Endogeneity issues in family business research: current status and future recommendations

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Endogeneity Issues in Family Business Research:

Current Status and Future Recommendations

Abstract: Although the family business research field and related disciplines are paying increasing attention to improvements in methodology, there is still insufficient attention being paid to endogeneity issues. We therefore raise awareness of endogeneity and suggest ways to reduce biased results in family business studies. We review publications in the family business literature in terms of (1) the consideration of endogeneity issues; (2) sources of endogeneity for different research topics; and (3) various methods that researchers have used to control for endogeneity. We discuss important lessons learned from the review, and offer methodologically-oriented recommendations for future family business studies.

Key Words: Literature Review, Endogeneity, Quantitative Methods, Family Business

Introduction

Over the past few decades, there has been significant growth in family business research, and increasing attention has been paid to the empirical methods and analytic techniques that are used in this research discipline (Hair & Sarstedt, 2014). There are several review articles highlighting advantages, disadvantages, and issues associated with various empirical methods and techniques (Evert et al., 2016; Pindado & Requejo, 2015; Block et al., 2011). However, endogeneity—which refers to the correlations of predictor variables with the error terms in regression equations—can bias results in quantitative studies, yet it has received insufficient attention to date.

Endogeneity is a critical issue because it compromises key conditions for claiming causality (Hamilton & Nickerson, 2003; Bascle, 2008). A failure to consider and correct for

endogeneity can lead to biased and inaccurate estimates, and may lead to incorrect conclusions about causal relationships between key variables. Different research disciplines give differing amounts of attention to endogeneity issues, and this causes scholars with different academic backgrounds to have different views, even though they may all study family business. For example, in the field of strategic management, scholars began to pay special attention to this issue in the 1990s (Shaver, 1998), and other studies have been published since then on the topic (e.g. Hamilton & Nickerson, 2003; Nandialath et al., 2014; Certo et al., 2016). There are similar studies in the areas of finance and economics that examine endogeneity issues as they relate to small business ownership (Demsetz & Villalonga, 2001; Roberts & Whited, 2013; Wintoki, et al., 2012).

To date, there has been no systematic analysis of the specific problem of endogeneity in the field of family business. However, family business research might be particularly vulnerable to endogeneity problems because of the imperfect observability of family systems. For example, the characteristics of both "family" and "business" could be shaped by the intertwining of these two systems (Bennedsen et al., 2007). This overlap between family and business systems might give rise to problems such as variable omission, selection bias, measurement error, and simultaneous causality (e.g. Barth et al., 2005; Chrisman & Patel, 2012; Cucculelli et al., 2019). In fact the *family system* as opposed to the business system may contain unobserved factors such as emotional attachments and dominant coalitions that create unobserved heterogeneity in *family firms*, and even determine the very existence of family firms (Ramón-Llorens et al., 2017). Due to family members' concerns about privacy and the difficulty in proxying unmeasured family variables, measurement error could occur (Cucculelli et al., 2019). All of these factors might result in unique endogeneity issues in family business research. An increasing number of articles in the general management field have pointed out empirical issues associated with endogeneity

(Clougherty et al., 2016; Guide & Ketokivi, 2015; Reeb, 2012; Semadeni et al., 2014). Following this trend, this paper serves the research field of family business.

In this article, we review the family business literature in terms of 1) the degree of consideration of endogeneity issues in family business studies; 2) the main sources of endogeneity in different types of independent variables; and 3) various methods (especially the instrumental variable method) that authors have used to control for endogeneity. We read 563 family business articles (in 106 different journals) that may have had endogeneity issues, and coded the information about endogeneity for each of them. We find that although the importance of addressing endogeneity has been evident for years, especially in high-quality journals, there are still gaps because a considerable number of studies either fail to discuss the sources of endogeneity, or fail to use appropriate methods to control for endogeneity. Moreover, there are still some inappropriate correction methods being used for certain sources of endogeneity.

As a result of our review, we identify the specific sources of endogeneity in family business research. Based on the type of explanatory variables, we offer suggestions of the most likely sources of endogeneity that researchers may encounter. We also identify better methods for controlling endogeneity according to different sources of endogeneity. Furthermore, we explain the most widely used method—instrumental variables—as a way to correct endogeneity problems. The fundamental purpose of this article is to offer recommendations which will help family business researchers to identify the sources of endogeneity and apply effective approaches to minimize the problem of endogeneity.

Endogeneity in Family Business Research

In this section, we define endogeneity, discuss its sources, and outline possible methods to correct for endogeneity issues. Because correlation between independent variables and the error term is the issue in endogeneity, we also describe the main types of independent variables that are

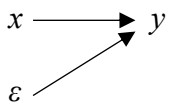
used in family business research. The sources of endogeneity we reviewed are generalized, and we will summarize the unique sources in family business research after our review of the literature. The correction methods are not evident in all the methods, and we focus only on the most widely used or theoretically representative methods.

Endogeneity and Possible Outcomes

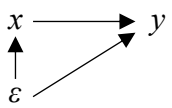
Endogeneity is typically described in the context of regression analysis. Consider the following basic simple regression equation:

$$y = \alpha + \beta x + \varepsilon$$

In this equation, y represents the dependent variable, α represents a constant, β represents the estimated coefficient, x represents the independent variable, and ε represents the error term. The simple regression model assumes that x is uncorrelated with the error ε in the equation, which means the independent variable x is *exogenous*. The only direct effect of x on y is via the term βx. The following path diagram shows this relationship schematically:



The absence of a directional arrow from ε to x means that there is no association between x and ε. The error term ε covers all factors other than x that influence y. Assume one such factor in ε is u, a high u will on average be associated with a high x, and a correlation between x and ε would be introduced. That means the independent variable x becomes *endogenous*. Then a more appropriate schematic diagram is:



where there is an association between x and ε.

Under these circumstances, the OLS estimator $\hat{\beta}$ is inconsistent with β, because $\hat{\beta}$ combines the desired direct effect of x on y (β) and the undesired indirect effect that a relationship between x and ε has on y. Thus, the independent variable x is said to be endogenous when it is related to ε. The inconsistency of $\hat{\beta}$ is referred to as endogeneity bias. Theoretically, endogeneity suggests that there might exist alternative explanations for the causal relationship.

Sources of Endogeneity

The literature emphasizes four primary sources of endogeneity: omitted variable, selection bias, measurement error, and simultaneous causality (Wooldridge, 2015).

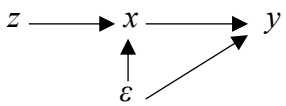
O*mitted variable bias* occurs when a variable which affects the dependent variable and is correlated with an independent variables is omitted from the regression model (Vella, 1998). The result is that the relationship between the independent variable and dependent variable is mis-specified. *Selection bias* occurs when the data are selected by some unobserved processes such that randomness cannot be guaranteed, and the sample is therefore not representative of the whole population (Clougherty et al., 2016; Greene, 2011). Self-selection, as a special form of selection bias (Certo et al., 2016), refers to a situation where individuals select themselves into a specific group. *Measurement error*, or so-called errors-in-variables, refers to a situation when variables are imperfectly measured and their true values remain unobserved (Wooldridge, 2010). *Simultaneous causality* refers to the situation where there is a reciprocal causal relationship between independent and dependent variables (Wooldridge, 2015). These four sources of endogeneity can all occur at the same time, or be inter-related with each other (Wooldridge, 2010), which means that scholars should evaluate the complete endogeneity potential of their studies.

Common Correction Methods

Several major correction methods have been developed to deal with endogeneity issues. Since we only focus on the instrumental variable method in the recommendations below, we suggest that scholars gain basic knowledge about other methods (for some notable works, see Heckman, 1979; Blundell & Bond, 1998; Li et al., 2021; Imbens & Woldridge, 2009; Abadie, 2005) when the instrumental variable method is not applicable.

[Insert Table 1 here.]

Instrumental Variable (IV) Method. This approach aims to exclude the endogenous part of an independent variable from the regression by introducing an instrumental variable, z, which has the property that z has a relationship with x but does not have a relationship with y except indirectly through its association with x. This is referred to as the exclusion restriction, which is illustrated in the following path diagram:



When there is only one endogenous variable, the most common IV method is two stage least square (2SLS). In the first stage, instrumental variables are used as independent variables to regress endogenous explanatory variables. In the second stage, the predicted values of the explanatory variables from the first stage are used for analysis. This approach is suitable for all kinds of sources of endogeneity, but finding a good instrumental variable can be challenging. We will discuss the criterion of choosing good instrumental variables in the "recommendations for using the IV method" section.

