Market integration between Turkey and Eurozone countries

Article

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ABSTRACT

Following economic reforms, Turkey has witnessed interesting shifts in the dimensions of supply in various subsectors and has achieved substantial economic growth rates. It has been claimed that Turkey's accession will increase the size of the European internal market and strengthen the relative competitiveness of the European Union in the global economy. This paper examines the degree of integration of the Turkish economy and the European markets, as well as the nature of price convergence across major cities for common baskets of goods. A series of unit root tests are performed to assess price convergence by taking into account non-linearity, cross-sectional correlations, and structural breaks. The empirical findings document that both Turkish and the European markets are well integrated. The highest rate of convergence for Turkey occurs in the categories of Fresh fruit and vegetables (Supermarket) and canned good (mid-prices stores), suggesting the presence of arbitrage activities across common baskets of goods.

JEL classification: O570; C330; F150

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1. Introduction

Over the last four decades, the European Union (EU) has advanced to a closer economic integration by the removal of certain trade barriers, the establishment of a single market and the establishment of the Economic and Monetary Union (EMU). In addition, there have been certain attempts towards tax harmonization and structural reforms across product markets to increase the extent of competition and reduce potentially harmful distortions caused by different forms of government interventions (Sosvilla-Rivero, 2004). With those initiatives, the level of market integration has been enhanced, which has exerted a downward pressure on tradable goods and services prices, leading to reduced price fluctuations across the EMU countries, as well as across the countries that the EMU countries trade with. It is obvious that the presence of the EMU has been beneficial to both the participating countries and the countries they trade, such as Turkey. Given that EMU countries have experienced certain price fluctuations, as the globalization is growing, many countries, such as Turkey, have been affected by such fluctuations. Over the last few decades, the gradual removal of distorted price structures and trade restrictions have actually led to a stronger integration of the Turkish economy and international markets. It is also significant for policymakers to acknowledge the extent and the determinants of both market integration and price convergence across different goods markets as to design and implement various internal and external trade policies to meet the challenges of globalization.

Given the above discussion, the goal of this paper is to provide empirical evidence on the extent of price convergence across certain Eurozone cities and Istanbul, spanning the period 2000-2010 and using methodological approaches based on linear univariate unit root tests. The tested hypothesis suggests that there exist weak trade barriers between Eurozone countries and Turkey in the presence of price convergence with respect to certain types of goods. To the best of our knowledge, no empirical work on price convergence, along with the effects of potential trade barriers, exists in the relevant literature. This study employs the exponential smooth threshold autoregressive (ESTAR) model to examine the deviations from the law of one price (LOP). This modeling approach can implicitly capture the presence of non-zero transaction costs in international trade and results in a band of inaction within which international price differentials (i.e., potential profit margins) are too small to cover the arbitrage costs. Only if the international price differentials are outside the band of inaction, the arbitrage activities can be active and, hence, price differentials are likely to disappear/converge[1].

[1] For details on the theoretical and empirical arguments, please, refer to Dumas (1992), Taylor (2001), Granger

The current studies mostly focus on testing price convergence in terms of the law of one price for several goods baskets. However, there is no single study that explicitly investigates price convergence between the Eurozone and Turkey. The results are expected to provide a clear response to the question: 'what is the extent of price convergence between Eurozone members and Turkey for a certain basket of goods'. The findings are expected to shed more light on the current situation of potential trade barriers between Eurozone countries and Turkey for future studies. The rest of the paper is structured as follows. Section 2 reviews the literature. Section 3 explains the data, the empirical model, and the econometric methodology, while Section 4 provides the empirical results. Section 5 concludes and provides certain policy implications.

2. Literature review

The study is related to a number of strands in the literature. The first strand considers whether price convergence occurs inside a single country, using either time series or panel methodologies. Chan et al. (2010) describe price convergence across different provinces in Canada by considering different trade barriers, such as tax applications and transportation costs. Their findings document the absence of any convergence across the Canadian regions. Das and Bhattacharya (2008) question whether there exists any price convergence across various regions in India. They highlight the absence of such convergence.

A different strand explores price convergence across a panel of countries by employing panel data methodologies. Dreger et al. (2008) focus on the effects of the EU enlargement process on price convergence. Their analysis from 24 EU economies with comparative price levels for 41 product categories reveals two primary price developments: higher competition and catching up processed in the low-income countries. Price convergence does occur, albeit the speed of adjustment is relatively slow. Higher levels of competition exert a downward pressure on prices, whereas catching-up of low-income countries leads to a rise in price levels, as well as higher inflation. Tasic (2007) explores whether the relative hypothesis of purchasing power parity holds for ten Balkan countries. His results provide supportive evidence for slow convergence, even after controlling for a number of socio-economic factors and they document that non-tariff barriers to trade remain the main driver of slow convergence. Sosvilla-Riviero and Gil-Pareja (2004) investigate the relationship between market integration and price convergence in international markets within the EU region. After choosing Germany as the benchmark country, their findings illustrate moderate price convergence dynamics. Goldberg and Verboven (2003) investigate the

and Terasvirta (1993), Michael et al. (1997), Baum et al. (2001), Taylor et al. (2001) and Fan and Wei (2006).

relationship between integration and price convergence across 150 vehicle products in five distinct European markets. Their findings indicate the presence of strong pair converging rates. Rogers et al. (2001) also provide strong evidence on price level convergence in Europe for 165 goods and services across 26 European cities in 18 countries. Funke and Koske (2007) analyze the development of disaggregated prices in the EU. Their study employed monthly data on 90 consumer price indices, grouped into 11 broader categories of goods and services. They display that price convergence is much lower for the case of the new ten EU member countries, as well as for those product groups that show price convergence.

A close, albeit different, strand of the literature explores price convergence on the regional or urban level. Ceglowski (2003) investigates the behavior of intra-national prices across 25 Canadian cities. He finds a strong positive role for distance and provincial borders in intercity price disparities. Fan and Wei (2003) test the validity of the law of one price in China using both univariate linear and non-linear unit root test. Their results shed light on the extent of the process of marketization in the Chinese economy. Nenna (2001) explains the presence of divergence in relative prices across certain cities in Italy. His results highlight the validity of the core of the Harrod-Balassa-Samuelson hypothesis, which explains how differentials in productivity growth rates between tradable and non-tradable goods may lead to inflation differentials, by altering the internal price structure. Parsley and Wei (2001) investigate the role of the presence of border effects between Japan and the US. Focusing on price dispersions in relevance to city-pairs, their findings confirm previous findings that crossing national borders adds significantly to price dispersions.

The closest contributions to our work in terms of econometric methodology are the recent papers by Apergis et al. (2017), Dang and Yang (2016), Apergis and Lau (2015), Akhmedjonov and Lau (2012), and Chan et al. (2010); they all have considered price convergence across different markets. Apergis et al. (2017) analyze the convergence of wholesale electricity prices across Australian States using the Phillips and Sul (2007) methodology, providing evidence on the convergence and quantifying the rate of convergence. Apergis and Lau (2015) find no evidence of electricity price convergence for Tasmania and Western Australia. Akhmedjonov and Lau (2012) examine price convergence dynamics in Russian energy markets find a limited degree of integrated national energy markets. Dang and Yang (2016) investigate the extent of price convergence in the Association of Southeast Asian Nations (ASEAN). Their results document that the degree of market integration is lower than that across European countries.

3. Data and methodology

3.1.Data

Annual data on certain prices of baskets of goods, such as staples, fresh fruit and vegetables, canned food, meat and fish, beverages and household supplies, obtained from The Economic Intelligence Unit (EIU) are obtained from 14 cities, i.e. Istanbul, Amsterdam, Athens, Barcelona, Brussels, Dublin, Frankfurt, Helsinki, Lisbon, Madrid, Milan, Paris, Vienna, and Zurich, spanning the period 2000-2010. This particular database is considered as the world's foremost provider of country, industry and management analysis.

Given that there is the need of currency conversion between Eurozone countries and Turkey, the conversion of the Turkish Lira into euros has been followed. The beginning of the time sample coincides with the introduction of the Euro as a common currency. The groups of goods are selected with respect to their daily usage in terms of food and household supplies. Foods are defined in terms of sub groups, i.e. staples (butter, sugar, cheese, etc.), fresh fruit and vegetables (potatoes, mushrooms, etc.), canned food, meat and fish, and beverages. Household supply groups include items, such as laundry detergents, soaps, toilet tissues, etc. All 134 goods are described in Appendix A.

Survey prices are obtained and listed from two types of stores: supermarkets and medium-priced retailers. While the majority of cities provide a wide selection of goods and stores at different price levels, this range narrows considerably at several locations. In some cities, the entire range of prices has to be collected at the few stores where goods of internationally comparable quality can be found. The prices are broken down by groups named; national economic indicators, food, alcohol, household supplies, personal care, tobacco, clothing, utilities, domestic help, recreation, transport, office and residential rents, schools, health and sports, business trip costs, and salaries and disposable income. In this analysis, foods and household supplies are used and accepted as the indicator of daily goods. The dataset is grouped under 6 subgroups in order to simplify the process. In particular, the foods groups include;

Staples: white bread, butter, margarine, white rice, spaghetti, flour, sugar, cheese, cornflakes, yoghurt, milk, olive oil, and peanut or corn oil.

Fresh fruits and vegetables: potatoes, onions, mushrooms, tomatoes, carrots, oranges, apples, lemons, bananas, lettuce and eggs.

Canned food: peas, tomatoes, peaches and sliced pineapples.

Meat and fish: beef, veal, lamb, pork, ham, bacon, chicken, frozen fish and fresh fish.

Beverages: instant coffee, ground coffee, tea bags, cocoa, drinking chocolate, Coca-Cola, tonic water, mineral water and orange juice.

Household supplies groups include: Soap, laundry detergents, toilet tissues, dishwashing liquids, insect-killer sprays, light bulbs, batteries, frying pans, electric toasters, laundry and dry cleaning.

The price of each product in Turkey is converted into Euros through the spot exchange rate in the specified month. Exchange rate (Euro/TRY) data are obtained from the Central Bank of the Republic of Turkey, measured as end of month spot exchange rates. The first step of the empirical analysis estimates price variations across cities, thus, we convert raw data into price variations as:

$$y_{ijt} = \ln (v_{ijt}/\bar{v}_{jt}) \quad (1)$$

where y_{ijt} denotes price variations, with i standing for city, j for product and t for time; v_{ijt} is the raw price of product j, in city i at time t, and $\bar{v}_{jt}$ denotes the mean of v_{ijt} across cities at t. The price differential variability is defined as the standard deviation over time of the percentage price differences $y_{ijt} = \ln (v_{ijt}/\bar{v}_{jt})$, while the mean absolute price differential is defined as the mean absolute deviation of the log of prices across cities, that is, the mean over time of $\ln (v_{ijt}/\bar{v}_{jt})$ (Fan and Wei, 2003). Both measures show how prices can deviate from their mean over time and across cities.

In the second step, the empirical analysis considers the employment of linear univariate unit root testing procedures. If domestic and foreign prices are expressed in the same currency, then identical goods should have the same price on a global basis (Funke, 2008). The presence of price differences is expected to cause arbitrage opportunities with respect to the price of a product, thus, providing a convergence pattern. The most common approach to investigate price convergence patterns is to apply specific unit root testing methodologies, which will identify the stationarity character of price differentials. More specifically, such methodological approaches test the following hypothesis:

H_0: Relative prices are non-stationary, against H_1: Relative prices are stationary

In case the results indicate the rejection of the null hypothesis, then the process is stationary and the relative prices follow a stationary process, implying price convergence in the long run and the absence of any trade barriers.

