+) *** on Operational Innovation and Organisational Innovation (-) ** on Products Innovation, Services Innovation and (-) *** on Marketing Methods Innovation	(+) *** on Operational Innovation and Organisational Innovation (-) ** on Products Innovation, (-) *** on Services Innovation and Marketing Methods Innovation
Firm Size Squared	(+) *** on Marketing Methods Innovation (-) *** on Operational Innovation and Organisational Innovation	(+) *** on Marketing Methods Innovation (-) *** on Operational Innovation and Organisational Innovation	(+) *** on Marketing Methods Innovation (-) *** on Operational Innovation and Organisational Innovation

Exports	(+) *** on Products Innovation and Operational Innovation (-) *** on Organisational or Managerial Innovation	(+) *** on Products Innovation and Operational Innovation (-) *** on Organisational or Managerial Innovation and (-) * on Services Innovation	(+) *** on Products Innovation and Operational Innovation (-) *** on Organisational or Managerial Innovation
Sites/Branches/Subsidiaries	Insignificant	Insignificant	Insignificant
Updated Equipment and High Technology	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations
Family-Owned Businesses	(+) *** on Products Innovation and Marketing Methods Innovation (-) *** on Organisational or Managerial Innovation	(+) *** on Products Innovation and Marketing Methods Innovation (-) *** on Organisational or Managerial Innovation	(+) *** on Products Innovation and Marketing Methods Innovation (-) *** on Organisational or Managerial Innovation
Firm Age	(+) *** on Services and Operational Innovations	(+) *** on Services and Operational Innovations	(+) *** on Services and Operational Innovations
Firm Age Squared	(+) * on Marketing Methods Innovation (-) *** on Services and (-) ** on Operational Processes Innovations	(+) * on Marketing Methods Innovation (-) *** on Services and Operational Processes Innovations	(+) * on Marketing Methods Innovation (-) *** on Services and Operational Processes Innovations
Location	(-) *** on Products Innovation	(-) *** on Products Innovation	(-) *** on Products Innovation

Businesses Led by a Female	(+) *** on Organisational or Managerial Processes Innovation (-) *** on Products Innovation and (-) ** on Marketing Methods Innovation	(+) *** on Organisational or Managerial Processes Innovation (-) *** on Products Innovation and (-) ** on Marketing Methods Innovation	(+) *** on Organisational or Managerial Processes Innovation (-) *** on Products Innovation and (-) ** on Marketing Methods Innovation
Businesses Led by a Male	(+) *** on Marketing Methods Innovation and (+) ** on Organisational Innovation (-) ** on Products Innovation	(+) *** on Marketing Methods Innovation and (+) ** on Organisational Innovation (-) ** on Products Innovation	(+) *** on Marketing Methods Innovation and (+) ** on Organisational Innovation (-) ** on Products Innovation
Executive Founders	(+) *** on Operational Innovation (-) *** on Marketing Methods Innovation and Organisational Innovation	(+) *** on Operational Innovation (-) *** on Marketing Methods Innovation and Organisational Innovation	(+) *** on Operational Innovation (-) *** on Marketing Methods Innovation and Organisational Innovation

The summary 5.2 demonstrates that in the 1990s, only the ***younger*** small and medium-sized British firms were more likely to be services innovators. But in the 2010s, the services innovators are the ***smaller and mid-aged*** British firms. Moreover, the ***small-sized*** British firms in the 2010s tend to innovate their products, whereas the ***medium-sized*** firms tend to innovate their organisational or managerial processes. Also, the ***medium-sized and mid-aged*** British firms tend to innovate their operational processes, whereas ***ageing small and medium-sized*** British firms tend to innovate their marketing methods.

In the 1990s, the British SMEs that *'exported'* their products and services were more likely to innovate their marketing methods whereas in the 2010s, the British SMEs that *'export'*

their product and services are more likely to innovate their products and operational processes and less likely to innovate their organisational or managerial processes.

The results show that the effect of the *'sites/ branches/ subsidiaries'* on innovation outcomes is insignificant with the SMEs in the 2010s unlike with the SMEs in the 1990s where the effect was positive with services and marketing methods innovations and negative on operational processes innovation. It indicates that the British firms with more branches and subsidiaries in the 1990s were more likely to innovate their services and marketing, but not their operational processes. It is perhaps due to higher costs of managing multi-branches and subsidiaries and earlier innovations. The conclusion from the previous literature of Leiponen (2006), is that the 'sites or branches or subsidiaries' have an indirect relationship with innovation at the firm level as it depends on firm's ability to share and transfer knowledge and resources across branches or sites or subsidies. The negative effect may reflect a below industry average of knowledge sharing or resources exchange between branches and head office and the positive effect indicates an above industry average of sharing of resources and new ideas. When the effect is insignificant, it may imply that the extent of sharing resources and knowledge is negligible or tiny. *It implies that more knowledge exchange and resources transfer among branches and subsidiaries is required in the British SMEs to enable them to innovate their services and marketing methods.*

Summary 5. 2 British SMEs Comparison of Impact of FCs on Innovations

1. Firm Characteristics		
Variables	**British SMEs in the 2010s**	**British SMEs in the 1990s**
Firm Size	(+) *** on Operational Innovation and Organisational Innovation (-) ** on Products Innovation, (-) *** on Services Innovation and Marketing Methods Innovation	(-) *** on Services Innovation
Firm Size Squared	(+) *** on Marketing Methods Innovation (-) *** on Operational Innovation and Organisational Innovation	(+) *** on Services Innovation

Exports	(+) *** on Products Innovation and Operational Innovation (-) *** on Organisational or Managerial Innovation	(+) ** on Marketing Methods Innovation
Sites/Branches/Subsidiaries	Insignificant	(+) * on Services Innovation and (+) ** on Marketing Methods Innovation (-) ** on Operational Innovation
Updated Equipment and High Technology	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Operational Innovation And Organisational Innovation
Family-Owned Businesses	(+) *** on Products Innovation and Marketing Methods Innovation (-) *** on Organisational or Managerial Innovation	(+) *** on Innovation Outcomes
Firm Age	(+) *** on Services and Operational Innovations	(-) ** on Services Innovation
Firm Age Squared	(+) * on Marketing Methods Innovation (-) *** on Services and Operational Processes Innovations	(-) * on Services Innovation
Location	(-) *** on Products Innovation	Insignificant
Businesses Led by a Female	(+) *** on Organisational or Managerial Processes Innovation (-) *** on Products Innovation and (-) ** on Marketing Methods Innovation	Insignificant
Businesses Led by a Male	(+) *** on Marketing Methods Innovation and (+) ** on Organisational Innovation (-) ** on Products Innovation	Insignificant
Executive Founders	(+) *** on Operational Innovation (-) *** on Marketing Methods Innovation and Organisational Innovation	Insignificant

Also, the results show that the effect of the *'updated equipment and high technology'* on all innovation outcomes is positive with the British SMEs in the 2010s and is also positive with the British SMEs in the 1990s on operational and organisational or managerial processes. It is supported by the finding of Hong, Oxley, McCann and Le (2016) that updated equipment and high technology have a positive impact on innovation outcomes.

According to the results, the effect of the *'family-owned businesses'* on the innovation outcomes is positive on products and marketing methods innovations and is negative on organisational or managerial processes innovation with the British SMEs in the 2010s whereas the effect is merely positive on all innovation outcomes for the SMEs in the 1990s. Laforet, S. (2013) found that a dynamic environment positively affects young innovative family firms. It may indicate that the effect of family-owned businesses on innovation outcomes at the firm level may depend on the extent of changes in the business environment. The positive changes in the business environment positively affect innovation outcomes at family-owned firms. The negative business environmental changes negatively affect innovation at family-owned firms. No changes in the business environment may indicate insignificant effect.

The results show that the *'location'* has a negative effect on products innovation with the British SMEs in the 2010s while it was insignificant with the British SMEs in the 1990s. It may indicate that the British SMEs that are located in the urban area are usually experiencing lower products innovation in the urban areas as compared with the rural areas. It could be due to compliance with the corporate responsibility and the corporate code of ethics that restricts firms in manufacturing and production sectors to manufacture their products in industrial areas which are usually far from the residential and commercial areas. Although the effect is the same as the British SMEs in the 1990s and 2010s, this result is surprising since the previously reviewed literature does not support it. Brouwer, Budil-Nadvornikova, and Kleinknecht (1999) suggested that the unique specification of the location directly or indirectly influence the firm's innovation as firms in the urban agglomerations tends to invest more in the R&D activities in product development compared to the firms situated in rural areas. Audretsch (2003), Sedgley and Elmslie (2004), Herrera, Munoz-Doyague, and Nieto

(2010) found that the agglomeration has a positive impact on innovation when regarding the human capital, R&D and high technology sector as control variables. Bell (2005) found that clusters produce more innovation than remote firms. Alegre and Chiva (2008), Falk (2008) argued that the location is usually used as a control variable in innovation empirical studies to fix the differences in inter-regional or inter-country samples. However, Hong, Oxley, McCann and Le (2016) found that the location is insignificant on innovation outcomes with the SMEs in New Zealand.

Furthermore, the results of the four estimators show that the effect of the following three variables: the *'businesses led by a female', 'businesses led by male'* and *'executive founders'* were insignificant with the British SMEs in the 1990s, but they are significant with the British SMEs in the 2010s.

Firstly, the 'businesses led by a female' is positive on organisational or managerial processes innovation and negative on products and marketing methods innovations. Secondly, the 'businesses led by male' is positive on marketing methods and organisational or managerial process innovations, but is negative on products innovation. The recent literature has shown that the effect can take any sign positive or negative or insignificant. On the one hand, Akulava (2015) found the effect of the 'businesses led by female' have a positive effect on innovation. He also found that female-led firms are more innovative than male-led firms. However, Kalleberg and Leicht (2001) argued that the 'businesses led by male' are more innovative, especially when the innovation is measured using hard indicators such as patenting activity and research and development expenses.

On the other hand, Smith-Doerr's (2010) argued that the relationship between gender and innovation is negative. It is because the innovation in its traditional form has negatively influenced women's participation in the male-dominated industry. However, other studies found no difference between male and female business owners when taking into consideration the introduction of new products, new organisational structures and other forms of innovation (Kalleberg and Leicht, 2001).

Thirdly, the effect of the 'executive founders' is positive on operational processes but is negative on organisational or managerial process and marketing methods innovations. Hong, Oxley, McCann and Le (2016) found that business makeup factors matters for innovation. It

includes the organisational structure and business ownership. Therefore, the level of commitment extended by the 'executive founders' towards the innovation may explain the variation of the effect. The higher commitment of executive founders on introducing major changes in the firm may support their higher likelihood to undergo operational processes innovation whereas the lack of commitment from their end may result in their less likely to involve in both the organisational processes and marketing methods innovations.

To sum up, three key firm characteristics derive different types of innovation at the British SMEs in the 2010s; the firm size, the firm age and the updated equipment and high technology. Still, the location has a negative impact on products innovation as compared with the British SMEs in the 1990s. Also, there is no clear role for the sites, branches and subsidiaries in boosting different types of innovation. The rest of the five firm characteristics- the exports, the family-owned businesses, the businesses led by a female, the businesses led by a male and the executive founders- have shown controversial effects. They have positive and negative effects on different types of innovation.

What are the Firm Behaviour Elements that matter for Innovation at the Firm Level?

The summary 5.3 shows that the effect of the firm behaviour elements on the innovation outcomes. The results are the same using the four estimators and except with the *formal intellectual property protection rights*. It is insignificant using the three estimators- the logit, the probit and the multivariate probit- which are estimators beyond the OLS and are used specially to estimate discrete choice models; hence they are more accurate.

The results show that the *'capability for expansion'* and the *'R&D'* have a positive effect on innovation outcomes using the four estimators. *'formal training'* has a controversial effect according to the results. It is positive on services, operational and organisational or managerial processes innovations whereas it is negative on marketing methods innovation. The positive effect is supported by literature, whereas the negative effects are surprising, but can be explained. The 'formal training' becomes negative when it is over conducted and openly accessed to the public as it becomes easier for competitors to imitate the firm's products, services and processes. Also, the competitors may capture the business idea and make it a reality before it is implemented by the firm that generated the business idea. *In short, comprehensive free accessed formal training can inspire competitors to innovate.*

Summary 5. 3 Comparison of Impact of FBs on Innovations by Estimators

Variables	PROBIT	LOGIT	MVPROBIT
Capability for Expansion	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations
R&D	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations
Formal IP Protection Rights	Insignificant	Insignificant	Insignificant
Formal Training	(+) *** on Services Innovation, Operational and Organisational Processes Innovations (-) *** on Marketing Methods Innovation	(+) *** on Services Innovation, Operational and Organisational Processes Innovations (-) *** on Marketing Methods Innovation	(+) *** on Services Innovation, Operational and Organisational Processes Innovations (-) *** on Marketing Methods Innovation

The summary 5.4 compares the results of the effect of firm behaviour elements on innovation outcomes between the British SMEs in the 2010s and the British SMEs in the 1990s. First, the British SMEs that have the *'capability for expansion'* are more likely to innovate all the five types of innovations whereas the British SMEs in the 1990s that behaved the same innovated their services only. They are even less likely to innovate their operational processes, perhaps due to the higher cost of innovation.

Second, the British SMEs that invest in the *'R&D'* are also now more likely to innovate all the five types of innovations whereas the British SMEs in the 1990s that involved in the R&D activities innovated only their products and services.

This comparison indicates that the British SMEs that have the capability to expand and invest in the R&D activities are now more likely to innovate different types of innovation than it used to be in the 1990s perhaps due to several reasons such as the impact of the fourth industrial revolution that focuses on the artificial intelligence, the SMEs' adoption to major changes in higher technology and the healthier business environment that encourages innovation at the firm, industry and country levels.

Summary 5. 4 British SMEs Comparison on Impact of FBs on Innovations

2. Firm Behaviour		
Variables	**British SMEs in the 2010s**	**British SMEs in the 1990s**
Capability for Expansion	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Services Innovation (-) *** on Operational Innovation
R&D	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) * on Products Innovation, (+) ** on Services Innovation
Formal IP Protection Rights (FIPPRs)	Insignificant	(+) * on Products Innovation (-) * on Services Innovation, (-) *** on Organisational Innovation
Formal Training	(+) *** on Services Innovation, Operational and Organisational Processes Innovations (-) *** on Marketing Methods Innovation	(+) *** on Services Innovation and (+) ** on Marketing Methods Innovation (-) * on Products Innovation

Third, the British SMEs in the 2010s that have acquired *"formal intellectual property protection rights"* have an insignificant effect on innovation. However, the case is different with the British SMEs in the 1990s as the effect of 'FIPPRs' was positive on product innovation and negative on services and organisational or managerial processes innovations. Jong and Hippel (2009) found that using various types of intellectual property protection such as patents, trademarks, brands, etc. have a positive effect on innovation. However,

patents and trademarks may have a negative effect on innovation as they may block other firms from entering the market and may also block the firm's resources to innovate another type of innovations. Sometimes, the effect of trademarks is insignificant because the trademarks are not innovation incentive.

Fourth, the British SMEs that conduct 'formal training' are more likely to innovate their services and processes, whereas the British SMEs in the 1990s that behaved the same innovated their services and marketing methods. Moreover, now some of the British SMEs are less likely to innovate their marketing methods if they are investing in 'formal training' because training is costly and perhaps the some of the British SMEs consider training their employees and other stakeholders as a substitute for marketing methods innovation. It is different from the British SMEs in the 1990s as their investment in formal training made them less likely to innovate new products. It could be due to the risks inevitable from the over the transfer of knowledge. For example, the movement of key staff and their faster implementation of the new business idea as well as the quicker imitation by competitors. Frenz and Ietto-Gillies (2009) suggested that the knowledge transfer between each unit is likely to affect the innovation in the firm.

To sum up, the capability for expansion and the investment in the R&D are the two key firm behaviour that affects all types of innovations of the British SMEs in the 2010s. The FIPPRs is insignificant, and the formal training has a controversial effect on innovation. It is positive on services and processes innovations and negative on marketing methods innovation.

What are the Business Environment factors that matter for Innovation at the Firm Level?

The summary 5.5 presents the effect of business environment factors on different types of innovation using the three estimators. The results are the same as the four estimators. The effect of all business environment factors is positive on innovation outcomes except with the *'access to external finance'* and the *'access to unskilled labour market'*. They have controversial effects (positive and negative) on different types of innovation. The literature fully supports the positive effect, but the literature does not support the negative effect; hence, it is considered as a surprising result.

Summary 5. 5 Comparison of Impact of BEs on Innovations by Estimators

Variables	PROBIT	LOGIT	MVPROBIT
Competition	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations
Access to New Exports Market	(+) *** on Products Innovation and Organisational Innovation, (+) ** on Operational Innovation and (+) * on Marketing Methods Innovation	(+) *** on Products Innovation and Organisational Innovation, (+) ** on Operational Innovation and (+) * on Marketing Methods Innovation	(+) *** on Products Innovation, (+) ** on Operational Innovation and Organisational Innovation and (+) * on Marketing Methods Innovation
Access to External Finance	(+) *** on Organisational Innovation (-) *** on Services Innovation and (-) ** on Products Innovation	(+) *** on Organisational Innovation (-) *** on Services Innovation and (-) ** on Products Innovation	(+) *** on Organisational Innovation (-) *** on Services Innovation and (-) ** on Products Innovation
Access to ICT	(+) *** on Services, Operational, Organisational and Marketing Methods Innovations, (+) ** on Products Innovation	(+) *** on Services, Operational, Organisational and Marketing Methods Innovations, (+) ** on Products Innovation	(+) *** on Services, Organisational and Marketing Methods Innovations, (+) ** on Products and Operational Innovations
Access to Skilled Labour Market	(+) *** on Marketing Methods Innovation, (+) ** on Products and Organisational Innovations	(+) *** on Marketing Methods Innovation, (+) ** on Products and Organisational Innovations	(+) *** on Marketing Methods Innovation, (+) ** on Products and Organisational Innovations

Access to Unskilled Labour Market	(+) *** on Services and Operational Innovations (-) *** on Marketing Methods Innovation	(+) *** on Services and Operational Innovations (-) *** on Marketing Methods Innovation	(+) *** on Services and Operational Innovations (-) *** on Marketing Methods Innovation
Access to Local Business Networks	(+) *** on Products and Operational Innovations, (+) * on Services Innovation	(+) *** on Products and Operational Innovations, (+) ** on Services Innovation	(+) *** on Products and Operational Innovations, (+) ** on Services Innovation
Access to Universities and Research Centre	(+) *** on Products, Services, Operational and Organisational Processes Innovations	(+) *** on Products, Services, Operational and Organisational Processes Innovations	(+) *** on Products, Services, Operational and Organisational Processes Innovations
Access to Government Support	(+) *** on Products, Services, Operational and Organisational Processes Innovations	(+) *** on Products, Services, Operational and Organisational Processes Innovations	(+) *** on Products, Services, Operational and Organisational Processes Innovations

The summary 5.6 compares the results of the effect of business environment factors on innovation outcomes between the British SMEs in the 2010s and the British SMEs in the 1990s. By comparing the results, I found that the *'access to unskilled labour market'*, the *'access to universities and research centres'*, and the *'access to government support'*-which were insignificant with the British SMEs in the 1990s- are significant with the British SMEs in the 2010s. *It implies that the collaboration and partnerships of universities, research centres and the government with the British SMEs have widened and strengthened in the last two decades. Also, access to the unskilled labour market has become easier.*

Summary 5. 6 British SMEs Comparison on Impact of BEs on Innovations

3. Business Environment		
Variables	**British SMEs in the 2010s**	**British SMEs in the 1990s**
Competition	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(-) * on Marketing Methods Innovation
Access to New Exports Market	(+) *** on Products Innovation, (+) ** on Operational Innovation and Organisational Innovation and (+) * on Marketing Methods Innovation	(+) *** on Products Innovation, Services Innovation, Operational Innovation and Organisational Innovation
Access to External Finance	(+) *** on Organisational Innovation (-) *** on Services Innovation and (-) ** on Products Innovation	(+) ** on Operational Innovation
Access to ICT	(+) *** on Services, Organisational and Marketing Methods Innovations, (+) ** on Products and Operational Innovations	(+) *** on Services Innovation and Organisational Innovation (-) *** on Products Innovation
Access to Skilled Labour Market	(+) *** on Marketing Methods Innovation, (+) ** on Products and Organisational Innovations	(+) * on Products Innovation, (+) *** on Operational Innovation (-) *** on Services Innovation and (-) ** on Organisational Innovation
Access to Unskilled Labour Market	(+) *** on Services and Operational Innovations (-) *** on Marketing Methods Innovation	Insignificant
Access to Local Business Networks	(+) *** on Products and Operational Innovations, (+) ** on Services Innovation	(+) *** on Products Innovation, (+) ** on Services Innovation and Marketing Methods Innovation, (+) * on Organisational Innovation
Access to Universities and Research Centre	(+) *** on Products, Services, Operational and Organisational Processes Innovations	Insignificant
Access to Government Support	(+) *** on Products, Services, Operational and Organisational Processes Innovations	Insignificant

Firstly, the British SMEs in the 1990s that operated in a market of *'monopolist competition'* were less likely to innovate their marketing methods. Then, as years passed, the British SMEs in the 2010s that operate in such a competitive environment became innovators of all the different types of innovation. The availability of competitive market with a certain degree of power is a good foundation for innovation at the firm and industry levels; hence the influence of 'monopolistic competition' is always positive on different types of innovation. It is because of the threat of competition and the fight for survival motivates firms to innovate (Baumol, 2002). *It implies that the British SMEs that operate in a healthy competitive environment tend to innovate all different types of innovation.*

Secondly, the British SMEs in the 1990s that had *'access to new exports markets'* innovated all types of innovations except the marketing methods innovation. Now, the British SMEs innovate all the five different types of innovation. *It may imply that the British SMEs are undergoing positive changes in the market demand than they were in the 1990s; which require the adoption of innovative marketing methods.* Golovko & Valentini (2011) concluded that participating in the new exports markets can promote the firm's learning, and thus enhance innovation.

Thirdly, the British SMEs that had the *'access to external finance'* in the 1990s innovated their operational processes. The British SMEs in the 2010s innovate their organisational or managerial processes. Also, the results show that British SMEs in the 2010s with the 'access to external finance' are less likely to innovate their products and services. It might be due to the type of financial facility as it might do not meet the shareholders' expectation; hence, it is rejected. It can be accepted, but it may affect other types of innovations negatively. Kim, S., Lee, H. and Kim, J (2016) found that indirect external financing such as bank loans makes a negative impact on technological product innovation.

Fourthly, the *'access to ICT'* usually has a positive influence on all types of innovations as it is the case found with the British SMEs in the 2010s. Also, the British SMEs in the 1990s that had 'access to ICT' innovated their services and organisational or managerial processes. This positive impact of ICT on innovation is supported by Higon (2011). However, surprisingly, the British SMEs in the 1990s that had the 'access to ICT' were less likely to

innovate their products. It may be due to oversharing access and information about firm's product to the public which enables competitors to absorb enough knowledge required for them to imitate the product or inspire them to innovate something better that captures a broader market base.

Fifthly, the British SMEs in the 2010s that have the *'access to skilled labour market'* tend to innovate their products, marketing methods and organisational or managerial processes whereas the British SMEs in the 1990s with the same access innovated their products and operational processes. It is supported by Stock, Greis and Fischer (2001) who found that access to the skilled labour market is positively related to the innovation due to the firm's ability to convert new ideas or external information to a commercial product as suggested by Cohen and Levinthal (1990).