Two-stage Heckman Technique. The Two-Stage Heckman approach (Heckman, 1979; Heckman, 1990) is primarily designed for correcting endogeneity issues stemming from, or related to, selection bias including both truncation and treatment effects. Truncation occurs when only the outcomes of treated observations are observable; treatment effect occurs when we

observe outcomes of both treated and non-treated observations. Similar to the IV approach discussed above, the Two-Stage Heckman approach often relies upon instrumental variables in the first-stage Probit model, in which instrumental variables (and other controls) are used as independent variables to estimate the occurrence of the self-selecting variable. However, the instrumental variables in this method could be non-exclusive restriction (Heckman & Navarro-Lozano, 2004), which means that the choice of instrumental variables might be simpler than it is for the IV method. Based upon the estimated first-stage model, the inverse Mills ratio is calculated and then included as an additional control in the second-stage (e.g., Fattoum-Guedri et al., 2018).

Arellano-Bond Difference GMM (*Difference GMM*) and Arellano-Bover/Blundell-Bond System GMM (*System GMM*). Both methods extend the traditional generalized method of moments (GMM) approach by addressing the specific endogeneity issues associated with dynamic panel data (Arellano & Bover, 1995; Blundell & Bond, 1998; Greene, 2011). Endogeneity due to simultaneity or reversed causality are often tackled by controlling for the time lag between independent variables and the dependent variable in the model (e.g., Croce & Martí, 2014) [1]

Matching. The purpose of the matching method is to replicate the conditions of a natural experiment (Imbens & Woldridge, 2009; Rosenbaum & Rubin, 1983; Dehejia & Wahba, 2002). According to the type of technique used, it can be divided into many categories. Among them, propensity score matching (PSM) is a commonly-used matching method that uses propensity scores (occurrence probability) to simulate random grouping. This approach often requires a large

1. Nevertheless, lagging independent variables may create their own endogeneity problems. In the example mentioned above, one can argue that due to reverse/simultaneous causality, firm performance in t-2 (which by nature relates to firm performance in t) may also affect family ownership in t-1. The *Arellano-Bond Difference GMM* and *Arellano-Bover/Blundell-Bond System GMM* are designed to control for this particular type of endogeneity (which is referred to as *dynamic endogeneity* in Schultz et al., 2010, and according to Wooldridge, 2010, dynamic endogeneity can be considered a type of simultaneity problem).

sample size, and often suffers from the risk of non-randomized sample matching (Hamilton & Nickerson, 2003). PSM is mostly suitable for correcting endogeneity stemming from either omitted variable[2] or selection bias (e.g., Nekhili et al., 2018), as other endogeneity issues (including simultaneous causality and measurement error) cannot be neutralized by randomized matching[3].

Difference-in-Differences Analysis (DID). DID (e.g., Bertrand et al. 2004) refers to a statistical approach which explores the effect of an exogenous event by differentiating a treatment group (when the event happens) and a control group (when the event does not happen). This method is widely used in policy analysis, especially in analyzing the impact of changes in government policies (Athey & Imbens, 2006). DID is useful in controlling for endogeneity stemming from selection bias with exogenous treatments and events (e.g. Chang & Shim, 2015).

The Fixed Effect Model (FE). When good instruments are tough to find, researchers may rely on time series properties of the data to control for endogeneity. One such approach is fixed effect models, in which the "fixed effect" refers to those unobserved variables that are time-invariant. Hence the fixed effect can be used to correct endogeneity issues that do not change with time.

Experiments. An ideal randomized experiment can distribute the samples randomly, which ensures that the treatment level of the explanatory variables has no relationship with the error term (Stock & Watson, 2003, 2011). Thus, endogeneity bias could be eliminated. However, due to the high costs and concerns for external validity, this method is not commonly used in family business research. However, if conditions are favorable, an experiment could be a good

2. PSM may help deal with endogeneity stemming from omitted variables. This is because omitted variables might influence the distribution of groups in the sample, whereas PSM uses propensity scores to simulate randomly matched groups.
3. There are various approaches to propensity score matching including nearest neighbor, kernel, caliper, and radius (Caliendo & Kopeinig, 2008).

choice (e.g., Lude and Prügl studied the public's cognitive bias on investing in family firms in 2019).

Others. There are many other methods to correct endogeneity problems by simulating natural experiments or by combining the correction methods of endogeneity with different research methods. Although these methods are not common in family business, they may be appropriate in certain situations. For example, regression discontinuity design (RDD) is a quasi-experimental technique where the assignment to treatment and control groups is not random (D. S. Lee & Lemieux, 2010). By adopting IV approaches and using a simple two-step estimator with reduced form regression, endogeneity in semiparametric quantile regression models could also be addressed (Lee, 2007; Galvao, 2011). In survey research, IV approaches can also be combined in structural equation models (SEMs) (Sande & Ghosh, 2018).

Uniqueness of Endogeneity in Family Business Research

The family business field may be particularly vulnerable to endogeneity issues because of the owning family's involvement in the business. Family business researchers may therefore be particularly interested in *endogenous family-related independent variables* that do not exist in the general management literature. When discussing the effectiveness of instrumental variables, the exclusion restriction assumes that the instrumental variables should hold strong relevance for the independent or endogenous variables, and the effect of instrument variables on the dependent variable should only be through the independent or endogenous variable. It can therefore be argued that the special types of endogeneity in the family business field all stem from family-centered independent or endogenous variables.

Probably the most common endogenous variable that family business scholars may use is a binary variable to differentiate family from non-family firms, but there are also studies that examine different types of independent variables which are often associated with family business

heterogeneity. For instance, research shows that the nature of the goals that are set, the type of governance systems that are enacted, and the resources that are available through family involvement lead to differences in behaviors and outcomes among family firms and between family and nonfamily firms (e.g. Chrisman et al., 2012; Gómez-Mejía et al., 2011; Carney, 2005; Sirmon & Hitt, 2003). Built upon this line of literature, Chrisman et al. (2013) proposed a goals-governance-resources framework in order to explain the primary sources of heterogeneity in the family business population. Here, goals include family-centered noneconomic goals that generate socioemotional wealth (SEW), in addition to financial goals. Governance includes the form and structure of the family's control of the business. Resources include the human, social, and financial resources endowed and leveraged by the family.

In the following sections, we explain how we classify different sets of independent variables that are used in the family business literature. We discuss the different types of endogeneity issues stemming from these independent variables and their corresponding correction methods.

Review Methods

Sample Collection

To ensure the representativeness and the quality of the articles reviewed, we first checked all journals that ranked equal to or above ABS 2 that publish management articles according to the *Academic Journal Guide (2018)* by *Chartered ABS* (Appendix: Journal List). Then, using "family firm" and "family business" as keywords on Web of Science, we searched the family business literature published in each journal from 2000 to 2019; we obtained 938 articles from 138 journals in 14 fields. Next, we downloaded all 938 articles and scanned them for content. We then removed articles that used the following methods because the endogeneity issues are less likely to occur in these methods: 1) review; 2) research note; 3) commentary; 4) conceptual

article; 5) Qualitative Comparative Analysis (QCA) method; 6) factor analysis; 7) ANNOVA (analysis of variance); 8) content analysis; 9) network analysis; 10) correlation analysis; 11) meta-analysis; 12) historical study; 13) case study; and 14) other qualitative methods. After this activity, we were left with 563 articles from 106 journals in 10 fields.

Next, we checked each of these articles to see if they mentioned endogeneity issues. We searched "endog" as the prefix of related words like "endogeneity" or "endogenous variable," and then read the related content. If there was truly some concern regarding endogeneity issues, we put the article into a database entitled "articles mentioning endogeneity." If there was no search result, we browsed the methods, results, and limitation sections of the article, especially the footnotes and tables of these sections, to make sure the article did not mention this issue. If an article did not mention endogeneity, we put it into a database entitled "articles not mentioning endogeneity," and only coded its types of independent variables in the next stage. After these additional refinements, we found that 264 of the articles (46.9%) dealt with endogeneity issues in their content, while 229 (40.7%) used one or more methods to correct for endogeneity. The remaining 35 articles simply mentioned possible endogeneity issues in the limitation or discussion section.

Table 2 shows the description of sample articles in different journal categories, the independent variables that were used, and the research field. It shows that AJG(ABS) rank 4 and above (including the UTD research rankings and FT research rankings) has the highest proportion of articles addressing endogeneity issues. There is also an imbalanced distribution in the percentage of articles addressing endogeneity issues in articles with different types of independent variables. Finance and economics articles are more likely to address endogeneity concerns compared to others.