3.2.*Non-linear panel unit root tests*

There is a growing body in the literature on studying non-linear adjustments across macroeconomic variables. The equalization dynamics of prices of goods and factors of production follows a non-linear dynamic pattern (Taylor et al., 2001; Sarno et al., 2004). These models suggest that price adjustments follow a non-linear path due to the presence of "bands of inaction"

in the adjustment process. Within these bands, arbitrage activities across tradable goods is not profitable, because transaction costs are greater than price differences (Krugman, 1993). In the same fashion, Lau (2010) examines empirically whether the regional growth dynamics in China follows a non-linear path, while the economy may only experience a high growth rate when it reaches the threshold level of human capital accumulation and then starts to engage in trade with other regions. Our study employs the exponential smooth threshold autoregressive (ESTAR) modeling approach to examine the deviations from the law of one price (LOP). The model can implicitly capture the presence of non-zero transaction costs in international trade. Non-linear panel unit root tests not only can capture the theoretical essence of trade costs in arbitrage activities, but they can also achieve higher power performance as compared to their alternative of linear panel unit root tests (Lau et al., 2012).

The series of interest for a particular product in city i, at time t, is $y_{i,t}$, and is defined as:

$$y_{i,t=\ln(\frac{V_{i,t}}{\bar{V}_t})} \qquad t = 1 \ldots . T \qquad (1)$$

where $V_{i,t}$ is the actual price in city *i* at time *t*; $y_{i,t}$ is the relative price, and $\bar{V}_t$ is the average price across all cities at time *t*. Following Ucar and Omay (2009), the Data Generating Process (DGP) for the panel data of interest $y_{i,t}\ is\ a$ panel exponential smooth transition autoregressive process of order one $\left(PESTAR(1)\right)$ on the time domain $t = 1,2, \ldots, T$ for the cross section units $i = 1,2, \ldots, N$. Consider $y_{i,t}$ follows the DGP with fixed effect (heterogeneous intercept) parameter α_i:

$$\Delta y_{i,t} = \alpha_i + \phi_i y_{i,t-1} + \gamma_i y_{i,t-1}\left[1 - exp\left(-\theta_i y_{i,t-d}^2\right)\right] + \varepsilon_{i,t} \qquad (2)$$

where $d \geq 1$ is the delay parameter and $\theta_i > 0$ implies the speed of mean reversion for all i. Assuming $\phi_i = 0$ for all i and $d = 1$, yields a $PESTAR(1)$ model:

$$\Delta y_{i,t} = \alpha_i + \gamma_i y_{i,t-1}\left[1 - exp\left(-\theta_i y_{i,t-1}^2\right)\right] + \varepsilon_{i,t} \qquad (3)$$

We can conduct the non-linear panel data unit root test based on regression (3) for the null hypothesis $\theta_i = 1$ for all i against $\theta_i > 1$ for some i under the alternative. However, the fact that γ_i is not identified under the null, and therefore this hypothesis of $\theta_i = 1$ cannot be tested. The problem was tackled by using a first-order Taylor series approximation methodology that reparametrizes Equation (3) and the auxiliary regression yields:

$$\Delta y_{i,t} = \alpha_i + \delta_i y_{i,t-1}^3 + \varepsilon_{i,t} \qquad (4)$$

where $\delta_i = \theta_i \gamma_i$. The null hypothesis for unit root testing is based on regression (4) and is developed as follows:

$H_0 : \delta_i = 0,$ for all $i,$ (linear nonstationarity) (5)

$H_1 : \delta_i < 0,$ for some $i,$ (nonlinear stationarity)

The Kapetanios, Shin, and Snell (2003) statistic (KSS) for the ith individual is simply t-ratio of δ_i in regression (4) defined by:

$$t_{i,NL} = \frac{\Delta y_i' M_\tau y_{i,-1}^3}{\hat{\sigma}_{i,NL}\left(y_{i,-1}' M_\tau Y_{i,-1}\right)^{3/2}} \quad (6)$$

where $\hat{\sigma}_{i,NL}^2$ is the consistent estimator such that $\hat{\sigma}_{i,NL}^2 = \Delta y_i' M_\tau \Delta y_i/(T-1)$, $M_\tau = I_T - \tau_T(\tau_T'\tau_T)^{-1}\tau_T'$. The proposed panel unit root tests of Ucar and Omay (2009) is computed by taking the average of individual KSS statistics[2]. For a fixed T, the proposed statistics is computed as:

$$\bar{t}_{NL} = \frac{1}{N}\sum_{i=1}^{N} t_{i,NL} \quad (7)$$

Finally, we adapted the testing procedure of Omay Çorakcı and Emirmahmutoğlu (2017), which provides a testing procedure in non-linear panel unit root testing while taking into account of structural break[3].

3.3. The log-t test

The Phillips and Sul (2007) testing procedure is a test of σ-convergence for a panel of time series. The analysis employs a regression-based convergence test (Phillips and Sul, 2007) to examine the price convergence across Istanbul and major Eurozone cities. An advantage of this methodology is that it does not require the assumptions of stationarity or the presence of common factors for the data generating process. Let P_{it} denotes the price level for city i at time t for a particular

[2] We also used the nonlinear panel unit root test under the cross section dependency by Cerrato et al. (2011) and results are available upon request, but the way they handled cross section dependency may lead to a non-convergent critical values and asymptotic results. This issue has already been solved by the paper Ucar and Omay (2009) through the use of sieve bootstrap algorithm, and the proposed. Therefore, we control these results by using the Ucar and Omay (2009) test. We would like to thank the anonymous referee for pointing out these issues. Detailed comparison between sieve bootstrap and common correlated effect estimator of Pesaran (2007) is available in Omay Hasanov and Shin (2017). Moreover, the proposed methods of Ucar and Omay (2009) is not so general to capture asymmetries in the Data Generating Process (DGP), hence, we also apply a more general testing procedure of Emirmahmutoğlu and Omay (2014), which they have used asymmetric exponential smooth transition framework. The added advantage of this method is that it can also control asymmetries in the arbitrage actions in price convergence process. Results are available upon request.

[3] As our sample period is from 2000-2010 where the financial global crises occurred, therefore, it is robust to use a test which also controls this possible structural break in the testing procedure.

product; the variable can be decomposed into two components: the common components of cross-sectional dependence in a panel, g_{it} and the transitory components, a_{it}, such that:

$$P_{it} = g_{it} + a_{it} \quad (8)$$

After generating both the common and the idiosyncratic components, the non-linear model can be specified as:

$$P_{it} = \left(\frac{g_{it} + a_{it}}{\mu_t}\right)\mu_t = \delta_{it}\mu_t \quad \text{for all } i \text{ and } t, \quad (9)$$

where μ_t is the common component and δ_{it} is a time-varying idiosyncratic element. We then compute the time-varying loadings δ_{it}, such that the number of clusters can be determined. Phillips and Sul (2007) define the transition coefficient as h_{it} and extract the time-varying factor loading δ_{it}:

$$h_{it} = \frac{X_{it}}{\frac{1}{N}\sum_{i=1}^{N} X_{it}} = \frac{\delta_{it}\mu_t}{\frac{1}{N}\sum_{i=1}^{N} \delta_{it}\mu_t} = \frac{\delta_{it}}{\frac{1}{N}\sum_{i=1}^{N} \delta_{it}} \quad (10)$$

where h_{it} is the transition parameter that measures δ_{it} in relation to the panel average at time t and, therefore, describes the transition path for the price in city i relative to the panel average. Next, we calculate the cross sectional variance ratio $\frac{H_1}{H_t}$, where:

$$H_t = \frac{1}{N}\sum_{i=1}^{N}(\hat{h}_{it} - 1)^2 \quad (11)$$

Phillips and Sul (2012) further show that the transition distance H_t has a limiting form of:

$$H_t \sim \frac{A}{L(t)^2 t^{2\alpha}} \; as \; t \to \infty$$

where A is a positive constant, L(t) is a function of t and α denotes the convergence speed. In order to test for the null hypothesis of convergence, they perform the log t regressions, such that the null hypothesis of convergence is:

$$H_0: \delta_i = \delta \text{ and } \alpha \geq 0$$

In essence, a test of σ -convergence is the log-t test consists in estimating:

$$\text{Log}\left(\frac{H_1}{H_t}\right) - 2\log L(t) = \hat{a} + \hat{b}\log t + \hat{u}_t \quad (12)$$

where $L(t) = \log(t+1)$ and the fitted coefficient of log t is $\hat{b} = 2\hat{\alpha}$, where $\hat{\alpha}$ is the estimate of α in the null hypothesis. The test statistic $t_{\hat{b}}$ is normally distributed. The decision rule for the null hypothesis of convergence is rejected, if $t_{\hat{b}} < -1.65$.

4. Empirical results

As a preliminary analysis of price dynamics, we compute the price dispersion across cities. Price dispersion is measured as the log standard deviation of prices across cities at time t for a particular product. Figures 1 through 6 show the trend of log deviations of Staples prices, Meat and Fish prices, Household Supply prices, Fresh Fruit and vegetables prices, Canned Food prices, and Beverages prices, respectively, from their mean across cities and time. They illustrate that these price dispersions increase in later time periods, with Cheese prices, Ham prices, Electronic Toaster prices, Mushrooms prices, Sliced Pineapples prices, and Instant Coffee prices, respectively, exhibiting the highest price deviations among other products.

[Insert Figure 1 to Figure 6 about here]

However, the graphical illustration provides only a trend price deviation across cities and the inherent price information regarding the degree of convergence/divergence or cluster convergence can only be explored by non-linear panel unit root tests and the regression-based test by Philips and Sul (2009). An assessment regarding price convergence across European markets and Turkey can be carried out through non-linear panel unit root tests. Table 1 reports the convergence rate using non-linear unit root tests for the categories of interest using evidence from 13 European cities and Istanbul[4]. The convergence rate turns out to be the highest for Beverages (Supermarket): 67 percent, following by Staples (Mid-priced store), Canned food (Supermarket), Canned food (Mid-priced store), Household supplies (Mid-priced store), Household supplies (Supermarket), Meat and fish (Supermarket), Meat and fish (Mid-priced store), Fresh fruit and vegetables (Mid-priced store), Staples (Supermarket), Fresh fruit and vegetables (Supermarket), and Beverages (Mid-priced store)[5]. For robustness, we use the non-linear panel unit root test of Omay, Çorakcı and Emirmahmutoğlu (2017) and Table 1 reports the convergence rate across product categories. The findings suggest that the convergence rate is the highest for Fresh fruit and vegetables (Supermarket), Fresh fruit and vegetables (Mid-priced store), Staples (Mid-priced store), Beverages (Supermarket), Household supplies (Supermarket), Meat and fish (Supermarket), Meat and fish (Mid-priced store), Staples (Supermarket), Household supplies (Mid-priced store), Beverages (Mid-priced store), Canned food (Supermarket), Canned food (Mid-priced store). The convergence rate is the highest at the 1% significance level for Margarine, 500 g (supermarket), Tomatoes (1 kg) (mid-priced store), Eggs (12) (supermarket), and Frozen fish fingers (1 kg) (supermarket). Services, such as laundry and dry cleaning, are non-tradable and, therefore, should

[4] The univariate ADF convergence test results, based on 1868 tests, are available upon request.