However, the British SMEs in the 1990s that had the 'access to skilled labour markets' were less likely to innovate their services and organisational or managerial processes. *It may imply that recently the British SMEs have become more flexible and receptive to changes as they became organisational or managerial processes innovators.*

Sixthly, the *'access to unskilled labour market'* was insignificant with the British SMEs in the 1990s. However, this has changed as the British SMEs in the 2010s tend to innovate their services and operational processes perhaps due to availability of formal periodical training that equips 'unskilled labour' with adequate skills required to improve the quality standards of firm's services and processes. Also, they are less likely to innovate their marketing methods because unskilled labour lacks or have a lower absorptive capacity as suggested by Cohen and Levinthal (1990). However, the marketing methods innovation is already handled well with the 'skilled labour' that can be outsourced if they are not available.

Seventhly, the *'access to local business networks'* usually has a positive impact on different types of innovation, and this is the case with both the British SMEs in the 1990s and 2010s. This result is supported by Audretsch (2003), Sedgley and Elmslie (2004), Herrera, Munoz-Doyague, and Nieto (2010) who found that agglomeration and business networks have a positive impact on innovation.

Last but not least, the impact of the *'access to universities and research centres'* on the British SMEs in the 1990s was insignificant. However, this is not the case with the British SMEs in the 2010s that have the 'access to universities and research centres' tend to innovate all types of innovations except the marketing methods innovation. It is supported by Freel (2000), who argued that university links enable SMEs to improve their innovative capacity or capabilities by gaining access to sophisticated technology and technical expertise.

Finally, the effect of the *'access to government support'* on the British SMEs in the 1990s was insignificant. However, this is not the case with the British SMEs in the 2010s that have the "access to government support" tend to innovate all types of innovations except the marketing methods innovation. It is supported by Marcus (1981), who found that government regulations affect the innovation rate and substance. Choi and Lim (2017) found that the government and public policies provide fiscal incentives and information are positively associated with SMEs' innovation performance through their internal innovation capacity.

Given the last two results, it may be apt to conclude that *recently the British SMEs have broader and effective collaboration with universities and research centres as well as they receive proper aid and support from the government than it used to be in the 1990s*.

To sum up, seven key business environment factors affected innovation at the British SMEs in the 2010s. These are the presence of monopolistic competition, the access to new exports markets, the ICT, the skilled labour market, the local business networks, the external R&D and the government support. The access to the unskilled labour market boosted the services and operational processes innovations, but not the marketing methods. Access to external finance enhanced the organisational or managerial processes innovation, but not the products and services innovations.

Section 5.4 answers the fourth research question of What are the current internal and external barriers to innovation for the British SMEs in the 2010s?

5.4 Barriers to Innovation

The firm behaviour and business environment factors that have a negative impact on innovation outcomes might be by default, some of the internal and external barriers to innovation. The regression results pinpointed some of the barriers as follows:

There are ***internal*** barriers that are derived from the negative impact of the firm behavioural element on an innovation outcome. For example, the presence of formal training made some of the British SMEs less likely to innovate their marketing methods. It is because formal training has positively influenced the firm's services and processes; hence, they did not innovate due to earlier innovations. On the one hand, formal training is costly, and its continuous conduction may impose financial constraints. On the other hand, some of the British SMEs may consider formal training as a substitute for marketing methods innovation since the employees get to gain new business networks during the training.

Moreover, the British SMEs in the 2010s have underutilised the acquisition of the FIPPRs, controlled the access to subsidiary's resources and limited the knowledge and resources transfer to the extent that both FIPPRs and access to sites/branches/subsidiaries resources have an insignificant effect on innovation.

It is also worth noting that the *culture of innovation has advanced with the British SMEs in the 2010s* as the role of businesses led by the female, the businesses led by a male and the executive founders in making innovation decisions and choices have been activated. However, still, the focus of these leaderships is on the process's innovations rather than on the products innovation. It raises a concern that still, obstacles are facing the buyout of a complete and integrated innovation system and initiatives.

Besides, ***external*** barriers are derived from the negative influence of some business environment factors on specific innovation outcomes. For instance, some British SMEs that have access to external finance tend to be less likely to innovate their products and services. It is perhaps due to availing an improper financial facility as well as the *uncertainty and excessive perceived risks*. Also, access to the unskilled labour market made some British SMEs in the 2010s to less likely to innovate their marketing methods, perhaps due to earlier innovations of services and operational processes.

Furthermore, the BIS dataset revealed from the responses of the survey participants some barriers to a firm's success that are facing some of the British SMEs, which may also hold as barriers to innovation. These are the financial constraints, the bureaucratic hurdles, the lack of R&D activities or the inadequate R&D investment, the lack of cooperation with

universities and other relevant partners, the lack of technological and market information, the intellectual property management, the project management and organisational cultures.

5.5 Conclusion

The chapter aimed to investigate the current drivers of innovation in the British SMEs using the Department of Business Innovation and Skills (BIS) SMEs dataset on various sectors in 2015 in the United Kingdom nations. The dataset includes 15,502 SMEs of various sectors: production & construction, transport, retail & food service, business services, and other services across the UK.

I, therefore, analysed the impact of variables related to the firm's characteristics and behaviour as well as the business environment on innovation outcomes for the British SMEs in the 2010s. To test this relationship, I used three estimators: LOGIT, PROBIT and the MVPROBIT. The innovation model predicts that different types of innovation at the firm level are influenced by the firm characteristics, the firm behaviour and the business environment. Moreover, the innovation outcomes are correlated, so the MVPROBIT estimator is superior to other estimators in explaining the innovation model.

At the firm level, the summary of statistics revealed that 46.8% of the British SMEs innovate their organisational or managerial processes, 35.7% of them innovate their services, 32.2% innovate their marketing methods, 26.4% innovate their operational process, and only 21.7% innovate their products (table 3.13). It implies that *the focus in the British SMEs has shifted to internal and external services and marketing methods innovations rather than products and operational processes innovations.* This chapter gives answers to the four-research question as follows.

C1: Three key firm characteristics derive different types of innovation at the British SMEs in the 2010s; the 'firm size', the 'firm age' and the 'updated equipment and high technology'. Still, the location has a negative impact on products innovation as compared with the British SMEs in the 1990s. Also, there is no clear role for the sites, branches and subsidiaries in boosting different types of innovation. The rest of the five firm characteristics-the exports, the family-owned businesses, the businesses led by the female, the businesses led by a male

and the executive founders- have shown controversial effects. They have positive and negative effects on different types of innovation.

In the 1990s, only the ***younger*** small and medium-sized British firms were more likely to be services innovators. But in the 2010s, the services innovators are the ***smaller and mid-aged*** British firms. Moreover, the ***small-sized*** British firms in the 2010s tend to innovate their products, whereas the ***medium-sized*** firms tend to innovate their organisational or managerial processes. Also, the ***medium-sized and mid-aged*** British firms tend to innovate their operational processes, whereas ***ageing small and medium-sized*** British firms tend to innovate their marketing methods.

C2: The 'capability for expansion' and the investment in the 'R&D' are the <u>two</u> key firm behaviour that affects all types of innovations of the British SMEs in the 2010s. The FIPPRs is insignificant, and the formal training has a controversial effect on innovation. It is positive on services and processes innovations and negative on marketing methods innovation.

C3: Seven key business environment factors affect innovation at the British SMEs in the 2010s. These are the presence of monopolistic competition, the access to new exports markets, the ICT, the skilled labour market, the local business networks, the external R&D and the government support. The access to the unskilled labour market boosted the services and operational processes innovations, but not the marketing methods. Access to external finance enhanced the organisational or managerial processes innovation, but not the products and services innovations.

C4: There are '*internal* barriers' such as the excess conduction of formal training made some of the British SMEs to less likely innovate their marketing methods because the formal training is costly and the existence of earlier innovations. *Moreover, the British SMEs in the 2010s have underutilised the acquisition of the FIPPRs as they shifted from products innovators to services and processes innovators. They also controlled the access to subsidiary's resources and limited the knowledge and resources transfer to the extent that both FIPPRs and access to sites/branches/subsidiaries resources have an insignificant effect on innovation.* It is also worth noting that the *culture of innovation has advanced with the British SMEs in the 2010s* as the role of businesses led by the female, the businesses led by a male and the executive founders in making innovation decisions and choices have been

activated. However, still, the focus of these leaderships is on the process's innovations rather than on the products innovation. It raises a concern that still, obstacles are facing the buyout of a complete and integrated innovation system and initiatives.

Besides, there are '*external* barriers' such as access to improper external finance make the British SMEs in the 2010s less likely to innovate their products. Also, the access to unskilled labour market made some British SMEs to less likely to innovate their marketing methods perhaps due to earlier innovations or due to their resistance to changes and inability to learn new required skills despite the conduction of the formal training.

Furthermore, the BIS dataset revealed *'other barriers'* to innovation. These are the financial constraints, the bureaucratic hurdles, the lack of R&D activities or the inadequate R&D investment, the lack of cooperation with universities and other relevant partners, the lack of technological and market information, the intellectual property management, the project management and organisational cultures.

At this stage of the research, it is necessary to identify some limitations which need to be considered in further work. Firstly, the dataset is cross-sectional as the survey was conducted in 2015. Secondly, some potential explanatory variables that were included in a recent empirical study were not available in the dataset such as oligopoly, sufficient production capacity, inward direct investment, labour productivity and transport. However, new variables are added to the model to test their effects on various innovation outcomes such as: the sites/branches/subsidiaries, the business led by female, the business led by male, executive founders, the formal training, the access to external finance, the access to universities and other research institutions, and the access to government support.

To sum up, the findings show that there are key specific firm's characteristics, firm behaviour and business environment factors that matter for innovation in the British SMEs in the 2010s. The major barriers to firms' innovation that may be facing some of the British SMEs according to the survey respondents are: lack of suitable staff recruitment with specific skills, financial constraints, absence of research and development (R&D) department and lower investment in R&D, aggressive competition in the market, and some strict regulations.

There are similarities and differences between the British SMEs in the 1990s and 2010s in terms of drivers and barriers of innovation. The key similarities in the firm characteristics that matter the most in innovation are the firm size, firm age, updated equipment and high technology. However, the British SMEs in the 1990s were product innovation oriented so they focused on exporting high quality branded products, whereas the British SMEs in 2010s focused more on technology and digital processes.

Both the British SMEs in the 1990s and 2010s invested heavily on R&D activities, but in 2010s the British SMEs have increased their capability to expand their product ranges and services which made the shift to incremental product innovation rather than radical product innovation as was the case in the 1990s.

The competition, access to new export markets and to strong local business networks are common key business environment factors in both British SMEs in the 1990s and 2010s. However, there are differences as the British SMEs in the 1990s had higher access to external finance while the British SMEs in the 2010s have higher access to ICT, skilled labour markets, external R&D and government support.

There are also similarities and differences between the British SMEs in the 1990s and 2010s in terms of barriers to innovation. Both faced internal barriers due to resources and financial constraints and external barriers due to bureaucratic hurdles of laws and regulations, which results in delay in innovation. However, they also faced different barriers. For instance, the British SMEs in the 1990s did not have proper access to unskilled labour markets. They had neither enough opportunity for external R&D collaborations nor for government support. Whereas the British SMEs in 2010s that did not innovate suffered from lack of up to date organisational or corporate culture for innovation. A revolutionary culture that can motivate them to innovate radically rather than incrementally. This is mainly due to lack of highly outstanding skilled employees in areas of technology and digital channels which are hard to find and sometimes are unaffordable.

Chapter 6: Investigating the drivers and barriers of innovation in Omani SMEs

6.1 Introduction

The Sultanate of Oman is ranked No. 73 out of 128 countries in terms of Global Innovation Index as per OECD report (2016). Whereas the other countries of the Cooperation Council for the Arab States (GCC) are ranked as follows: The United Arab Emirates' 41 out of 128 countries followed by the Kingdom of Saudi Arabia ranking 49, Qatar 50, the Kingdom of Bahrain 56, Kuwait 67 respectively with score ranging from 39.4% to 32.2%. Oman's ranking in the GCC (total six countries) was the No. 6 in 2016 and 2017, moved to No. 5 in 2018 and back to No. 6 in 2019. So, on the one hand, what are the barriers to innovation in the Omani SMEs that can be highlighted to find out ways to overcome them and create a suitable environment for innovation in Oman? On the other hand, the UK is always ranked among the top 5 innovators global according as per OECD, So, what are the drivers of innovation in British firms that can inspire SMEs in Oman to become among the top 20 Global innovators in the future? One obvious feature is the high level of the education system due to the existence of at least 3 of the Top 10 Universities worldwide in the UK with the large scale of R&D, having the most citable documents and access to ICT. Another important feature is the large domestic market scale and e-government.

Therefore, this chapter investigates the innovation model using the sample of 200 Omani SMEs dataset (2018) who have responded to the online survey. It compares the findings of the Omani SMEs with the British SMEs in the 1990s and the 2010s.

This chapter also raises the following research questions:

Q1: What are the key specific firm characteristics that impact innovation outcomes in the Omani SMEs in the 2010s?

Q2: What are the key firm behavioural elements that matter for the Omani SMEs in the 2010s in deciding on whether to innovate or not?

Q3: What are the key specific business environment factors that influence the choice of innovation in the Omani SMEs in the 2010s?

Q4: What are the barriers that may prevent the Omani SMEs in the 2010s from innovating and how to overcome them?

To avoid duplication, the key empirical literature relating to innovation model is available in chapter 2. The remaining of this chapter is structured as follows. Section 6.2 presents the dataset and research methodology, including the results output. Section 6.3 covers the analyses and discussion. Section 6.4 investigates the recent barriers of the innovation in the Omani SMEs, and section 6.5 recaps the findings followed by the conclusion.

6.2 Data and Research Methodology

An online survey targeting SMEs in Oman is designed in google forms to explore the drivers and the barriers to innovation in the Omani SMEs. The survey consists of 8 sections: the firm, the product, the innovation opportunity, the education and skills, the finance & growth, the impact of government, and the plans. The online survey helped in identifying the Omani SMEs' characteristics, behaviour, and the environmental factors that matter for the innovation at the SME level. It also helped in identifying the barriers of innovation at the Omani SMEs.

The survey has gone through ethical review, according to the procedures specified by the University of Reading's Research Ethics Committee, and has been allowed to proceed. It took three months to collect 200 responses from 1st of July to 30th September 2018. It took an average of 20 minutes for the questionnaire to get completed by the respondents, who are the owners and the senior executives of the small and medium-sized enterprises in Oman.

The survey targeted only SMEs in Oman from different sectors which are defined based on the size of the enterprise of the registered businesses in Riyada, the Public Authority for SME Development. The responses of the survey formed a dataset. The dataset is exported to STATA software to run the regression analysis. The results of the regression are compared with the results of the previous two chapters.

For more information about the Omani online survey dataset and the sampling strategy, please refer to chapter 3. This chapter uses the innovation model mentioned in chapter 4 as the starting point for the regression analyses. It also uses five dependent variables to capture different innovation outcomes: product innovation, service innovation, operational process

innovation, organisational or managerial processes innovation, and marketing methods innovation at the firm level.

The hypotheses are tested on whether the firm's characteristics, behaviour and business environment have an impact on the firm's innovation by regressing five innovation outcomes at the firm the level using three estimation techniques: PROBIT, LOGIT and the multivariate probit (MVPROBIT).

Firstly, since the explained variables are binary, it is more appropriate to use beyond ordinary least square estimators, especially those related to discrete choice modelling. Therefore, the PROBIT estimator is used.

The five innovation models are estimated separately, as shown in table 6.1. The pseudo-r-squared is approximately 0.2 in every innovation outcome at the firm level, which suggest that all the five models are good fits.

Table 6. 1 Probit Estimator on Innovations in Omani SMEs in the 2010s

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	1.140	2.635*	2.119*	0.027	-0.270
	[1.304]	[1.425]	[1.279]	[1.184]	[1.151]
Firm Size Squared	-0.513	-1.300**	-1.155**	0.206	0.282
	[0.597]	[0.643]	[0.585]	[0.544]	[0.535]
Exports	0.281	0.471	0.002	0.379	0.326
	[0.463]	[0.426]	[0.459]	[0.429]	[0.442]
Sites/Branches/Subsidiaries	0.219	-1.238*	-1.008*	-0.995*	-0.640
	[0.546]	[0.748]	[0.571]	[0.588]	[0.563]
Updated Equipments and High Technology	0.150	0.442*	0.893***	-0.213	-0.179
	[0.252]	[0.234]	[0.255]	[0.239]	[0.242]
High Quality Branded Product	-0.165	-0.506*	-0.327	-0.778**	-0.403
	[0.313]	[0.301]	[0.315]	[0.324]	[0.307]
Firm Age	0.121	0.164	-0.244	-0.023	-0.443
	[0.334]	[0.322]	[0.323]	[0.329]	[0.339]
Firm Age Squared	-0.033	-0.086	0.101	0.052	0.131
	[0.110]	[0.103]	[0.105]	[0.107]	[0.112]
Location	0.112	0.237	0.475*	-0.087	-0.169
	[0.270]	[0.252]	[0.267]	[0.253]	[0.255]
Family-Owned Businesses	-0.083	0.319	0.078	0.001	-0.383
	[0.235]	[0.228]	[0.228]	[0.230]	[0.234]

Businesses Led by a Female	-0.182	-0.128	-0.678**	0.163	-0.064
	[0.289]	[0.279]	[0.298]	[0.280]	[0.279]
Businesses Led by a Male	-0.180	0.408	0.485*	0.005	-0.108
	[0.266]	[0.256]	[0.267]	[0.257]	[0.261]
Executive Founders	-0.022	0.049	-0.179	0.211	0.224
	[0.245]	[0.230]	[0.242]	[0.244]	[0.244]
Capability for Expansion	1.425***	0.289	0.220	0.316	0.637**
	[0.315]	[0.293]	[0.299]	[0.303]	[0.296]
R&D	0.299	-0.227	0.391	0.700**	0.217
	[0.290]	[0.291]	[0.283]	[0.281]	[0.292]
Formal IP Protection Rights	-0.298	0.009	-0.179	0.201	0.916***
	[0.270]	[0.258]	[0.262]	[0.265]	[0.273]
Formal Training	0.440*	0.582**	0.161	-0.054	0.236
	[0.250]	[0.261]	[0.252]	[0.256]	[0.252]
Competition	0.704***	0.702***	0.429*	0.796***	0.815***
	[0.227]	[0.226]	[0.226]	[0.226]	[0.225]
Access to New Exports Market	0.283	-0.318	0.407	-0.226	-0.017
	[0.522]	[0.481]	[0.490]	[0.485]	[0.491]
Access to External Finance	-0.123	0.029	-0.123	-0.174	-0.277
	[0.263]	[0.246]	[0.257]	[0.252]	[0.257]
Access to ICT	0.202	0.381	0.135	0.527**	0.068
	[0.260]	[0.248]	[0.256]	[0.255]	[0.257]
Access to Skilled Labour Market	-0.276	-0.131	-0.229	-0.046	-0.238
	[0.258]	[0.245]	[0.248]	[0.244]	[0.249]
Access to Unskilled Labour Market	-0.030	0.248	-0.288	-0.217	-0.086
	[0.286]	[0.275]	[0.281]	[0.287]	[0.282]
Access to Local Business Networks	0.569**	0.441*	0.165	0.471**	0.926***
	[0.236]	[0.229]	[0.230]	[0.227]	[0.231]
Access to Universities and Research Centre	0.270	-0.092	0.019	0.621**	0.273
	[0.275]	[0.257]	[0.265]	[0.257]	[0.276]
Access to Government Support	-0.187	0.672**	1.093***	0.082	0.269
	[0.339]	[0.338]	[0.332]	[0.318]	[0.350]
Constant	-1.925***	-1.196*	-0.982	-0.840	-0.239
	[0.671]	[0.706]	[0.649]	[0.622]	[0.592]
Observations	200	200	200	200	200
Log likelihood	-93.67	-101.4	-98.45	-98.90	-97.16
LR Chi2	88.65	71.03	75.22	70.58	82.86
pseudo r-squared	0.321	0.259	0.276	0.263	0.299

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Secondly, the LOGIT estimator, which is one of the common estimators for binary choices models, is used. It is easier to interoperate its results than those that are generated by the probit estimator. Both PROBIT and LOGIT estimators give the same result, preference of the method depends on the researcher's choice, but logit as a regressor is mostly preferred.

Table 6. 2 Logit Estimator on Innovations in Omani SMEs in the 2010s

VARIABLES	(1) Products Innovation	(2) Services Innovation	(3) Operational Processes Innovation	(4) Organisational or Managerial Processes Innovation	(5) Marketing Methods Innovation
Firm Size	1.955	4.322*	3.581	0.217	-0.483
	[2.188]	[2.534]	[2.250]	[2.108]	[1.902]
Firm Size Squared	-0.910	-2.156*	-1.998*	0.263	0.483
	[1.005]	[1.141]	[1.030]	[0.963]	[0.889]
Exports	0.454	0.850	0.042	0.565	0.529
	[0.784]	[0.702]	[0.780]	[0.742]	[0.721]
Sites/Branches/Subsidiaries	0.324	-2.104*	-1.746*	-1.742*	-0.986
	[0.920]	[1.268]	[1.028]	[1.017]	[0.909]
Updated Equipments and High Technology	0.271	0.781**	1.546***	-0.376	-0.256
	[0.427]	[0.394]	[0.439]	[0.409]	[0.413]
High Quality Branded Product	-0.261	-0.813	-0.519	-1.420**	-0.683
	[0.534]	[0.512]	[0.547]	[0.577]	[0.527]
Firm Age	0.184	0.336	-0.380	-0.044	-0.773
	[0.573]	[0.547]	[0.552]	[0.569]	[0.574]
Firm Age Squared	-0.046	-0.155	0.161	0.087	0.224
	[0.188]	[0.177]	[0.178]	[0.182]	[0.189]
Location	0.233	0.444	0.810*	-0.146	-0.267
	[0.465]	[0.431]	[0.448]	[0.436]	[0.440]
Family-Owned Businesses	-0.128	0.515	0.161	0.033	-0.641
	[0.406]	[0.384]	[0.387]	[0.393]	[0.405]
Businesses Led by a Female	-0.384	-0.173	-1.097**	0.302	-0.123
	[0.505]	[0.471]	[0.504]	[0.470]	[0.471]
Businesses Led by a Male	-0.270	0.697	0.860*	0.023	-0.207
	[0.459]	[0.436]	[0.456]	[0.439]	[0.439]
Executive Founders	-0.053	0.073	-0.260	0.396	0.386
	[0.429]	[0.389]	[0.410]	[0.419]	[0.416]
Capability for Expansion	2.462***	0.515	0.309	0.621	1.069**
	[0.559]	[0.493]	[0.520]	[0.522]	[0.510]
R&D	0.443	-0.409	0.656	1.153**	0.354
	[0.489]	[0.509]	[0.484]	[0.484]	[0.499]
Formal IP Protection Rights	-0.542	-0.057	-0.343	0.407	1.540***
	[0.471]	[0.445]	[0.449]	[0.460]	[0.471]
Formal Training	0.802*	0.940**	0.275	-0.119	0.403
	[0.442]	[0.443]	[0.425]	[0.436]	[0.427]
Competition	1.216***	1.233***	0.784**	1.343***	1.367***
	[0.391]	[0.388]	[0.391]	[0.391]	[0.387]
Access to New Exports Market	0.473	-0.457	0.679	-0.327	-0.017
	[0.874]	[0.796]	[0.854]	[0.823]	[0.806]
Access to External Finance	-0.200	0.032	-0.218	-0.284	-0.437
	[0.443]	[0.416]	[0.439]	[0.430]	[0.440]
Access to ICT	0.346	0.618	0.217	0.922**	0.083
	[0.446]	[0.417]	[0.437]	[0.450]	[0.439]
Access to Skilled Labour Market	-0.531	-0.236	-0.390	-0.072	-0.420

	[0.437]	[0.416]	[0.417]	[0.418]	[0.427]
Access to Unskilled Labour Market	-0.002	0.489	-0.533	-0.388	-0.164
	[0.489]	[0.477]	[0.487]	[0.495]	[0.479]
Access to Local Business Networks	0.999**	0.725*	0.264	0.775**	1.531***
	[0.411]	[0.394]	[0.390]	[0.388]	[0.393]
Access to Universities and Research Centre	0.460	-0.091	0.018	1.073**	0.453
	[0.469]	[0.440]	[0.448]	[0.444]	[0.474]
Access to Government Support	-0.315	1.234**	1.907***	0.030	0.472
	[0.599]	[0.603]	[0.586]	[0.542]	[0.597]
Constant	-3.223***	-2.037*	-1.647	-1.477	-0.427
	[1.156]	[1.168]	[1.139]	[1.029]	[0.970]
Observations	200	200	200	200	200
Log likelihood	-93.68	-101.1	-98.24	-98.96	-97.58
LR Chi2	88.61	71.76	75.64	70.44	82.02
pseudo r-squared	0.321	0.262	0.278	0.262	0.296

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Thirdly, since one form of innovation may lead to the generation of another type(s) of innovation(s), perhaps nonlinear relationship may exist. Also, the firm may introduce more than one type of innovations at a time. To avoid misspecification bias issues that may result from ignoring such assumptions, I agree with Shangqin Hong, Les Oxley, Philip McCann and Trinh Le (2016) that it is perhaps inappropriate to assume independence between various innovation variables whereas there is a correlation between various innovation outcomes. Therefore, the MVPROBIT estimator is used to estimate the five innovation models at the firm level in one shot, as illustrated in table 6.3. This table also presents a moderate correlation between different innovation outcomes value ranging from 0.283 to 0.528 at the firm level.