[Insert Table 2 here.]

Coding

In order to facilitate the review—which focuses on both sources of endogeneity and correction methods—we encode the text information into quantitative data. In particular, we code 1) categories of independent variables; 2) sources of endogeneity; 3) correction methods for endogeneity and 4) details in instrumental variable (IV) methods. This coding was used in both the "articles with endogeneity" and "articles without endogeneity" databases.

Categories of independent variables. The independent variables in our sample articles can be divided into four categories: 1) family firms vs. non-family firms, which focus on the difference between family and non-family firms; 2) heterogeneity in family firms, including variables related to goals, governance, and resources stemming from the intertwining of family and business systems; 3) business-related variables, including firm characteristics or firm performance; and 4) non-firm level variables, including those at the individual (e.g., the entrepreneur's personal attributes), industry (e.g., market structure), or regional (e.g., regional economic development) levels.

Sources of endogeneity. The general management literature identifies 4 sources for endogeneity (Antonakis et al., 2010; Bascle, 2008; Li et al., 2021). They include: 1) omitted variables (specifically classified as unobserved heterogeneity and omitted variable bias; similar words are "unobserved variables," "latent factors," etc.); 2) selection bias (specifically classified as self-selection and sample selection bias; similar words are "non-random," "strategic choice," etc.); 3) measurement error; and 4) simultaneous causality (similar words are "simultaneity," "reverse causality," etc.). For those articles that do not mention the specific source but refer to "endogeneity" in general, we categorize them as "no mention."

Correction methods for endogeneity. The descriptions of correction methods in most reviewed articles are clear. We coded 12 common methods, including the instrumental variable

IV method (which contains 6 subcategories), the two-stage Heckman technique (including the switch regression model), the Difference GMM and System GMM methods, PSM and other matching methods, DID and other quasi natural experiments, fixed effects, lagged explanatory variables, more control variables, and proxy variables. For some indistinguishable or rare methods, we coded them as "other methods." If the article used the IV method, we set up an additional database entitled "IV method."

Details in instrumental variable (IV) methods. We also coded the various types of instrumental variables, the process of choosing instrumental variables, and the weak instrument test. We classified the instrumental variables into four categories: family-related (those focusing on demographic information of individual family members or the whole family), business-related (those representing financial and managerial information in the business), time-related (lagged independent and control variables), and higher-level instrumental variables (those at a higher level of analysis compared to endogenous variables, such as those containing regional information).

We determined whether the choice of instrumental variable was based on sufficient reasoning, discussion, and logic. We read the related content carefully, to see if there was any description about "the instrumental variables being related to the independent variable" and "the instrumental variables not being directly related to the dependent variable." If yes, we coded "1" in "relationship with independent variable" or "lack of direct relationship with dependent variable", and "0" otherwise. We also checked the related content of the report regarding a weak instrument test. If the article reported this kind of F test and discussed the weak instrumental variable issue, we coded "1" in "weak instrument test".

Endogeneity Issues in Family Business Studies

Based on the 563 articles we coded, we report on the general situation of endogeneity issues in family business studies, including: 1) trends of reporting endogeneity issues; 2) sources of endogeneity; 3) correction methods used, and 4) details in the IV method.

Temporal Trends of Endogeneity Issues in Family Business Studies

Figure 1 shows the temporal distribution of the number of articles addressing endogeneity issues during the period from 2000 to 2019. There was some fluctuation over the years, but the number of articles addressing endogeneity has steadily increased.

Because there were only small numbers of business-related (e.g., firm performance) and other (e.g., national culture, government policy) independent variables, and because they have minimal theoretical importance, we focus only on family firms vs. non-family firms and family business heterogeneity articles. The latter refers to those articles exploring the variations within the family business population in terms of family-centered economic and non-economic goals, family-based or family–endowed resource portfolios, and family governance as well as its antecedents and consequences. As shown In Table 3, the number of articles addressing endogeneity issues increased over time.

[Insert Figure 1 and Table 3 here.]

Source of Endogeneity Issues in Family Business Studies

Table 4 shows the distribution of sources of endogeneity in our sample articles. Since some articles have multiple sources of endogeneity, we separate articles with only one source from articles reporting multiple sources. Among all articles, simultaneous causality appears to be the most common cause of endogeneity reported by family business scholars. It accounts for 37.12% (85 out of 229) of the one-source articles and 19.21% (44 out of 229) of the multi-sources articles, respectively (85 + 44 = 129 articles in total). Omitted variables occupied second

place in the sample articles, accounting for 18.78% (43 out of 229) of the one-source articles and 17.47% (40 out of 229) of the multi-sources articles, respectively (43 + 40 = 83 articles in total). Among them, unobserved heterogeneity outnumbered omitted variable bias. Selection bias was the third common source in the sample articles, appearing in 9.61% (22 out of 229) of the one-source articles and 8.30% (19 out of 229) of the multi-sources articles respectively; self-selection outweighed sample selection bias. Among all the samples, only one multi-sources article reported possible measurement error, showing that this problem has not been given enough attention in family business research.

[Insert Table 4 here.]

Table 5 matches the source of endogeneity with different independent variables. As previously mentioned, unique independent variables in the family business literature may bring in some endogeneity issues that do not exist in non-family business studies. Although the number of articles with different independent variable categories varies greatly—which may lead to the similarity of the proportion of articles from different sources—there are still slight differences in the distribution of articles from different sources. In general, articles with family firm versus non-family firm independent variables have a higher proportion of selection bias (36.59%). And there is a large proportion of simultaneous causality (62.02%) in the studies of family business heterogeneity independent variables, which implies the complex relationship between family firm heterogeneity and outcomes (Chrisman et al., 2013). Among them, governance, goals, and multiple factors (others) follow the same trend; a study using resources as an independent variable is the only article addressing the measurement error issue. For the articles with non-firm level independent variables, omitted variable bias is the most common source of endogeneity (8.43%), while articles with business-related independent variables are more likely to identify selection bias problem(12.20%).

[Insert Table 5 here.]

Correction Methods in Family Business Studies

Methods that have been used to correct for endogeneity are summarized in Table 6. As with Table 5, we separate the articles that used a single method from those that used multiple methods. Since endogeneity issues that arise from different sources demand different correction methods (Certo et al., 2016), we also count the most common sources of different methods.

[Insert Table 6 here.]

It is clear that the IV approach is the most used method, accounting for 45.85% in total (25.33% in single method articles and 20.52% in multiple methods articles, respectively). Among them, 2SLS is the most common approach. Simultaneous causality is the most important source of endogeneity identified in the articles using this approach. The two-stage Heckman technique is the second most commonly used method, and is found in 19.21% of the total articles (10.48% in single method articles and 8.73% in multiple methods articles, respectively). Although selection bias is the most common sources of endogeneity identified by those choosing this approach, there are still many articles which mention other sources of endogeneity when using this method (14 out of 24 articles used a single correction method). Difference or system GMM is also widely used (12.22% in total), with omitted variable and simultaneous causality being the most common sources of endogeneity. Matching and DID are usually used in multi-methods articles, and they are often used in combination. Most of the articles using these methods identified the issue of omitted variable, but articles with other endogeneity issues also seemed to use these two methods. Finally, fixed or random effect models are also widely used, especially in the multi-methods articles (13.54%). Only 4 articles with omitted variable used the fixed effect approach.

Instrumental Variable Approach in Family Business Studies

Our review shows that the IV method is the most common approach in addressing endogeneity issues in family business studies, and it is widely used regardless of the sources of endogeneity. In this section, we therefore evaluate this approach in more detail.

According to Wooldridge (2015), an effective instrumental variable needs to be 1) not directly related (or only weakly related) to the dependent variable; instrumental variable that violates this requirement are called invalid instrument (e.g. Murray, 2006; Wooldridge, 2015); and 2) strongly related to the independent variable (also called strong instrument); instrumental variables that violate this requirement are called weak instruments (e.g. Sanderson & Windmeijer, 2016). These two conditions are often discussed under the condition of "exclusion restriction" which as noted above means that the instrumental variables should hold strong relevance to the independent or endogenous variables, and the effect of instrument variables on the dependent variable should only be through the independent or endogenous variables (e.g. Adams et al., 2009).

Choosing the right instrumental variables is crucial because an invalid or weak instrument may cause inconsistent estimation and cannot correct endogeneity issues. Table 7 reports information on instrumental variables, including the number of articles in each category, instrumental variable statement, type of independent variable, and the weak instrument test in these articles using the IV approach. We divided the instrumental variables into four categories according to the coding section, and we also separated the single type of instrument articles from the multi-type ones.

