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FOOD COMPETITION IN WORLD MARKETS: SOME EVIDENCE FROM A PANEL DATA ANALYSIS OF TOP EXPORTING COUNTRIES

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Abstract

This paper investigates the relevance of relative prices and world income as determinants of food exports for the top trading countries in the period 1992-2012 using a panel data framework. A distinction between processed and unprocessed goods is drawn and, within this last category, a specific focus on commodities is made. We find that price elasticities generally take lower values for processed goods, and the opposite holds for income elasticities. Processed goods are also characterized by an inverse relationship between price elasticities and average unit values. The overall analysis leads to the conclusion that both emerging and advanced countries should increase their export specialization in processed goods. Furthermore, developed economies could face the fierce competition from emerging countries by enhancing the quality content of their processed goods exports.

JEL: F14, L66, Q17, C23

Keywords: Food Exports, Price and Income elasticities, Cross-country comparisons, Panel data analysis, Panel Granger causality

1. Introduction

Since the 1960s, a new wave of globalization has quickened the pace of world integration. International trade has played a key role in this process, as shown by an unprecedented increase in export growth rate, stimulated also by the liberalization process promoted by the WTO multilateral trade negotiations during the 1990s. Despite its nature of a necessary good, and the persistence of many protectionist policies, food is an important element of world merchandise trade with an incidence on total exports slightly below 10 per cent (see Table 1).[1] Although this percentage is declining, food continues to play a key role in total exports of both advanced and emerging countries.

Table 1 about here

The most remarkable case is Argentina, where food accounts for about 50 per cent of exports on average over the period 1992-2012,[2] followed by Brazil, Australia, Thailand and the Netherlands (28.22, 17.44, 15.97 and 15.39 per cent respectively). Moreover, in countries like Brazil, Canada, Indonesia, and Malaysia, the share of food on total exports has considerably increased in the last twenty years. These figures show that a traditional sector like food, usually classified among the low-tech industries,[3] can still represent an important growth-driver, supporting GDP, employment and the balance of payments, even in advanced countries.

In identifying the factors influencing export performance, the literature highlights foreign income as the most important determinant both of trade in general (KRUGMAN, 1989; IRWIN, 2002 and ESTEVADEORDAL ET AL., 2003) and of agricultural products in particular (see COYLE ET AL., 1998; HAQ & MEILKE, 2009 and SERRANO & PINILLA, 2010). Moreover, KRUGMAN (1989) observes that in the long-run Purchasing Power Parity (PPP) holds as a general tendency, so that different export growth rates across countries are principally determined by non-price competitiveness, as empirically

[1] As confirmation of the huge increase in international trade in the second-globalization era, both total and food exports grew very rapidly and significantly faster than production (SERRANO & PINILLA, 2010), as proved by their historical income elasticities, showing values greater than 1 during the last twenty years (1.7 and 1.1 respectively).
[2] This is the time span used in the analysis.
[3] According to the OECD (2002) classification, a firm or an industrial sector is considered high or low-tech if its ratio between R&D expenditure and turnover is either higher than 5 per cent or lower than 0.9 per cent respectively.

reflected in income elasticities (see also CAPORALE & CHIU, 1999). However, it should be noticed that the PPP theory holds only for tradable goods at the aggregate level and in the very long-run, when real exchange rates show no substantial change and thus have no central role in export performance. In the short and medium-run, and even in time spans as long as a decade, evidence in favour of the validity of the PPP theory is not clear, so that countries may experience changes in their relative export prices which modify their competitiveness (GOLDBERG & KNETTER, 1997 and KRUGMAN, 1987). Hence, especially at a disaggregated level, relative prices matter, and price elasticities are as important as income elasticities in explaining export performance.