[5] We also conducted Emirmahmutoğlu and Omay (2014) panel unit root test, which they have used asymmetric exponential smooth transition framework. Results are similar to that of Ucar and Omay (2009) nonlinear panel unit root test, and they are available upon request.

display price non-convergence. The evidence of price convergence was more prevalent for highly perishable consumer goods, such as meats, fruits, and vegetables than for durable consumer goods, such as frying pan and electric toaster. The market structure for vegetable was close to perfect competition, which led to similar price across different countries.

[Insert Table 1 about here]

Table 2 reports the convergence rate across cities using the individual non-linear unit root tests of Cerrato, Peretti, and Stewart (2013). Overall, Dublin (supermarket), Paris (supermarket), Dublin (Mid-priced store), and Istanbul (Mid-priced store) are the cities that have the highest convergence rate[6], implying that Turkey has been well integrated into the European market since year 2000. The highest rate of convergence seem to be Beverages (supermarkets) and Canned food (Mid-priced stores), amounting to 60% and 50%, respectively. By contrast, the lowest convergence rates occur in Canned food (supermarkets) and Meat and fish (Mid-priced stores), amounting to 0% and 10%, respectively[7]. This finding is not surprising as Turkey is the top-5 trading partner with EU, and 80% of FDI inflows into Turkey come from the EU. Overall, Turkish markets are well integrated into the European markets when comparing to major European cities, implying that there is adequate evidence of arbitrage activities between them. It is possible that significant transaction costs, internal trade barriers, and imperfect market structure may still exist.

[Insert Table 2 about here]

Table 3 reports the convergence rate by categories for each city; the convergence rate for Istanbul is high in comparison to the European countries, with the exception of canned foods (supermarkets). Fischer (2012) investigates price convergence dynamics within the EMU using washing machine prices and sales volumes for 17 European countries from 1999 to 2002. His findings document price divergence, which is attributed to diverging relative wages in both the retail and the wholesale sectors. Furthermore, subgroup price convergence for European countries was additionally found, whereas Spain and France belong to one group, while Belgium, Sweden, and Netherlands belong to another convergence group. Italy and Hungary do not belong to any convergence club.

[Insert Table 3 about here]

[6] For the 10 percent significance level we have 47.83% for Istanbul (Mid-priced store), 40.00% for Istanbul (supermarket), 35.94% for Dublin (supermarket), and 35.38% for Dublin (Mid-priced store). Detailed results are available upon request.
[7] This conclusion is calculated from the univariate nonlinear unit root test (by product). Detailed results are available upon request.

Using the cluster convergence test by Phillips and Sul (2012), we can conclude that this test provides no evidence of convergence in washing machines prices within the Eurozone cities (Fischer, 2012). Table 4 reports the results on subgroup price convergence. We can clearly document that the number of clusters is ranged from one to four. Moreover, the converging cities for some products are low (i.e., Toilet tissue (two rolls) (supermarket)), while are high for others (i.e., Lemons (1 kg) (supermarket)). In general, the convergence rate in terms of the number of products in a certain category is high for the case of durable goods, i.e. canned food (92.86%). Istanbul forms a convergence cluster with European cities across all products in the category of canned food; for example, the convergence cluster for "Tomatoes, canned (250 g) (supermarket)" consists of Istanbul, Amsterdam, Athens, Barcelona, Brussels, Frankfurt, Milan, and Vienna[8].

Finally, it is interesting to identify European cities that form a convergence cluster with Istanbul by the categories of products. In the case of "Staples", 19.23% (or 5 out of 26) of products involves Istanbul forming a cluster, while Paris and Vienna are the most apparent candidates in the cluster. For the case of "Meat and Fish", 57.89% (or 22 out of 38) of products involves Istanbul that forms a cluster, while Amsterdam, Frankfurt, Milan, Paris, Vienna, and Zurich are the most apparent candidates in the cluster. For the category of "Household supplies", 63.64% (or 14 out of 22) of products involves Istanbul that forms a cluster, while cities Amsterdam, Brussels, Athens, Brussels, Frankfurt, Madrid, and Zurich are the most apparent candidates in the cluster. For the case of "Fresh fruit and vegetables", 59.09% (or 13 out of 22) of products involves Istanbul that forms a cluster, along with Paris, Vienna, and Zurich. For the category of "Canned food", 100.00% (or 8 out of 8) of products involves Istanbul that forms a cluster, along with Amsterdam, Athens, Barcelona, Brussels Helsinki, Lisbon, Madrid, Paris, Vienna, and Zurich. For the category of "Beverages", 22.22% (or 4 out of 18) of products involves Istanbul that forms a cluster, along with Amsterdam, Athens, Brussels, Frankfurt, Lisbon, Milan, Paris, Vienna, and Zurich. Moreover, we can note that Zurich is the European city that remains in the same cluster with Istanbul across the majority of products. As a direction of further research, the determinants of the apparent price divergence remain to be investigated. Among other factors, diverging relative wages in the retail sectors across European cities and Istanbul, as well as country-specific consumer preferences may play a role here.

[Insert Table 4 about here]

5. Conclusion

[8] This finding indicates that even Istanbul does not converge to the mean of the European cities for canned food but it does form convergence cluster with some of the European cities.

As the EU and the Turkish government have been negotiating to upgrade their Customs Union[9], it is interesting to policymakers to understand the dynamics of market integration between Turkish and the EU cities. Under certain restrictions on preferences and technologies, spatial competitive equilibrium of a "market economy" exists in which trade occurs at fixed transportation costs. Price information transparency and availability of transportation facilities are the most influential factors affecting the price behavior across different cities (Zhou et al., 2000). The major sources of price discrimination across national borders are the demand elasticity, import quotas, and collusion, whereas they affect international pricing and, hence, the rate of price convergence across the common market (Verboven, 1996).

This study provided evidence that there are arbitrage activities between the Turkish and the European markets. However, the highest rate of convergence for Turkey are the categories of Beverages (supermarkets) and Canned food (Mid-priced stores), amounting to 60% and 50%, respectively. By contrast, the lowest convergence rates occur in relevance to the Canned food (supermarkets) and Meat and fish (Mid-priced stores), amounting to 0% and 10%, respectively.

In terms of policy implications, it is generally accepted that policymakers in Turkey need to establish reduced inflation rates at the lowest possible cost, while avoiding excessive current account imbalances and financial instability (and, potentially sudden reversals of capital flows). Therefore, the convergence results recommend the achievement of disinflation rates across the tradables goods, while it becomes evident that these policymakers need to respond in a manner that ensures adequate policy reactions to certain factors driving prices. In terms of fiscal policy, the economy needs a careful handling of changes in indirect taxes, while a prudent implementation of fiscal policy supports the avoidance of excessive aggregate domestic demand and the generation of external imbalances. Such actions, mostly envisaged by similar policies implemented across the EU, are supposed to leave to the monetary policy more room hitting its own policy targets. In addition, given the experience of the Turkish economy with wage inflation, the question arises whether incomes policies could also play their role in containing wages growth in line with productivity developments. In addition, efforts to speed up privatization in sectors whose product prices are still administered could turn out to be a welcome contribution to disinflation. This would also facilitate the full liberalization of these sectors, including more openings to imports, which also contribute to lower prices. In terms now of monetary policy, Turkey can let its central bank to contribute to the process of disinflation, while maintaining a

[9] "EU and Turkey Announce Modernization of Customs Union," European Commission Daily News, May 12, 2015, http://europa.eu/rapid/midday-express-12-05-2015.htm

reasonable degree of external balance. To this end, the primary objective of the central bank should be the reduction of inflation expectations by following either exchange rate-based strategies or direct inflation targeting strategies. In that respect, the central bank should emphasize on a more effective and active communication policy. Given that the Turkish government experiences a growing share of foreign strategic interests in the domestic banking sector, the exchange rate has a major impact on inflation performance.

Further research is also needed to examine the determinants of price divergence among the European goods markets, but it is out of the scope of this study. It is still possible that significant transaction costs, internal trade barriers, and imperfect market structure may still exist as trade barriers, hence, preventing Turkey from being fully integrating into the EU market. There are two future research directions to investigate the factors affecting price convergence. The internal factor is monetary policies, as they affect relative price dispersions in Turkey, with the research providing evidence that pure policy tools (i.e., interest rates or exchange rates manipulation) increase relative price variability more than mixed policies (Berument et al., 2009). These findings imply that the use of mixed policies in Turkey may decrease the degree of price convergence with other European cities as higher economic policy uncertainty can be generated for international trade participants. Future research efforts could also examine the determinants of price differentials from the perspective of market structures and non-tariff barriers.

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Table 1

Rate of Convergence by Categories : Nonlinear Panel Test: Omay, Çorakcı and Emirmahmutoğlu (2017)

Category	Number of Products	Sig.5%	Sig.10%	Sig.5%	Sig.10%
Fresh fruit and vegetables (Supermarket)	11	2	2	18%	18%
Fresh fruit and vegetables (Mid-priced store)	11	2	3	18%	27%
Staples (Mid-priced store)	13	2	4	15%	31%
Beverages (Supermarket)	9	1	2	11%	22%
Household supplies (Supermarket)	9	1	2	11%	22%
Meat and fish (Supermarket)	19	2	4	11%	21%
Meat and fish (Mid-priced store)	19	2	3	11%	16%
Staples (Supermarket)	13	1	2	8%	15%
Beverages (Mid-priced store)	9	0	1	0%	11%
Canned food (Supermarket)	4	0	0	0%	0%
Canned food (Mid-priced store)	4	0	0	0%	0%

Table 2

Rate of convergence by cities (univariate non-linear tests).

City	Number of product	Sig.5%	Sig.10%	Sig.5%	Sig.10%
Istanbul (Mid-priced store)	69	13	33	18.84%	47.83%
Istanbul (supermarket)	65	19	26	29.23%	40.00%
Dublin (supermarket)	64	15	23	23.44%	35.94%
Dublin (Mid-priced store)	65	13	23	20.00%	35.38%
Milan (Mid-priced store)	69	9	22	13.04%	31.88%
Lisbon (Mid-priced store)	69	11	21	15.94%	30.43%
Zurich (supermarket)	65	11	19	16.92%	29.23%
Paris (supermarket)	65	15	18	23.08%	27.69%
Milan (supermarket)	64	7	16	10.94%	25.00%
Madrid (Mid-priced store)	69	10	17	14.49%	24.64%
Amsterdam (supermarket)	65	8	16	12.31%	24.62%
Brussels (Mid-priced store)	68	8	16	11.76%	23.53%
Helsinki (Mid-priced store)	69	12	16	17.39%	23.19%
Athens (supermarket)	65	10	15	15.38%	23.08%
Helsinki (supermarket)	65	8	15	12.31%	23.08%
Lisbon (supermarket)	65	7	15	10.77%	23.08%
Barcelona (supermarket)	65	5	15	7.69%	23.08%
Amsterdam (Mid-priced store)	69	10	15	14.49%	21.74%
Athens (Mid-priced store)	69	10	15	14.49%	21.74%
Madrid (supermarket)	65	5	14	7.69%	21.54%
Brussels (supermarket)	64	7	13	10.94%	20.31%
Frankfurt (supermarket)	65	11	13	16.92%	20.00%
Vienna (supermarket)	65	5	13	7.69%	20.00%
Vienna (Mid-priced store)	69	11	13	15.94%	18.84%
Barcelona (Mid-priced store)	69	10	13	14.49%	18.84%
Zurich (Mid-priced store)	69	7	12	10.14%	17.39%
Paris (Mid-priced store)	69	4	12	5.80%	17.39%
Frankfurt (Mid-priced store)	69	4	10	5.80%	14.49%

Table 3

Non-linear unit root tests and convergence rates at 5% (by category).