[Insert Table 7 here.]

Table 7 shows that the business-related variable is by far the most commonly used instrument, with the family-related instrumental variable a distant second. More than half of the articles did not clarify if the instrumental variable was effective, or did not provide sufficient

reasoning, discussion, and logic for making that determination. Furthermore, only 25.0% (single type of instrument) and 40.0% (multi-types of instrument) of the articles reported the weak instrument test in their research.

For studies using a single type of instrument, 53.16% discussed how the instrumental variable is related to the independent variable, and 45.57% discussed why the focal instrumental variable is not likely to have a strong direct correlation with the dependent variable. Articles using family/non-family firms or non-firm level independent variables account for most of these articles, and 40.0% of them reported the weak instrument test. There are 11 articles in total that used time-related instrumental variables, but only a few of them report how instruments were chosen and the result of a weak instrument test. The articles using higher-level instruments had the highest ratio of reporting the theoretical validity of instrument variables (66.70% in the single type of instrument and 53.80% in the multi types of instrument, respectively). The ratio of the weak instrument test fluctuated among different categories.

Challenges of Endogeneity in the Family Business Literature

Our review shows an increasing trend of addressing endogeneity issues in family business research; it also shows diverse discussions of the issue, as well as various approaches for dealing with endogeneity that add robustness to our understanding. and empirical challenges in addressing endogeneity issues. We discuss several of these gaps in the following paragraphs.

Unbalanced Distribution across Different Disciplines

Articles published by scholars from different disciplines exhibit large variations in dealing with endogeneity issues (see Table 2 for details). For example, in our sample, 79.30% of the finance journal articles and 64.29% of the economics journal articles at least attempt to address the issue of endogeneity. But only 32.11% of entrepreneurship articles discussed endogeneity issues. Similarly, only about 30% of the articles on ethics, international business,

and strategy dealt with endogeneity issues. This may be due to different backgrounds among scholars. Indeed, our review suggests that family business researchers without an economics or finance background should pay more attention to endogeneity issues in their empirical research.

Unbalanced Distribution of Independent Variables

The literature shows that family firms not only differ significantly from non-family firms (Gómez-Mejía et al., 2011), but also differ from each other (Chua et al., 2012; Sharma & Nordqvist, 2008). As we discussed earlier, the literature has a very strong emphasis on the family versus non-family firm variable (48.72%), and the variable measuring heterogeneity caused by family governance (43.89%). There are fewer studies directly using family-centered goals (10.71%) or family-endowed resources (28.21%) as independent variables.

Thus, while we encourage more research on family business goals and resources as independent variables, it is also important to note that these two types of independent variables might bring in endogeneity issues that are different from the cases in which either family versus non-family binary variables or family governance variables are used.

Measurement Errors

There are several potential sources of measurement errors in the family business literature. For example, when taking a survey, family members might be inclined to under-report family ownership or family conflict to present a "low profile" to the public, especially given the prevailing criticism toward family firm governance in businesses. Indeed, since family respondents might intentionally *manipulate their answers* for family or firm reasons, measurement error might be more severe in the family business field than in other management disciplines. However, only one article in our sample mentioned this possibility (Table 4). While the existence of measurement error does not necessarily mean low quality data or the existence of

endogeneity issues, scholars need to seriously consider the possibility of measurement errors and take action to ameliorate their effect.

Mismatch between Source and Correction

We found some mismatches between the source of endogeneity and the correction methods that were applied (see Table 6). We also found some clearly inappropriate methods used by family business scholars. We found that many articles that used the two-stage Heckman technique did not discuss the existence of selection bias. As Certo et al. (2016)'s simulation showed, the Heckman method is not effective when other sources of endogeneity are present. We also found that in some articles lagged variables were used to solve the simultaneous causality problem. Bellemare et al. (2017) pointed out that lagged variables are only appropriate for specific types of endogeneity issues. We discuss this issue in the section on time-related instruments below. Besides, there may be dynamic panel issues in this circumstance which would require simultaneous modeling of both causal directions. Finally, some articles with selection bias claimed that using more control variables is helpful, which is not completely accurate. Even if there is an omitted variable issue, more control variables can only play a limited role. Therefore, we suggest that researchers should analyze the possible sources of endogeneity in detail and choose robust correction methods for specific sources.

Errors in Using the IV Approach

When we coded the sample articles by reading them thoroughly, we noticed that some articles using the IV approach did not report all the test results that are needed to justify the use of instruments. And in most of the cases authors did not offer the test results in detail. Also, some articles reported only part of the process, tests, and statistics (see Table 7). If the instruments they selected cannot meet the conditions, the IV method cannot successfully correct the endogeneity

issues (Semadeni et al., 2014). This is because the effectiveness of the IV method depends heavily on the quality of the instruments.

Our review also shows that a considerable number of articles using the IV method did not specify the theoretical reasoning for the selection of instruments. This might increase the risk that the strong instrument and exclusion restriction requirements cannot be met. Similarly, a considerable number of articles do not report the weak instrument test or other test results, so the corrected results may still be biased. We call on future scholars to use the IV method according to the recommendations we provide below.

Recommendations for Using Instrumental Variables

As discussed above, the family business literature might present some unique challenges in resolving endogeneity issues. Given the fact that the Instrumental Variable method remains the most prevalent approach for dealing with endogeneity, we offer some specific recommendations on how to use the IV approach in family business studies. Below, we discuss sufficient reasoning and other issues behind the selection of instrumental variables, the report of initial results, invalid and weak instrumental variables, and model selections.

Sufficient Reasoning

Use of the IV method should be based on logical reasoning at each step in the process. That is to say, the source of endogeneity should be fully analyzed, instrument selection should be based on valid reasons, and the results of the IV method should be fully evaluated.

Reasoning behind the sources of endogeneity

To begin, the sources of endogeneity in the family business field should be clearly identified. Since endogeneity issues could be highly related with the independent variables and the appearance of unique family business related independent variables, special sources of

endogeneity in family business research may occur. Thus, we read related articles in detail and summarized unique sources of endogeneity in family business research. They are: 1) selection bias of family business; 2) omitted variables in family business; 3) simultaneous causality caused by business affecting the family; 4) measurement error from manipulated answers by family members; and 5) measurement error from family proxies. We suggest researchers choose a correction method according to the source of endogeneity, and we give practical suggestions on how to use the IV approach to better handle the challenges arising from endogeneity issues.

Failing to specify the sources of endogeneity might result in a mismatch between the source and the correction method. In addition to the sources of endogeneity in management studies we mentioned above, scholars of family business should pay special attention to the five unique sources that exist in family business research.

Selection bias of family business. There is a certain type of selection bias which usually appears in research that uses the distinction between family firms and non-family firms as an independent variable. There is a bias because the establishment or sale of a family business is not random (Chua et al., 2012). Any study of long-lived family firms is potentially susceptible to this selection bias. Similarly, firm strategy, firm goals, and performance outcomes might motivate the owning family to either strengthen or weaken its presence in the business. Put differently, whether a family firm remains a family firm is often a function of past performance and future prospects, whereas nonfamily firms typically only see ownership passing from one nonfamily owner to another and therefore their governance form is not affected.

Omitted variables in family business. In the family business field, strategic decisions are often assumed to be driven by family-centered noneconomic goals. Furthermore, family-centered noneconomic goals both influence and are influenced by the family's retention of a controlling interest in the firm. For example, Carnes and Ireland (2013) develop a conceptual model of how

the relationship between family goals and resources (familiness) and resource-bundling processes affect firm innovation. However, family-centered noneconomic goals are rarely measured. Scholars must consider the potential bias caused by the omission of these goals, and use methods designed for correcting that bias.

Business affecting the family. When exploring the causal connection between family involvement and firm level outcomes, there is a possibility that not only might the family affect the business, but the business might also affect the family. Thus, the problem of simultaneous causality might be particularly pronounced in the family business field, and a corresponding correction method should be used.

Manipulated answers by family members. As we mentioned earlier, family members may manipulate answers to questions about the family and the firm to maintain the family's privacy and reputation. This possibility exists in studies using questionnaires and/or interviews. We suggest that when researchers use items that family members might consider sensitive as independent variables, the possibility of such errors should be fully considered. The use of variables from different data generating processes or different databases, as well as verifying the information using archival data might help mitigate this issue.