Table 6. 3 MVPROBIT Estimator on Innovations in Omani SMEs in the 2010s

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	1.150	2.568*	2.103	-0.605	-0.270
	[1.360]	[1.547]	[1.287]	[1.185]	[1.151]
Firm Size Squared	-0.509	-1.270*	-1.141*	0.472	0.282
	[0.618]	[0.693]	[0.589]	[0.544]	[0.535]
Exports	0.181	0.570	0.039	0.570	0.326
	[0.485]	[0.410]	[0.439]	[0.426]	[0.442]
Sites/Branches/Subsidiaries	0.249	-1.039	-0.977*	-0.616	-0.640

	[0.541]	[0.804]	[0.576]	[0.532]	[0.563]
Updated Equipments and High Technology	0.271	0.431*	0.952***	-0.109	-0.179
	[0.249]	[0.231]	[0.256]	[0.234]	[0.242]
High Quality Branded Product	-0.142	-0.414	-0.168	-0.710**	-0.403
	[0.309]	[0.300]	[0.314]	[0.313]	[0.307]
Firm Age	0.066	0.219	-0.237	-0.089	-0.443
	[0.337]	[0.321]	[0.326]	[0.319]	[0.339]
Firm Age Squared	-0.010	-0.107	0.096	0.065	0.131
	[0.111]	[0.102]	[0.105]	[0.101]	[0.112]
Location	0.168	0.250	0.531**	-0.091	-0.169
	[0.271]	[0.254]	[0.262]	[0.245]	[0.255]
Family-Owned Businesses	-0.063	0.293	0.033	-0.002	-0.383
	[0.234]	[0.230]	[0.226]	[0.233]	[0.234]
Businesses Led by a Female	-0.175	-0.146	-0.695**	0.146	-0.064
	[0.289]	[0.276]	[0.299]	[0.273]	[0.279]
Businesses Led by a Male	-0.193	0.386	0.484*	-0.024	-0.108
	[0.265]	[0.259]	[0.264]	[0.256]	[0.261]
Executive Founders	0.019	0.011	-0.122	0.263	0.224
	[0.247]	[0.233]	[0.244]	[0.249]	[0.244]
Capability for Expansion	1.416***	0.237	0.172	0.142	0.637**
	[0.313]	[0.289]	[0.298]	[0.297]	[0.296]
R&D	0.343	-0.107	0.510*	0.807***	0.217
	[0.286]	[0.292]	[0.279]	[0.286]	[0.292]
Formal IP Protection Rights	-0.307	-0.028	-0.160	0.189	0.916***
	[0.268]	[0.260]	[0.258]	[0.256]	[0.273]
Formal Training	0.404	0.489*	0.200	-0.010	0.236
	[0.248]	[0.255]	[0.251]	[0.261]	[0.252]
Competition	0.672***	0.696***	0.382*	0.814***	0.815***
	[0.226]	[0.227]	[0.227]	[0.219]	[0.225]
Access to New Exports Market	0.351	-0.411	0.233	-0.382	-0.017
	[0.528]	[0.464]	[0.473]	[0.498]	[0.491]
Access to External Finance	-0.166	0.009	-0.237	-0.206	-0.277
	[0.262]	[0.243]	[0.259]	[0.252]	[0.257]
Access to ICT	0.152	0.380	0.109	0.395	0.068
	[0.262]	[0.252]	[0.261]	[0.254]	[0.257]
Access to Skilled Labour Market	-0.313	-0.124	-0.172	-0.068	-0.238
	[0.259]	[0.249]	[0.249]	[0.243]	[0.249]
Access to Unskilled Labour Market	-0.078	0.269	-0.381	-0.145	-0.086
	[0.289]	[0.277]	[0.283]	[0.295]	[0.282]
Access to Local Business Networks	0.547**	0.470**	0.189	0.484**	0.926***
	[0.232]	[0.228]	[0.228]	[0.227]	[0.231]
Access to Universities and Research Centre	0.313	-0.134	-0.063	0.561**	0.273
	[0.276]	[0.261]	[0.267]	[0.252]	[0.276]
Access to Government Support	-0.289	0.656*	1.098***	0.209	0.269
	[0.338]	[0.336]	[0.325]	[0.318]	[0.350]
Constant	-1.962***	-1.332*	-1.079	-0.860	-0.239
	[0.709]	[0.758]	[0.668]	[0.635]	[0.592]
Observations	200	200	200	200	200

rho21	rho31	rho41	rho51	rho32
0.502***	0.283**	0.467***	0.136	0.525***
[0.151]	[0.128]	[0.143]	[0.161]	[0.182]
rho42	rho52	rho43	rho53	rho54
0.390**	0.360**	0.805***	-0.004	0.528***
[0.161]	[0.142]	[0.183]	[0.136]	[0.149]

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

6.3 Research Analysis and Discussion

Table 6.4 of the multivariate probit at the firm level showed that there are correlations between the innovation outcomes. The positive and statistically significant test statistics give the MVPROBIT model superiority over the Probit and Logit estimators. The results and conclusions are as follows:

Who are the Product Innovators?

According to the MVPROBIT estimator, the product innovators at the firm level are not directly influenced by any of the thirteen firm characteristics included in the model. However, they are affected by one firm behaviour elements out of four total variables included in the model. These are the *'capability for expansion'* which is positive and statistically significant at 1%. Moreover, they are influenced by two business environment factors out of nine total variables included in the model. These are the *'monopolistic competition'* and the *'access to business networks'* which are both positive and statistically significant at 1% and 5% respectively.

The results indicate that the product innovators in Oman are the SMEs that can expand their products and services. They also work in a market of monopolistic competition where they enjoy a certain degree of power and strong business networks.

Who are the Service Innovators?

The service innovators at the firm level are affected by three out of thirteen firm characteristics. The *'firm size'* and the *'updated equipment and high technology'* are positive and statistically significant at 10%. The *'firm size squared'* is negative and statistically

significant, at 10%. They are also influenced by one out of four firm behaviour elements. It is the *'formal training'* which is positive and statistically significant at 10%.

The service innovators at the firm level are influenced by three out of nine business environment variables. The *'monopolistic competition'*, the *'access to local business networks'* and the *'access to government support'* which are both positive and significant at 1%, 5% and 10% respectively.

According to the findings, the service innovators are most likely to be the medium-sized Omani firms with a lesser effect on services innovation as they become larger. Therefore, they focus on conducting formal training to their employees on a periodical basis. They also invest in updated equipment and high technology. They operate in a competitive market and have strong local business networks. They are most likely to be supported by the government.

Who are the Operational Process Innovators?

The operational process innovators at the firm level are affected by six out of thirteen firm characteristics elements. The *'updated equipment and high technology'*, the *'location'* and the *'businesses led by male'* which are positive and significant at 1%, 5% and 10% respectively. Besides, the *'firm size squared'* and the access to resources of *'sites/branches/subsidiaries'* which are negative and statistically significant at 10% whereas the *'access to businesses led by a female'* is negative and statistically significant at 5%.

They are influenced by one out of four firm behaviour variables: the *'R&D'* which is positive and statistically significant at 10%.

They are also impacted by two out of nine business environment factors. The *'monopolistic competition'* and the *'access to government support'* which are positive and statistically significant at 10% and 1% respectively.

The results show that the operational processes innovators are more likely to be the medium-sized Omani SMEs. They are mainly male-led businesses, as they are less likely to have female managers. They are more likely to be located in the urban area but are less likely to have access to branches or subsidiary resources. They operate in a competitive business

environment and are supported by the government. They differentiate themselves by investing in R&D, updated equipment and new technology.

Who are the Organisational or Managerial Innovators?

The organisational or managerial innovators at the firm level are influenced by one out of thirteen firm characteristics. It is the *'high quality branded products'* which is negative and statistically significant at 5%.

They are affected by only one out of four firm behaviour variables. It is the *'R&D'* which is positive and statistically significant at 1%.

They are influenced by three out of nine business environment factors. These are the *'access to local business networks'* and the *'access to universities research centres'* which are both positive and significant at 5% as well as the *'monopolistic competition'* which is positive and statistically significant at 1%.

The organisational or managerial process innovators are the Omani SMEs that operate in a monopolistic market. They are less likely to produce branded products. They focus on the internal and the external R&D as they have good connections with the universities and the research centres as well as strong local business networks.

Who are the Marketing Methods Innovators?

The marketing methods innovators at the firm level are not directly affected by any of the thirteen firm characteristics included in the innovation models. However, they are influenced by two out of four firm behaviour elements. These are the *'capability for expansion'* and the '*formal intellectual property protection rights'* which are positive and statistically significant at 5% and 1% respectively.

They are also impacted by two out of nine business environment variables. The *'monopolistic competition'* and the *'access to local business networks'* which are positive and statistically significant at 1%.

The marketing methods innovators are more likely to be the Omani SMEs that are trademarks and operate in a monopolistic competition. They can expand by utilising their strong business networks.

The results of the four estimators on the innovation outcomes at the firm level: PROBIT, LOGIT and the MVPROBIT are compared with e results of the previous chapters on the British SMEs in the 1990s and the 2010s as follows.

Summary 6. 1 Comparison of Impact of FCs on Innovations by Estimators

Variables	**PROBIT**	**LOGIT**	**MVPROBIT**
Firm Size	(+) * on Services and Operational Innovations	(+) * on Services Innovation	(+) * on Services Innovation
Firm Size Squared	(-) ** on Services and Operational Innovations	(-) * on Services and Operational Innovations	(-) * on Services and Operational Innovations
Exports	Insignificant	Insignificant	Insignificant
Sites/Branches/Subsidiaries	(-) * on Services, Operational and Organisational Innovations	(-) * on Services, Operational and Organisational Innovations	(-) * on Operational Innovation
Updated Equipments and High Technology	(+) *** on Operational Innovation and (+) * on Services Innovation	(+) *** on Operational Innovation and (+) ** on Services Innovation	(+) *** on Operational Innovation and (+) * on Services Innovation
High Quality Branded Product	(-) ** on Organisational Innovation	(-) ** on Organisational Innovation	(-) ** on Organisational Innovation
Family-Owned Businesses	Insignificant	Insignificant	Insignificant
Firm Age	Insignificant	Insignificant	Insignificant
Firm Age Squared	Insignificant	Insignificant	Insignificant
Location	(+) * on Operational Innovation	(+) * on Operational Innovation	(+) ** on Operational Innovation

Businesses Led by a Female	(-) ** on Operational Innovation	(-) ** on Operational Innovation	(-) ** on Operational Innovation
Businesses Led by a Male	(+) * on Operational Innovation	(+) * on Operational Innovation	(+) * on Operational Innovation
Executive Founders	Insignificant	Insignificant	Insignificant

Firm Characteristics

There are thirteen firm characteristics elements in each innovation model, as shown in summary 6.1. It shows that the *'exports'*, the *'family-owned businesses'*, the *'firm age'*, the *'firm age squared'* and the *'executive founders'* are insignificant with all of the four estimators. *indicates that it does not matter for the Omani SMEs to have exports and executive founders on board to innovate. Also, the firm age does not matter for the Omani SMEs to innovate. Moreover, being a family-owned business does not impact innovation decisions and choices at the firm level in Oman.*

Besides, the *'Sites/branches/subsidiaries'* is negative on services, operational processes and organisational or managerial processes innovations with the probit and logit estimators and negative only on operational processes innovation with MVPROBIT estimator. *It implies that Omani SMEs that have several sites or branches or have access to subsidiary resources are less likely to innovate their services and processes.*

The rest of the firm characteristics have the same effect on the different types of innovation using the four estimators. They are discussed in details in summary 6.2 that compares the results of estimating the firm characteristics on innovation outcomes using the MVPROBIT estimator. It lists the results of the Omani SMEs in the 2010s, the British SMEs in the 2010s and the British SMEs in the 1990s for comparison.

The results show that the *'medium-sized'* Omani firms innovate their services and operational processes, whereas the *'small and medium-sized'* British firms in the 1990s innovated their services only. The 'medium-sized' British firms in the 2010s tend to innovate their

operational and organisational processes as well as their marketing methods. The *'smaller'* British firms in the 2010s innovate their products, services and marketing methods. *It implies that in general small and medium-sized firms are services and marketing methods innovators. As firms grow in size, they become more concern about operational and organisational or managerial processes innovations. Whereas the smaller firms are the product innovators* as Langlois (2003), concluded that entrepreneurs bring innovations to life. *In short, the smaller firms innovate radically whereas; the larger firms innovate incrementally.*

The *'sites/branches/subsidiaries'* has an insignificant effect on innovation with the British SMEs in the 2010s, but they had a positive effect on services and marketing methods innovations with the British SMEs in 1990s. However, they have a negative effect on the operational processes' innovation with both the Omani SMEs and the British SMEs in the 1990s. *It implies that the SMEs that have multiple sites and branches across the country and subsidiaries abroad may prefer to use standardised operational processes and may prefer to innovate the services and marketing methods to meet the diverse market demands and tastes in different locations.* As Leiponen (2006) argued that organisational structure is an element of business makeup where a firm could be a single-location firm or a subsidiary of another firm or a headquarter or a branch establishment in which innovation get effected according to how the firm is receptive to knowledge transfer and spillovers

The results show that the Omani SMEs which use the *'updated equipment and high technology'* tend to innovate their services and operational processes. Also, the British SMEs in the 1990s that used updated equipment and technology innovated their operational and organisational processes. The British firms in the 2010s that use advanced technology and equipment have become a full-fledged innovator as they innovate all the five different types of innovation. *It implies that as SMEs adapt to major changes in technology and advanced equipment, the higher the tendency to become a fully-fledged innovator.* As Santamaria, Nieto, and Barge-Gil (2009) suggested that the use of advanced technology, machinery and updated equipment such as robots and automatic machines is positively affecting the innovation at the firm level.

The results show that the *'high quality branded products'* has a negative impact on organisational or managerial processes innovation in the Omani SMEs, but it has a positive influence on all types of innovations with the British SMEs in the 1990s. This variable was not available in the BIS dataset, but the existing literature supports whether the impact is positive or negative on innovation. *It indicates that the Omani SMEs that branded their products are less likely to innovate their processes since they already have a sustainable competitive advantage resulted from differentiating their products and services through branding which is, in this case, a substitute for innovation.* According to the World Intellectual Property Report (2011), firms use branding as a strategy to control and manage consumers' perception of their products and image. In many cases, branding creates a sustainable competitive advantage for firms. The firm that invests in branding also invests in innovation. So, a complementary relationship exists between branding and innovation. Also, sometimes, firms face a choice between either branding or innovating. Branding complements innovation. *Therefore, the effect of branding on innovation depends on the relationship type between branding and innovation. The effect is positive when a complementary relationship exists, and it is negative when a substitution relationship exists.*

Summary 6. 2 Impact of FCs on Innovations for Omani and British SMEs

1. Firm Characteristics			
Variables	**Omani SMEs in the 2010s**	**British SMEs in the 2010s**	**British SMEs in the 1990s**
Firm Size	(+) * on Services Innovation	(+) *** on Operational Innovation and Organisational Innovation (-) ** on Products Innovation, (-) *** on Services Innovation and Marketing Methods Innovation	(-) *** on Services Innovation
Firm Size Squared	(-) * on Services and Operational Innovations	(+) *** on Marketing Methods Innovation (-) *** on Operational Innovation and Organisational Innovation	(+) *** on Services Innovation
Exports	Insignificant	(+) *** on Products Innovation and Operational Innovation	(+) ** on Marketing Methods Innovation

		(-) *** on Organisational or Managerial Innovation	
Sites/Branches/Subsidiaries	(-) * on Operational Innovation	Insignificant	(+) * on Services Innovation and (+) ** on Marketing Methods Innovation (-) ** on Operational Innovation
Updated Equipments and High Technology	(+) *** on Operational Innovation and (+) * on Services Innovation	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Operational Innovation and Organisational Innovation
High Quality Branded Product	(-) ** on Organisational Innovation	Not Available	(+) *** on Products, Operational Processes, Organisational or Managerial Processes and Marketing Methods Innovations
Family-Owned Businesses	Insignificant	(+) *** on Products Innovation and Marketing Methods Innovation (-) *** on Organisational or Managerial Innovation	(+) *** on Innovation Outcomes
Firm Age	Insignificant	(+) *** on Services and Operational Innovations	(-) ** on Services Innovation
Firm Age Squared	Insignificant	(+) * on Marketing Methods Innovation (-) *** on Services and Operational Processes Innovations	(-) * on Services Innovation
Location	(+) ** on Operational Innovation	(-) *** on Products Innovation	Insignificant
Businesses Led by a Female	(-) ** on Operational Innovation	(+) *** on Organisational or Managerial Processes Innovation	Insignificant

		(-) *** on Products Innovation and (-) ** on Marketing Methods Innovation	
Businesses Led by a Male	(+) * on Operational Innovation	(+) *** on Marketing Methods Innovation and (+) ** on Organisational Innovation (-) ** on Products Innovation	Insignificant
Executive Founders	Insignificant	(+) *** on Operational Innovation (-) *** on Marketing Methods Innovation and Organisational Innovation	Insignificant

Furthermore, the *'firm location'* has a positive effect on operational processes innovation with the Omani SMEs, but it is negative on products innovation with the British SMEs in the 1990s and the 2010s. *It may imply that the Omani SMEs that are located in urban areas innovate more of their operational processes. It may be due to the existence of facilities and a healthier business environment in urban areas than in rural areas. However, the British SMEs are less likely to innovate their products when they are located in urban areas as* firms in manufacturing or production sectors *may be* obliged to manufacture products in the industrial areas which are usually situated in rural and remote areas to avoid pollution near the residential areas. As Brouwer, Budil-Nadvornikova, and Kleinknecht (1999) suggested that the unique specification of the location directly or indirectly influence the firm's innovation as firms in the urban agglomerations tend to invest more in the R&D activities in product development compared to the firms situated in the rural areas as Audretsch (2003), Sedgley and Elmslie (2004), Herrera, Munoz-Doyague, and Nieto (2010) found that agglomeration has a positive impact on innovation when regarding the human capital, the R&D and the high technology sector as control variables. Bell (2005) found that clusters produce more innovation than remote firms.

The *'businesses led by a female'* in Oman are less likely to innovate their operational processes, whereas the '*businesses led by male'* are more likely to innovate their operational

processes. Both the businesses led by a female and the businesses led by the male are insignificant with the British SMEs in the 1990s. Both the businesses led by a female and the businesses led by a male with the British SMEs in the 2010s are more likely to innovate their organisational or managerial processes and are less likely to innovate their products. However, they also behave differently as businesses led by the female with the British SMEs in the 2010s tend to innovate their marketing methods whereas businesses led by a male with the British SMEs in the 2010s are less likely to their marketing methods. *It may imply that there are no huge differences between businesses led by a male or female in terms of organisational or managerial processes and products innovations. However, the businesses led by the male are more innovative than businesses led by the female in operational processes and marketing methods as Kalleberg and Leicht (2001) found no difference between male and female business owners when taking into consideration the introduction of new products, new organisational structures and other forms of innovation. However, when innovation is measured using hard indicators such as patenting activity and research and development expenses, the male-owned firms outperform the female-owned firms.*

The summary 6.2 also shows that five out of thirteen total firms characteristics included in the innovation models are insignificant. These are the exports, the firm age; the family-owned businesses and the executive founders.

Although the *'exports'* has an insignificant effect on innovation in the Omani SMEs, it is positive on products and operational processes innovation with the British SMEs in the 2010s and positive on marketing methods innovation with the British SMEs in the 1990s. However, it has a negative effect on organisational or managerial processes with the British SMEs in the 2010s. *It implies that the British SMEs which export their products and services usually are more likely to innovate their products and processes that are manufacturing or production-oriented rather than innovating managerial or organisational processes a*s Lin and Chen (2007) found that the firms that export their products tend to be innovative.

The *'firm Age'* is insignificant with the Omani SMEs. *It implies that the firm age does not matter in the Omani SMEs' decision to whether innovate or not.* The results also show that the *'mid-aged'* British SMEs in the 2010s innovate their services, operational processes and marketing methods whereas the 'younger' British SMEs in the 1990s innovated only their

services. *It may imply that the younger British SMEs in the 1990s that innovated their services are now more innovative as they also innovate their organisational or managerial processes and marketing methods.*

The results show that the *'family-owned businesses'* in Oman has an insignificant effect on innovation outcomes, whereas it is positive on all the different types of innovation with the British SMEs in the 1990s. Also, results show that the 'family-owned businesses' by the British in the 2010s are more likely to innovate their marketing methods and less likely to innovate their organisational and operational processes. *It may imply that the family-owned businesses in the UK are less innovative now than they used to be in the 1990s. It may be due to the existence of the organisational and cultural rigidities with the older family-owned businesses. Besides, the younger family-owned business may be more vulnerable to the dynamic changes in the business environment than the older ones as found by* Laforet (2013).