When price competeviness is considered, standard international trade theory underlines the advantage of having higher price elasticities, because of their favorable effects on export volumes and the balance of payments.[4] However, this argument holds only either for the whole economy or for undifferentiated products depending on price competition (see, among others, ATHUKORALA & SEN, 1998 for food trade). Many studies, moreover, show that prices are indicators of quality (AIGINGER, 1997, SCHOTT, 2004, 2008 and FONTAGNÉ ET AL., 2008), so that high relative prices, when they signal a high quality standard of goods, are not necessarily disadvantageous in trade competition. Product quality can actually be a discriminating factor for the success or decline of food and other low-tech exports, so that even advanced countries can successfully compete in traditional industries if they rely on high-quality rather than low-price exports. In particular, countries characterized by high prices and quality reputation are likely to exhibit a more inelastic foreign demand for their products. However, as time goes by, demand can become more elastic if international markets recognize a decrease in product quality, so that there will be a shift toward products from countries with the same quality but lower prices. On the contrary, despite higher prices, foreign demand can remain inelastic if world consumers recognize the superiority of a country's products and are willing to pay more for high-quality goods. Ultimately, our working hypothesis is that advanced countries characterized by high relative prices and inelastic export demand can successfully compete in traditional products on international markets. In this context, the food industry is an interesting

[4] In fact, the Marshall-Lerner condition suggests that the higher the price elasticities of exports and imports, and the sum of these, the greater the effects of a relative price change on trade volumes and foreign currency net inflows.

case study since in several countries it is a large traditional sector making a big contribution to employment and value added. It also generates positive economic and social externalities in terms of reputation, tourism attraction and environmental protection. Food products can be divided into unprocessed and processed goods, according to level of processing. Inelastic export demand for higher-quality products is thought to hold especially for processed goods, which are characterized by higher value-added content and greater differentiability, so that quality can play a determinant role in triggering export performance, particularly for advanced countries.

The empirical analysis developed in this paper is original for the following reasons. First, in line with the most recent applied econometric literature on panel data, it tests the relevance of world income and relative prices as determinants of food exports for the top trading countries in the time period 1992-2012. Second, focusing mainly on processed food, it investigates the hypothesized existence of an inverse relationship between average unit values (AUVs) and export price elasticities, whereby countries with higher AUVs will generally exhibit a more inelastic foreign demand and vice versa.[5] On this point, then, we depart from traditional literature for which quality is usually captured by the export income elasticity (see, among others, KRUGMAN, 1989, SCHOTT, 2004 and HALLAK, 2006), which is thought to reflect the non-price competitiveness of a country, also influenced by factors including export composition, destination markets, embodied technology, marketing strategies and promotion, distribution services and financial assistance to exporters. Finally, by using world income as the same scale variable in the export function estimation of the top food exporting countries, the paper allows within-sample comparisons of price and income elasticities. This investigation enables us to derive some policy implications about the export prospects and the sustainability of the trade specialization model for the countries analyzed. In particular the paper sheds some light on the issue of whether a traditional industry like food can continue to play the role of a growth-driver both in developing and in advanced economies. This conclusion appears at variance with recent literature on industrial policy, which mainly suggests that investment in traditional sectors should be discouraged and R&D expenditure in high-tech industries promoted (See, for example, OECD, 2010 and EUROPEAN COMMISSION, 2010), because of their

[5] In this paper, elasticities are considered in their absolute value. An increase in elasticity, in absolute value, will thus imply a decrease in its algebraic value and vice versa.

higher productivity growth rates (LUCAS, 1988, GROSSMAN & HELPMAN, 1991 and FAGERBERG, 2000).

The rest of the paper proceeds as follows. Section 2 presents the data and the model specification. Section 3 outlines the testing framework which includes unit root tests, cointegration tests and panel Granger causality analysis. Section 4 reports the estimated long-run export price and income elasticities of the leading countries in international food trade. A specific investigation of the export function parameters of unprocessed, commodities and processed goods is then performed. Section 5 concludes and hints at the main policy implications of the estimation results.

2. Model Specification and Data

We start by selecting the top fifteen food exporters in the world, using as ranking criterion their export performance in 2012, the last year for which complete data are available. The countries selected are Argentina, Australia, Belgium, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, the Netherlands, Spain, Thailand and the USA. They constitute a very heterogeneous sample: India and Indonesia are classified by the World Bank as Lower Middle-Income countries; Argentina, Brazil, China and Thailand are Upper Middle-Income countries; all others are High-Income OECD members.[6] Table 2 reports the 2012 export values and market shares of these fifteen economies, which together account for 61.50 per cent of world food exports. The USA, with an export value of 138,034 million USD and a market share of 10.04 per cent, is the top food exporter, followed by the Netherlands, Germany, Brazil and France (6.13, 5.71 5.61 and 5.23 per cent respectively). India is the bottom country in the table, with a share of 2.22 per cent of world food trade.