Family proxies. In the study of family businesses using secondary data, there are often a large number of "previously applied residual proxies (e.g., family ownership and/or management)" (Hauck et al., 2016). Although an increasing number of comprehensive measurements of family business have been developed to capture different aspects of family involvement in business (e.g., Berrone et al., 2012; Gómez-Mejía et al., 2011; Debicki et al., 2016; Zellweger, 2017), or family characteristics (Chu, 2011; Xu et al., 2015; Long & Mathews, 2011), there are still many studies using simple governance characteristics to proxy family business.

Reasoning behind the selection of instrumental variables

The selection of instruments should have sufficient reasoning. Although IVs are currently the most widely used method for correcting endogeneity issues in family business research, we still found that many articles are not rigorous enough in using this method. When using IV, it is of critical importance to find proper instrumental variables. Exclusion restrictions or strong instrument requirements should be met but since there are few tests that can determine whether the exclusion restriction is met, researchers must rely on judgment backed by reasoning and logic. The process that is used should clearly explain theoretically why each instrumental variable is related to the independent variable and not directly related to the dependent variable. This process is very important because previous studies have shown that inappropriate instrumental variables may lead to more biased results compared to OLS estimates (Larcker & Rusticus, 2010). As part of the nature of the endogeneity problem, we suggest that researchers discuss the direction of the bias whenever possible.

Instrumental Variable Selections

We also recommend the exercise of creativity when selecting high-quality instrumental variables. First, we suggest that researchers consider instruments from different data generating processes or from different databases to avoid the common method bias between instruments and dependent variables (Jakobsen & Jenson, 2015; Conway & Lance, 2010). This is especially important in studies based on primary data where a single or small number of respondents may be the source of all or most of the data being used. When the instrumental variables come from the same closed system as the dependent variables, the risk of an underlying relationship between these two may increase. Specifically, using variables from the same data generating process or database might lead to selection bias issues, if the variables are selected by the same unobserved process associated with the database. Similarly, if measurement error is aligned with data entry and data processing, then using multiple variables from the same data generating process or the

same database may enhance the risk of endogeneity issues. Last, using multiple data generating processes and databases might enhance the breadth of valid instrumental variables that scholars can use in addressing endogeneity issues in family business. For example, the financial and managerial variables in Bennedsen et al. (2007) come from Købmandsstandens Oplysningsbureau (KOB) which is a dataset assembled by a Danish private firm using annual reports. The family-related instrument (the first-born child's gender), is collected from the official Danish Civil Registration System.

Second, we recommend that researchers choose instruments with fewer shortcomings. In the following paragraphs, we evaluate the advantages and disadvantages of several common types of instruments for reference. Since it is rare to find a perfect way to deal with endogeneity problems in the existing literatures (Li et al., 2021), the examples in the following may not be perfect.

Business-related Instruments

There are many articles using business- related instrumental variables (see Table 7). But business-related variables are not always preferred, especially when the dependent variable is also business-related. In this scenario, it might be challenging to explain the lack of a relationship between instrumental variables and dependent variables.

Family-related Instruments

For family business studies, it is almost intuitive to use family-related instruments, especially when the independent variable concerns the family's involvement in the business (e.g., family ownership), and the dependent variable is addressing a specific phenomenon in the business (e.g., a firm's strategy or performance). One unique advantage of family-related instrumental variables is their lack of relationship or weak relationships with either firm behavior or performance. For instance, Bennedsen et al. (2008) used the CEO's number of children as an

instrument to test the true relationship of board size with firm performance. However, finding a good family-related instrument could be challenging.

Time-related Instruments

The IV-based GMM method, and its extensions (Difference GMM and System GMM), use lagged independent variables as instruments. Compared to other IV-based approaches, GMM does not rely upon external exogenous instruments, which in practice might be difficult to identify. Nevertheless, GMM can only be used when the database is longitudinal. Also, several tests need to be performed in order to warrant the validity of instruments and the specification of the GMM models (Roodman, 2009). As Bellemare and colleagues note (2017), time-related instruments such as lagged independent variables are not appropriate in situations where 1) endogeneity stems from omitted variables with no temporal dynamics; 2) reverse causality does not exist; or 3) reverse causality exists but the causal effect of independent variable on the dependent variable is only contemporaneous (Bellemare et al., 2017).

Higher-level Instruments

This category includes social, regional, and industry instruments that are related to endogenous independent variables, but won't influence the dependent variables directly. One advantage of higher-level instruments is that they often come from a database that is different from the primary database. Also, these instruments are often obtained from public databases, hence no additional survey or interview is needed. Nevertheless, scholars still need to justify why these instruments are not directly relevant to the dependent variable. However, a higher-level instrument might only have limited power in explaining variation at a lower level, which may lead to a weak instrument problem. For instance, when studying how copreneurship affects the profitability of family firms, scholars can search for regional variables such as the frequency of divorce, which by nature reflects that both wives and husbands would be involved in a family

business (Amore et al., 2017). Nevertheless, such an instrument does not explain the differences of two family firms that are located in the same city. In this regard, researchers need to "disaggregate" the region or industry as much as possible (e.g., use county data rather than state data or 4-digit rather than 2-digit SIC codes), since instruments at a lower level can explain more variations among endogenous variables. It is also important to select higher level instruments with different bases (e.g., region versus industry). Put differently, two instruments based on the same type of aggregation might be highly correlated and yield little additional predictive power than one. Using higher-level instruments in combination with other family- or time-related instruments is another alternative.

[Insert Table 8 here.]

Report Initial Results

As mentioned above, some studies have shown that estimates using IV methods might also be biased; sometimes even more so than OLS estimates (Larcker & Rusticus, 2010). It may be because of the quality of the instruments, since weak or invalid instruments can increase rather than reduce estimation biases. As W. Jiang (2017, p. 128) argues,

> In theory an IV estimate could actually deviate even more than the corresponding un-instrumented estimate from the population average treatment effect in the same direction if an exogenous shock changes the probability of treatment but does not result in uniform assignment between the treated and not-treated.

Also, scholars may be motivated to select instruments that yield the best results aligned with their hypotheses.

Invalid Instrument

For methods using instrumental variables such as 2SLS, authors need to test whether the instrument variables are significantly correlated with the independent variables and the dependent variables. In the case of the instrument and the independent variable there should be reason to assume that the correlation is due to a causal relationship. However, in the case of the instrument and the dependent variable there should be strong arguments about why the instrument does not directly cause the dependent variable even though the two are correlated. This is important because there are few if any statistical tests that can determine if the instrument is valid, i.e., meets the exclusion restriction. Researchers should also ensure that the coefficients of the instrumental variables are significant in the first stage of the model. It is difficult to achieve the exclusion restriction, it is at least possible to determine the individual and joint significance of the estimated coefficients of instrumental variables in the first stage regression.

Over-identifying restriction tests, such as the Sargan test (Sargan, 1958), Hansen's J-statistic (L. P. Hansen, 1982), and the Basmann statistic (Basmann, 1960), are among the few available for identify whether the instruments are valid. But these are applicable only for situation of over-identification (using more instruments than necessary for at least one endogenous variable). The null hypothesis is that all instruments are exogenous and valid assuming that at least one of the instruments is exogenous (Larcker & Rusticus, 2010; Roberts & Whited, 2013). Rejection of the null hypothesis can mean that some instruments are either correlated with the errors and the dependent variable, or that they are omitted variables that should be included as control variables in the model.

In either case, the model as estimated is not correctly specified. When the instruments are plausibly or approximately exogenous, it can still be used (Conley et al., 2012). Running a union of confidence interval (UCI) estimation, a local to zero (LTZ) estimation, and a full Bayesian approach are all suitable for this issue.

Weak Instrument

The purpose of the weak instrument test is to determine if the instrument is sufficiently correlated with the endogenous variables. The weak instrument test intends to specify whether the instruments are weak, i.e., they explain little variation in the endogenous variables (Bascle, 2008). Multiple tests are available that can be used. If only one variable is believed to be endogenous, the Conditional Likelihood Ratio (CLR) test is recommended (Moreira, 2003). If models include more than one endogenous variable, then AR tests (Anderson & Rubin, 1949) can be used. Given a weak instrument, Baltagi (2007) suggests that scholars should either find better instruments, or use alternative regression techniques such as limited information maximum likelihood estimation (LIML) that are less vulnerable to weak instrument issues.

In addition, if the exclusion restriction can be met for multiple instruments, arguably multiple instruments can be better than a single instrument. However, choosing many instruments may create the "many instrument problem" because it makes the exclusion restriction more complex to assess. When there are many weak instruments, the jackknife instrumental variables estimator (JIVE) could help address the problem (C. Hansen & Kozbur, 2014). Kolesár et al. (2015) pointed out that a modified-bias-corrected-two-stage-least-squares (MBTSLS) estimator could help many invalid instruments achieve consistent estimation.