The 'executive founders' is insignificant on all five types of innovations with the Omani SMEs and the British SMEs in the 1990s. *However, the British SMEs in the 2010s that have executive founders on their board tend to more likely innovate their operational processes and less likely to innovate their organisational and marketing methods. The effect varies depending on the level of commitment extended by the executive founders on introducing different types of innovation at the firm level as found by Hong, Oxley, McCann and Le (2016). Therefore, the positive effect on operational processes innovation reflects the higher commitment in introducing new significant changes in this area by the executive founders. Also, the lack of commitment from their end reflects the negative effect on marketing methods and organisational or managerial processes innovations*.

To sum up, four key firm characteristics impact some of the innovation outcomes in the Omani SMEs. These are the *'firm size'*, the *'updated equipment and high technology'*, the *'location'*, and the *'businesses led by male'*. The first two firm characteristics positively influence the services and operational processes innovations, whereas the latter two influence only the operational processes innovation. Moreover, the roles of the exports, the access to sites/branches/subsidiaries, the family-owned businesses, the businesses led by a female and the executive founders need to be activated and find out ways for boosting the innovation at the firm level in the Omani SMEs.

The summary 6.3 shows the effect of firm behaviour elements on innovation outcomes. The results are almost the same using the four estimators, especially with *the 'formal intellectual property protection rights*' which has a positive impact on marketing methods using all the four estimators. However, there are few small variations in the effect of the rest variables as follows.

The *'capability for expansion'* has a positive influence on products and marketing methods innovations using the three estimators. The *'R&D'* has a positive impact on organisational or managerial processes and operational processes innovations using the MVPROBIT estimator and has only a positive effect on the organisational or managerial processes innovation using the rest of estimators. The *'formal training'* has a positive effect on services innovation only using the MVPROBIT estimator and has a positive impact on services and products innovations using LOGIT and PROBIT estimators.

Summary 6. 3 Comparison of Impact of FBs on Innovations by Estimators

Variables	**PROBIT**	**LOGIT**	**MVPROBIT**
Capability for Expansion	(+) *** on Products Innovation and (+) ** on Marketing Methods Innovation	(+) *** on Products Innovation and (+) ** on Marketing Methods Innovation	(+) *** on Products Innovation and (+) ** on Marketing Methods Innovation
R&D	(+) ** on Organisational Innovation	(+) ** on Organisational Innovation	(+) *** on Organisational Innovation and (+) * on Operational Innovation
Formal IP Protection Rights	(+) *** on Marketing Methods Innovation	(+) *** on Marketing Methods Innovation	(+) *** on Marketing Methods Innovation
Formal Training	(+) ** on Services Innovation and (+) * on Products Innovation	(+) ** on Services Innovation and (+) * on Products Innovation	(+) * on Services Innovation

The summary 6.4 presents the results of estimating the firm behaviour elements on the innovation outcomes using the MVPROBIT estimator. It compares the results of the Omani SMEs in the 2010s with the British SMEs in the 2010s and the British SMEs in the 1990s.

Summary 6. 4 Impact of FBs on Innovations for Omani and British SMEs

2. Firm Behaviour			
Variables	**Omani SMEs in the 2010s**	**British SMEs in the 2010s**	**British SMEs in the 1990s**
Capability for Expansion	(+) *** on Products Innovation and (+) ** on Marketing Methods Innovation	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) *** on Services Innovation (-) *** on Operational Innovation
R&D	(+) *** on Organisational Innovation and (+) * on Operational Innovation	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(+) * on Products Innovation, (+) ** on Services Innovation
Formal IP Protection Rights	(+) *** on Marketing Methods Innovation	Insignificant	(+) * on Products Innovation (-) * on Services Innovation and Marketing Methods Innovation, (-) *** on Organisational Innovation
Formal Training	(+) * on Services Innovation	(+) *** on Services Innovation, Operational and Organisational Processes Innovations (-) *** on Marketing Methods Innovation	(+) *** on Services Innovation and (+) ** on Marketing Methods Innovation (-) * on Products Innovation

Firstly, the Omani SMEs that have the *'capability for expansion'* innovate their products and marketing methods. The British SMEs in the 1990s used to innovate their services, but not their operational processes perhaps because they had high costs of expansion and earlier innovation; hence they were less likely to incur extra costs for additional innovations. However, the British SMEs in the 2010s that can expand to innovate all the five different types of innovation. *It may imply that the British SMEs operate now in a much healthier and competitive business environment where innovations are important for survival and growth. Also, more government support is extended to them as well as higher collaborations with*

business networks and research centres. As Santamaria, Nieto, and Barge-Gil (2009) argued that effect of expansion in terms of products and expertise is positive on innovation outcomes as it is easier for expanding firms to develop and adopt new technologies that will improve their activities and processes.

Secondly, the Omani SMEs that involve in the *'R&D'* activities tend to innovate only their organisational and operational processes whereas the British SMEs in the 1990s that invested in the R&D activities innovated only their products and services. Now, the British SMEs that invest in the R&D innovate all the five types of innovations. *It may imply that as the SMEs become mature and put more efforts in investing in R&D activities and in collaborating with the external R&D centres whether private or public, the innovation spectrum is widening according to the maturity of market's sectors* as many researchers regarded R&D as the most important driver of innovation, particularly in the context of the SMEs. Choi, Y. and Lim, U. (2017) found that SMEs' innovation capacity related to R&D activities is positively associated with their innovation performance.

Thirdly, the *'formal intellectual property protection rights'* has a positive impact on marketing methods innovation with the Omani SMEs. It has an insignificant effect on innovation with the British SMEs in the 2010s that have acquired formal intellectual property protection rights. However, this was not the case with the British SMEs in the 1990s as the effect of the FIPPRs was positive on product innovation and negative on services and organisational or managerial processes and marketing methods innovations. *It may imply that Omani SMEs that have acquired FIPPRs such as patents and trademarks are more likely to innovate their marketing methods. Also, since the British SMEs in the 1990s were products oriented, then it may imply that they have acquired more of patents to protect their business ideas and turn them into radical or incremental products innovations a*s Jong, and Hippel (2009) found that using various types of intellectual property protection such as patents and trademarks have a positive effect on innovation. *However, patents and trademarks may also have a negative effect on innovation as they may block the firm's resources to innovate another type of innovations. It may explain why the British SMEs in the 1990s were less likely to innovate their services, processes and marketing methods. Furthermore, sometimes, the effect of trademarks is insignificant because the trademarks are not innovation incentive;*

hence the effect of trademarks with the British SMEs in the 2010s is insignificant on all the different types of innovations.

Fourthly, the Omani SMEs that invest in the *'formal training'* are more likely to innovate their services. The British SMEs in the 2010s that conduct formal training are more likely to innovate their services and processes regardless of whether they are operational or organisational. Also, the British SMEs in the 1990s that behaved the same innovated their services and marketing methods. *However, the British SMEs in the 2010s are less likely to innovate their marketing methods if they invest in the formal training perhaps due to the high training costs and maybe the some of the British SMEs consider training their employees and other stakeholders as a substitute for the marketing methods innovation. It is not the case with the British SMEs in the 1990s as their investment in formal training made them less likely to innovate their products. It may be due to the staff turn over to open their new businesses or to join competitors in which they take advantage of shared knowledge and commercialise the new business idea to a product that outperform the existing products in the original firm.* Frenz and Ietto-Gillies (2009) suggested that the knowledge transfer between each unit is likely to affect the innovation in the firm.

To sum up, there are four key firm behaviour element that impacts innovation at the firm level in the Omani SMEs. The *'capability for expansion'* positively influences the product and marketing methods innovations. The *'R&D'* positively affects the operational and organisational or managerial processes innovations. The *'FIPPR'* positively impacts the marketing methods innovation, and the *'formal training'* positively influences the services innovation.

Business Environment

The summary 6.5 shows the effect of business environment factors on different types of innovations. The results are almost the same using the three estimators except in one case where the effect of the *'access to ICT'* on the innovation outcomes is insignificant using the MVPROBIT estimator whereas it has a positive effect on the organisational or managerial innovation using the rest of the estimators.

The results also show that four of the business environment factors are insignificant. These are the *'access to new exports markets'*, the *'access to external finance'*, the *'access to skilled labour market'* and the *'access to unskilled labour market'*. *It may imply that these variables do not affect the Omani SMEs choice to innovate different types of innovations at the firm level. However, as the market becomes more mature and competitive with the industrial sectors, they may become supportive to innovation in the future as shown in the previous chapter with the British SMEs in the 2010s and as supported by the literature.*

Summary 6. 5 Comparison of Impact of BEs on Innovations by Estimators

Variables	**PROBIT**	**LOGIT**	**MVPROBIT**
Competition	(+) *** on Products, Services, Organisational and Marketing Methods Innovations, (+) * on Operational Innovation	(+) *** on Products, Services, Organisational and Marketing Methods Innovations, (+) ** on Operational Innovation	(+) *** on Products, Services, Organisational and Marketing Methods Innovations, (+) * on Operational Innovation
Access to New Exports Market	Insignificant	Insignificant	Insignificant
Access to External Finance	Insignificant	Insignificant	Insignificant
Access to ICT	(+) ** on Organisational Innovation	(+) ** on Organisational Innovation	Insignificant
Access to Skilled Labour Market	Insignificant	Insignificant	Insignificant
Access to Unskilled Labour Market	Insignificant	Insignificant	Insignificant
Access to Local Business Networks	(+) *** on Marketing Methods Innovation, (+) ** on Products	(+) *** on Marketing Methods Innovation, (+) ** on Products	(+) *** on Marketing Methods Innovation, (+) ** on Products,

	and Organisational Innovations, (+) * on Services	and Organisational Innovations, (+) * on Services Innovation	Services and Organisational Innovations
Access to Universities and Research Centre	(+) ** on Organisational Innovation	(+) ** on Organisational Innovation	(+) ** on Organisational Innovation
Access to Government Support	(+) *** on Operational Innovation and (+) ** on Services Innovation	(+) *** on Operational Innovation and (+) ** on Services Innovation	(+) *** on Operational Innovation and (+) * on Services Innovation

The summary 6.6 compares the results of the impact of business environment variables on different types of innovations in Omanis SMEs with those of the British SMEs in the 2010s and the British SMEs in the 1990s. The results are similar except that four business environment factors are insignificant with the Omani SMEs- access to proper external finance, new exports markets, skilled and unskilled labour markets- and the *'access to ICT'* that is also insignificant in this case since the MVPROBIT estimator is favoured. These variables may be insignificant due to the immature Omani market concerning such business environment factors. Moreover, the *'access to universities & research centre'* and the *'access to government support'* were insignificant with the British SMEs in the 1990s.

Summary 6. 6 Impact of BEs on Innovations for Omani and British SMEs

3. Business Environment			
Variables	**Omani SMEs in the 2010s**	**British SMEs in the 2010s**	**British SMEs in the 1990s**
Competition	(+) *** on Products, Services, Organisational and Marketing Methods Innovations, (+) * on Operational Innovation	(+) *** on Products, Services, Operational, Organisational and Marketing Methods Innovations	(-) * on Marketing Methods Innovation
Access to New Exports Market	Insignificant	(+) *** on Products Innovation, (+) ** on Operational Innovation and Organisational Innovation and (+) * on	(+) *** on Products Innovation, Services Innovation, Operational Innovation and Organisational Innovation

		Marketing Methods Innovation	
Access to External Finance	Insignificant	(+) *** on Organisational Innovation (-) *** on Services Innovation and (-) ** on Products Innovation	(+) ** on Operational Innovation
Access to ICT	Insignificant	(+) *** on Services, Organisational and Marketing Methods Innovations, (+) ** on Products and Operational Innovations	(+) *** on Services Innovation and Organisational Innovation (-) *** on Products Innovation
Access to Skilled Labour Market	Insignificant	(+) *** on Marketing Methods Innovation, (+) ** on Products and Organisational Innovations	(+) * on Products Innovation, (+) *** on Operational Innovation (-) *** on Services Innovation and (-) ** on Organisational Innovation
Access to Unskilled Labour Market	Insignificant	(+) *** on Services and Operational Innovations (-) *** on Marketing Methods Innovation	Insignificant
Access to Local Business Networks	(+) *** on Marketing Methods Innovation, (+) ** on Products, Services and Organisational Innovations	(+) *** on Products and Operational Innovations, (+) ** on Services Innovation	(+) *** on Products Innovation, (+) ** on Services Innovation and Marketing Methods Innovation, (+) * on Organisational Innovation
Access to Universities and Research Centre	(+) ** on Organisational Innovation	(+) *** on Products, Services, Operational and Organisational Processes Innovations	Insignificant
Access to Government Support	(+) *** on Operational Innovation and (+) * on Services Innovation	(+) *** on Products, Services, Operational and Organisational Processes Innovations	Insignificant

The business environment factors are compared between the Omani SMEs and the British SMEs as follows.

Firstly, the effect of the *'monopolistic competition'* is positive on all types of innovation with the Omani SMEs. The British SMEs that operated in a monopolistic competitive market started as operational processes innovators in the 1990s then they became a fully-fledged innovator as they innovated all the different types of innovations. *It indicates that the influence of the 'monopolistic competition' is always positive on different types of innovation and as the business environment reaches maturity, there are greater chances for the SMEs that possess a monopolistic power in the market to practice all types of innovations.* As Baumol (2002) suggested that the urge for survival and success due to competition motivates firms to innovate. Also, Schumpeter (1942) gave preference for the imperfectly competitive market over perfect competition and suggested that the monopolistic firms are more innovative than the other firms as they have some degree of market power. *It implies that both the Omani and the British SMEs that have the privilege to operate in a healthy competitive environment tend to innovate all different types of innovations.*

Secondly, the effect of the *'access to new exports markets'* on innovation in the Omani SMEs in the 2010s is insignificant. The British SMEs in the 1990s that had 'access to new exports markets' innovated all types of innovations except the marketing methods innovation. The British SMEs in the 2010s tend to innovate all the five different types of innovations. *On the one hand, this may suggest that the access to new exports markets does not influence the Omani SMEs to innovate currently as they still have more potential to sell in the local and regional market as the SMEs are still not mature or ready enough to explore and invest in new markets. Some of the Omani SMEs may also have limited production capacity and issues with the productivity and compliance to the international quality standards. On the other hand, this may also imply that the British SMEs now are having greater access to new exports markets than they used to have in the 1990s, which might drive the British SMEs in 2010s to innovate all the different types of innovations.* Golovko & Valentini (2011) concluded that participating in new exports markets can promote the firm's learning, and thus enhance the innovation.

Thirdly, the effect of *'access to external finance'* on innovation in the Omani SMEs in the 2010s is insignificant. *It may suggest that access to external finance does not influence the Omani SMEs' decision to innovate.* The British SMEs that had 'access to external finance' in the 1990s were operational processes innovators, and now they have become organisational or managerial processes innovators. Also, the results show that the British SMEs in the 2010s with access to external finance are less likely to innovate their products and services. It might be due to the type of finance as it could be not appropriate to meet the entrepreneurs' expectation; hence they reject it, or they accept it to innovate their organisational or managerial processes instead of their products and services. *In short, this may imply that* the *SMEs that have access to external finance tend to innovate their processes rather than their products and services.* As Kim, Lee, and Kim (2016) found that the indirect external financing such as bank loans makes a negative impact on technological product innovation whereas direct external financing of security issues has a positive impact on innovation.

Fourthly, the effect of *'access to ICT'* on innovation in the Omani SMEs in the 2010s is insignificant. *It may suggest that access to ICT does not influence the Omani SMEs to innovate.* In general, the access to ICT has a positive influence on all types of innovations as it is the case found with the British SMEs in the 2010s. Also, the British SMEs in the 1990s that had access to ICT innovated their services and organisational or managerial processes. This positive impact of ICT on innovation is supported by Higon (2011). However, surprisingly, the British SMEs in the 1990s that had access to ICT were less likely to innovate their products. It may be due to the easy access to information about the firm's product through technology and modern communication channels, which enables the competitors to absorb enough knowledge required for them to imitate the products or may even inspire them to innovate something better that captures a wider market base than the original innovator.

Fifthly, the effect of *'access to skilled labour market'* on innovation in the Omani SMEs in the 2010s is insignificant. *It may suggest that the access to* skilled labour market *does not influence the Omani SMEs to innovate.* The British SMEs in the 2010s that have access to skilled labour market tend to innovate their products, marketing methods and organisational

or managerial processes whereas the British SMEs in the 1990s innovated their products and operational processes. As Stock, Greis and Fischer (2001) found that access to the skilled labour market is positively related to innovation due to the firm's ability to transform new ideas into commercial products as suggested by Cohen and Levinthal (1990).

However, the British SMEs in the 1990s that had access to skilled labour markets were less likely to innovate their services and organisational or managerial processes. *It may imply that now the British SMEs are more flexible and receptive to changes as they have become organisational or managerial processes innovators.*

Sixthly, the effect of the *'access to unskilled labour market'* on innovation in the Omani SMEs in the 2010s is insignificant. Also, *the* 'access to unskilled labour market' was insignificant with the British SMEs in the 1990s. *It may suggest that the access to the* skilled labour market in the Omani SMEs in the 2010s and the British SMEs in the 1990s *did not influence the SMEs to innovate.* However, this has changed as the British SMEs in the 2010s tend to innovate their services and operational processes perhaps due to availability of formal periodical training that equips unskilled labour with adequate skills required to improve the quality standards of firm's services and processes. Besides that, the British SMEs in the 2010s are less likely to innovate their marketing methods because the unskilled labour lacks or have a lower absorptive capacity as suggested by Cohen and Levinthal (1990). Moreover, the marketing methods innovation is already well handled with the skilled labour that can be outsourced if they are not available.

Seventhly, the results have shown that the *'access to local business networks'* has a positive impact on all types of innovations except with the operational processes innovation, which is insignificant. It is the case with both the Omani SMEs in the 2010s and the British SMEs in the 1990s. *It may imply that the situation with the Omani SMEs is similar to the British SMEs in the 1990s in terms of stronger access to local business networks than the current scenario with the British SMEs in the 2010s.* This result is supported by Audretsch (2003), Sedgley and Elmslie (2004), Herrera, Munoz-Doyague, and Nieto (2010) who found that the agglomeration has a positive impact on innovation.

Last but not least, the impact of the *'access to universities and research centres'* on the British SMEs in the 1990s was insignificant. *It may have suggested that the* access to

universities and research centres in the British SMEs in the 1990s did not influence them to innovate. The Omani SMEs that have access to universities and research centres have a positive impact on organisational or managerial processes innovation. Also, the British SMEs in the 2010s that have 'access to universities and research centres' tend to innovate all types of innovations except the marketing methods innovation, which is insignificant. *It may imply that as the research and development collaboration is highly extended to the SMEs; they tend to innovate to a higher capacity.* Freel (2000) argued that the university links enable the SMEs to improve their innovative capacity or capabilities by gaining access to sophisticated technology and technical expertise.

Finally, the effect of *'access to government support'* on the British SMEs in the 1990s was insignificant. *It may have suggested that* access to *government support did not influence the British SMEs in the 1990s to innovate.* However, this is not the case with the British SMEs in the 2010s that have 'access to government support' as they tend to innovate all types of innovations except the marketing methods innovation. Also, the Omani SMEs that have access to government support tend to innovate their services and operational processes. *It may imply that as the government support is highly extended to the SMEs, they tend to innovate to a higher capacity.* It is supported by Marcus (1981), who found that government regulations affect the innovation rate and substance. Choi and Lim (2017) found that the government and the public policies provide fiscal incentives and information which are positively associated with the SMEs' innovation performance through their internal innovation capacity.

Given the last two results, it may be apt to conclude that *now the British SMEs have a wider and effective collaboration with the universities and the research centres as well as they receive proper aid and support from the government than it used to do in the 1990s*.

To sum up, four key business environment factors drive the Omani SMEs in the 2010s to innovate. These are the *'monopolistic competition'*, the *'access to strong business networks'*, the *'access to universities and research centres'* and the '*access to government support'*. The access to monopolistic competition positively influences all the five different types of innovations in the Omani SMEs. The access to local business networks positively impacts all the innovation outcomes except the operational process innovation. The access to the

universities and research centres positively affects the organisational or managerial processes, whereas access to government support positively influences the services and organisational processes innovations. However, two of these business factors were not among the drivers of innovation in the British SMEs in the 1990s. These are access to government support and external R&D which may imply that there are changes in the market dynamics due to the presence of the 4th industrial revolution and the urge to have a well-diversified economy; which has offered the Omani SMEs in the 2010s more support than the one received by the British SMEs during the 1990s. Furthermore, there is a need to activate the Omani SMEs' access to the new exports markets, the external finance, the ICT, the skilled and the unskilled labour markets to encourage them to innovate various types of innovations especially the products and the marketing methods.

Since the results show that quite a number of explanatory variables are insignificant, it is important to carry out further analysis and investigate the overall innovation conceptual framework, as illustrated in figure 2.2 (chapter 2).

Table 6.4 demonstrates the impact of the business environment on firm behaviour. Four firm behaviour elements are tested: the capability for expansion, the R&D, the formal intellectual property protection rights and the formal training. The columns 1, 2, 3 and 4 present the results of estimating these different firm behaviour elements using nine business environment variables. *The results show that all of the business environment factors impact different types of innovations through at least one of the firm behaviours as follows.*

Table 6. 4 Testing the Relationship, FB=f(be)

	(1)	(2)	(3)	(4)
VARIABLES	Capability for Expansion	R&D	Formal IP Protection Rights	Formal Training
Competition	0.121*	0.114*	0.019	0.076
	[0.064]	[0.059]	[0.073]	[0.068]
Access to New Exports Market	0.130	0.382***	0.139	0.430***
	[0.102]	[0.094]	[0.101]	[0.089]
Access to External Finance	0.151**	0.095	0.197***	0.175***
	[0.062]	[0.061]	[0.071]	[0.067]
Access to ICT	0.097	-0.024	0.164**	0.072
	[0.067]	[0.063]	[0.077]	[0.069]
Access to Skilled Labour Market	0.127*	0.059	0.252***	-0.000
	[0.073]	[0.071]	[0.086]	[0.078]

Access to Unskilled Labour Market	-0.219***	-0.144**	-0.122*	-0.075
	[0.067]	[0.066]	[0.073]	[0.070]
Access to Local Business Networks	-0.050	0.112*	0.060	-0.037
	[0.065]	[0.063]	[0.070]	[0.063]
Access to Universities and Research Centre	-0.032	0.211***	-0.086	0.124
	[0.069]	[0.072]	[0.082]	[0.078]
Access to Government Support	0.205**	-0.072	0.087	0.049
	[0.088]	[0.081]	[0.098]	[0.092]
Constant	0.189***	0.112*	0.187**	0.150**
	[0.068]	[0.066]	[0.075]	[0.071]
Observations	200	200	200	200
R-squared	0.190	0.251	0.158	0.241

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Firstly, the Omani SME's *'capability for expansion'* depends on competition, access to external finance, access to the skilled labour market and government support. It is less likely to depend on the unskilled labour market. However, access to new exports markets, ICT, local businesses networks, universities and research centres have no indirect effect on innovation outcomes through the firm behaviour 'capability for expansion'. *This implies that the Omani SMEs are capable of expanding their products and services if they face a monopolistic competition and have access to proper finance channels, skilled labour market and proper support from the government. The Omani SMEs that have the capability for expansion, as shown earlier in summary 6.4 are more likely to innovate their products and marketing methods.*

Secondly, the Omani SME's investment in *'R&D'* is influenced by competition, access to new exports markets, access to local business networks and access to universities and research centres. It is also less likely to depend on the unskilled labour market. *This implies that the Omani SMEs are able to invest in R&D activities if they face a monopolistic competition and have access to new exports markets, local business networks and universities research centres. The Omani SMEs that are investing in R&D as shown previously in summary 6.4 are more likely to innovate their operational, organisational or managerial processes.*

Thirdly, the Omani SME's acquiring *'formal intellectual property protection rights'* is impacted by the access to external finance, access to ICT and access to the skilled labour market. It is also less likely to depend on the unskilled labour market. *This implies that the*

Omani SMEs tend to acquire formal intellectual property protection rights (FIPPR) if they have access to external finance, ICT and skilled labour market. Omani SMEs that are investing in FIPPR, as shown earlier in summary 6.4 are more likely to innovate their marketing methods.