Category	No_Product	Amsterdam	Athens	Barcelona	Brussels	Dublin	Frankfurt	Helsinki	Istanbul	Lisbon	Madrid	Milan	Paris	Vienna	Zurich
Staples (supermarket)	13	1	2	1	0	2	5	4	4	0	0	3	2	0	2
Fresh fruit and vegetables (supermarket)	11	3	1	1	3	5	2	0	4	3	2	1	2	2	1
Canned food (supermarket)	4	1	1	0	0	1	0	1	0	0	0	0	0	1	0
Meat and fish (supermarket)	19	0	3	2	3	3	2	1	4	3	2	2	5	2	6
Beverages (supermarket)	9	1	0	0	1	2	1	0	5	0	0	0	1	0	1
Household supplies (supermarket)	9	2	3	1	0	2	1	2	2	1	1	1	5	0	1
Staples (Mid-priced store)	13	2	2	4	0	2	1	4	2	1	1	1	0	1	0
Fresh fruit and vegetables (Mid-priced store)	11	3	2	2	3	0	1	3	2	2	2	4	0	1	1
Canned food (Mid-priced store)	4	1	1	1	0	3	1	0	2	1	0	0	0	1	0
Meat and fish (Mid-priced store)	19	2	4	1	2	5	0	2	2	4	3	2	3	3	1
Beverages (Mid-priced store)	9	1	0	1	1	1	0	2	2	2	1	1	0	1	1
Household supplies (Mid-priced store)	13	1	1	1	2	2	1	1	3	1	3	1	1	4	4

Table 4

Phillips and Sul (2007) test on subgroup price convergence

Name	Type	Category	Number of converging club	Number of converging cities	Istanbul							
Butter, 500 g (mid-priced store)	m	Staples	3	14	Y	1	2	8	9	10	11	13
Butter, 500 g (supermarket)	s	Staples	2	6	N							
Cheese, imported (500 g) (mid-priced store)	m	Staples	2	8	N							
Cheese, imported (500 g) (supermarket)	s	Staples	1	9	N							
Cornflakes (375 g) (supermarket)	s	Staples	2	12	N							
Cornflakes (375 g) (mid-priced store)	m	Staples	1	11	N							
Flour, white (1 kg) (supermarket)	s	Staples	2	8	N							
Flour, white (1 kg) (mid-priced store)	m	Staples	1	7	N							
Margarine, 500 g (mid-priced store)	m	Staples	4	14	Y	8	13					
Margarine, 500 g (supermarket)	s	Staples	2	9	N							
Milk, pasteurised (1 l) (supermarket)	s	Staples	1	13	N							
Milk, pasteurised (1 l) (mid-priced store)	m	Staples	1	13	N							
Olive oil (1 l) (supermarket)	s	Staples	3	11	N							
Olive oil (1 l) (mid-priced store)	m	Staples	3	9	N							
Peanut or corn oil (1 l) (supermarket)	s	Staples	2	7	N							
Peanut or corn oil (1 l) (mid-priced store)	m	Staples	2	9	N							
Spaghetti (1 kg) (supermarket)	s	Staples	2	13	N							
Spaghetti (1 kg) (mid-priced store)	m	Staples	2	11	N							
Sugar, white (1 kg) (supermarket)	s	Staples	2	7	N							
Sugar, white (1 kg) (mid-priced store)	m	Staples	4	12	Y	8	12					
White bread, 1 kg (mid-priced store)	m	Staples	3	14	Y	8	12					
White bread, 1 kg (supermarket)	s	Staples	1	8	N							
White rice, 1 kg (mid-priced store)	m	Staples	3	9	N							
White rice, 1 kg (supermarket)	s	Staples	2	11	N							
Yoghurt, natural (150 g) (supermarket)	s	Staples	2	12	N							
Yoghurt, natural (150 g) (mid-priced store)	m	Staples	3	11	Y	8	12					
			2	268	364	73.63						19.23
Bacon (1 kg) (supermarket)	s	Meat and fish	1	12	N							

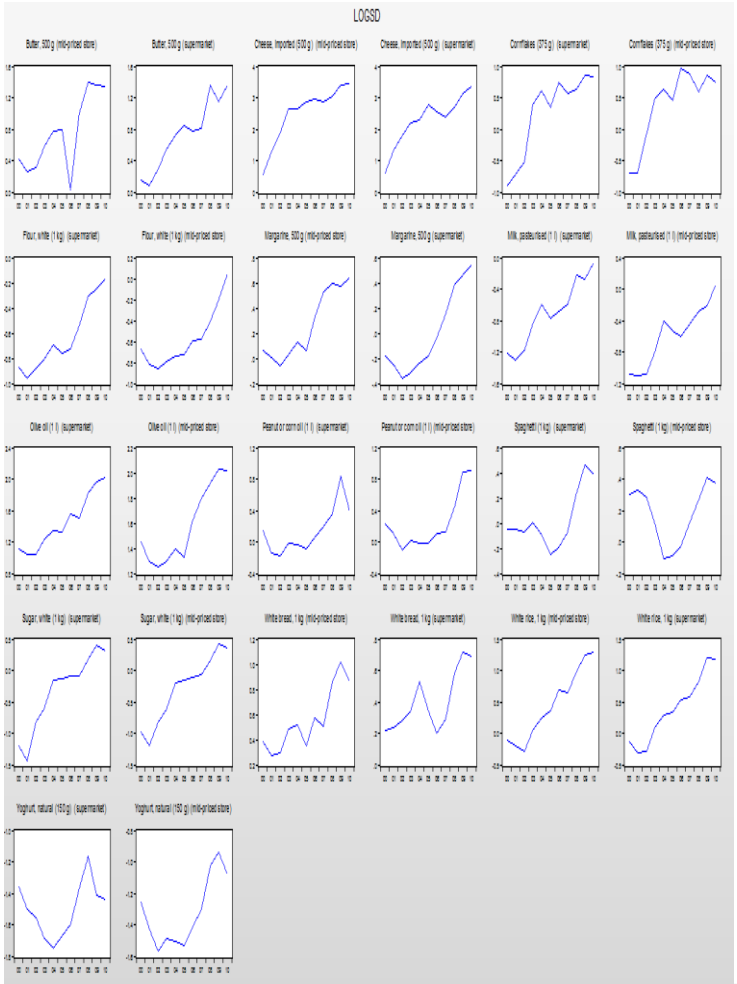
Bacon (1 kg) (mid-priced store)	m	Meat and fish	1	10	N								
Beef: filet mignon (1 kg) (mid-priced store)	m	Meat and fish	3	13	Y	8	14						
Beef: filet mignon (1 kg) (supermarket)	s	Meat and fish	3	13	Y	8	14						
Beef: ground or minced (1 kg) (supermarket)	s	Meat and fish	1	7	N								
Beef: ground or minced (1 kg) (mid-priced store)	m	Meat and fish	3	11	N								
Beef: roast (1 kg) (supermarket)	s	Meat and fish	3	12	N								
Beef: roast (1 kg) (mid-priced store)	m	Meat and fish	1	13	N								
Beef: steak, entrecote (1 kg) (supermarket)	s	Meat and fish	4	14	Y	3	8	14					
Beef: steak, entrecote (1 kg) (mid-priced store)	m	Meat and fish	2	14	Y	3	6	7	8	10	12	14	
Beef: stewing, shoulder (1 kg) (supermarket)	s	Meat and fish	1	7	N								
Beef: stewing, shoulder (1 kg) (mid-priced store)	m	Meat and fish	1	13	N								
Chicken: fresh (1 kg) (supermarket)	s	Meat and fish	3	14	Y	8	14						
Chicken: fresh (1 kg) (mid-priced store)	m	Meat and fish	3	14	Y	4	8	12					
Chicken: frozen (1 kg) (supermarket)	s	Meat and fish	2	14	Y	6	8	10	11				
Chicken: frozen (1 kg) (mid-priced store)	m	Meat and fish	2	14	Y	3	4	8	10	11	12	13	
Fresh fish (1 kg) (supermarket)	s	Meat and fish	1	14	Y	1	2	3	4	5	6	7	
						9	10	11	12	13	14	8	
Fresh fish (1 kg) (mid-priced store)	m	Meat and fish	1	12	Y	1	2	3	4	5	6	7	
						10	12	13	14	8			
Frozen fish fingers (1 kg) (supermarket)	s	Meat and fish	2	6	N								
Frozen fish fingers (1 kg) (mid-priced store)	m	Meat and fish	1	8	N								
Ham: whole (1 kg) (supermarket)	s	Meat and fish	3	7	N								
Ham: whole (1 kg) (mid-priced store)	m	Meat and fish	3	12	Y	8	14						
Lamb: chops (1 kg) (supermarket)	s	Meat and fish	2	12	Y	8	14						
Lamb: chops (1 kg) (mid-priced store)	m	Meat and fish	3	12	Y	8	14						
Lamb: leg (1 kg) (supermarket)	s	Meat and fish	5	14	Y	8	14						
Lamb: leg (1 kg) (mid-priced store)	m	Meat and fish	5	14	Y	4	6	8	14				
Lamb: stewing (1 kg) (mid-priced store)	m	Meat and fish	3	11	Y	8	14						
Lamb: stewing (1 kg) (supermarket)	s	Meat and fish	3	11	Y	8	14						
Pork: chops (1 kg) (supermarket)	s	Meat and fish	1	4	N								
Pork: chops (1 kg) (mid-priced store)	m	Meat and fish	1	11	N								
Pork: loin (1 kg) (supermarket)	s	Meat and fish	1	8	N								

Pork: loin (1 kg) (mid-priced store)	m	Meat and fish	2	13	N								
Veal: chops (1 kg) (supermarket)	s	Meat and fish	3	11	Y	3	8	10	11				
Veal: chops (1 kg) (mid-priced store)	m	Meat and fish	2	12	Y	2	5	6	7	8	9	10	
						13	14						
Veal: fillet (1 kg) (supermarket)	s	Meat and fish	1	10	N								
Veal: fillet (1 kg) (mid-priced store)	m	Meat and fish	1	10	Y	1	2	3	5	6	7	8	
						10	14						
Veal: roast (1 kg) (supermarket)	s	Meat and fish	4	12	Y	1	2	7	8	11	14		
Veal: roast (1 kg) (mid-priced store)	m	Meat and fish	3	13	Y	7	8	9	10	12	13	14	
			2	432	532	81.20						57.89	
Batteries (two, size D/LR20) (mid-priced store)	m	Household supplies	3	13	Y	2	4	6	8	14			
Batteries (two, size D/LR20) (supermarket)	s	Household supplies	2	8	Y	2	4	6	8	13	14		
Dishwashing liquid (750 ml) (mid-priced store)	m	Household supplies	3	13	Y	8	14						
Dishwashing liquid (750 ml) (supermarket)	s	Household supplies	3	14	Y	8	14						
Dry cleaning, man's suit (mid-priced outlet)	m	Household supplies	2	9	N								
Dry cleaning, trousers (mid-priced outlet)	m	Household supplies	4	14	Y	4	8						
Dry cleaning, woman's dress (mid-priced outlet)	m	Household supplies	1	7	N								
Electric toaster (for two slices) (mid-priced store)	m	Household supplies	3	14	Y	7	8						
Electric toaster (for two slices) (supermarket)	s	Household supplies	4	14	Y	6	8						
Frying pan (Teflon or good equivalent) (mid-priced store)	m	Household supplies	3	14	Y	1	3	6	8	10			
Frying pan (Teflon or good equivalent) (supermarket)	s	Household supplies	2	14	Y	1	2	3	4	5	6	7	
						10	14						
Insect-killer spray (330 g) (mid-priced store)	m	Household supplies	4	13	Y	7	8	13					
Insect-killer spray (330 g) (supermarket)	s	Household supplies	2	11									
Laundry (one shirt) (mid-priced outlet)	m	Household supplies	2	12									
Laundry detergent (3 l) (mid-priced store)	m	Household supplies	1	8									
Laundry detergent (3 l) (supermarket)	s	Household supplies	2	14	Y	3	4	6	8	10	11	14	
Light bulbs (two, 60 watts) (mid-priced store)	m	Household supplies	3	14	Y	5	8	14					
Light bulbs (two, 60 watts) (supermarket)	s	Household supplies	2	13	Y	1	6	8	9	11	12	14	
Soap (100 g) (mid-priced store)	m	Household supplies	1	13	N								