Model Selection[4]

In addition to the above models that are suitable for dealing with invalid and weak instruments, there are several other common models. IV-2SLS is the most common approach in the Instrumental Variable category (Chrisman & Patel, 2012). IV-3SLS is primarily used for structural equations in which at least one equation contains endogenous independent variables

4. To yield better estimates, the error should be adjusted for heteroscedasticity especially for the second stage of 2SLS (McCullagh & Nelder, 1989).

(e.g., Liu et al., 2015). IV-Probit/Logistic and IV-Tobit are used for dummy or censored dependent variables (e.g., Du, 2015). However, given this situation the risk of forbidden regression (Wooldridge, 2010) may arise. Forbidden regression refers to the situation where the first-stage model uses a non-linear regression technique (e.g. Probit or Logit). Forbidden regression might result in biased estimates, as only linear regression in the first stage guarantees that covariates and fitted values in the second stage will be uncorrelated with the error (Wooldridge, 2010).

We suggest that scholars use these models cautiously and choose other model specifications to test for robustness. For example, the Generalized Method of Moments (GMM) encompasses a system of two sets of dynamic equations developed by Blundell and Bond (1998), and the IV-GMM[5] approach refers to the analytic model in which instrumental variables are used to analyze endogenous variables in a set of multiple dynamic equations (e.g. Herrera-Echeverri et al., 2016).

Finally, there are a number of tests that authors can use to ensure the validity of methods used in controlling for endogeneity. The Hausman or Durbin-Wu-Hausman (DWH) test is often used as a proxy for the presence of underlying endogeneity issues. In general, the goal of the Hausman test is to determine whether the OLS estimates are consistent. If the test yields an insignificant result, then we cannot reject the null hypothesis and it is not necessary to control for endogeneity. The effectiveness of the Hausman test depends upon the selection of instrumental variables. In other words, if authors do not select appropriate instruments, it is quite possible that

5. Generally speaking, the use of the Generalized Method of Moments (GMM) in controlling for endogeneity (Ullah et al., 2018) refers to the Difference GMM and the System GMM.

the Hausman test might yield an inaccurate result (Semadeni et al., 2014). Hence, it should be used with caution[6], and conducted only after finding a good instrument.

Discussion and Conclusion

Endogeneity is an importance empirical issue in management disciplines, especially in the family business literature. When aiming to publish high quality articles, family business researchers must pay attention to the potential impact of endogeneity issues, as well as possible approaches that will help to control for endogeneity. Based on our review, it appears that family business researchers have not paid enough attention to the issue of endogeneity. Our review (Tables 5-8) suggests that there are several issues in the field of family business research that need to be addressed.

To begin, the familiarity of scholars with the endogeneity problem is unbalanced across disciplines. Scholars coming from sociology, psychology, and even management studies need to become more acquainted with endogeneity and pay more attention to controlling it. In addition, we also find that the family business literature has not paid enough attention to endogeneity in general, particularly endogeneity that emanates from measurement error. Measurement error might be particularly relevant to family business, given the privacy and secrecy concerns of the owning family. Furthermore, we find some mismatch between the sources of endogeneity and the correction methods. For instance, the Heckman method is often misused, as this method is designed to tackle endogeneity issues stemming from selection bias. Finally, studies need to consistently disclose the theoretical reasoning for the selection of instrument variables, and include appropriate tests of instrumental variables to increase the likelihood that they meet exclusion restriction requirements.

6, See the following link on how to perform the Durbin-Wu-Hausman Test in STATA
https://www.stata.com/support/faqs/statistics/durbin-wu-hausman-test/

Given the current status of the field, we provided recommendations for analyzing unique sources of endogeneity, and we also discuss recommendations on applying the IV approach in family business studies. For instance, we recommend that family business researchers disclose more information when tackling possible endogeneity in their studies; this includes analyzing the source of endogeneity and elaborating the reasons for choosing instruments. Family business researchers should also be creative when choosing instruments. In this regard, we evaluate different types of instruments, the advantages of using different databases, and how to deal with weak or invalid instruments.

In this paper, we have tried to use language that a typical sociology, psychology, or management scholar can understand when we discuss empirical issues and correction methods that are relevant to the issue of endogeneity. We have tried to avoid writing an article full of statistical and econometric terms. But we also recognize that our study has some limitations. The recommendations we present are based the methods which researchers have already used in the literature. It is possible that we have missed some new statistical techniques that have been used to address endogeneity issues in the family business literature. If this is so, we encourage other researchers to identify and use those new techniques to increase our understanding of endogeneity issues. We hope that our review and our recommendations will help family business researchers to better understand endogeneity issues and the possible means that can be used to correct for endogeneity.

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Figure 1: Numbers of Articles Addressing Endogeneity Issues

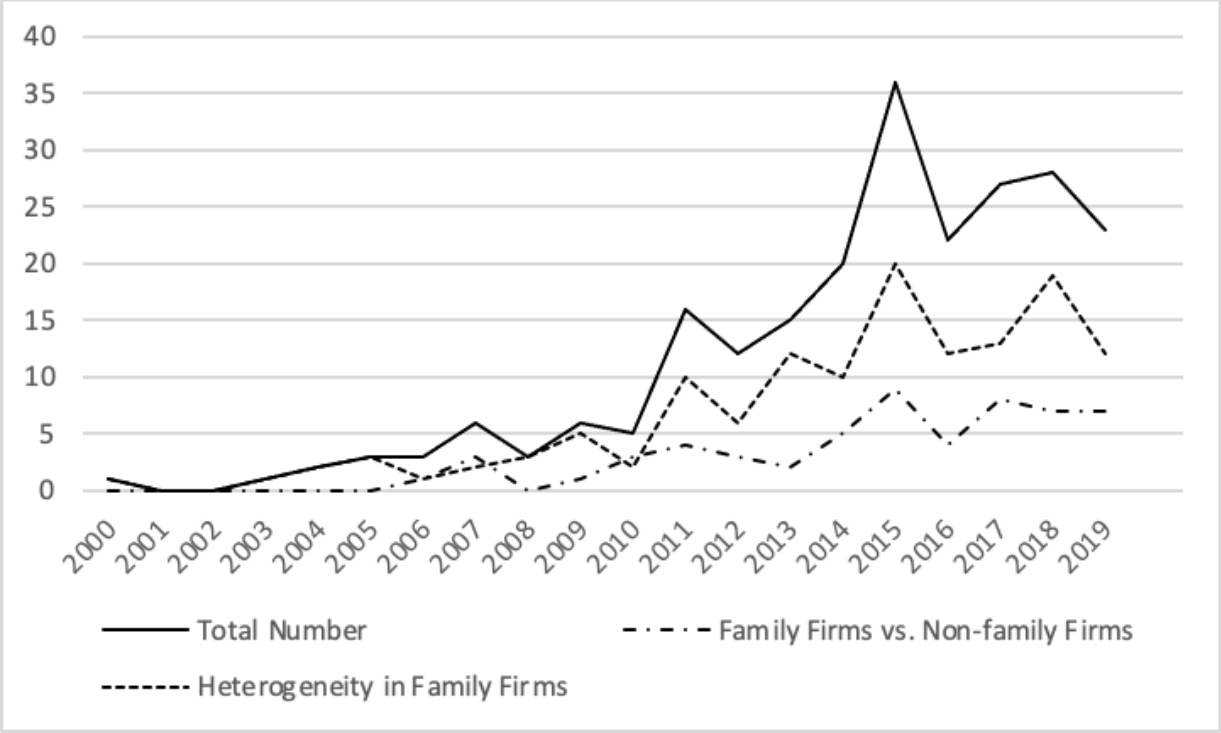

Table 1: Matching Endogeneity Sources with Correction Methods

Correction Methods	**Sources of Endogeneity**
Instrumental Variable (IV)	Suitable for all sources.
Two-Stage Heckman Technique	Selection bias.
Difference/System GMM	Omitted variable issue. Also dynamic endogeneity issues in longitudinal analysis.
Fixed Effect Model	Omitted variables that do not change over time.
Matching	Omitted variables and selection bias.
Difference-in-Differences Analysis	Omitted variables and selection bias caused by the difference between exogenous treatment and control groups, or by the rise of certain exogenous events.