Fourthly, the Omani SME's conduction of the *'formal training'* is influenced by the access to new exports markets and access to external finance. *This implies that the Omani SMEs tend to conduct formal training if they have access to external finance and new exports market. Omani SMEs that are investing in formal training, as shown previously in summary 6.4 are more likely to innovate their services.*

In short, the four-firm behaviour elements indicate that the Omani SMEs' behaviour elements are influenced by business' environment factors. Therefore, the relationship of FB=f(be) exist. Also, the business environment factors can impact different types of innovations through the firm's behaviour. Some of these business environment factors (e.g. the access to new exports market, the access to external finance, the access to ICT, the access to skilled and unskilled labour markets) were insignificant on innovation when the direct relationship is investigated as shown in summary 6.6. However, they have a positive and indirect effect on innovation through business firm behaviour elements.

Table 6.5 demonstrates the impact of firm behaviour and business environment factors on firm characteristics. It consists of twelve firm characteristics models. Columns 1, 2, 3, …, 13 present the results of estimating different firm characteristics elements using four firm behaviour variables and nine business environment variables.

There are three results as follows: the majority of the firm characteristics elements impact different types of innovations through firm behaviour and business environment factors. These are the *'exports'*, the *'updated equipment and high technology'*, the *'high quality branded products'*, the *'firm age'*, the *'firm age squared'*, the *'location'*, the *'businesses led by a female'* and the *'businesses led by a male'*. Therefore, the relationship, FC= *f (fb, be), holds in such cases.*

Moreover, there are two firm characteristics that are influenced only by the business environment factors without the firm behaviour elements. These are the *'firm size squared'*

and the *'family-owned businesses'*, which brings into attention that FC= *f (be).* Also, there are two firm characteristics that are not influenced by either business environment factors or firm behaviour variables. These are the *'sites/branches/subsidiaries'* and executive *founders*.

To sum up, while investigating the direct relationship between the explanatory variables and the innovation outcomes, nine variables were insignificant. These are exports, family-owned businesses, firm age, executive founders, access to new exports markets, access to external finance, access to ICT, access to skilled labour and unskilled labour markets. However, when additional tests were carried out, it is found that an indirect relationship between the explanatory variables and the innovation outcomes exist. For example, exports positively impact all the five types of innovation through the capability to expansion, access to new exports markets and through the access to government support. Access to unskilled labour market impacts products, processes and marketing methods innovations through the expansion, R&D and FIPPRs. Moreover, family-owned business is influenced by the access to the unskilled labour market; hence, it also indirectly impacts the products, processes and marketing methods innovations. Also, access to ICT positively influences marketing methods innovation through the FIPPR. In addition, access to external finance positively affects products, services and marketing innovations through expansion, FIRRP and formal training.

Table 6.5 Testing the Relationship, FC=f (fb, be)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
VARIABLES	Firm Size	Firm Size Squared	Exports	Sites/ Branches/ Subsidiaries	Updated Equipment and High Technology	High Quality Branded Product	Firm Age	Firm Age Squared	Location	Family-Owned Businesses	Businesses Led by Female	Businesses Led by Male	Executive Founders
Capability for Expansion	0.010	0.027	0.082*	-0.006	0.086	0.421***	0.201	0.607	-0.170**	-0.010	0.188**	0.171**	-0.047
	[0.087]	[0.182]	[0.045]	[0.038]	[0.080]	[0.064]	[0.194]	[0.605]	[0.082]	[0.090]	[0.076]	[0.081]	[0.087]
R&D	-0.040	-0.068	-0.025	-0.001	0.078	0.132*	-0.132	-0.295	-0.050	0.087	-0.066	0.061	-0.027
	[0.092]	[0.194]	[0.048]	[0.040]	[0.085]	[0.068]	[0.207]	[0.645]	[0.087]	[0.096]	[0.081]	[0.086]	[0.092]
Formal IP Protection Rights	0.060	0.046	-0.012	0.034	0.054	0.352***	0.357**	1.179**	-0.028	0.011	-0.059	-0.032	0.026
	[0.076]	[0.160]	[0.039]	[0.033]	[0.070]	[0.056]	[0.170]	[0.530]	[0.071]	[0.079]	[0.066]	[0.071]	[0.076]
Formal Training	0.038	0.026	0.029	-0.004	0.188**	0.051	-0.040	-0.080	0.047	-0.058	0.159**	0.060	0.049
	[0.082]	[0.174]	[0.042]	[0.036]	[0.076]	[0.061]	[0.185]	[0.576]	[0.078]	[0.086]	[0.072]	[0.077]	[0.082]
Competition	0.111	0.256*	-0.051	0.015	0.004	0.092*	-0.093	-0.149	-0.003	0.002	-0.034	-0.011	-0.075
	[0.073]	[0.153]	[0.038]	[0.032]	[0.067]	[0.053]	[0.164]	[0.509]	[0.069]	[0.076]	[0.064]	[0.068]	[0.073]
Access to New Exports Market	0.159	0.319	0.801***	0.000	-0.004	-0.084	0.666***	1.640**	-0.035	-0.118	0.114	0.348***	0.141
	[0.108]	[0.228]	[0.056]	[0.047]	[0.100]	[0.079]	[0.243]	[0.755]	[0.102]	[0.113]	[0.094]	[0.101]	[0.108]
Access to External Finance	0.028	0.040	0.034	-0.021	0.195***	-0.045	0.219	0.946*	0.007	-0.059	0.232***	0.157**	0.102
	[0.075]	[0.157]	[0.038]	[0.033]	[0.069]	[0.055]	[0.167]	[0.521]	[0.070]	[0.078]	[0.065]	[0.069]	[0.075]
Access to ICT	-0.022	-0.082	0.008	0.056	0.171**	0.035	-0.362**	-1.250**	0.066	-0.055	0.236***	0.007	0.025
	[0.079]	[0.167]	[0.041]	[0.035]	[0.073]	[0.058]	[0.178]	[0.553]	[0.075]	[0.083]	[0.069]	[0.074]	[0.079]
Access to Skilled Labour Market	-0.002	-0.067	-0.023	0.007	0.040	-0.044	0.086	0.020	0.050	-0.087	0.023	-0.043	0.056
	[0.080]	[0.168]	[0.041]	[0.035]	[0.074]	[0.059]	[0.179]	[0.558]	[0.075]	[0.083]	[0.070]	[0.074]	[0.080]
Access to Unskilled Labour Market	0.024	0.103	-0.041	-0.003	0.134	-0.030	-0.003	-0.002	0.094	-0.156*	0.031	0.031	-0.087
	[0.088]	[0.186]	[0.045]	[0.039]	[0.081]	[0.065]	[0.198]	[0.616]	[0.083]	[0.092]	[0.077]	[0.082]	[0.088]

Access to Local Business Networks	0.033	0.079	-0.005	-0.052	0.195***	0.037	-0.123	-0.203	-0.003	-0.051	0.060	0.049	0.015
	[0.072]	[0.152]	[0.037]	[0.032]	[0.067]	[0.053]	[0.162]	[0.505]	[0.068]	[0.075]	[0.063]	[0.067]	[0.072]
Access to Universities and Research Centre	-0.023	-0.047	0.025	-0.020	-0.083	0.117*	-0.030	-0.339	-0.011	-0.023	0.056	0.177**	0.123
	[0.083]	[0.174]	[0.043]	[0.036]	[0.076]	[0.061]	[0.186]	[0.578]	[0.078]	[0.086]	[0.072]	[0.077]	[0.083]
Access to Government Support	0.134	0.292	-0.106**	0.045	0.074	0.055	-0.172	-0.674	0.160*	-0.030	-0.063	-0.003	-0.050
	[0.100]	[0.210]	[0.051]	[0.044]	[0.092]	[0.073]	[0.224]	[0.698]	[0.094]	[0.104]	[0.087]	[0.093]	[0.100]
Constant	0.914***	1.131***	0.069	0.929***	0.018	0.004	1.381***	3.137***	0.667***	0.638***	-0.054	0.188**	0.553***
	[0.087]	[0.184]	[0.045]	[0.038]	[0.080]	[0.064]	[0.196]	[0.610]	[0.082]	[0.091]	[0.076]	[0.081]	[0.087]
Observations	200	200	200	200	200	200	200	200	200	200	200	200	200
R-squared	0.068	0.057	0.619	0.050	0.280	0.522	0.119	0.123	0.067	0.060	0.279	0.259	0.063

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Section 6.4 below answers the fourth research question of what are the current internal and external barriers to innovation for Omani SMEs.

6.4 Barriers to Innovation

The regression results show that neither the firm behaviour elements nor the business environment factors have a negative impact on the innovation outcomes. However, there are several firm characteristics and business environment factors that are insignificant on innovation outcomes which bring into attention important concerns as follows.

On the one hand, the results present red flags at the firm level; which may act as *'internal barriers'* to innovation in the some of the Omani SMEs. There is a weakness in the export's intensity at the Omani SMEs. The absent role of the family-owned business, the executive founders and businesses led by the female in initiating innovative activities.

On the other hand, the results also raised flags at the business environment level; which may act as *external barriers* to innovation in the Omani SMEs. The weak access to new exports markets, the skilled and unskilled labour markets and the ICT. Also, the lack of proper types of external finance facilities for entrepreneurs.

Moreover, the online Omani SMEs dataset revealed *'other types of barriers'* to innovation from the responses of the survey participants that are facing the Omani SMEs. These are the financial constraints (33% votes), the bureaucratic hurdles of laws and regulations (36% votes), the lack of R&D activities or inadequate R&D investment (27% votes), the lack of cooperation with universities and other relevant partners (25% votes), the lack of technological and market information (28% votes), the intellectual property management, project management and organisational cultures (22% votes). Others (15% votes) such as lack of skilled labour and lack of government support in terms of adequate financial schemes and advice.

6.5 Conclusion

The chapter investigated the drivers of innovation in the Omani SMEs using the online survey that has been developed and distributed via an online link to a list of registered SMEs in Riyada Oman.

The relationship and effect of the firm's characteristics and behaviour as well as the business environment on different types of innovations in the Omani SMEs are investigated. Three estimators: LOGIT, PROBIT, and the MVPROBIT were used to estimate the innovation models: products, services, operational processes, organisational or managerial processes and marketing methods. Since the innovation outcomes are correlated, the MVPROBIT estimator was selected as a superior measurement tool to the other estimators in explaining the innovation outcomes.

At the firm level, the summary of statistics revealed that 57% of the Omani SMEs innovate their services, 49% of them innovate their marketing methods, 46% of them innovate their products, 42% innovate their operational processes, and 40% innovate their organisational or managerial processes (table 3.19). The four research questions are answered in this chapter as follows.

C1: four key firm characteristics impact some of the innovation outcomes in the Omani SMEs. These are the *'firm size'*, the *'updated equipment and high technology'*, the *'location'*, and the *'businesses led by male'*. The first two firm characteristics positively influence the services and operational processes innovations, whereas the latter two influence only the operational processes innovation. Moreover, the roles of the exports, the access to sites/branches/subsidiaries, the family-owned businesses, the businesses led by a female and the executive founders need to be activated and find out ways for boosting the innovation at the firm level in the Omani SMEs.

The firm size matters in Oman as the 'medium-sized' Omani firms innovate their services and operational processes whereas the firm age does not matter in the Omani SMEs as it is insignificant on all five types of innovations.

C2: there are four key firm behaviour element that impacts different types of innovations at the firm level in the Omani SMEs. The *'capability for expansion'* positively influences the product and marketing methods innovations. The *'R&D'* positively affects the operational and organisational or managerial processes innovations. The *'FIPPR'* positively impacts the marketing methods innovation, and the *'formal training'* positively influences the services innovation.

C3: four key business environment factors drive the Omani SMEs in the 2010s to innovate. These are the *'monopolistic competition'*, the *'access to strong business networks'*, the *'access to universities and research centres'* and the '*access to government support'*. The access to the monopolistic competition positively influences all the innovations outcomes in the Omani SMEs. Access to local business networks positively impacts all different types of innovations except the operational process innovation. The access to the universities and research centres positively affects the organisational or managerial processes, whereas access to government support positively influences the services and organisational processes innovations. However, two of these business factors were not among the drivers of innovation in the British SMEs in the 1990s. These are thee access to government support and the access to external R&D which may imply that there are changes in the market dynamics due to the presence of the 4th industrial revolution and the urge to have a well-diversified economy; which has offered the Omani SMEs in the 2010s more support than the one received by the British SMEs during the 1990s. Furthermore, there is a need to activate the Omani SMEs' access to the new exports markets, the external finance, the ICT, the skilled and the unskilled labour markets to encourage them to innovate various types of innovations especially the products and the marketing methods.

The results also indicate that an indirect relationship between the explanatory variables and the innovation outcomes exist through the firm behaviour and business environment factors.

C4: there are some *internal barriers* to innovation in the Omani SMEs such as the low export's intensity and the absent role of the family-owned business, the executive founders and businesses led by the female in initiating innovative activities. *There are also some external barriers* to innovation such as the weak access to new exports markets, the skilled and unskilled labour markets and the ICT — also, the lack of proper types of external finance for entrepreneurs.

Moreover, there are *other types of barriers* to innovation from as per the responses of the online survey. These are the financial constraints, the bureaucratic hurdles of laws and regulations, the lack of R&D activities or inadequate R&D investment, the lack of cooperation with universities and other relevant partners, the lack of technological and market information, the intellectual property management, project management and

organisational cultures. Also, ‘others’ like lack of skilled labour and lack of government support in terms of adequate financial schemes and advice.

Finally, at this stage of the research, it is necessary to identify some limitations which need to be considered in further work. Firstly, the dataset is cross-sectional as the online survey was conducted in 2018. A panel data may enable the research to have an in-depth representative analysis. Secondly, the total survey participants are only 200 and results may be better with a larger sample.

To conclude, there are similarities in the determinants of innovation between the British and the Omani SMEs. Firm size, updated equipments and high technology are common firm characteristics. However, firm location and businesses led by male are important drivers in the Omani SMEs, which are not in the British SMEs. The British SMEs have other different firm characteristics that matter for innovation such as firm age, exports intensity and branded products that are not quite common in the Omani SMEs.

As a firm behaviour, both the British and the Omani SMEs engage heavily on R&D activities and have higher capability for expansion in terms of their offered products and services. However, the Omani SMEs engage more in formal training and in acquiring FIPPRs. The key common business environment factors that foster innovation activities in the British and Omani SMEs are the competition, local business networks, access to external R&D and government support. However, the British SMEs also enjoy access to new exports markets, external finance, ICT and skilled labour market which are still not active drivers to innovation in the Omani SMEs.

Furthermore, there are key common barriers in both the British and the Omani SMEs. There are internal barriers like financial constraints and lack of up-to-date organisational innovation culture. There are also external barriers such as bureaucratic hurdles of laws and regulations which hinders or delays the innovation activity at SMEs level. However, the Omani SMEs face different barriers or challenges that are not present in the British SMEs such as weak exports extensity, weak access to ICT, difficult access to skilled labour market, and lack of access to new exports markets.

Chapter 7: Conclusion

7.1 Introduction

Innovation is neither restricted to the most developed economies nor restricted to the high technology sectors. Innovation has transformed into a worldwide vision, influencing all sectors of the economy. Therefore, innovation is an important driver of economic growth as it does not benefit consumers and businesses only, but the economy as a whole. This research investigated what determines and deters different types of innovations in the British and the Omani small and medium-sized enterprises (SMEs) and highlighted the major obstacles that may hinder their decision and choice to innovate.

The overall research raised four important questions, as follows:

1. What are the key specific firm characteristics that impact innovation outcomes in the British and the Omani SMEs?
2. What are the key firm behavioural elements that matter for the British and the Omani SMEs in deciding on whether to innovate or not?
3. What are the key specific business environment factors that influence the choice of innovation in the British and the Omani SMEs?
4. What are the barriers that may prevent the British and the Omani SMEs from innovating and how to overcome them?

The research examined four key hypotheses as follows:

The first and second hypotheses suggest that there are internal drivers of innovation in the form of key specific "SMEs' characteristics" and key specific "firms' behaviour elements". The third hypothesis suggests that there are external drivers of innovation in the form of the "business environment factors". Both types of drivers of innovation affected directly or indirectly SMEs' choice and decision to innovate.

The fourth hypothesis claimed that the barriers to innovation might also be internal or external to the SMEs. They may differ from one firm to another according to their belongingness to specific sectors and their development of countries and markets. This research, however, did not cover the sectoral analysis as the innovation models were already exhausted with explanatory variables.

The first three hypotheses are indirectly related to profit opportunity-seeking because they test the determinates of innovation at the firm level. Three estimation techniques are used to regress five innovation outcomes: PROBIT, LOGIT and multivariate probit (MVPROBIT).

This concluding chapter summarises the findings of the study and provides answers to the research questions (section 7.2). Section 7.3 discusses the study's contribution, limitation and recommends some areas for future research. Finally, section 7.4 considers implications for policymakers and SMEs, followed by the references and the appendices in sections 7.5 and 7.6.

7.2 Substantive Findings

In general, the number of firms that are engaged in different types of innovations is lower than the number of firms that do not innovate in all the three studied datasets. The British SMEs in the 1990s primarily innovated their products, followed by their processes and services. The marketing methods innovation was the least practised type of innovation by the British SMEs during that period. This finding reflects the British economy in the 1990s, as it was highly industrialised and starting to move towards a knowledge-based economy. Later the British SMEs in the 2010s shifted their focus as they become more processes and services innovation-oriented followed by marketing methods innovation. The product innovation is the least practised kind of innovation in the meantime. This finding also reflects the transfer of the British economy to the crypto- economy that requires innovative process solutions to protect privacy, sensitive information and wealth.

The situation with the Omani SMEs is somewhere between the British SMEs in the 1990s and the British SMEs in the 2010s. This finding reflects the Omani economy's diversification initiatives aiming to leapfrog from a natural resources-based economy to a knowledge-based economy. Therefore, the government of Sultanate of Oman has intervened in the market by developing a healthy foundation to achieve a full entrepreneurship ecosystem. The Omani SMEs are mostly service-oriented, followed by marketing methods and products innovations. The processes innovations are the least practised among the different types of innovations at the firm level.

The barriers to innovation in the British and Omani SMEs are either internal or external to the firm. They may be prevented internally mostly by adopting the innovation culture,

starting with the executive founders or both female and male entrepreneurs who play a big role in inspiring the team to innovate. The external barriers may reduce by activating the well-harmonised entrepreneurship ecosystem that aims for the economy's transformation to KE through innovation.

The summary 7.1 presents the key drivers and barriers of innovation in the British and Omani SMEs according to the regression results for the innovation model. There are two common key firm characteristics in the British and Omani SMEs: the 'firm size' and the 'updated equipment & high technology'. The 'firm age' matters in innovation with the British SMEs in and after the 1990s. There are also two common key firm behaviour elements: the 'R&D' and the 'capacity for expansion'. The presence of competition, access to local business networks, access to external R&D and government support are the four common key business environment factors.

Summary 7. 1 Key Drivers and Barriers of Innovation in the SMEs

SMEs	**Key Drivers of Innovation**	**Key Barriers of Innovation**
British, 1990s	5 FCs: • Firm size • Firm age • Exports • High quality branded products • Updated equipment and high technology 1 FB: • R&D 4 BEs: • Access to local business networks • Access to new exports markets • Monopolist Competition • Access to external finance	• Lack of government support. • Lack of access to external R&D. • Lack of proper finance vehicles for innovation. • Lack of access to unskilled labour markets
British, 2010s	3 FCs: • Firm Size • Firm Age • Updated equipment and high technology	• Financial constraints • Bureaucratic hurdles • Lack of innovative organisational culture

	2 FBs: • R&D • Capability for expansion 7 BEs: • Monopolistic Competition • Access to new exports markets • ICT • Access to skilled labour markets • Access to local business networks • Access to university and research centres • Access to government support	
Omani, the 2010s	4 FCs: • Firm Size • Updated equipment and high technology • Location • Businesses led by male 4 FBs: • R&D • Capability for expansion • FIPPR • Formal training 4 BEs: • Monopolistic Competition • Access to local business networks • Access to universities and research centres • Access to government support	• Lack of engagement in innovation by family-owned businesses, female-led businesses, businesses with the executive founder on board. • Weak exports and lack of access to new exports markets • Weak access to skilled and unskilled labour markets • Weak access to ICT • Financial constraints The bureaucratic hurdles of laws and regulations

The next subsections summarise the answers to the four research questions for the British SMEs in the 1990s and 2010s as well as for the Omani SMEs in the 2010s.

7.2.1 The British SMEs in the 1990s

The major findings for the British SMEs in the 1990s are as follows:

Firstly, five key firm characteristics derived the different types of innovations at the British SMEs in the 1990s: the firm size, firm age, exports extensity, brands, updated equipment and high technology. The younger British SMEs in the 1990s were more likely to innovate their services. The SMEs that exported their products and services were more likely to innovate their marketing methods to sell them. The SMEs that produced higher quality and branded products innovated all types of innovation except their services. Firms that had updated equipment and high technology were more likely to innovate their processes. There was no specific gender dominating the innovation initiatives in the management team, and the executive founders were not active enough in making the innovation choices at the firm level. The location had a negative impact on products innovation. There was also no clear role for the sites, branches and subsidiaries in boosting different types of innovations.

Secondly, the investment in the R&D was the key firm behaviour that mattered the most for product and services innovations in the British SMEs in the 1990s. It is followed by the FIPPRs that protected the firm's product innovation and gave them the impulse to innovate more products, but not the services, organisational processes and marketing methods innovations. The firm's capability for expansion boosted the services innovation, but not the operational processes. The formal training helped the firms to innovate their services and marketing methods, but not their products.

Thirdly, four key business environment factors affected innovation at the British SMEs in the 1990s. Those were the access to local business networks, access to new exports markets, the presence of the monopolistic competition and the access to external finance. The access to local business networks helped the British SMEs in the 1990s to innovate all types of innovations except their operational processes. However, the presence of the monopolistic competition and access to external finance made it possible for them to innovate their operational processes. Also, the access to new exports market boosted the firms to innovate their products, services and processes. T*here was a lack of access to unskilled labour markets, the government support and research of universities; hence, they acted as barriers to innovation for the British SMEs in the 1990s.* Access to skilled labour market boosted the

products and operational processes innovations, but not the services and organisational processes innovations. Access to ICT enhanced the services and organisational innovations, but not the products innovation.