Soap (100 g) (supermarket)	s	Household supplies	3	13	Y	8	12	14				
Toilet tissue (two rolls) (mid-priced store)	m	Household supplies	1	5	N							
Toilet tissue (two rolls) (supermarket)	s	Household supplies	1	4	N							
			2	254	308	82.47						63.64
Apples (1 kg) (supermarket)	s	Fresh fruit and vegetables	1	9	N							
Apples (1 kg) (mid-priced store)	m	Fresh fruit and vegetables	1	6	N							
Bananas (1 kg) (supermarket)	s	Fresh fruit and vegetables	1	9	N							
Bananas (1 kg) (mid-priced store)	m	Fresh fruit and vegetables	1	6	N							
Carrots (1 kg) (supermarket)	s	Fresh fruit and vegetables	3	13	Y	8	14					
Carrots (1 kg) (mid-priced store)	m	Fresh fruit and vegetables	3	14	Y	8	12	14				
Eggs (12) (supermarket)	s	Fresh fruit and vegetables	4	14	Y	8	14					
Eggs (12) (mid-priced store)	m	Fresh fruit and vegetables	3	14	Y	8	14					
Lemons (1 kg) (supermarket)	s	Fresh fruit and vegetables	2	14	Y	8	14					
Lemons (1 kg) (mid-priced store)	m	Fresh fruit and vegetables	2	14	Y	8	14					
Lettuce (one) (supermarket)	s	Fresh fruit and vegetables	1	4	N							
Lettuce (one) (mid-priced store)	m	Fresh fruit and vegetables	2	12	N							
Mushrooms (1 kg) (supermarket)	s	Fresh fruit and vegetables	2	14	Y	8	13					
Mushrooms (1 kg) (mid-priced store)	m	Fresh fruit and vegetables	2	14	Y	8	7					
Onions (1 kg) (supermarket)	s	Fresh fruit and vegetables	2	11	Y	1	2	8	9	10	11	
Onions (1 kg) (mid-priced store)	m	Fresh fruit and vegetables	2	12	N							
Oranges (1 kg) (supermarket)	s	Fresh fruit and vegetables	3	10	N							
Oranges (1 kg) (mid-priced store)	m	Fresh fruit and vegetables	2	10	N							
Potatoes (2 kg) (mid-priced store)	m	Fresh fruit and vegetables	2	12	Y	8	12					
Potatoes (2 kg) (supermarket)	s	Fresh fruit and vegetables	2	14	Y	8	12					
Tomatoes (1 kg) (supermarket)	s	Fresh fruit and vegetables	3	14	Y	8	14					
Tomatoes (1 kg) (mid-priced store)	m	Fresh fruit and vegetables	3	14	Y	8	13					
			2	254	308	82.47						59.09
Peaches, canned (500 g) (supermarket)	s	Canned food	1	12	Y	1	2	4	5	6	7	8
						10	12	13	14			
Peaches, canned (500 g) (mid-priced store)	m	Canned food	2	11	Y	1	2	3	4	8	9	10
						13	14	12				
Peas, canned (250 g) (supermarket)	s	Canned food	3	13	Y	2	3	4	7	8	9	10

Peas, canned (250 g) (mid-priced store)	m	Canned food	2	12	Y	1	2	3	4	7	8	9	
						11	14						
Sliced pineapples, canned (500 g) (supermarket)	s	Canned food	2	14	Y	1	3	4	5	8	9	10	
						12	14						
Sliced pineapples, canned (500 g) (mid-priced store)	m	Canned food	2	14	Y	5	7	8	9	11	12	13	
Tomatoes, canned (250 g) (supermarket)	s	Canned food	2	14	Y	1	2	3	4	6	8	11	
						13							
Tomatoes, canned (250 g) (mid-priced store)	m	Canned food	2	14	Y	1	2	3	4	5	6	7	
						11	12	13	14	9	10		
			2	104	112	92.86							100.00
Coca-Cola (1 l) (supermarket)	s	Beverages	2	14	Y	1	2	3	4	5	8	9	
						11	12	13	14				
Coca-Cola (1 l) (mid-priced store)	m	Beverages	2	14	Y	1	2	4	5	8	9	11	
						14							
Cocoa (250 g) (supermarket)	s	Beverages	1	8	N								
Cocoa (250 g) (mid-priced store)	m	Beverages	1	9	N								
Drinking chocolate (500 g) (supermarket)	s	Beverages	2	9	N								
Drinking chocolate (500 g) (mid-priced store)	m	Beverages	3	11	N								
Ground coffee (500 g) (supermarket)	s	Beverages	1	11	N								
Ground coffee (500 g) (mid-priced store)	m	Beverages	1	5	N								
Instant coffee (125 g) (supermarket)	s	Beverages	3	12	N								
Instant coffee (125 g) (mid-priced store)	m	Beverages	2	11	N								
Mineral water (1 l) (supermarket)	s	Beverages	2	10	N								
Mineral water (1 l) (mid-priced store)	m	Beverages	1	8	N								
Orange juice (1 l) (mid-priced store)	m	Beverages	3	11	N								
Orange juice (1 l) (supermarket)	s	Beverages	3	14	Y	6	8						
Tea bags (25 bags) (supermarket)	s	Beverages	2	10	N								
Tea bags (25 bags) (mid-priced store)	m	Beverages	4	11	N								
Tonic water (200 ml) (supermarket)	s	Beverages	2	11	N								
Tonic water (200 ml) (mid-priced store)	m	Beverages	2	10	Y	6	7	8	12	13			
			2	189	252	75.00							22.22

The identification procedure for potential clusters is explained in the discussion paper version of the study. The one-sided test rejects the null hypothesis of club convergence if to 1.65.
1=Amsterdam; 2=Athens; 3=Barcelona; 4=Brussels; 5=Dublin; 6=Frankfurt; 7=Helsinki; 8=Istanbul; 9=Lisbon; 10=Madrid; 11=Milan; 12=Paris; 13=Vienna; 14=Zurich;


LOGSD
Butter, 500 g (mid-priced store)
Butter, 500 g (supermarket)
Cheese, imported (500 g) (mid-priced store)
Cheese, imported (500 g) (supermarket)
Cornflakes (375 g) (supermarket)
Cornflakes (375 g) (mid-priced store)
Flour, white (1 kg) (supermarket)
Flour, white (1 kg) (mid-priced store)
Margarine, 500 g (mid-priced store)
Margarine, 500 g (supermarket)
Milk, pasteurised (1 l) (supermarket)
Milk, pasteurised (1 l) (mid-priced store)
Olive oil (1 l) (supermarket)
Olive oil (1 l) (mid-priced store)
Peanut or corn oil (1 l) (supermarket)
Peanut or corn oil (1 l) (mid-priced store)
Spaghetti (1 kg) (supermarket)
Spaghetti (1 kg) (mid-priced store)
Sugar, white (1 kg) (supermarket)
Sugar, white (1 kg) (mid-priced store)
White bread, 1 kg (mid-priced store)
White bread, 1 kg (supermarket)
White rice, 1 kg (mid-priced store)
White rice, 1 kg (supermarket)
Yoghurt, natural (150 g) (supermarket)
Yoghurt, natural (150 g) (mid-priced store)

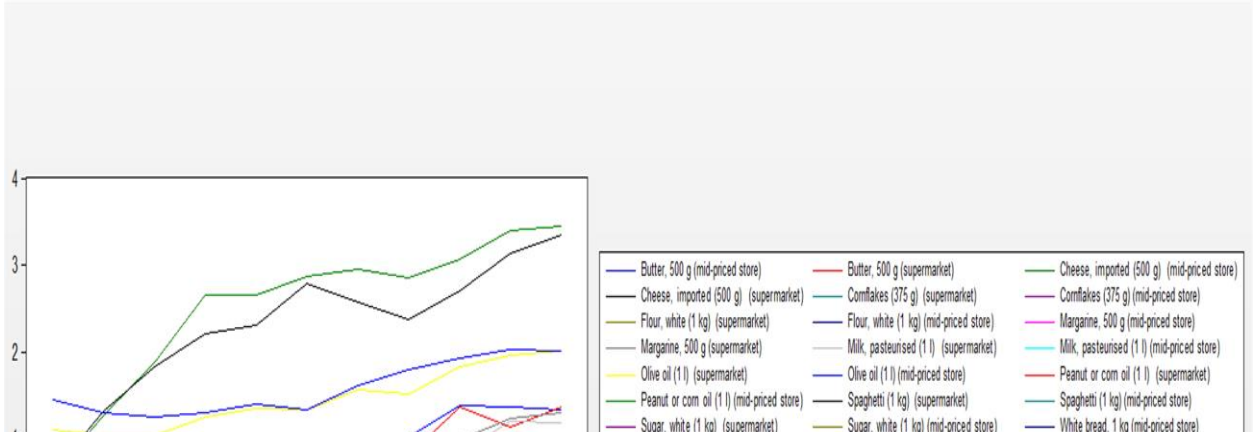
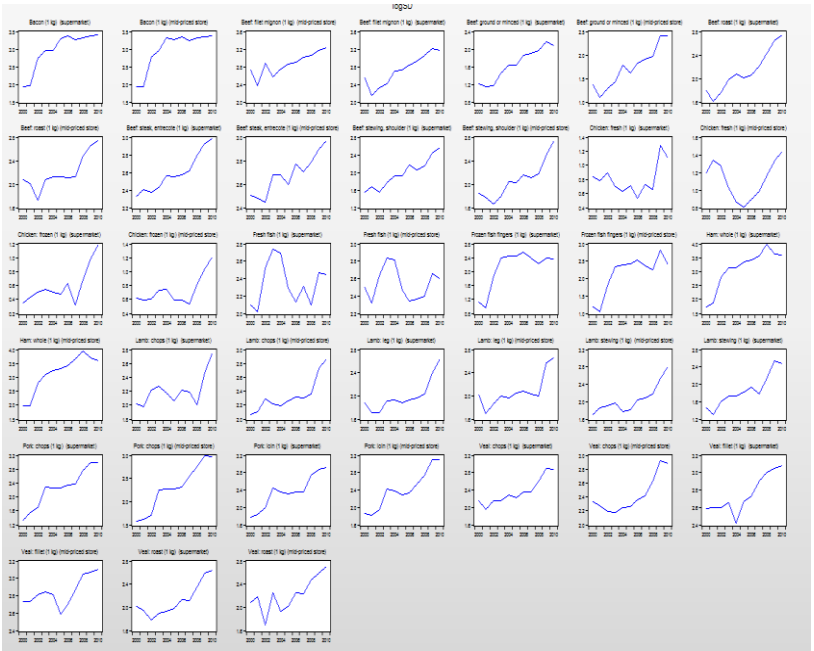