Table 2: Article Description

		Total Number of Articles	Number of Family Business Articles Addressing Endogeneity Issues	Proportion (%)
Journal Category	UTD Research Rankings	36	19	52.78%
	FT Research Rankings	140	64	45.71%
	AJG (ABS) Rank 4 and above	163	87	53.37%
	AJG (ABS) Rank 3	241	95	39.42%
	AJG (ABS) Rank 2	159	47	29.56%
Independent Variable Type	Family Firms vs. Non-family Firms	117	57	48.72%
	Heterogeneity in Family Firms	341	134	39.30%
	Governance	262	115	43.89%
	Resource	39	11	28.21%
	Goals	28	3	10.71%
	Others	12	5	41.67%
	Business Related	52	24	46.15%
	Non-Firm Level	53	14	26.42%
Research Field	Accounting	38	14	36.84%
	Economics	14	9	64.29%
	Entrepreneurship - Small Business Management	246	79	32.11%
	Ethics-Corporate Social Responsibility-Management	94	32	34.04%
	Finance	87	69	79.31%
	Human Resource Management & Employment Studies	9	0	0.00%
	International Business & Area Studies	39	14	35.90%
	Innovation	8	3	37.50%
	Organization Studies	4	2	50.00%
	Strategy	24	7	29.17%
Total		563	229	40.67%

Note. There were 35 out of 563 articles that mentioned endogeneity issues in the Conclusion or Limitations sections. The research field is categorized according to the Academic Journal Guide (2018) by Chartered ABS. "Non-firm-level independent variable" means the variable is from the individual, industry, or regional level (e.g., national culture, one-child policy); "business related independent variable" means some business variables other than governance, resources, or goals type (e.g., firm performance, firm size).

Table 3: Number and Percentage of Articles Addressing Endogeneity (2000-2019)

Year	Family Firms vs. Non-family Firms	Heterogeneity in Family Firms	Total Number
Period 1: 2000-2004			
Number of studies addressing endogeneity issues	0	4	4
Number of total studies	0	11	12
Period 2: 2005-2009			
Number of studies addressing endogeneity issues	5	14	21
Number of total studies	13	41	64
Period 3: 2010-2014			
Number of studies addressing endogeneity issues	17	40	68
Number of total studies	40	132	212
Period 4: 2015-2019			
Number of studies addressing endogeneity issues	35	76	136
Number of total studies	62	157	275
Cumulative: 2000-2019			
Number of studies addressing endogeneity issues	57	134	229
Number of total studies	115	341	563

Table 4: Sources of Endogeneity

Source of Endogeneity	Number of Articles	Proportion (%) among 229 Family Business Articles Addressing Endogeneity Issues
Omitted Variable	43	18.78%
Unobserved Heterogeneity	29	12.66%
Omitted Variable Bias	14	6.11%
Selection Bias	22	9.61%
Self- Selection	18	7.86%
Sample Selection Bias	4	1.75%
Measurement Error	0	0.00%
Simultaneous Causality	85	37.12%
Multiple Sources	51	22.27%
Include: Omitted Variable	40	17.47%
Include: Selection Bias	19	8.30%
Include: Measurement Error	1	0.44%
Include: Simultaneous Causality	44	19.21%
No Specific Mention	28	12.23%

Note. One article might report multiple sources of endogeneity

Table 5: Source of Endogeneity in Different Independent Variable Categories

Independent Variable Types	Omitted Variable		Selection Bias		Measurement Error		Simultaneous Causality	
	Num.	Prop.	Num.	Prop.	Num.	Prop.	Num.	Prop.
Family Firms vs. Non-family Firms	26	31.33%	15	36.59%	0	0.00%	28	21.71%
Heterogeneity in Family Firms	45	54.22%	20	48.78%	0	0.00%	80	62.02%
Governance	38	45.78%	18	43.90%	0	0.00%	69	53.49%
Resource	6	7.23%	1	2.44%	1	100.00%	7	5.43%
Goals	0	0.00%	0	0.00%	0	0.00%	1	0.78%
Others	1	1.20%	1	2.44%	0	0.00%	3	2.33%
Business-Related	5	6.02%	5	12.20%	0	0.00%	12	9.30%
Non-Firm Level	7	8.43%	1	2.44%	0	0.00%	9	6.98%

Note. Because this table does not count articles with "no specific mention" in sources of endogeneity, and because there are 51 articles that have multiple sources of endogeneity (see Table 4), the number of articles with different independent variables types in this table is not equal to the number of articles in Table 2.

Table 6: Endogeneity Correction in the Family Business Literature

Correction Methods for Endogeneity	Number of Articles	Proportion (%)	Main Sources of Endogeneity (claimed in articles)
Instrumental Variables (IV)	58	25.33%	Simultaneous Causality (33)
IV—2SLS	51	22.27%	
IV—3SLS	1	0.44%	
IV—Probit / Logistic	2	0.87%	
IV—Tobit	2	0.87%	
IV—GMM	1	0.44%	
IV—Others	1	0.44%	
Two-Stage Heckman Technique	24	10.48%	Selection Bias (10)
Difference / System GMM	17	7.42%	Omitted Variable (11); Simultaneous Causality (11)
Matching	9	3.93%	Omitted Variable (4)
Difference-in-Differences Analysis	2	0.87%	Omitted Variable (1); Simultaneous Causality (1)
Fixed Effect Model	6	2.62%	Omitted Variable (4)
Lagged Explanatory Variables	17	7.42%	Simultaneous Causality (11)
More Control Variables	5	2.18%	Selection Bias (3)
Multiple Methods	82	35.81%	Simultaneous Causality (52)
Include: IV	47	20.52%	Simultaneous Causality (31)
Include: Two-Stage Heckman Technique	20	8.73%	Selection Bias (12)
Include: Difference / System GMM	11	4.80%	Simultaneous Causality (8)
Include: Matching	17	7.42%	Simultaneous Causality (10)
Include: Difference-in-Differences Analysis	9	3.93%	Omitted Variable (5)
Include: Fixed/Random Effect Model	31	13.54%	Simultaneous Causality (22)
Other Methods	9	3.93%	Omitted Variable (4); Simultaneous Causality (4)
Total	229	100.00%	Simultaneous Causality (129)

Note. Main sources of endogeneity are extracted from the original articles. These are the "claimed" sources of endogeneity from articles using different types of correction methods. 2SLS = two-stage least square; 3SLS = three-stage least square; GMM = generalized method of moments.

Table 7: Categories of Instrumental Variables

Category	Number	Relationship with Independent Variable	Lack of Direct Relationship with Dependence Variable	Independent Variable Types (Decending Order, Only Top 3 listed)	Weak Instrument Test
Family- related variables	10	9 (90.0%)	8 (80.0%)	Family Firms vs. Non-family Firms (4); Others (3); Heterogeneity in Family Firms – Governance (2)	4 (40.0%)
Business- related variables	60	30 (50.0%)	25 (41.7%)	Heterogeneity in Family Firms – Governance (35); Family Firms vs. Non-Family Firms (15); Business Related (5)	15 (25.0%)
Time- related variables	6	1 (16.7%)	1 (16.7%)	Heterogeneity in Family Firms – Governance (5); Business Related (1)	1 (16.7%)
Higher- level variables	3	2 (66.7%)	2 (66.7%)	Family Firms vs. Non-family Firms (1); Heterogeneity in Family Firms – Governance (1); Others (1)	0 (0.00%)
Multiple categories	18	9 (50.0%)	6 (33.3%)	Heterogeneity in Family Firms – Governance (8); Family Firms vs. Non-family Firms (6); Business Related (3)	7 (38.9%)
Include: Family- related variables	5	2 (40.0%)	0 (0.0%)	Heterogeneity in Family Firms – Governance (2); Family Firms vs. Non-Family Firms (1); Heterogeneity in Family Firms – Resources (1)	0 (0.00%)
Include: Business- related variables	15	6 (40.0%)	5 (33.3%)	Heterogeneity in Family Firms – Governance (6); Family Firms vs. Non-Family Firms (6); Others (2)	6 (40.0%)
Include: Time- related variables	5	2 (40.0%)	2 (40.0%)	Heterogeneity in Family Firms – Governance (2); Family Firms vs. Non-Family Firms (2); Business Related (1)	2 (40.0%)
Include: Higher- level variables	13	7 (53.8%)	5 (38.5%)	Heterogeneity in Family Firms – Governance (6); Family Firms vs. Non-Family Firms (4); Business Related (3)	7 (53.8%)

Note. "Relationship with independent variable" means that, among the articles using the instrumental variable approach, the number of which explained how the instrumental variables are correlated with independent variables, "lack of direct relationship with dependent variable" means the number of articles using the instrumental variable approach that explain why the instrumental variables are not directly related to the dependent variables (or error term). Four out of 105 articles that used the two-stage least square method did not report the instrumental variables they used.