Fourthly, there were internal barriers that derived from the negative impact of some firm behaviour elements on specific innovation outcomes. For example, the presence of FIPPRs such as patents made some of the British SMEs less likely to innovate their services and processes as they have guaranteed the profits generated from their protected products and achieved a competitive advantage in the market; hence they did not innovate other types of innovation due to earlier innovations. Also, the exaggeration of free accessed formal training acted as a barrier for some British SMEs from innovating more products because too much formal training could sometimes directly or indirectly lead to the spillover of the core knowledge to competitors who may copy the innovative ideas and launch similar products. Also, the over access to firm's subsidiary resources made some British SMEs in the 1990s more reluctant to innovate their operational processes because it was cheaper for them to use the subsidiary's processes or procedures rather than innovating new ones since they belonged to the same group and especially if they were located in the same region and undergo the same rules and regulations. Furthermore, one of the strong internal barriers in the British SMEs in the 1990s was the uncompleted innovation culture due to the inactive role of the business' entrepreneurs and the executive founders in making innovation decisions and choices.

Last but not least, there were external barriers derived from the negative influence of some business environment factors on specific innovation outcomes. For instance, some British SMEs that have over access to ICT became less likely to innovate their products perhaps due to core knowledge spillover to competitors using the unlimited access to ICT especially the social media through the horizontal networks. However, access to ICT influenced them to innovate other routine and incremental innovations related to their services and organisational or managerial processes. Moreover, the limited access to the unskilled labour market and the proper types of external finance facilities, lack of access to relevant external R&D and lack of government support were also critical barriers that discouraged some of the British SMEs in the 1990s to innovate.

Finally, the responses of the survey participants divided the barriers to innovation in the British SMEs in the 1990s into three key groups: economic, internal and other factors as follows. First comes the economic barriers: too high costs of innovations, excessive perceived risk of innovation, lack of appropriate sources of financing innovations, and longer payoff period of innovations. Second, comes the barriers at the firm level (internal barriers): firms have a too-small potential for innovation, lack of skilled personnel, lack of information on markets, innovation costs are hard to control, lack of information on technology and resistance to change or organisational rigidities. Third, comes the other barriers: Lack of responsiveness from customers, uncertainty on the timing of innovation, lack of technological opportunities, rigid laws and regulations, innovation is easy to be copied, and there is no need to innovate due to earlier innovations.

7.2.2 The British SMEs in the 2010s

The major findings for the British SMEs in the 2010s are as follows:

Firstly, three key firm characteristics derive different types of innovations at the British SMEs in the 2010s; the 'firm size', the 'firm age' and the 'updated equipment and high technology'. Still, the location has a negative impact on products innovation as compared with the British SMEs in the 1990s. Also, there is no clear role for the sites, branches and subsidiaries in boosting different types of innovations. The rest of the five firm characteristics-the exports, the family-owned businesses, the businesses led by the female, the businesses led by a male and the executive founders- have shown controversial effects. They have positive and negative effects on different types of innovations.

Besides, it is worth emphasising that in the 1990s, only the younger small and medium-sized British firms were more likely to innovate their services. But in the 2010s, the services innovators become the smaller and mid-aged British firms. Moreover, the small-sized British firms in the 2010s tend to innovate their products, whereas the medium-sized firms tend to innovate their organisational or managerial processes. Also, the medium-sized and mid-aged British firms tend to innovate their operational processes, whereas ageing small and medium-sized British firms tend to innovate their marketing methods.

Secondly, the 'capability for expansion' and the investment in the 'R&D' are the two key firm behaviours that affect all types of innovations of the British SMEs in the 2010s. The

FIPPRs is insignificant, and the formal training has a controversial effect on innovation. It is positive on services and processes innovations and negative on marketing methods innovation.

Thirdly, seven key business environment factors affect innovation at the British SMEs in the 2010s. These are the presence of monopolistic competition, the access to new exports markets, the ICT, the skilled labour market, the local business networks, the external R&D and the government support. The access to the unskilled labour market boosted the services and operational processes innovations, but not the marketing methods. Access to external finance enhanced the organisational or managerial processes innovation, but not the products and services innovations.

Fourthly, there are 'internal barriers' such as the excess conduction of formal training made some of the British SMEs to less likely innovate their marketing methods because the formal training is costly and the existence of earlier innovations. Moreover, the British SMEs in the 2010s have underutilised the acquisition of the FIPPRs as they shifted from products innovators to services and processes innovators. They also controlled the access to subsidiary's resources and limited the core knowledge and resources transfer to the extent that both FIPPRs and access to sites/branches/subsidiaries resources have an insignificant effect on innovation.

Moreover, the culture of innovation has advanced with the British SMEs in the 2010s as the role of businesses led by the female, the businesses led by a male and the executive founders in making innovation decisions and choices have been activated. However, still, the focus of these leaderships is on the process's innovations rather than on the products innovation. It raises a concern that still, obstacles are facing the buyout of a complete and integrated innovation system and initiatives.

Last but not least, there are 'external barriers' such as access to improper external finance make the British SMEs in the 2010s less likely to innovate their products. Also, the access to unskilled labour market made some British SMEs to less likely to innovate their marketing methods perhaps due to earlier innovations or due to their resistance to changes and inability to learn new required skills despite the conduction of the formal training.

Finally, the BIS dataset revealed 'other barriers' to innovation. These are the financial constraints, the bureaucratic hurdles, the lack of R&D activities or the inadequate R&D investment, the lack of cooperation with universities and other relevant partners, the lack of technological and market information, the intellectual property management, the project management and organisational cultures.

7.2.3 The Omani SMEs in the 2010s

The major findings for the Omani SMEs in the 2010s are as follows:

Firstly, four key firm characteristics impact some of the innovation outcomes in Omani SMEs. These are the 'firm size', the 'updated equipment and high technology', the 'location', and the 'businesses led by male'. The first two firm characteristics positively influence the services and operational processes innovations, whereas the latter two influence only the operational processes innovation. Moreover, the roles of the exports, the access to sites/branches/subsidiaries, the family-owned businesses, the businesses led by a female and the executive founders need to be activated and find out ways for boosting the innovation at the firm level in the Omani SMEs.

Furthermore, it is worth emphasising that the firm size matters in Oman as the 'medium-sized' Omani firms innovate their services and operational processes whereas the firm age does not matter in the Omani SMEs as it is insignificant on all five types of innovations.

Secondly, there are four key firm behaviour element that impacts different types of innovations at the firm level in the Omani SMEs. The 'capability for expansion' positively influences the product and marketing methods innovations. The 'R&D' positively affects the operational and organisational or managerial processes innovations. The 'FIPPR' positively impacts the marketing methods innovation, and the 'formal training' positively influences the services innovation.

Thirdly, four key business environment factors drive the Omani SMEs in the 2010s to innovate. These are the 'monopolistic competition', the 'access to strong business networks', the 'access to universities and research centres' and the 'access to government support'. The access to the monopolistic competition positively influences all the innovations outcomes in the Omani SMEs. Access to local business networks positively impacts all different types of

innovations except the operational process innovation. The access to the universities and research centres positively affects the organisational or managerial processes, whereas access to government support positively influences the services and organisational processes innovations. However, two of these business factors were not among the drivers of innovation in the British SMEs in the 1990s. These are the access to government support and the access to external R&D which may imply that there are changes in the market dynamics due to the presence of the 4th industrial revolution and the urge to have a well-diversified economy; which has offered the Omani SMEs in the 2010s more support than the one received by the British SMEs during the 1990s. Furthermore, there is a need to activate the Omani SMEs' access to the new exports markets, the external finance, the ICT, the skilled and the unskilled labour markets to encourage them to innovate various types of innovations especially the products and the marketing methods.

Fourthly, there are some internal barriers to innovation in the Omani SMEs such as the low export's intensity and the absent role of the family-owned business, the executive founders and businesses led by a female in initiating innovative activities. There are also some external barriers to innovation such as the weak access to new exports markets, the skilled and unskilled labour markets and the ICT — also, the lack of proper types of external finance for entrepreneurs.

Finally, there are other types of barriers to innovation from as per the responses of the online survey. These are the financial constraints, the bureaucratic hurdles of laws and regulations, the lack of R&D activities or inadequate R&D investment, the lack of cooperation with universities and other relevant partners, the lack of technological and market information, the intellectual property management, project management and organisational cultures. Others such as lack of skilled labour and lack of government support in terms of adequate

To sum up, innovation in SMEs is not easy and simple. If it were so, all firms would have become innovators. The number of firms that innovate is very much lower than the firms that do not innovate. However, some firms that do not innovate have key characteristics or operate in a business environment that inspires other firms to innovate. Therefore, there are direct and indirect factors that drive innovation at the firm level.

7.3 The Research Contribution and Limitation

This empirical research added value to the existing literature as follows.

Firstly, this research follows the current British surveys on SMEs and establishes a new dataset for the Omani SMEs. The framework can be used in future studies to establish larger data samples. More prominently, the design of the research allows the usage of the findings pertaining to innovation among British SMEs to draw implications for innovation among Omani SMEs.

Secondly, it filled the existing gap in the literature since SMEs' theories have only been applied in limited countries and rarely been applied to the Cooperation Council for the Arab States of the Gulf (GCC), including Oman. There is no published research on SMEs' drivers and barriers to innovation for any Arab country.

Thirdly, the research provided comparisons of the results of different types of innovations in three survey datasets: the British SMEs in the 1990s, the British SMEs in the 2010s and the Omani SMEs in the 2010s.

Last but not the least, unlike the previously published papers, it separated the service innovation from the product innovation to make it clear that product innovation means goods innovation and investigates the effect of different variables on product and service innovations separately.

Finally, unlike all the previous published papers on innovation models, it took into consideration the effects of medium-sized and mid-aged firms by including the firm size squared and firm age squared.

This research used cross-sectional datasets, which raises causality and endogeneity concerns. Since the research investigates 5 innovation models with 25 explanatory variables each, there is a difficulty on treating this matter, which is the main research limitation. Hence, it would be useful to investigate the innovation model using panel data in future research. The panel dataset will enable the researcher to perform binary choice models for panel data such as the pooled estimation, the random effect, and the fixed effects. Also, it will enable the researcher to see the changes that happened in the SMEs over multiple years. Besides, this research did not cover the sectoral analysis as the models were already exhausted enough with

explanatory variables. Therefore, it will be interesting to do in-depth sectoral analysis with limited explanatory variables in the model. Moreover, it will be interesting to perform clusters analysis to evaluate the behaviour and performance of the SMEs in each cluster.

7.4 The Research Implications for Policymakers

7.4.1 The Implications for the British SMEs

From the research findings, the two least practised innovations by the British SMEs in the 2010s are the products and marketing methods. To overcome the barriers to marketing methods innovation is tricky as it may occur due to the shortage of skilled, digital and tech professionals as well as the limited access to the skilled labour that is specialised in the marketing methods innovation as they are expensive. The marketing and public relations, business development and web designers are among the topmost demanded human capital in the UK (Gfk, 2013). Whilst access to the unskilled labour market is easier for the British SMEs, such type of personnel requires informal training because the formal training may expose the core knowledge to leakage to external parties. External support is required from the government, banks and external R&D agents to help the British SMEs boost their products innovation as follows.

I. The government should encourage SMEs to protect their product innovation through subsidising the acquiring of formal intellectual property protection rights within initial two years to enable SMEs benefits from the product's sales and be able to come up with new incremental or radical innovated products.
II. The banks and finance and lease companies shall provide suitable and innovative types of financial vehicles and products for the SMEs to enable them to run the R&D activities.
III. The external R&D agents such as universities and research centres should effectively collaborate with the SMEs to improve existing products and work together to innovate products new to the industry.

Moreover, the role of executive founders, businesses led by a female and family-own businesses is required to be widen and enrolled in more innovative activities. It can be done by fostering the following:

I. To increase the funding directed towards innovation in the British SMEs in general and to businesses led by females in particular by encouraging the creation of financial solutions and launch new investment vehicles specifically to promote the innovation sector. As female entrepreneurs may require special attention to active their role and maximise their participation in the market by providing access to expertise, mentoring and networking opportunities.

II. To continue the culture of open innovation for the British SMEs, especially for the family-owned business, business-led by females and executive founders as Dahlander (2007) argued that the new firms in new industries would resume experiencing various forms of openness in their innovation strategies and control over external stakeholders.

III. To track and to evaluate the impact of all the initiated policies (by the government) that encourage participation in different types of innovation and update the processes at the firm level.

Furthermore, the role of location and access to branches and subsidiaries' resources is dormant on different types of innovation in the British SMEs, which is surprising because it is a highly developed economy. Large corporates are active merely. Change has to start with the British entrepreneurs to activate their impact as follows.

I. To participate effectively in the smart cities' technologies located in London, Bristol, Manchester, Birmingham, Leeds, Glasgow, Nottingham, Milton Keynes, Peterborough, Cambridge, Oxford, Aberdeen, Edinburgh, Newcastle, Belfast, Sheffield and Liverpool as De Waal (2014) and Townsend (2013) argue that they are the beginning of profound changes that will see cities advance to become far more than just a conglomeration of people, buildings and infrastructure.

II. To engage and use the technological advancement methods; which are the hub for new technological innovations. For example, the blockchain, the payment finality and the bitcoins (crypto-currency) which constitute the crypto-economy to protect sensitive information either in storage or in communication (Saper, 2013).

III. To complete the cycle of innovation by attracting mergers and acquisitions that enable higher participation in international digital clusters.

7.4.2 The Implications for the Omani SMEs

There are three different stages of economic development: the factor-driven, the efficiency-driven, and the innovation-driven. Oman is still in the first stage of economic development as it relies heavily on oil and gas. However, the government- post the slump in the oil prices in 2014- has taken the diversification initiatives into implementation to leapfrog to the innovation-driven economic development stage. The knowledge-based economy is a solution for the internal and external barriers to innovation in Oman, and it can be developed by:

I. Creating the knowledge-based economy that is innovation-oriented and that attracts both inside and outside investments of specialised R&D firms.

II. Investing in the research and development capabilities at educational and research institutions.

III. Building technology transfer parks and investing in its knowledge spillover.

IV. Encouraging and supporting the start-ups, incubation that perform innovative activities.

V. Generating high skilled labour and well knowledgeable students that meet the workplace demands.

To conclude, at a macro level, the learning lesson for Omani SMEs from the experience of SMEs in UK, Oman shall develop policies for the whole entrepreneurial-innovation ecosystem to reflect on the strategic plans and work on creating industries, promoting exports, creating talented human capital, producing high quality branded products, acquiring up to date equipments and advanced high technology, investment in internal and external R&D, ICT, access to new exports markets, access to proper channels of external finance and access to strong local business networks in order to innovate different types of innovations. Moreover, government support is essential in an innovative way. For example, Oman may encourage small firms who are in the same business activities to merge to gain market share, to be resilience to challenges and risks and to cooperate in completing the innovation cycle.

At a micro level, in the context of new and small firms, it is impossible to ignore the unique strategic role of the executive founders, the businesses led by a female and family-owned businesses. It is due to the influence of their personal or family history, attitudes and behaviours towards the firm's open innovations strategy. There is plenty of recent literature- (Vanhaverbeke et al., 2014), (Gruber and Henkel, 2006) and (West and Kuk, 2014)- that hint of the role of the founder's beliefs and studies in enabling start-ups and family-owned businesses in opening up to innovation and promoting it as a part of the organisational culture.

7.5 References

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7.6 Appendices

Appendix for Chapter 3

A3. 1 Mapping the innovation model variables with the selected CBR survey questions

Mapping Innovation Model Variables with the Survey Questions			
First: Innovations Variables			
Variable Name	**Question**	**Responses**	**Logic**
1) Product Innovation at Firm Level	D1. NEW411) Technologically new or significantly improved manufactured product (Innovation new to your firm but not to your industry)	Response to D1. NEW411) □ Yes □ No	1 if the firm launched a new or significantly improved product at a firm-level during the last three financial years, 0 otherwise.
2) Service Innovation at Firm Level	D1. NEW414) New or significantly improved service product (Innovation new to your firm but not to your industry)	Response to D1. NEW414) □ Yes □ No	1 if the firm launched new or significantly improved service at a firm-level during the last three financial years, 0 otherwise.

3) Operational Process Innovation at Firm Level	D1. NEW412) Technologically new or significantly improved methods of producing manufactured product (Innovation new to your firm but not to your industry)	Response to D1. NEW412) □ Yes □ No	1 if the firm used new or significantly improved operational processes at a firm-level during the last three financial years, 0 otherwise.
4) Organisational or Managerial Process Innovation at Firm Level	D1. NEW415) New method to produce and deliver your service product (Innovation new to your firm but not to your industry)	Response to D1. NEW415) □ Yes □ No	1 if the firm launched new significantly improved organisational or managerial processes at a firm-level during the last three financial years, 0 otherwise.
5) Marketing Methods Innovation at Firm Level	D1. NEW413) Technological improvements in supply, storage or distribution systems for the manufactured product (Innovation new to your firm but not to your industry)	Response to D1. NEW413) □ Yes □ No	1 if the firm launched new or significantly improved marketing methods at a firm-level during the last three financial years, 0 otherwise.

Second: Explanatory Variables			
Firm Characteristics			
6) Firm Size 7) Firm Size Squared	A4. AVEMP4) Please provide the average number of employees (including part-timers and working directors) for the latest financial year for which you have data available	Response to A4. AVEMP4) Number of employees	Log of the total average number of employees in the firm for the latest financial year.
8) Exports	A4. EXP4) Exports……..	Response to A4. EXP4) Number of exports	1 if the firm has exported goods and services, 0 otherwise.
9) Sites/Branches/ Subsidiaries	29) Access to Sites, Branches and Subsidiary Resources	D3. SRC402) Please indicate the importance of subsidiary resources for your firm's innovation activities during the past three years.	Response to D3. SRC402) □ Insignificant □ Slightly Significant □ Moderately Significant □ Very Significant Crucial Significant
10) Firm Age	A1. year4) In what year did your firm begin trading?	Response to A1. Year4) The exact year in the number	Log of the total number of years since the firm started its operations.

11) Firm Age Squared			
12) Business-led by Female	A6. CSPGEN4) Please answer each of these questions about your firm's Chief Executive/Senior Partner/Proprietor: Gender?.....	Response to A6. CSPGEN4) □ Male □ Female	1 if the firm is led by the female, 0 otherwise.
13) Business-led by Male	A6. CSPGEN4) Please answer each of these questions about your firm's Chief Executive/Senior Partner/Proprietor: Gender?.....	Response to A6. CSPGEN4) □ Male □ Female	1 if the firm is led by the male, 0 otherwise.
14) Location	URBRUR4) Is your headquarters or main office located in an urban or rural area?	Response to URBRUR4) □ Conurbation □ Large towns □ Small towns □ Rural	1 if the firm's headquarters is located in an urban area, 0 otherwise.

15) Branded High-Quality Product	D4. OBJ413) Please indicate the importance of Improving product quality as objectives of your firm's innovation activities during the last three years:	Response to D4. OBJ413) □ Insignificant □ Slightly Significant □ Moderately Significant □ Very Significant □ Crucial Significant	1 if the firm considered the quality and branding of product a priority in their innovation activities during the last three years, 0 otherwise.
16) Executive Founders	A8. CSP44) Is the Chief Executive/Senior Partner/Proprietor a founder of the business?	Response to A8. CSP44) □ Yes □ No	1 if the firm's Chief executive or Senior partner or Proprietor are founders of the business, 0 otherwise.

17) Updated Equipment & High Technology	E4. IMPAC408) Please assess the impact of the new technology on meeting your business objectives.	Response to E4. IMPAC408) □ No impact □ Slight impact □ Moderate □ Important Crucial	1 if the firm finds there is an impact of new technology and updated equipment in the firm's business objectives, 0 otherwise.
Firm Behaviour			
18) Capability for Expansion (by product line)	C8. ARR402) Have you entered into such arrangements to expand the range of expertise or products offered to customers?	Response to C8. ARR402) □ Yes □ No	1 if the firm has arranged to expand its range of expertise or products, 0 otherwise.
19) R&D	D8. RD45) Did your firm engage in R&D in the last financial year?	Response to D8. RD45) □ Yes □ No	1 if the firm has engaged in R&D activities in the last financial year, 0 otherwise.

20) Formal IP Protection Disclosure	D3. SRC410) Please indicate the importance of patent disclosures for your firm's innovation activities during the past three years.	Response to D3. SRC410) □ Insignificant □ Slightly Significant □ Moderately Significant □ Very Significant □ Crucial Significant	1 if the firm considered patents disclosures important for their innovation activities during the past three years, 0 otherwise.
21) Formal Training	B3. TRAIN4) Is formal training provided for any occupational groups?	Response to B3. TRAIN4) □ Yes □ No	1 if the firm provided formal training, 0 otherwise.
Business Environment			
22) Competition	C4. COMPS4) How many firms do you regard as serious competitors?	Response to C4. COMPS4)	1 if the firm has one or more competitors, 0 otherwise.

		Several serious competitors are many.	
23) Access to New Exports Market	D4. OBJ4034) Please indicate the importance of gaining new markets or market share as objectives of your firm's innovation activities during the last three years.	Response to D4. OBJ4034) □ Insignificant □ Slightly Significant □ Moderately Significant □ Very Significant □ Crucial Significant	1 if the firm considered accessing to new exports market important during the last three years, 0 otherwise.
24) Capability for Accessing External Finance	F6. FINANC4) Have you made attempts to obtain additional finance (i.e. additional to internal cash flows) in the last two years?	Response to F6. FINANC4) □ Yes □ No	1 if the firm had access to external finance in the last two years, 0 otherwise.

25) Access to Information and Communication Technology (ICT)	D3. SRC417) Please indicate the importance of computer-based information networks for your firm's innovation activities during the past three years.	Response to D3. SRC417) □ Insignificant □ Slightly Significant □ Moderately Significant □ Very Significant □ Crucial Significant	1 if the firm considered ICT important in the past three years, 0 otherwise.
26) Access to Skilled Labour Market	B1. RECDIF41) Could you please also indicate if you are currently finding it difficult to recruit skilled employees?	Response to B1. RECDIF41) 1 □ Yes □ No	1 if the firm doesn't have problems in accessing the skilled labour market is good at its location, 0 otherwise.
27) Access to Unskilled Labour Market	B1. RECDIF42) Could you please also indicate if you are currently finding it difficult to recruit suitable unskilled employees?	Response to B1. RECDIF42)1 □ Yes □ No	1 if the firm doesn't have problems in accessing the unskilled labour market is good at its location, 0 otherwise.

28) Access to Local Business Network	D3. SRC405) Please indicate the importance of clients or customers for your firm's innovation activities during the past three years.	Response to D3. SRC405) □ Insignificant □ Slightly Significant □ Moderately Significant □ Very Significant □ Crucial Significant	1 if the firm considered access to local business networks is important during the past three years, 0 otherwise.
29) Access to Universities and Research Centres	D3. SRC408) Please indicate the importance of universities and higher education institutions' information and resources for your firm's innovation activities during the past three years.	Response to D3. SRC408) □ Insignificant □ Slightly Significant □ Moderately Significant □ Very Significant □ Crucial Significant	1 if the firm considered access to universities and higher education institution resources is important during the past three years, 0 otherwise.
30) Access to Government Support	D3. SRC416) Please indicate the importance of government and research institutions for your firm's innovation activities during the past three years.	Response to D3. SRC416) □ Insignificant	1 if the firm considered access to government support is important during the

		□ Slightly Significant □ Moderately Significant □ Very Significant □ Crucial Significant	past three years, 0 otherwise.