4
3
2
Butter, 500 g (mid-priced store)
Butter, 500 g (supermarket)
Cheese, imported (500 g) (mid-priced store)
Cheese, imported (500 g) (supermarket)
Cornflakes (375 g) (supermarket)
Cornflakes (375 g) (mid-priced store)
Flour, white (1 kg) (supermarket)
Flour, white (1 kg) (mid-priced store)
Margarine, 500 g (mid-priced store)
Margarine, 500 g (supermarket)
Milk, pasteurised (1 l) (supermarket)
Milk, pasteurised (1 l) (mid-priced store)
Olive oil (1 l) (supermarket)
Olive oil (1 l) (mid-priced store)
Peanut or corn oil (1 l) (supermarket)
Peanut or corn oil (1 l) (mid-priced store)
Spaghetti (1 kg) (supermarket)
Spaghetti (1 kg) (mid-priced store)
Sugar, white (1 kg) (supermarket)
Sugar, white (1 kg) (mid-priced store)
White bread, 1 kg (mid-priced store)

Figure 1(a): Log deviation of "Staples" prices from mean across countries and periods (individual cross sections)



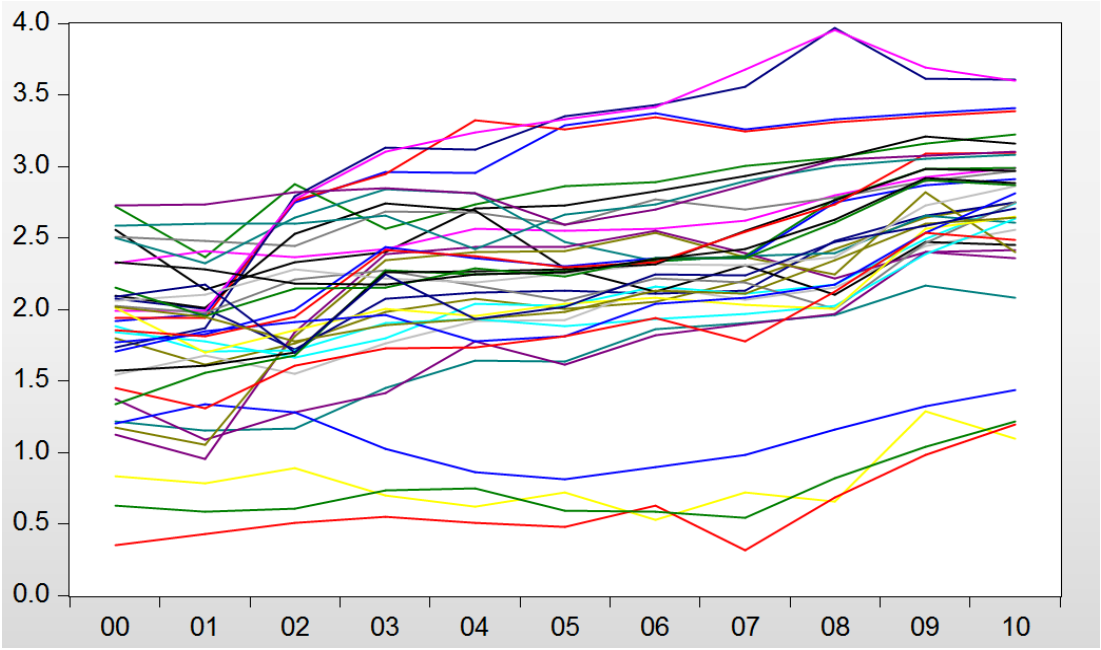
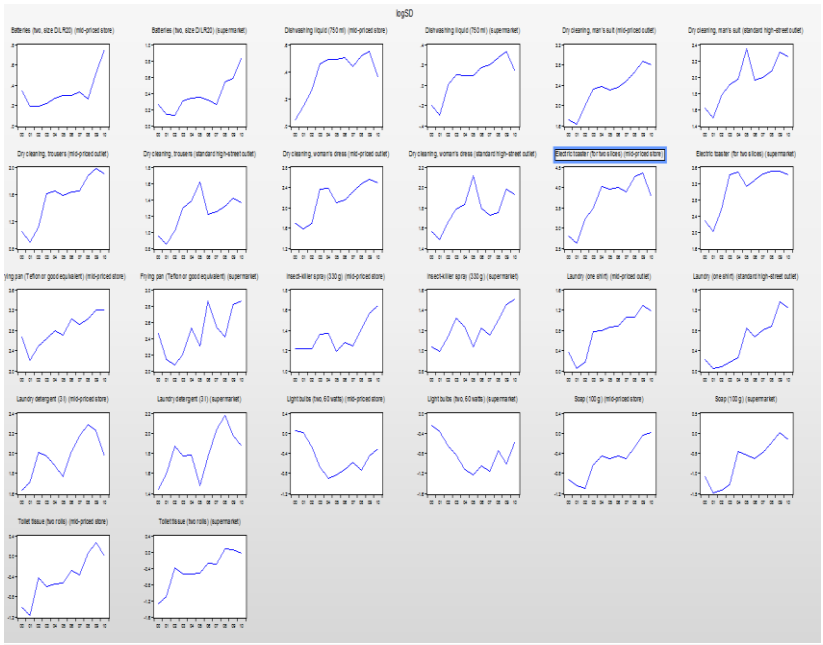

4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00
01
02
03
04
05
06
07
08
09
10

Figure 2(a): Log deviation of "Meat and Fish" prices from mean across prices from mean across countries and periods (individual cross sections)

Figure 2(a): Log deviation of "Meat and Fish"


logSD

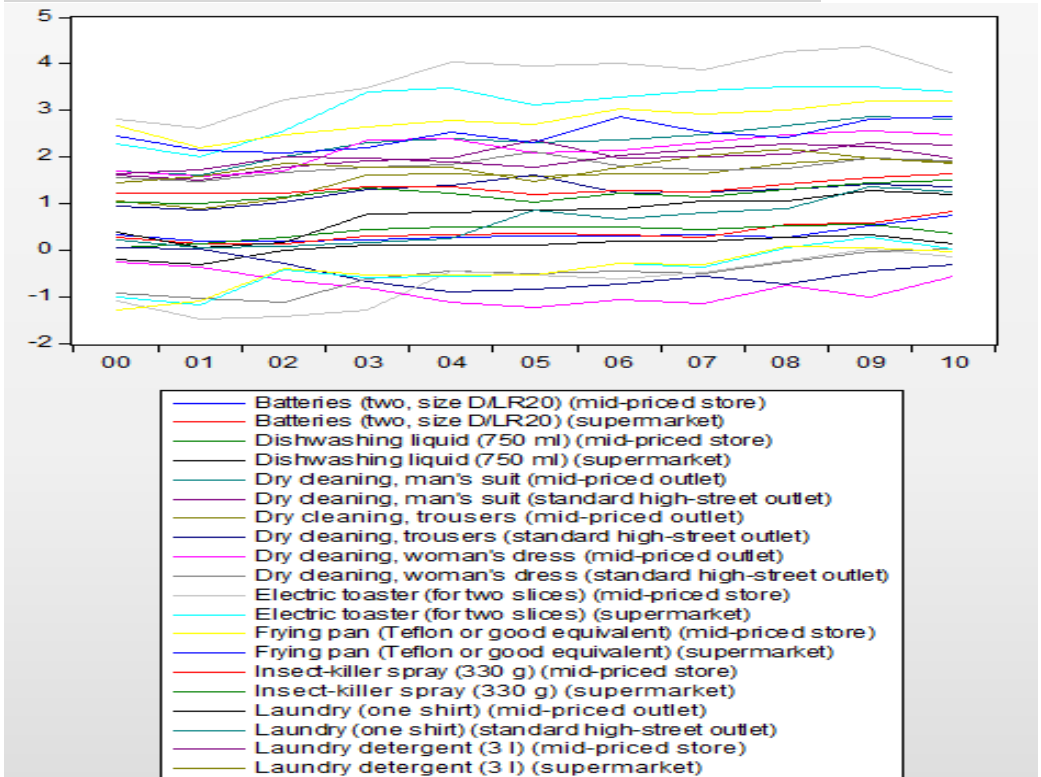
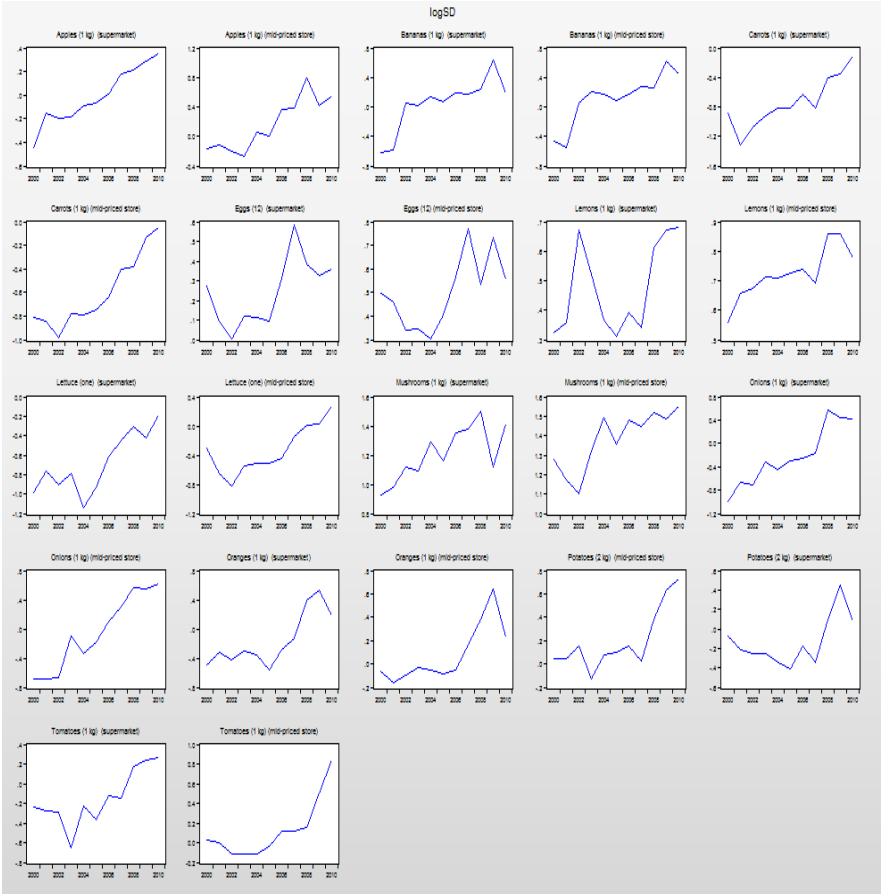

5
4
3
2
1
0
-1
-2
00
01
02
03
04
05
06
07
08
09
10
Batteries (two, size D/LR20) (mid-priced store)
Batteries (two, size D/LR20) (supermarket)
Dishwashing liquid (750 ml) (mid-priced store)
Dishwashing liquid (750 ml) (supermarket)
Dry cleaning, man's suit (mid-priced outlet)
Dry cleaning, man's suit (standard high-street outlet)
Dry cleaning, trousers (mid-priced outlet)
Dry cleaning, trousers (standard high-street outlet)
Dry cleaning, woman's dress (mid-priced outlet)
Dry cleaning, woman's dress (standard high-street outlet)
Electric toaster (for two slices) (mid-priced store)
Electric toaster (for two slices) (supermarket)
Frying pan (Teflon or good equivalent) (mid-priced store)
Frying pan (Teflon or good equivalent) (supermarket)
Insect-killer spray (330 g) (mid-priced store)
Insect-killer spray (330 g) (supermarket)
Laundry (one shirt) (mid-priced outlet)
Laundry (one shirt) (standard high-street outlet)
Laundry detergent (3 l) (mid-priced store)
Laundry detergent (3 l) (supermarket)