Table 2 about here

[6] According to the most recent World Bank classification (2013 Edition), based on estimates of gross national income (GNI), Lower Middle-Income countries have a GNI between 1,036 and 4,085 USD, Upper Middle-Income countries have a GNI between 4,086 and 12,615 USD, and High-Income countries are characterized by a GNI equal to or greater than 12,616 USD.

The data used for our estimates, disaggregated at 4-digit level according to the Standard International Trade Classification (Rev. 3), are taken from the UN Comtrade database. The analysis considers all food products and the final selection includes 119 goods for each country in the 1992-2012 period.[7] Belgium, India, Indonesia and Thailand were however excluded from our analysis because of incomplete records and poor quality of data. The series are organized into eleven distinct panel datasets, one for each of the remaining countries. Each balanced panel is then characterized by 119 cross-sections (the selected goods) spanning the period 1992-2012, for a total of 2,499 observations.

Table 3 about here

Descriptive statistics of export volumes, market shares and AUVs are shown in Table 3, which reports the level of these variables at the beginning and the end of the considered time period, together with the average value for the same time span.[8,9] Export volumes increase considerably in most countries. In particular, they double in Australia, Germany, the Netherlands and Spain, triple in Argentina and almost quintuple in Brazil. Market shares increase in Argentina, Australia, Brazil, Germany, the Netherlands and Spain, while they decrease in all the other countries (China, France, Italy and the USA). The highest AUVs on average are recorded by Italy (1.24), the Netherlands (1.18) and Spain (1.09), while the lowest AUVs are recorded by Argentina, Australia and the USA (0.28, 0.41 and 0.41 again respectively).

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[7] The complete list of selected goods is reported in Table A1 in the Appendix. We excluded from the analysis the following items: 0124 (meat of horses, asses and mules), 0173 (liver of any animals), 0243 (blue-veined cheese), 0354 (fish liver & roes), 0451 (rye, unmilled), 0721 (cocoa beans) and 0725 (cocoa shells & other cocoa waste) because of missing records.

[8] Hereafter, export market shares indicate the ratios between the export volume of each country and the total export volume of the 11 countries considered in the analysis.

[9] The export unit values for each good *i* and country *j* (AUV_{ijt}) are computed as follows: $AUV_{ijt} = \frac{VX_{ijt}}{X_{ijt}}$, where the variables VX_{ijt} and X_{ijt} are respectively the export values and volumes for each good *i* and country *j* in any year *t*. Similarly, the average export unit values for each good *i* in the whole sample of *M* selected countries (AUV_{it}) are obtained as follows $AUV_{it} = \frac{\sum_{j=1}^{M} VX_{ijt}}{\sum_{j=1}^{M} X_{ijt}}$.

Our empirical analysis is based on the following traditional export function, estimated for each country in the sample, under the assumption that goods are imperfect substitutes:

$$lnX_{it} = \alpha_i + \beta_i lnRP_{it} + \gamma_i lnGDPW_t + \varepsilon_{it} \qquad (1)$$

where i and t refer to the i-th good and the t-th year respectively, with i=1,…,N and t=1,…,T. X_{it} is the yearly export volume for each of the 119 considered goods; RP_{it} is the yearly relative export price of each good[10] and $GDPW_t$ is the annual chained-volume index of world GDP, expressed for convenience in constant 2005 USD on the basis of the International Monetary Fund data (World Economic Outlook Database, April 2014 Edition), which is invariant for each cross-section. All variables are transformed into natural logarithms and labelled lnX_{it}, $lnRP_{it}$ and $lnGDPW_t$. The coefficients β_i and γ_i are the food export price and income elasticities, respectively. β_i is expected to be negative, and γ_i positive. The α_i are the intercepts for each good, and the ε_{it} the error terms. For the sake of efficiency, Equation (1) is estimated without the inclusion of a time trend (See HANSEN, 1992).