A3. 2 Mapping the innovation model variables with the selected BIS survey questions

Mapping Innovation Model Variables with the Survey Questions			
First: Innovations Variables			
Variable Name	**Question**	**Responses**	**Logic**
1) Product Innovation	J1) Has your business introduced any new or significantly improved goods in the last three years?	Response to J1) □ Yes □ No □ Don't know □ Refused	1 if the firm launched a new or significantly improved product during the last three financial years, 0 otherwise.
2) Service Innovation	J1a) Has your business introduced any new or significantly improved services in the last three years?	Response to J1a) □ Yes □ No □ Don't know □ Refused	1 if the firm launched new or significantly improved service during the last three financial years, 0 otherwise.
3) Operational Process Innovation	J3) Has your business introduced any new or significantly improved processes for producing or supplying goods or services in the last three years?	Response to J3) □ Yes □ No □ Don't know □ Refused	1 if the firm used new or significantly improved operational processes during the last three financial years, 0 otherwise.

4) Organisational or Managerial Process Innovation	There was no direct question that says: "Has your business introduced any new or significantly improved **organisational or managerial processes**?" However, I selected a related question: F5) Do you have a formal written business plan? If Yes: Is this kept up to date?	Response to F5) □ Yes- Kept up to date □ Yes- but not kept up to date □ No □ Don't know □ Refused	1 if the firm launched new significantly improved organisational or managerial processes during the last three financial years, 0 otherwise.
5) Marketing Methods Innovation	There was no direct question that says: "Has your firm introduced any new or significantly improved **marketing methods**?" However, I selected a related question: E4) Does your business uses its website or a third-party website to do any of the e-commerce activities such as directly take orders of goods and services and accepts e-payments?	Response to E4) □ Yes □ No	1 if the firm launched new or significantly improved marketing methods during the last three financial years, 0 otherwise.
Second: Explanatory Variables			
Firm Characteristics			
6) Firm Size	A2) What is the total No. of employees of your firm in the last 12 months across all sites? (numbers of employees excluding partners and owners)	Response to A2_2015) The total number of employees in the firm in the	Log of the total number of employees in the firm for the latest financial year.

6A) Firm Size by Category 7) Firm Size Squared		last 12 months ---------- Response to A2) □ Zero Employees □ Micro: 1-9 Employees □ Small: 10-49 Employees □ Medium: 50-249 Employees	Categories are based on a certain number of employees.
8) Exports	C1-C2) Whether you export your goods or services?	Response to C2) □ Yes □ No □ Don't Know	1 if the firm exports goods, 0 otherwise.

9) Sites/Branches/ Subsidiaries	A1) How many sites in the UK does your business operate from, including your head office?	Response to A1) □ 1 □ 2 □ 3 □ 4-10 □ 11+ □ Don't know/ uncertain □ Refused	1 if the firm has one or more than one site/branch/subsidiary, 0 otherwise.
10) Updated Equipment & High Technology	O7b) Does your business has its website so that customers can directly order and pay for goods and services?	Response to O7b) □ Yes □ No	1 if the firm has high technology and updated equipment, 0 otherwise.
11) Firm Age 11A) Firm Age by Category	A6) How many years has this business been trading? It includes under all ownerships and all legal statuses	Response to A6_2015 Response to A6) □ 1 □ 2 □ 3 □ 4 □ 5 □ 6-10 □ 11-20 □ More than 20	Log of the total number of years since the firm started its operations. Age of the firm by category, since it was established (Categorical numerical variable).

12) Firm Age Squared		□ Don't know	
13) Location	A10) Is your headquarters or main office located in an urban area?	Response to A10) □ Urban □ Rural □ Not provided	1 if the firm's headquarters is located in an urban area, 0 otherwise.
14) Family Owned Business	A12) Is your business a family-owned business, that is one which is majority-owned by members of the same family?	Response to A12) □ Yes □ No □ Refused	1 if the firm is owned by a family, 0 otherwise.
15) Business-led by Women	Whether the business is women-led?	Response: □ Yes □ No	1 if the firm is led by women, 0 otherwise.
16) Business-led by Men	Whether the business is men-led?	Response: □ Yes □ No	1 if the firm is led by men, 0 otherwise.

17) Executive Founders	A2a) Including yourself, how many working owners and partners are there in your firm	Response to A2a) is the total number of executive owners	1 if the firm has executive founders, 0 otherwise.
Firm Behaviour			
18) Capability for Expansion (by product line)	F4.3) How capable is your business in developing and introducing new products or services	Response to F4.3) □ Very Poor □ Poor □ Average □ Strong □ Very Strong □ Don't know □ Not applicable	1 if the firm has an average and above-average capability to develop and introduce new products and services, 0 otherwise.
19) R&D	R4d) Does your business plan to develop and launch new products/services in the next three years?	Response to R4d) □ Yes □ No	1 if the firm has R &D activities or function for the creation of new products and services, 0 otherwise.
20) Formal IP Protection	H8g) What did you try to obtain finance for Protecting Intellectual property in the last 12 months?	Response to H8g) □ Yes □ No	1 if the firm acquired Intellectual property rights in the last 12 months, 0 otherwise.
21) Formal Training	N3) Was any of this training and development designed to lead to a formal qualification, regardless of whether this has been achieved or not?	Response to N3) □ Yes □ No	1 if the firm has formal training programmes, 0 otherwise.

		□ Don't know	
Business Environment			
22) Competition	J5e) Did your introduction of new goods, service or process innovations involve co-operation with Competitors or other businesses in your industry?	Response to J5e) □ Yes □ No	1 if the firm has one or more competitors, 0 otherwise.
23) Capability for Accessing External Finance	F4.4) How capable is your business in accessing external finance?	Response to F4.4) □ Very Poor □ Poor □ Average □ Strong □ Very Strong □ Don't know □ Not applicable	1 if the firm has an average and above-average capability to access to external finance, 0 otherwise.
24) Access to New Export Market	C4a) Do you plan to increase your levels of exports over the next few years?	Response to C4a) □ Yes □ No □ Don't Know	1 if the firm has or plans to explore new exports markets, 0 otherwise.

25) Access to Information and Communication Technology (ICT)	O7d) Does your business has its own social media profile, e.g. on Facebook, LinkedIn or Twitter?	Response to O7d) □ Yes □ No	1 if the firm has its own social media profile (the type of ICT), 0 otherwise.
26) Access to Skilled Labour Market	A2b) How many employees are temporary or casual staff?	Response to A2b) □ 1 □ 2 □ 3-5 □ 6-10 □ 11+ □ Don't know Refused	1 if the firm has access to the skilled labour market, 0 otherwise.
27) Access to Unskilled Labour Market	A2c) How many employees are outsourced from the agency?	Response to A2c) □ 1 □ 2 □ 3-5 □ 6-10 □ 11+ □ Don't know □ Refused	1 if the firm has access to the unskilled labour market, 0 otherwise.
28) Access to Local Business Network	A23a) In the last 12 months, have you had private sector businesses as customers?	Response to A23a) □ Yes □ No	1 if the firm has local business networks, 0 otherwise.

29) Access to Universities and Research Centres	J5g) Did your introduction of new goods, service or process innovations involve co-operation with Universities or other higher education institutions?	Response to J5g) □ Yes □ No	1 if the firm has access to universities or other higher education institutions, 0 otherwise.
30) Access to Government Support	J5h) Did your introduction of new goods, service or process innovations involve co-operation with government or public research institutes?	Response to J5h) □ Yes □ No	1 if the firm has access to government support, 0 otherwise.

A3. 3 Mapping the innovation model variables with the Omani SMEs survey questions

Mapping Innovation Model Variables with the Survey Questions			
First: Innovations Variables			
Variable Name	**Question**	**Answers**	**Logic**
1. Product Innovation	C1) Has your firm introduced any new or significantly improved **goods**?	Answer to C1) □ Yes □ No □ I don't know □ Not applicable	1 if the firm launched the new or significantly improved product during the last three financial years, 0 otherwise.
2. Service Innovation	C2) Has your firm introduced any new or significantly improved **services**?	Answer to C2) □ Yes □ No □ I don't know	1 if the firm launched new or significantly improved service during the last three financial years, 0 otherwise.
3. Operational Process Innovation	C3) Has your firm introduced any new or significantly improved **Operational processes** for producing or supplying goods or services?	Answer to C3) □ Yes □ No □ I don't know	1 if the firm used new or significantly improved operational processes during the last three financial years, 0 otherwise.
4. Organisational or Managerial	C4) Has your firm introduced any new or significantly improved	Answer to C4) □ Yes □ No	1 if the firm launched new or significantly improved organisational or managerial processes

Process Innovation	**organisational or managerial processes**?	□ I don't know	during the last three financial years, 0 otherwise.
5. Marketing Methods Innovation	C5) Has your firm introduced any new or significantly improved **marketing methods**?	Answer to C5) □ Yes □ No □ I don't know	1 if the firm launched new or significantly improved marketing methods during the last three financial years, 0 otherwise.
Second: Explanatory Variables			
Firm Characteristics			
Variable Name	**Question**	**Answers**	**Logic**
6. Firm Size	A11) What is the total No. of employees of your firm in the last 12 months across all sites? Please do not count the owners of the business.	Answer to A11) □ 0 □ 1-5 □ 6-25 □ 26-99 □ 100+	Log of the total number of employees in the firm for the latest financial year.

Firm Size (by Category) 7. Firm Size Squared		Firm Size Category: □ Zero Employees □ Micro □ Small □ Medium □ Upper Medium	
8. Exports	B11) Did you export your products and services outside Oman?	Answer to B11) □ Yes □ No □ Not applicable	1 if the firm exports products and services, 0 otherwise.
9. Sites/Branches/ Subsidiaries	A8) How many sites/branches/subsidiaries do you have?	Answer to A8) Open-ended	1 if the firm has a one or more than one site/branch/subsidiary, 0 otherwise.
10. Updated Equipment & High Technology	C14) Do you use new technology or have you experienced a major technology change **in the last three years**?	Answer to C14) □ Yes □ No □ Not applicable	1 if the firm has updated equipment and high technology, 0 otherwise.

11. Firm Age Firm Age by Category 12. Firm Age Squared	A7) In what year did you start trading under the present ownership?	Answer to A7) Open-ended Firm Age Category: □ (0-5) years □ (6-10) years □ (11-20) years □ More than 20 years	Log of the total number of years since the firm started its operations.
13. Location	A10) Is your headquarters or main office located in an urban area?	Answer to A10) □ Yes □ No	1 if the firm's headquarters is located in an urban area, 0 otherwise.
14. Branded Product	B1) Is your product branded?	Answer to B1) □ Yes □ No □ Not applicable	1 if the firm's product is branded, 0 otherwise.

15. Formal Intellectual Property Protection	C8) Are your products legally protected by patents? And, B2) Are your products and business formally protected by trademarks?	Answer to C8) & B2) □ Yes □ No □ I don't know	1 if the firm's products are protected by formal intellectual property protection, 0 otherwise.
16. Family-owned Business	A1) Are you a family-owned business?	Answer to A1) □ Yes □ No	1 if the firm is owned by a family, 0 otherwise.
17. Business-led by women	A13) Do you have female managers in your firm?	Answer to A13) □ Yes □ No	1 if the firm is led by women, 0 otherwise.
18. Employees of different genders	A12) Are your employees from different genders?	Answer □ Yes □ No	1 if the firm has employees of different genders, 0 otherwise.
Firm Behaviour			
Variable Name	**Question**	**Answers**	**Logic**
19. Expansion (by product line)	B1A) If you have a branded product, have you expanded in terms of product lines?	Answer to B1A) □ Yes □ No □ I don't know	1 if the firm has expanded in terms of expertise and product lines, 0 otherwise.

20. R&D	C9) Do you invest in Research & Development (R&D) projects and activities?	Answer to C9) □ Yes □ No □ I don't know	1 if the firm has R &D activities or function for the creation of new products and services, 0 otherwise.
21. Formal Training	D3) Has your firm arranged or funded any formal training or development programme for employees over the past 12 months?	Response to N3) □ Yes □ No □ Not applicable	1 if the firm has arranged or funded any formal training programmes over the past 12 months, 0 otherwise.
Business Environment			
Variable Name	**Question**	**Answers**	**Logic**
22. Competition	B7) Do you have competitors?	Answer to B7) □ Yes □ No □ I don't know	1 if the firm has one or more competitors, 0 otherwise.

23. Access to External Finance	E4) How capable is your business in accessing funding or external finance?	Answer to E4) □ Very Poor □ Poor □ Average □ Strong □ Very Strong □ Don't know □ Not applicable	1 if the firm has an average and above-average capability to access to external finance, 0 otherwise.
24. New Export Market	B11b) Have you entered new exports market?	Answer to B11b) □ Yes □ No □ I don't know	1 if the firm has new exports markets, 0 otherwise.
25. Information and Communication Technology (ICT)	B10) Does your business have its own social media profile, e.g. on Facebook, LinkedIn or Twitter?	Answer to B10) □ Yes □ No □ I don't know	1 if the firm has access to ICT, 0 otherwise.
26. Skilled Labour Market	D6) Do you have problems in accessing to Skilled Labour Market?	Answer to D6) □ Yes □ No □ I don't know	1 if the firm doesn't have problems in accessing the skilled labour market is good at its location, 0 otherwise.

27. Unskilled Labour Market	D7) Do you have problems in accessing to Unskilled Labour Market?	Answer to D7) □ Yes □ No □ I don't know	1 if the firm doesn't have problems in accessing the unskilled labour market is good at its location, 0 otherwise.
28. Local Business Network	C6) Did your introduction of new goods, services, operational processes, marketing methods and organisational or managerial innovations **involve cooperation** with another party or entity?	Answer to C6) □ Yes □ No □ I don't know	1 if the firm received cooperation from the local business networks, 0 otherwise.
29. Access to Universities and Research Centres	F3) Does your firm have access to universities and research centres in the last three years?	Answer to F3) □ Yes □ No □ I don't know	1 if the firm has access to universities and research centres in the last three years, 0 otherwise.
30. Government Support	F2) Did your firm receive any form of government support in the last three years?	Answer to F2) □ Yes □ No □ I don't know	1 if the firm received any form of government support in the last three years, 0 otherwise.

A3.4 Questionnaire on Omani Small and Medium-sized Enterprises

Private & Confidential

Main Sample Source:

Riyada (Oman's Public Authority for Small and Medium Enterprises)

Welcome to our Survey

I am a PhD researcher at the University of Reading in the United Kingdom studying Omani Small and Medium-Sized Enterprises (SMEs). The main purpose of this survey is to investigate the barriers to innovation in Omani SMEs.

This survey consists of 8 sections, and it will take you approximately 20 minutes or less to complete it depending on your responses to the questions that are relevant to your firm. We hope that the results of our survey will help us in identifying the Omani SMEs' characteristics, behaviour, and the environment surrounding them. We also hope to determine the drivers and barriers of innovation at SME level in Oman. Therefore, your response to the questions below is highly appreciated.

This survey has been subject to ethical review, according to the procedures specified by the University Research Ethics Committee, and has been allowed to proceed. Please note that no firm will be identified by name, and only aggregate results will be reported. Thank you in advance for participating in our survey. Special thanks to Riyada for their collaboration and support.

Section A: Your Firm

Thinking about your **firm, who owns it, how it is managed, what does it produce, and when it was established**, please answer the following questions.Are you registered in Riyada?

- Yes
- No

A1) Are you a family-owned business?

- Yes
- No

A2) What is your firm's legal status?

- Sole proprietorship
- Partnership
- Societe Anonyme Omanaise Generale (S.A.O.G)
- Societe Anonyme Omanaise Closed (S.A.O.C)
- Others, please specify in the below box:

A2a) Please describe your product

A3) What is your firm's business sector?

Please select the sectors that apply to your business

- Production or Manufacturing
- Construction
- Transportation
- Retail Trade & Food Services
- Business Services
- Others, please specify in the below box:

A4) In which stage your business is currently in? Please select one of the following options.

- Existence/start-up
- Survival
- Success
- Take off
- Maturity
- Others, please specify in the below box:

A5) What is the total number of founders of your business?

- 1
- 2
- 3
- More than 3

A6) Are any of the founders currently executive in the business?

- Yes
- No
- I don't know

A7) In what year did your business start trading under the present ownership?

A8) How many sites/branches/subsidiaries do you have?

A9) In which governates you are located? Please tick all the options where your office, sites or branches exist.

- ☐ Al Dakhiliya
- ☐ Al Dhahirah
- ☐ Al Batinah North
- ☐ Al Batinah South
- ☐ Al Buraimi
- ☐ Al Wusta
- ☐ Al Sharqiyah North
- ☐ Al Sharqiyah South
- ☐ Dhofar
- ☐ Muscat
- ☐ Musandam
- ☐ Others, please specify in the below box:

A10) Is your headquarters or main office located in an urban area?

- ☐ Yes
- ☐ No

A11) What is the total No. of employees of your firm in the last 12 months across all sites?

- ☐ 0
- ☐ 1-5
- ☐ 6-25
- ☐ 26-99
- ☐ 100+

A12) Are your employees from different genders?

- Yes
- No

A13) Do you have female managers in your firm?

- Yes
- No

A14) What is your total Annual Sales (in Omani Rials) in the last financial year?

- Less than 100,000.
- Between 100,000 – 500,000.
- Between 500,001 – 3,000,000.
- Others, please specify in the below box:

Section B: Your Product

Thinking about your **product, brand, customers, competitors, marketing and exports**, please answer the following questions:

B1) Is your product branded?

- Yes
- No
- Not applicable

B1a) If you have a branded product, have you expanded in terms of product lines?

- Yes
- No
- Not applicable

B2) Are your products and business formally protected by trademarks?

- Yes
- No
- I don’t know

B3) Do you have unique selling points?

- Yes
- No
- I don’t know

B4) Is your product certified by any international quality standards like ISO9001?

- Yes
- No
- Not applicable

B5) Do you offer specialised services to your customers?

- Yes
- No
- I don’t know

B6) Are your customers diversified in terms of geographical areas?

- Yes
- No
- I don’t know

B6a) If yes, your customers are from which geographical area? (please select that applies)

- Local
- Regional
- International
- All of the above

B7) Do you have competitors?

- Yes
- No
- I don’t know

B8) Does your firm has its own website?

- Yes
- No
- Under construction

B8a) If yes, in which of these ways can your website currently being used?

- So that customers can order and pay for goods or services directly from your website.
- To take bookings or orders, without payment at the time.
- To promote or showcase your goods or services, with contact details so that customers can get in touch.
- Others, please specify in the below box:

B9) Does your firm use a third-party website to promote or sell your goods or services, e.g. Amazon, Etsy or eBay?

- Yes
- No
- I don’t know

B9a) If yes, in which of these ways can the third-party websites be used?

- So that customers can order and pay for your goods or services directly from this website.
- To make bookings or orders, without payment at the time.
- To showcase your goods or services, with contact details so that customers can get in touch.
- Others, please specify in the below box:

B10) Does your firm have its own social media profile, e.g. on Facebook, LinkedIn or Twitter?

- ☐ Yes
- ☐ No
- ☐ I don't know

B10a) If yes, does your firm use social media for either of these purposes?

- ☐ So that customers can order or buy goods or services from you.
- ☐ For advertising and marketing purposes
- ☐ For communication and problem-solving.
- ☐ Others, please specify in the below box:

B11) Did you export your products and services outside Oman in **the last three years**?

- ☐ Yes
- ☐ No
- ☐ Not applicable

B11a) If yes, what is the approximate percentage of your annual sales derived from exports?

B11b) Have you entered the new export market in **the last three years**?

- ☐ Yes
- ☐ No
- ☐ I don't know

B12) Does your firm have access to Information Communications Technology (ICT)?

- ☐ Yes
- ☐ No
- ☐ I don't know

B12a) Does your firm have high-speed broadband?

- Yes
- No
- I don’t know

Section C: Innovation Opportunity

Thinking about **innovation initiatives and barriers to innovation** in your firm in **the last three years**, please answer the following questions.

C1) Has your firm introduced any new or significantly improved **goods**?

- Yes
- No
- I don’t know
- Not applicable

C1a) If yes, were any of these new or significantly improved **goods**:

- New to the **firm**
- New to the **industry**

C2) Has your firm introduced any new or significantly improved **services**?

- Yes
- No
- I don’t know

C2a) If yes, were any of these new or significantly improved **services**:

- New to the **firm**
- New to the **industry**

✓ Keeping in mind the following definition:

Operational processes are a set of activities or tasks that produce a specific product or service.

C3) Has your firm introduced any new or significantly improved **Operational processes** for producing or supplying goods or services?

- Yes
- No
- I don't know

C3a) Were any of these new or significantly improved **operational processes**:

- New to the **firm**
- New to the **industry**

✓ Keeping in mind the following definition:

Organisational processes or managerial processes are tasks of decision making, communication within the firm and organisational learning such as structuring, investigating, analysing, performance management, cost management and strategic planning like talent planning, expense, and capital budgeting.

C4) Has your firm introduced any new or significantly improved **organisational or managerial processes**?

- Yes
- No
- I don't know

C4a) Were any of these new or significantly improved **organisational or managerial processes**:

- New to the **firm**
- New to the **industry**

- ✓ Keeping in mind the following definition:

  Marketing methods are promotional ways of selling the products to the right people at the right price in the right place and time

C5) Has your firm introduced any new or significantly improved **marketing methods**?

- □ Yes
- □ No
- □ I don't know

C5a) Were any of these new or significantly improved **marketing methods**:

- □ New to the **firm**
- □ New to the **industry**

C6) Did your introduction of new goods, services, operational processes, marketing methods and organisational or managerial innovation **involve cooperation** with another party or entity?

- □ Yes
- □ No
- □ I don't know

C6a) If yes, please give a **scale from 1 to 5**; where 1 indicates very weak cooperation and 5 a very strong cooperation with you from the list below. Please do not select more than one answer per row.

	Very Weak	Weak	Average	Strong	Very Strong
Other businesses within your enterprise group.	□	□	□	□	□
Suppliers of equipment, materials, services or software.	□	□	□	□	□
Clients or customers from the private sector.	□	□	□	□	□
Clients or customers from the public sector.	□	□	□	□	□
Competitors or other businesses in your industry.	□	□	□	□	□
Consultants, commercial labs or private R&D institutes.	□	□	□	□	□
Universities or other higher education institutions.	□	□	□	□	□
Government or public research institutes.	□	□	□	□	□
Others	□	□	□	□	□

C7) Is there one significant innovation by your firm you would like to mention specifically?

- □ Yes
- □ No
- □ I don’t know

C7a) If yes, please mention it here:

C8) Are your products legally protected by patents?

- Yes
- No
- I don’t know

C9) Do you invest in Research & Development (R&D) projects and activities?

- Yes
- No
- I don’t know

C9a) If yes, does your firm have an R&D section or department?

- Yes
- No

C10) Given a **scale from 1 to 5**; where 1 indicates a very weak barrier and 5 a very strong barrier, kindly rank the following **barriers to innovation** in your firm. Please do not select more than one answer per row.