Figure 3(a): Log deviation of “Household Supplies” prices from mean across countries and periods (individual cross sections)



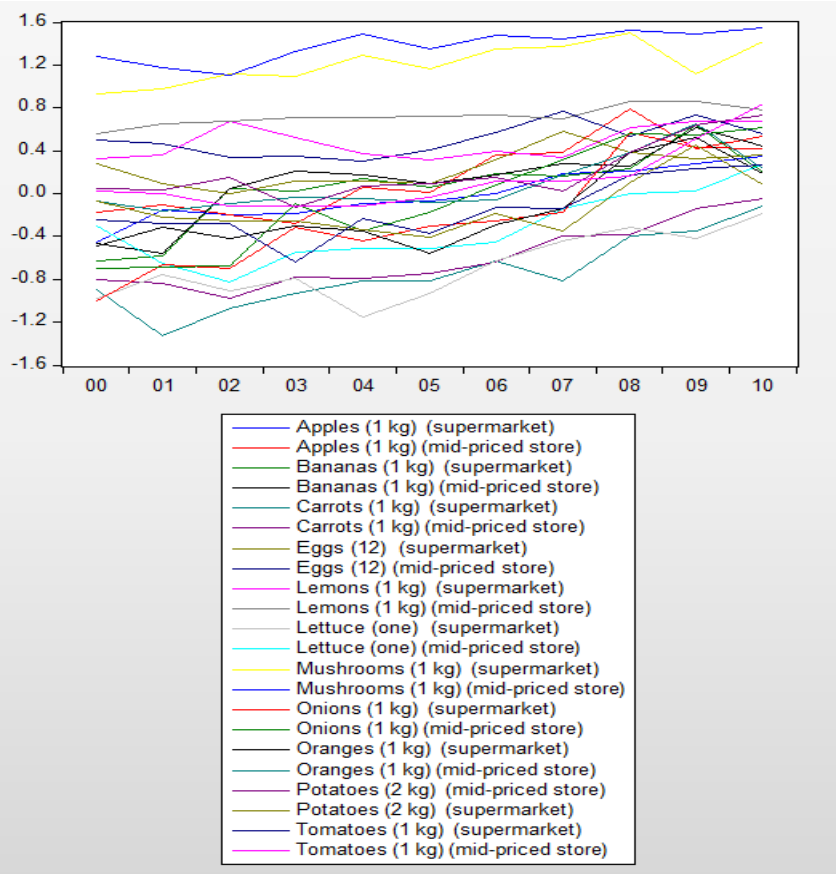
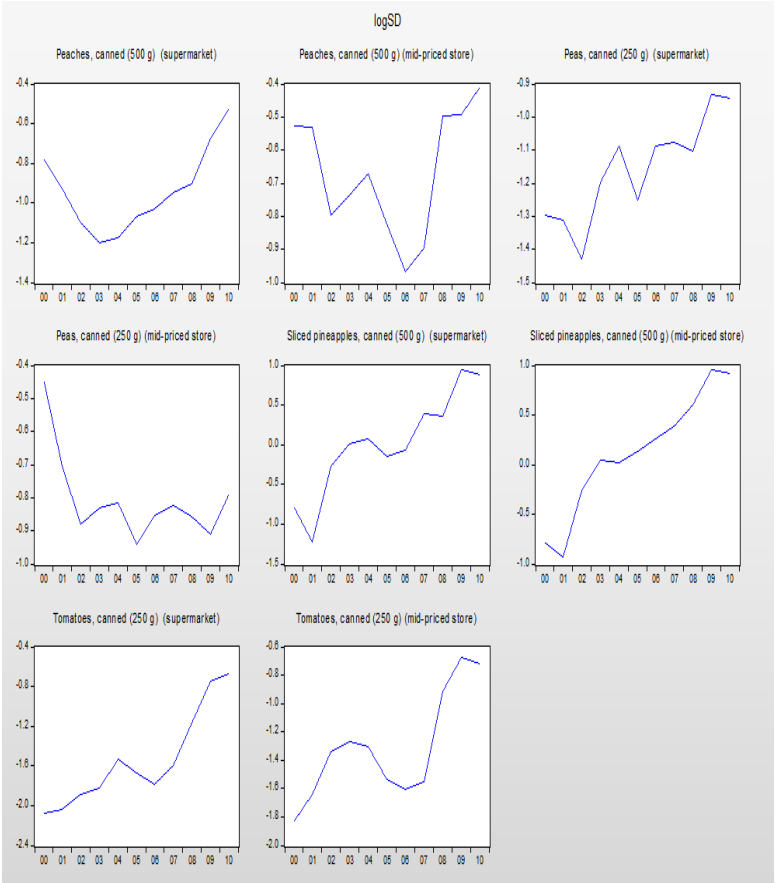


Figure 4(a): Log deviation of “Fresh fruit and vegetables” prices from mean across countries and periods (individual cross sections)


logSD
Peaches, canned (500 g) (supermarket)
Peaches, canned (500 g) (mid-priced store)
Peas, canned (250 g) (supermarket)
Peas, canned (250 g) (mid-priced store)
Sliced pineapples, canned (500 g) (supermarket)
Sliced pineapples, canned (500 g) (mid-priced store)
Tomatoes, canned (250 g) (supermarket)
Tomatoes, canned (250 g) (mid-priced store)

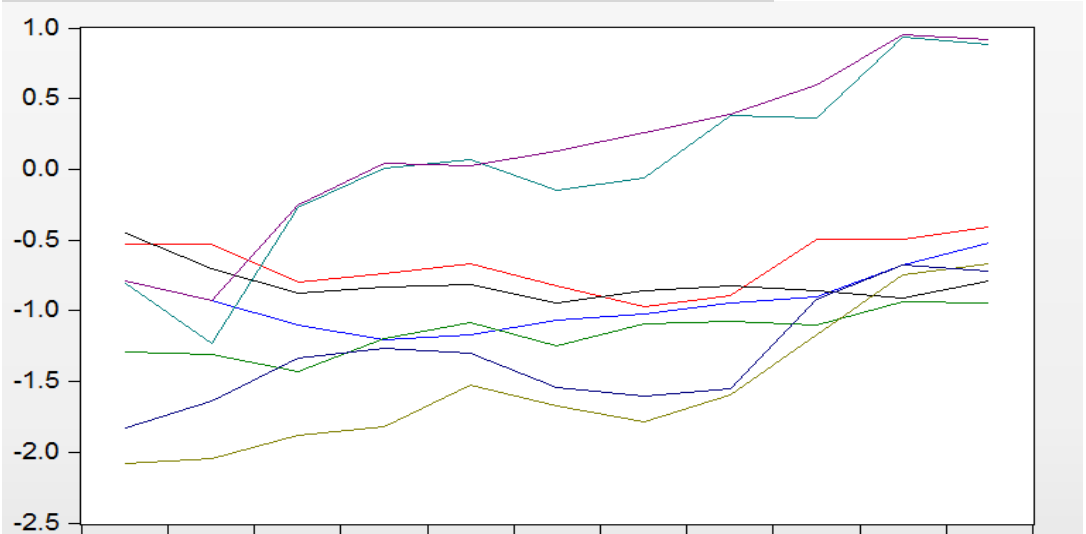
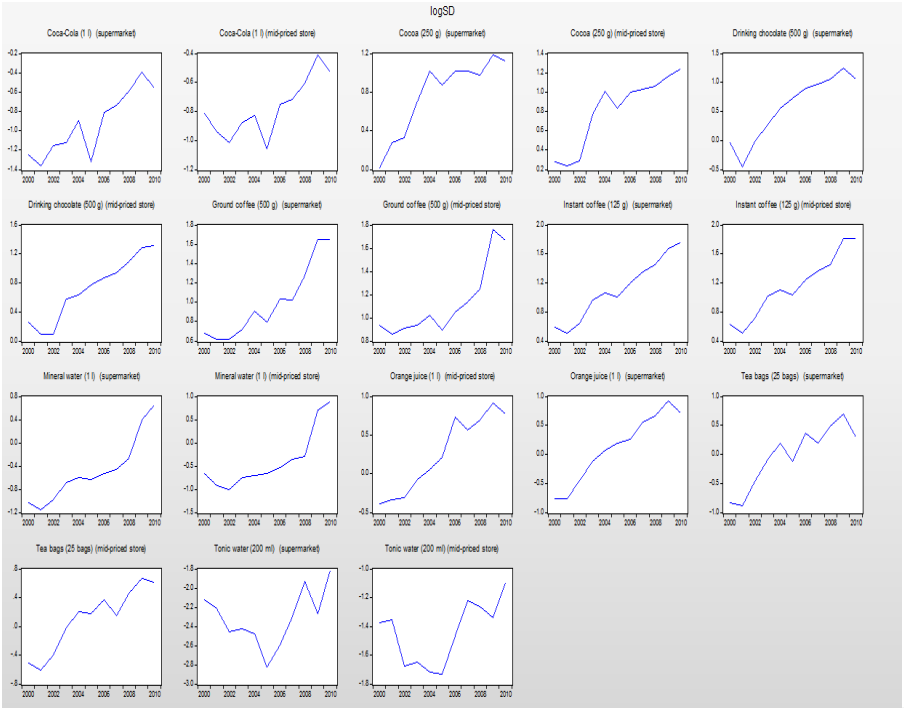

1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5

Figure 5(a): Log deviation of “Canned food” prices from mean across countries and periods (individual cross sections)


logSD
Coca-Cola (1 l) (supermarket)
Coca-Cola (1 l) (mid-priced store)
Cocoa (250 g) (supermarket)
Cocoa (250 g) (mid-priced store)
Drinking chocolate (500 g) (supermarket)
Drinking chocolate (500 g) (mid-priced store)
Ground coffee (500 g) (supermarket)
Ground coffee (500 g) (mid-priced store)
Instant coffee (125 g) (supermarket)
Instant coffee (125 g) (mid-priced store)
Mineral water (1 l) (supermarket)
Mineral water (1 l) (mid-priced store)
Orange juice (1 l) (mid-priced store)
Orange juice (1 l) (supermarket)
Tea bags (25 bags) (supermarket)
Tea bags (25 bags) (mid-priced store)
Tonic water (200 ml) (supermarket)
Tonic water (200 ml) (mid-priced store)