Table 8: Examples of Instrumental Variables

Independent Variable Type	Independent Variable	Dependent Variable	Instrumental Variable	Instrumental Variable Category	Reference
Family Firms vs. Non-family Firms	Family/Non-Family firms	Firm performance	Importance of family value	Family- related	Bennedsen et al. (2019)
	Family/Non-Family firms	Firm Productivity	The way family members are involved in the business	Family- related	Barbera & Moores (2011)
Heterogeneity in Family Firms – *Goals*	Succession Planning	Family firm growth	The number of generations serving on the board	Business- related	Eddleston et al. (2013)
Heterogeneity in Family Firms – *Resource*	Successor's CEO-related Human Capital	Gender preferences in the CEO successions	If the succession is due to death or serious disease of the previous owner or not	Family- related	Ahrens et al. (2018)
	Labor productivity	Incentive compensation plans	Whether the firm is located in a right-to-work state	Higher- level	Chrisman et al. (2017)
Heterogeneity in Family Firms – *Governance*	Family CEO	Succession decisions and performance	Gender of founder's first-born child	Family- related	Bennedsen et al. (2007)
	Family Management	Foreign sales	Regional divorce rate	Higher- level	Hennart et al. (2019)
Business-Related Independent Variable	Founder/Family Religion	Family-firm risk-taking	Regional density of Buddhist temples	Higher-level	F. Jiang et al. (2015)

Appendix: Journal List

Field	Journal	Journal Rank
Accounting	Accounting Review	UTD, FT, AJG (ABS) 4*
	Journal of Accounting Research	UTD, FT, AJG (ABS) 4*
	Contemporary Accounting Research	FT, AJG (ABS) 4
	Accounting and Business Research	AJG (ABS) 3
	Accounting Forum	AJG (ABS) 3
	Accounting Horizons	AJG (ABS) 3
	British Accounting Review	AJG (ABS) 3
	European Accounting Review	AJG (ABS) 3
	International Journal of Accounting	AJG (ABS) 3
	Journal of Accounting and Public Policy	AJG (ABS) 3
	Journal of Business Finance and Accounting	AJG (ABS) 3
	Accounting and Finance	AJG (ABS) 2
	Accounting in Europe	AJG (ABS) 2
	Accounting Research Journal	AJG (ABS) 2
	Advances in Accounting	AJG (ABS) 2
	Asian Review of Accounting	AJG (ABS) 2
	Australian Accounting Review	AJG (ABS) 2
	International Journal of Disclosure and Governance	AJG (ABS) 2
	Journal of Accounting in Emerging Economies	AJG (ABS) 2
	Journal of Management Control	AJG (ABS) 2
	Managerial Auditing Journal	AJG (ABS) 2
Economics	American Economic Review	FT, AJG (ABS) 4*
	Quarterly Journal of Economics	FT, AJG (ABS) 4*
	Journal of the European Economic Association	AJG (ABS) 4
	Review of Economics and Statistics	AJG (ABS) 4
	American Economic Journal: Macroeconomics	AJG (ABS) 3
	Ecological Economics	AJG (ABS) 3
	Applied Economics	AJG (ABS) 2
	Bulletin of Economic Research	AJG (ABS) 2
	CESifo Economic Studies	AJG (ABS) 2
	Economics of Innovation and New Technology	AJG (ABS) 2
	Managerial and Decision Economics	AJG (ABS) 2
	North American Journal of Economics and Finance	AJG (ABS) 2
Entrepreneurship - Small Business Management	Entrepreneurship, Theory and Practice	FT, AJG (ABS) 4
	Journal of Business Venturing	FT, AJG (ABS) 4
	Strategic Entrepreneurship Journal	FT, AJG (ABS) 4
	Entrepreneurship and Regional Development	AJG (ABS) 3
	Family Business Review	AJG (ABS) 3
	International Small Business Journal	AJG (ABS) 3
	Journal of Small Business Management	AJG (ABS) 3
	Small Business Economics	AJG (ABS) 3
	Entrepreneurship Research Journal	AJG (ABS) 2
	International Review of Entrepreneurship	AJG (ABS) 2
	Journal of Family Business Strategy	AJG (ABS) 2
	Journal of Small Business and Enterprise Development	AJG (ABS) 2
Ethics-Corporate Social Responsibility-Management	Academy of Management Journal	UTD, FT, AJG (ABS) 4*
	Administrative Science Quarterly	UTD, FT, AJG (ABS) 4*
	Journal of Management	FT, AJG (ABS) 4*
	Journal of Management Studies	FT, AJG (ABS) 4
	European Management Review	FT, AJG (ABS) 3
	Journal of Business Ethics	FT, AJG (ABS) 3
	British Journal of Management	AJG (ABS) 4
	Journal of Business Research	AJG (ABS) 3
	Australian Journal of Management	AJG (ABS) 2

Appendix: Journal List- Cont.

Field	Journal	Journal Rank
Ethics-Corporate Social Responsibility-Management	Business Ethics: A European Review	AJG (ABS) 2
	European Management Journal	AJG (ABS) 2
	Journal of Management & Organization	AJG (ABS) 2
	Review of Managerial Science	AJG (ABS) 2
	Scandinavian Journal of Management	AJG (ABS) 2
Finance	Journal of Finance	UTD, FT, AJG (ABS) 4*
	Journal of Financial Economics	UTD, FT, AJG (ABS) 4*
	Review of Financial Studies	UTD, FT, AJG (ABS) 4*
	Journal of Financial and Quantitative Analysis	FT, AJG (ABS) 4
	Journal of Corporate Finance	AJG (ABS) 4
	Corporate Governance: An International Review	AJG (ABS) 3
	European Financial Management	AJG (ABS) 3
	European Journal of Finance	AJG (ABS) 3
	International Review of Financial Analysis	AJG (ABS) 3
	Journal of Financial Services Research	AJG (ABS) 3
	Review of Corporate Finance Studies	AJG (ABS) 3
	Review of Quantitative Finance and Accounting	AJG (ABS) 3
	Corporate Governance: The International Journal of Business in Society	AJG (ABS) 2
	Emerging Markets Finance and Trade	AJG (ABS) 2
	Global Finance Journal	AJG (ABS) 2
	International Journal of Managerial Finance	AJG (ABS) 2
	International Tax and Public Finance	AJG (ABS) 2
	Pacific-Basin Finance Journal	AJG (ABS) 2
	Research in International Business and Finance	AJG (ABS) 2
	Review of Accounting and Finance	AJG (ABS) 2
Human Resource Management & Employment Studies	Human Resource Management (USA)	FT, AJG (ABS) 4
	International Journal of Human Resource Management	AJG (ABS) 3
	Journal of Organizational Effectiveness: People and Performance	AJG (ABS) 2
Innovation	Research Policy	FT, AJG (ABS) 4*
	Journal of Product Innovation Management	AJG (ABS) 4
	R&D Management	AJG (ABS) 3
	Creativity and Innovation Management	AJG (ABS) 2
	Industry and Innovation	AJG (ABS) 2
International Business & Area Studies	Journal of International Business Studies	UTD, FT, AJG (ABS) 4*
	Journal of World Business (formerly Columbia JWB)	AJG (ABS) 4
	Asia Pacific Journal of Management	AJG (ABS) 3
	International Business Review	AJG (ABS) 3
	Journal of International Management	AJG (ABS) 3
	Management and Organization Review	AJG (ABS) 3
	Management International Review	AJG (ABS) 3
	Asia Pacific Business Review	AJG (ABS) 2
	Cross Cultural & Strategic Management	AJG (ABS) 2
	Emerging Markets Review	AJG (ABS) 2
	Journal of Business Economics and Management	AJG (ABS) 2
	Thunderbird International Business Review	AJG (ABS) 2
Organization Studies	Organization Science	UTD, FT, AJG (ABS) 4*
	Human Relations	FT, AJG (ABS) 4
	European Journal of Work and Organizational Psychology	AJG (ABS) 3
Strategy	Strategic Management Journal	UTD, FT, AJG (ABS) 4*
	Global Strategy Journal	AJG (ABS) 3
	Long Range Planning	AJG (ABS) 3
	Business Strategy and the Environment	AJG (ABS) 2

Note. UTD refers to the University of Texas at Dallas (UTD) 24 Journal List; FT refers to 50 Journals used in Financial Times (FT) Research Rank; AJG (ABS) refers to Academic Journal Guide (2018) by Chartered ABS; AJG (ABS) 4* refers to journals ranked above AJG (ABS) 4.