	Very Weak	Weak	Average	Strong	Very Strong
The financial constraints (high cost of innovation and lack of finance).	□	□	□	□	□
The bureaucratic hurdles (laws & regulations).	□	□	□	□	□
Intellectual Property management, project management, and organisational culture.	□	□	□	□	□
Lack of technological and market information	□	□	□	□	□
Lack of R&D activities or inadequate R&D investment	□	□	□	□	□
Lack of cooperation with universities and other relevant partners	□	□	□	□	□
Others	□	□	□	□	□

C10a) If you think there are other barriers to innovation, please specify them in the below box:

C11) Does competition positively influence your decision to innovate your products, services, operational processes, organisational and managerial structures, and marketing methods?

- Yes
- No
- I don't know
- Not applicable

C11a) If yes, please give examples in the box below.

C12) Does competition negatively influence your decision to innovate your products, services, operational processes, organisational and managerial structures, and marketing methods?

- Yes
- No
- I don't know
- Not applicable

C12a) If yes, please give examples in the box below.

C13) Do you have or have you used updated equipment **in the last three years**?

- Yes
- No
- Not applicable

C14) Do you use new technology or have you experienced a major technology change **in the last three years**?

- Yes
- No
- Not applicable

Section D: Education & Skills

D1) What is the highest educational level for employees, excluding managers?

- ☐ Primary
- ☐ Diploma
- ☐ Bachelor
- ☐ Masters
- ☐ PhD
- ☐ Others, please specify in the below box:

D2) What is the highest educational level for managers?

- ☐ Primary
- ☐ Diploma
- ☐ Bachelor
- ☐ Masters
- ☐ PhD
- ☐ Others, please specify in the below box:

D3) Has your firm arranged or funded any formal training or development programme for employees over the past 12 months?

- ☐ Yes
- ☐ No
- ☐ Not applicable

- D3a) Did any of the managers receive this formal training or participated in the development programme during the past 12 months?
- Yes
- No
- Not applicable

D3b) What proportion of employees, including managers, have received formal training in the past 12 months?

- All of them
- Between 75% and 99%
- Between 50% and 74%
- Between 25% and 49%
- Between 10% and 24%
- Less than 10%
- Not applicable

D3c) Was any of this formal training and development designed to lead to a formal qualification, regardless of whether this has been achieved or not?

- Yes
- No
- Not applicable

D3d) What subjects or disciplines did the formal training or development programme covered?

- Leadership and management skills
- IT skills
- Health and safety
- Job-specific skills
- Team working skills
- Others, please specify in the below box:

D4) Which of these, if any, are reasons why you do not currently provide any formal training? (please tick what applies)

- ☐ All staff are sufficiently trained already
- ☐ Training not necessary in your type of business
- ☐ Too expensive
- ☐ Do not know where to find the right training
- ☐ Lack of time
- ☐ Employee turnover
- ☐ Others, please specify in the below box:

D5) Has your firm documented standard operating procedures?

- ☐ Yes
- ☐ No
- ☐ I don't know

D6) Do you have problems in accessing to Skilled Labour Market?

- ☐ Yes
- ☐ No
- ☐ I don't know

D7) Do you have problems in accessing to Unskilled Labour Market?

- ☐ Yes
- ☐ No
- ☐ I don't know

Section E: Finance & Growth

Considering the **finance and growth** of your firm **in the last three years**, please answer the questions below:

E1) Has your firm grown in terms of total employees?

- ☐ Yes
- ☐ No
- ☐ I don't know

E2) Has your firm grown in terms of sales turnover?

- ☐ Yes
- ☐ No
- ☐ I don't know

E3) Has your firm used finance for expansion purposes?

- ☐ Yes
- ☐ No
- ☐ I don't know

E3a) If yes, what form of finance did your firm use for expansion purposes? Please select that applies.

- ☐ Equity Finance
- ☐ Loan
- ☐ Trade Credit
- ☐ Factoring or invoice discounting
- ☐ Leasing or hire purchase
- ☐ Internal finance
- ☐ Others, please specify in the below box:

E4) How capable is your business in accessing external finance?

- Very Poor
- Poor
- Average
- Strong
- Very Strong
- Don’t know
- Not applicable

E5) How do you describe your firm growth in the last 12 months?

- Substantial Growth
- Significant Growth
- Moderate Growth
- Growth, don’t know how much
- No change
- Minor Shrinkage
- Significant Shrinkage

E6) Does your firm expect growth in the next 12 months?

- Substantial Growth
- Significant Growth
- Moderate Growth
- Growth, don’t know how much
- No change
- Minor Shrinkage

- Significant Shrinkage

Section F: Impact of government

F1) Is your Firm regulated by the local governmental body?

- Yes
- No
- I don't know

F2) Did your firm receive any form of government support in **the last three years**?

- Yes
- No
- I don't know

F2a) If yes, please specify the form of government support? (please select all that applies)

- Finance of venture
- Subsidy
- Tax exemption
- Being an incubator for some time
- Others, please specify in the below box:

F3) Does your firm have access to universities and research centres?

- Yes
- No
- I don't know

Section G: Future Plans

Thinking about your plan and development of your business **in the next three years**, please answer the following questions:

G1) Do you aim to increase the sales of your business?

- Yes
- No
- I don’t know

G1a) If yes, by approximately what percentage do you aim to increase your sales?

- 1-9%
- 10-24%
- 25-49%
- 50-74%
- 75-99%
- 100% or more

G2) How likely is that you will approach external finance providers?

- Very likely
- Fairly likely
- Not very likely
- Not at all likely

G3) Do you anticipate the closure of your firm?

- Yes
- No
- I don’t know

G4) Do you anticipate a full transfer of the ownership of your firm?

- Yes
- No
- I don’t know

G4a) If yes, will the ownership of your firm transfer partly or wholly to:

- Your own family
- Somebody else
- I don't know

G5) Does your firm plan to do any of the following?

- Increase the skills of the workforce
- Increase the leadership capability of managers
- Capital investment (in premises, machinery etc.)
- Develop and launch new products/services
- Introduce new working practice
- Others, please specify in the below box:

Section H: End

H1) If the Public Authority for Small and Medium Enterprises (Riyada) wants to carry out a further survey in about a year, to see how your firm is progressing, would you be willing to help with that research?

- Yes
- No

H2) Would you like us to email you the findings of the survey when the results are ready?

- Yes
- No

H2a) If yes, please provide us with the information below:

Name of your firm:

Address:

Firm Email:

H3) We also would appreciate if you can provide us with information about you as follows:

Your Gender:

- ☐ Female
- ☐ Male

Your position's title:

Your highest educational level:

- ☐ Primary
- ☐ Diploma
- ☐ Bachelor
- ☐ Masters
- ☐ PhD
- ☐ Others, please specify in the below box:

Your age:

- 18-34
- 35-50
- 51-65
- Others, please specify in the below box:

You reached the end of the survey. Thank you for your time. If you have any queries, you may contact Shamsa Al Sheibani on shamsa26@yahoo.com or s.m.n.alsheibani@pgr.reading.ac.uk.

The academic supervisors, Professor Mark Casson, and Dr Nigel Wadeson may also be reached on m.c.casson@reading.ac.uk and n.s.wadeson@reading.ac.uk respectively.

A3. 5 Ethics Approval

Application Form for UREC Applications

Application checklist

It must be completed by an academic staff member (e.g. supervisor)

Please to confirm that the following information has been included and is correct. Indicate (N/A) if not applicable:

Information Sheet:

Is on headed notepaper ☑

Includes Investigator's name and email/telephone number ☑

Includes Supervisor's name and email/telephone number ☑

A statement that participation is voluntary ☑

A statement that participants are free to withdraw their co-operation ☑

Reference to the ethical process ☑

Reference to Disclosure C] N/A ☑

Reference to confidentiality, storage and disposal of ☑

☐

Personal information collected ☑ N/A ☐

Consent form(s) ☐ N/A ☑

Other relevant material ☑ N/A ☐

Questionnaires ☐ N/A ☑

Advertisements or leaflets

Other (please specify)

Expected duration of the project (months) 6

Name (print) Mark Casson Signature. [redacted]

Principal Supervisor Professor Mark Casson

School: Politics, Economics and Intonational Relations

Title of Project: Survey on Omani Small and Medium-sized Enterprises

As part thesis: Small and Medium-sized Enterprises Transition to Knowledge Economy: Oman & UK.

Proposed starting date: 1st March 2018

Brief description of the Project:

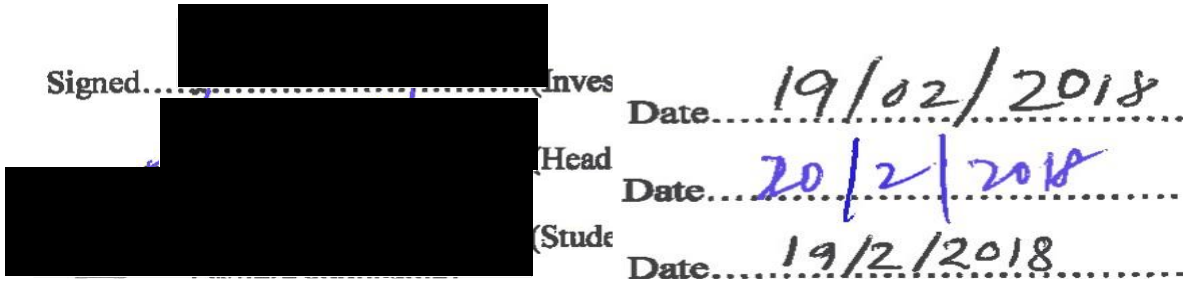
The survey targets small and medium-sized enterprises (SMEs) in Oman. It will investigate the barriers of innovation in Omani SMEs. It will also help us to identify the Omani firms' characteristics, behaviour and their business environment.

The questionnaire will be distributed to these firms through a shared link from an online survey tool, Google Forms. The Public Authority for Small and Medium Enterprises (Riyada) in Oman will help us in sharing the web link with their list of registered firms which are stored in their database. The participants of the survey are either firm founders or owners or senior executives. The results will be saved

automatically to google spreadsheets that can be easily converted to Excel file. The excel file will be exported to STATA software to perform regression analysis. The results will be compared with the results of similar analysis on a sample of British SNIE firms which data is available for free access on UK online data service.

I confirm that to the best of my knowledge I have made all information relevant to the SCFP Ethics Committee and I undertake to inform the Committee of any such information which subsequently becomes available whether before or after the research has begun.

I confirm that a list of the names and addresses subjects in this project will be compiled and that this, together with a copy of the Consent Form, will be retained within the School for a minimum of five years after the date that the project is completed. (Not applicable as the survey is not on individuals. It is on firms)



Appendix for Chapter 4

A4.1 Probit Estimator on Innovations without Firm Age Squared

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	0.083	-0.212***	0.089	-0.046	-0.067
	[0.066]	[0.074]	[0.070]	[0.068]	[0.084]
Firm Size Square	-0.018	0.040***	-0.003	0.010	0.014
	[0.012]	[0.013]	[0.012]	[0.012]	[0.014]
Exports	0.117*	-0.070	0.033	-0.084	0.173*
	[0.070]	[0.081]	[0.073]	[0.075]	[0.088]
Sites/Branches/Subsidiaries	-0.007	0.165*	-0.225**	0.129	0.216**
	[0.087]	[0.092]	[0.089]	[0.089]	[0.099]
Updated Equipments and High Technology	0.073	0.095	0.229***	0.183***	0.074
	[0.066]	[0.073]	[0.067]	[0.067]	[0.080]
High Quality Branded Product	0.482***	0.141	0.993***	0.399***	0.824***
	[0.117]	[0.130]	[0.135]	[0.123]	[0.181]
Firm Age	0.051	-0.091**	0.045	-0.033	-0.018
	[0.036]	[0.041]	[0.037]	[0.037]	[0.046]
Location	-0.126	-0.006	-0.070	0.076	-0.012
	[0.077]	[0.089]	[0.081]	[0.083]	[0.098]
Businesses Led by Female	0.012	-0.197	-0.326	0.040	-0.010
	[0.244]	[0.266]	[0.254]	[0.247]	[0.337]
Businesses Led by Male	0.034	-0.128	-0.094	0.022	0.244
	[0.218]	[0.234]	[0.220]	[0.221]	[0.295]
Executive Founders	-0.086	0.139	0.020	-0.140*	-0.101
	[0.080]	[0.094]	[0.083]	[0.083]	[0.100]
Capability for Expansion	-0.047	0.214***	-0.206***	0.058	-0.067
	[0.071]	[0.076]	[0.073]	[0.073]	[0.087]
R&D	0.132*	0.184**	0.018	-0.066	-0.007
	[0.070]	[0.079]	[0.072]	[0.074]	[0.087]
Formal IP Protection Rights	0.213*	-0.257*	0.009	-0.515***	-0.200
	[0.117]	[0.133]	[0.120]	[0.131]	[0.143]
Formal Training	-0.126*	0.291***	-0.081	0.042	0.159*
	[0.069]	[0.080]	[0.071]	[0.072]	[0.089]
Competition	0.027	0.026	-0.084	-0.112	-0.204**
	[0.083]	[0.095]	[0.085]	[0.084]	[0.102]
Access to New Exports Market	0.707***	0.510***	0.525***	0.583***	0.118
	[0.129]	[0.145]	[0.143]	[0.135]	[0.185]
Access to External Finance	-0.043	-0.044	0.135**	0.048	-0.057
	[0.064]	[0.072]	[0.065]	[0.066]	[0.080]
Access to ICT	-0.201***	0.343***	-0.088	0.483***	0.082
	[0.075]	[0.081]	[0.076]	[0.076]	[0.089]

Access to Skilled Labour Market	0.117*	-0.305***	0.287***	-0.147**	0.063
	[0.069]	[0.082]	[0.071]	[0.074]	[0.088]
Access to Unskilled Labour Market	-0.083	0.084	-0.041	0.085	0.076
	[0.073]	[0.086]	[0.074]	[0.077]	[0.090]
Access to Local Business Networks	0.435***	0.257**	0.063	0.122	0.159
	[0.093]	[0.108]	[0.096]	[0.098]	[0.121]
Access to Universities and Research Center	0.080	0.017	-0.036	-0.135	0.085
	[0.097]	[0.106]	[0.099]	[0.102]	[0.113]
Access to Government Support	-0.109	0.145	0.048	0.098	0.048
	[0.107]	[0.116]	[0.108]	[0.110]	[0.125]
Constant	-1.730***	-1.607***	-1.981***	-1.510***	-2.240***
	[0.260]	[0.281]	[0.269]	[0.263]	[0.354]
Observations	2,520	2,520	2,520	2,520	2,520
Log likelihood	-1159	-859.4	-1079	-1042	-688.5
LR Chi2	626.5	387.2	641.7	438.1	234.9
pseudo r-squared	0.213	0.184	0.229	0.174	0.146

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

A4. 2 Logit Estimator on Innovations without Firm Age Squared

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Products Innovation	Services Innovation	Operational Processes Innovation	Organisational or Managerial Processes Innovation	Marketing Methods Innovation
Firm Size	0.138	-0.352***	0.176	-0.079	-0.152
	[0.114]	[0.132]	[0.122]	[0.120]	[0.157]
Firm Size Square	-0.031	0.070***	-0.010	0.016	0.030
	[0.020]	[0.023]	[0.021]	[0.021]	[0.027]
Exports	0.198*	-0.154	0.058	-0.150	0.325**
	[0.119]	[0.145]	[0.124]	[0.130]	[0.165]
Sites/Branches/Subsidiaries	-0.008	0.267*	-0.377**	0.217	0.381**
	[0.141]	[0.158]	[0.149]	[0.148]	[0.176]
Updated Equipments and High Technology	0.116	0.161	0.371***	0.295**	0.113
	[0.110]	[0.130]	[0.113]	[0.116]	[0.149]
High Quality Branded Product	0.822***	0.259	1.823***	0.734***	1.744***
	[0.207]	[0.246]	[0.256]	[0.227]	[0.386]
Firm Age	0.081	-0.171**	0.073	-0.063	-0.027
	[0.062]	[0.074]	[0.065]	[0.065]	[0.086]
Location	-0.203	-0.021	-0.133	0.156	-0.003
	[0.131]	[0.160]	[0.138]	[0.146]	[0.184]

Businesses Led by Female	-0.001	-0.309	-0.532	0.023	-0.084
	[0.418]	[0.484]	[0.446]	[0.436]	[0.642]
Businesses Led by Male	0.031	-0.206	-0.127	0.001	0.383
	[0.370]	[0.423]	[0.386]	[0.388]	[0.554]
Executive Founders	-0.160	0.277	0.016	-0.243*	-0.151
	[0.136]	[0.172]	[0.142]	[0.145]	[0.186]
Capability for Expansion	-0.076	0.367***	-0.368***	0.114	-0.136
	[0.118]	[0.133]	[0.124]	[0.124]	[0.161]
R&D	0.213*	0.324**	0.039	-0.128	-0.020
	[0.116]	[0.140]	[0.121]	[0.126]	[0.160]
Formal IP Protection Rights	0.352*	-0.425*	0.007	-0.868***	-0.340
	[0.191]	[0.226]	[0.197]	[0.226]	[0.255]
Formal Training	-0.208*	0.499***	-0.127	0.093	0.309*
	[0.118]	[0.148]	[0.123]	[0.127]	[0.170]
Competition	0.044	0.038	-0.128	-0.199	-0.372*
	[0.144]	[0.174]	[0.151]	[0.149]	[0.194]
Access to New Exports Market	1.327***	1.037***	0.956***	1.105***	0.330
	[0.236]	[0.293]	[0.263]	[0.255]	[0.373]
Access to External Finance	-0.074	-0.073	0.218**	0.098	-0.103
	[0.107]	[0.129]	[0.110]	[0.115]	[0.148]
Access to ICT	-0.324***	0.584***	-0.142	0.803***	0.132
	[0.123]	[0.141]	[0.126]	[0.128]	[0.161]
Access to Skilled Labour Market	0.201*	-0.543***	0.467***	-0.285**	0.104
	[0.118]	[0.148]	[0.122]	[0.129]	[0.164]
Access to Unskilled Labour Market	-0.144	0.142	-0.063	0.132	0.120
	[0.123]	[0.153]	[0.126]	[0.135]	[0.166]
Access to Local Business Networks	0.710***	0.465**	0.081	0.209	0.289
	[0.158]	[0.204]	[0.160]	[0.171]	[0.230]
Access to Universities and Research Center	0.111	0.031	-0.078	-0.233	0.188
	[0.159]	[0.181]	[0.163]	[0.170]	[0.202]
Access to Government Support	-0.168	0.253	0.089	0.153	0.037
	[0.174]	[0.194]	[0.178]	[0.184]	[0.223]
Constant	-2.985***	-2.941***	-3.548***	-2.639***	-4.225***
	[0.452]	[0.521]	[0.482]	[0.468]	[0.678]
Observations	2,520	2,520	2,520	2,520	2,520
Log likelihood	-1162	-862	-1080	-1043	-689.4
LR Chi2	621.6	382.1	640.3	435.7	233.1
pseudo r-squared	0.211	0.181	0.229	0.173	0.145

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

A4. 3 MvProbit Estimator on Innovations without Firm Age Squared

VARIABLES	(1) Products Innovation	(2) Services Innovation	(3) Operational Processes Innovation	(4) Organisational or Managerial Processes Innovation	(5) Marketing Methods Innovation
Firm Size	0.084	-0.197***	0.098	-0.038	-0.061
	[0.067]	[0.074]	[0.069]	[0.068]	[0.082]
Firm Size Square	-0.018	0.038***	-0.005	0.008	0.012
	[0.012]	[0.013]	[0.012]	[0.012]	[0.014]
Exports	0.108	-0.066	0.029	-0.089	0.181**
	[0.070]	[0.080]	[0.072]	[0.075]	[0.087]
Sites/Branches/Subsidiaries	-0.007	0.161*	-0.211**	0.126	0.212**
	[0.087]	[0.093]	[0.089]	[0.088]	[0.097]
Updated Equipments and High Technology	0.059	0.093	0.224***	0.173**	0.052
	[0.066]	[0.073]	[0.066]	[0.067]	[0.079]
High Quality Branded Product	0.509***	0.115	1.002***	0.422***	0.816***
	[0.117]	[0.130]	[0.130]	[0.122]	[0.168]
Firm Age	0.045	-0.085**	0.047	-0.031	-0.019
	[0.036]	[0.041]	[0.037]	[0.037]	[0.045]
Location	-0.125	-0.009	-0.093	0.071	-0.030
	[0.077]	[0.088]	[0.079]	[0.083]	[0.097]
Businesses Led by Female	0.052	-0.193	-0.283	0.051	0.075
	[0.247]	[0.264]	[0.255]	[0.250]	[0.332]
Businesses Led by Male	0.077	-0.116	-0.070	0.013	0.279
	[0.221]	[0.232]	[0.222]	[0.225]	[0.291]
Executive Founders	-0.091	0.138	0.050	-0.137*	-0.097
	[0.080]	[0.093]	[0.082]	[0.083]	[0.098]
Capability for Expansion	-0.032	0.221***	-0.202***	0.070	-0.044
	[0.070]	[0.076]	[0.072]	[0.072]	[0.085]
R&D	0.122*	0.188**	0.022	-0.069	-0.039
	[0.070]	[0.078]	[0.072]	[0.074]	[0.086]
Formal IP Protection Rights	0.211*	-0.248*	0.002	-0.528***	-0.229*
	[0.117]	[0.132]	[0.118]	[0.130]	[0.139]
Formal Training	-0.125*	0.290***	-0.080	0.044	0.188**
	[0.069]	[0.080]	[0.071]	[0.072]	[0.088]
Competition	0.022	0.021	-0.049	-0.105	-0.182*
	[0.083]	[0.094]	[0.085]	[0.084]	[0.102]
Access to New Exports Market	0.691***	0.530***	0.517***	0.576***	0.197
	[0.129]	[0.146]	[0.138]	[0.134]	[0.175]
Access to External Finance	-0.041	-0.047	0.161**	0.049	-0.061
	[0.064]	[0.072]	[0.064]	[0.066]	[0.079]
Access to ICT	-0.207***	0.344***	-0.090	0.484***	0.076
	[0.075]	[0.081]	[0.075]	[0.076]	[0.086]
Access to Skilled Labour Market	0.121*	-0.303***	0.275***	-0.151**	0.071
	[0.069]	[0.082]	[0.070]	[0.074]	[0.086]

Access to Unskilled Labour Market	-0.089	0.091	-0.025	0.088	0.069
	[0.072]	[0.085]	[0.073]	[0.077]	[0.088]
Access to Local Business Networks	0.441***	0.236**	0.086	0.155	0.240**
	[0.092]	[0.108]	[0.094]	[0.097]	[0.117]
Access to Universities and Research Center	0.090	0.021	-0.012	-0.143	0.100
	[0.097]	[0.106]	[0.097]	[0.101]	[0.110]
Access to Government Support	-0.118	0.127	0.031	0.105	0.044
	[0.107]	[0.116]	[0.108]	[0.110]	[0.121]
Constant	-1.765***	-1.623***	-2.098***	-1.551***	-2.409***
	[0.264]	[0.279]	[0.272]	[0.267]	[0.351]
Observations	2,520	2,520	2,520	2,520	2,520

rho21	rho31	rho41	rho51	rho32
-0.212***	0.576***	0.144***	0.337***	-0.358***
[0.042]	[0.041]	[0.038]	[0.046]	[0.045]

rho42	rho52	rho43	rho53	rho54
-0.033	-0.056	0.229***	0.425***	0.487***
[0.042]	[0.047]	[0.038]	[0.045]	[0.050]

Note: Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1