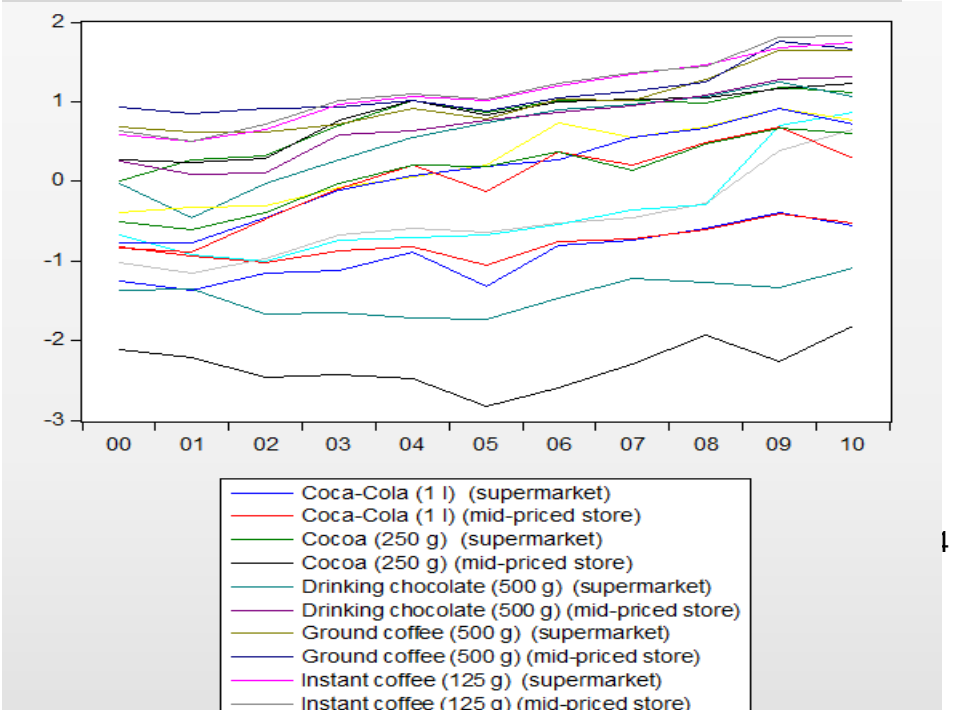

2
1
0
-1
-2
-3
00
01
02
03
04
05
06
07
08
09
10
Coca-Cola (1 l) (supermarket)
Coca-Cola (1 l) (mid-priced store)
Cocoa (250 g) (supermarket)
Cocoa (250 g) (mid-priced store)
Drinking chocolate (500 g) (supermarket)
Drinking chocolate (500 g) (mid-priced store)
Ground coffee (500 g) (supermarket)
Ground coffee (500 g) (mid-priced store)
Instant coffee (125 g) (supermarket)
Instant coffee (125 g) (mid-priced store)

Figure 6(a): Log deviation of “Beverages” prices from mean across countries and periods (individual cross sections)

Appendix A
Details of products

Product Name	**Category**
'White bread, 1 kg (supermarket)'	'Staples'
'White bread, 1 kg (mid-priced store)'	'Staples'
'Butter, 500 g (supermarket)'	'Staples'
'Butter, 500 g (mid-priced store)'	'Staples'
'Margarine, 500 g (supermarket)'	'Staples'
'Margarine, 500 g (mid-priced store)'	'Staples'
'White rice, 1 kg (supermarket)'	'Staples'
'White rice, 1 kg (mid-priced store)'	'Staples'
'Spaghetti (1 kg) (supermarket)'	'Staples'
'Spaghetti (1 kg) (mid-priced store)'	'Staples'
'Flour, white (1 kg) (supermarket)'	'Staples'
'Flour, white (1 kg) (mid-priced store)'	'Staples'
'Sugar, white (1 kg) (supermarket)'	'Staples'
'Sugar, white (1 kg) (mid-priced store)'	'Staples'
'Cheese, imported (500 g) (supermarket)'	'Staples'
'Cheese, imported (500 g) (mid-priced store)'	'Staples'
'Cornflakes (375 g) (supermarket)'	'Staples'
'Cornflakes (375 g) (mid-priced store)'	'Staples'
'Yoghurt, natural (150 g) (supermarket)'	'Staples'
'Yoghurt, natural (150 g) (mid-priced store)'	'Staples'
'Milk, pasteurised (1 l) (supermarket)'	'Staples'
'Milk, pasteurised (1 l) (mid-priced store)'	'Staples'

'Olive oil (1 l) (supermarket)'	'Staples'
'Olive oil (1 l) (mid-priced store)'	'Staples'
'Peanut or corn oil (1 l) (supermarket)'	'Staples'
'Peanut or corn oil (1 l) (mid-priced store)'	'Staples'
'Potatoes (2 kg) (supermarket)'	'Fresh fruit and vegetables'
'Potatoes (2 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Onions (1 kg) (supermarket)'	'Fresh fruit and vegetables'
'Onions (1 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Mushrooms (1 kg) (supermarket)'	'Fresh fruit and vegetables'
'Mushrooms (1 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Tomatoes (1 kg) (supermarket)'	'Fresh fruit and vegetables'
'Tomatoes (1 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Carrots (1 kg) (supermarket)'	'Fresh fruit and vegetables'
'Carrots (1 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Oranges (1 kg) (supermarket)'	'Fresh fruit and vegetables'
'Oranges (1 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Apples (1 kg) (supermarket)'	'Fresh fruit and vegetables'
'Apples (1 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Lemons (1 kg) (supermarket)'	'Fresh fruit and vegetables'
'Lemons (1 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Bananas (1 kg) (supermarket)'	'Fresh fruit and vegetables'
'Bananas (1 kg) (mid-priced store)'	'Fresh fruit and vegetables'
'Lettuce (one) (supermarket)'	'Fresh fruit and vegetables'
'Lettuce (one) (mid-priced store)'	'Fresh fruit and vegetables'
'Eggs (12) (supermarket)'	'Fresh fruit and vegetables'
'Eggs (12) (mid-priced store)'	'Fresh fruit and vegetables'
'Peas, canned (250 g) (supermarket)'	'Canned food'
'Peas, canned (250 g) (mid-priced store)'	'Canned food'
'Tomatoes, canned (250 g) (supermarket)'	'Canned food'
'Tomatoes, canned (250 g) (mid-priced store)'	'Canned food'
'Peaches, canned (500 g) (supermarket)'	'Canned food'

'Peaches, canned (500 g) (mid-priced store)'	'Canned food'
'Sliced pineapples, canned (500 g) (supermarket)'	'Canned food'
'Sliced pineapples, canned (500 g) (mid-priced store)'	'Canned food'
'Beef: filet mignon (1 kg) (supermarket)'	'Meat and fish'
'Beef: filet mignon (1 kg) (mid-priced store)'	'Meat and fish'
'Beef: steak, entrecote (1 kg) (supermarket)'	'Meat and fish'
'Beef: steak, entrecote (1 kg) (mid-priced store)'	'Meat and fish'
'Beef: stewing, shoulder (1 kg) (supermarket)'	'Meat and fish'
'Beef: stewing, shoulder (1 kg) (mid-priced store)'	'Meat and fish'
'Beef: roast (1 kg) (supermarket)'	'Meat and fish'
'Beef: roast (1 kg) (mid-priced store)'	'Meat and fish'
'Beef: ground or minced (1 kg) (supermarket)'	'Meat and fish'
'Beef: ground or minced (1 kg) (mid-priced store)'	'Meat and fish'
'Veal: chops (1 kg) (supermarket)'	'Meat and fish'
'Veal: chops (1 kg) (mid-priced store)'	'Meat and fish'
'Veal: fillet (1 kg) (supermarket)'	'Meat and fish'
'Veal: fillet (1 kg) (mid-priced store)'	'Meat and fish'
'Veal: roast (1 kg) (supermarket)'	'Meat and fish'
'Veal: roast (1 kg) (mid-priced store)'	'Meat and fish'
'Lamb: leg (1 kg) (supermarket)'	'Meat and fish'
'Lamb: leg (1 kg) (mid-priced store)'	'Meat and fish'
'Lamb: chops (1 kg) (supermarket)'	'Meat and fish'
'Lamb: chops (1 kg) (mid-priced store)'	'Meat and fish'
'Lamb: stewing (1 kg) (supermarket)'	'Meat and fish'
'Lamb: stewing (1 kg) (mid-priced store)'	'Meat and fish'
'Pork: chops (1 kg) (supermarket)'	'Meat and fish'
'Pork: chops (1 kg) (mid-priced store)'	'Meat and fish'
'Pork: loin (1 kg) (supermarket)'	'Meat and fish'
'Pork: loin (1 kg) (mid-priced store)'	'Meat and fish'
'Ham: whole (1 kg) (supermarket)'	'Meat and fish'
'Ham: whole (1 kg) (mid-priced store)'	'Meat and fish'
'Bacon (1 kg) (supermarket)'	'Meat and fish'

'Bacon (1 kg) (mid-priced store)'	'Meat and fish'
'Chicken: frozen (1 kg) (supermarket)'	'Meat and fish'
'Chicken: frozen (1 kg) (mid-priced store)'	'Meat and fish'
'Chicken: fresh (1 kg) (supermarket)'	'Meat and fish'
'Chicken: fresh (1 kg) (mid-priced store)'	'Meat and fish'
'Frozen fish fingers (1 kg) (supermarket)'	'Meat and fish'
'Frozen fish fingers (1 kg) (mid-priced store)'	'Meat and fish'
'Fresh fish (1 kg) (supermarket)'	'Meat and fish'
'Fresh fish (1 kg) (mid-priced store)'	'Meat and fish'
'Instant coffee (125 g) (supermarket)'	'Beverages'
'Instant coffee (125 g) (mid-priced store)'	'Beverages'
'Ground coffee (500 g) (supermarket)'	'Beverages'
'Ground coffee (500 g) (mid-priced store)'	'Beverages'
'Tea bags (25 bags) (supermarket)'	'Beverages'
'Tea bags (25 bags) (mid-priced store)'	'Beverages'
'Cocoa (250 g) (supermarket)'	'Beverages'
'Cocoa (250 g) (mid-priced store)'	'Beverages'
'Drinking chocolate (500 g) (supermarket)'	'Beverages'
'Drinking chocolate (500 g) (mid-priced store)'	'Beverages'
'Coca-Cola (1 l) (supermarket)'	'Beverages'
'Coca-Cola (1 l) (mid-priced store)'	'Beverages'
'Tonic water (200 ml) (supermarket)'	'Beverages'
'Tonic water (200 ml) (mid-priced store)'	'Beverages'
'Mineral water (1 l) (supermarket)'	'Beverages'
'Mineral water (1 l) (mid-priced store)'	'Beverages'
'Orange juice (1 l) (supermarket)'	'Beverages'
'Orange juice (1 l) (mid-priced store)'	'Beverages'
'Soap (100 g) (supermarket)'	'Household supplies'
'Soap (100 g) (mid-priced store)'	'Household supplies'
'Laundry detergent (3 l) (supermarket)'	'Household supplies'
'Laundry detergent (3 l) (mid-priced store)'	'Household supplies'

'Toilet tissue (two rolls) (supermarket)'	'Household supplies'
'Toilet tissue (two rolls) (mid-priced store)'	'Household supplies'
'Dishwashing liquid (750 ml) (supermarket)'	'Household supplies'
'Dishwashing liquid (750 ml) (mid-priced store)'	'Household supplies'
'Insect-killer spray (330 g) (supermarket)'	'Household supplies'
'Insect-killer spray (330 g) (mid-priced store)'	'Household supplies'
'Light bulbs (two, 60 watts) (supermarket)'	'Household supplies'
'Light bulbs (two, 60 watts) (mid-priced store)'	'Household supplies'
'Batteries (two, size D/LR20) (supermarket)'	'Household supplies'
'Batteries (two, size D/LR20) (mid-priced store)'	'Household supplies'
'Frying pan (Teflon or good equivalent) (supermarket)'	'Household supplies'
'Frying pan (Teflon or good equivalent) (mid-priced store)'	'Household supplies'
'Electric toaster (for two slices) (supermarket)'	'Household supplies'
'Electric toaster (for two slices) (mid-priced store)'	'Household supplies'
'Laundry (one shirt) (mid-priced outlet)'	'Household supplies'
'Dry cleaning, man"s suit (mid-priced outlet)'	'Household supplies'
'Dry cleaning, woman"s dress (mid-priced outlet)'	'Household supplies'
'Dry cleaning, trousers (mid-priced outlet)'	'Household supplies'