As highlighted by GOLDSTEIN & KHAN (1985), Equation (1) represents a standard export demand function appropriate for goods that are imperfect substitutes. Our decision to model food exports this way has two justifications. First, if domestic and foreign goods were perfect substitutes, either the domestic or the foreign good would swallow up the whole market when each is produced under constant (or decreasing) costs, and every country would become either an exporter or an importer of the traded good but not both. Second, the empirical evidence shows that the “law of one price” does not hold either across or within countries for differentiated or differentiable goods. The only possible exception to this is standard homogeneous commodities such as corn, which are sold on international commodity exchanges. However, as ARMINGTON (1969)

[10] Following an approach widely used in trade literature, we assume unit values to be good proxies for prices (See, among others, FONTAGNÉ ET AL., 2008; SCHOTT, 2008). The relative price RP_{ijt} is then obtained as the ratio between the export unit value of each selected country j for every good i at time t and the average export unit value of all countries considered in the sample for the same good and time (I.e. $RP_{ijt} = \frac{AUV_{ijt}}{AUV_{it}}$). In Equation (1) the country subscript j is omitted for ease of notation.

points out, products are always geographically differentiated, and domestic and foreign goods may differ by some real or perceived characteristics resulting from differences in the place of production (See also CROZET & ERKEL-ROUSSE, 2004). Even commodity goods may be of different variety or quality, thus justifying different prices. This is confirmed by the prices of food commodities computed in our sample and approximated by average unit values, which vary across countries. We can thus treat all food products, including commodities, as imperfect substitutes.

So basically, then, we can imagine our exporting countries as firms facing a market demand proxied by world GDP. If goods are imperfect substitutes by nature or by differentiation, then conditions of imperfect competition will prevail, so that firms will be price-makers, rather than sheer price-takers, as it would be in the case of perfect substitutability (true commodities). Under these market conditions, prices will be set as a mark-up over production costs. A high price may thus be the result either of a high level of costs or of profit margins (or both). According to basic microeconomic analysis, the mark-up will depend on the market power of the firm, which is in turn a function of the structural conditions of the market, such as the existence of entry barriers and the size of fixed costs. It will also depend on the features of the good, such as its quality content. In general, the higher the quality of a good, the lower its substitutability, and consequently the higher the mark-up, and thus the price. The market power of a firm is usually measured by the Lerner index, which is the opposite of the price elasticity of demand (in absolute terms). As a consequence, the lower this elasticity, the higher the market power of the firm and the final price. So in our case, a higher-quality good, characterized by a lower substitutability, will imply a more inelastic world demand, a higher market power of the exporting country and thus a higher export price. Since prices are determined not only by the mark-up but also by production costs, this relationship between demand elasticity and prices may be partly influenced by the level of costs. But the general hypothesis that more substitutable goods are likely to exhibit lower prices because of lower firm market power still holds.

Summarizing these points, we assume the following two relationships to hold. First, within the same country, less substitutable food products, i.e. processed goods, should display a lower price elasticity than unprocessed goods and commodities. Second, a country producing higher-quality goods should be able to set higher export prices and face a more inelastic demand. In a situation where countries compete against each other in the world market, the export price elasticity of countries producing higher-quality and hence higher-price goods should be lower than that of countries producing lower-quality and lower-price goods. Hence we should observe an inverse relationship between the export price elasticities and the export prices of our sample countries. As noted above, we assume that unit values can be considered as good proxies for prices (See, among others, FONTAGNÉ ET AL., 2008; SCHOTT, 2008). Prices in turn can be considered as good proxies for quality, especially considering the very detailed product disaggregation used in this study.[11] AUVs should therefore be able to capture relevant features of food exports, such as differentiation and reputation, which appear to be particular important in international markets.

3. A causality analysis between export volumes, relative prices and world income

3.1 Panel unit root tests

Before estimating Equation (1), we perform a panel Granger-type causality test to verify the existence of any causal effect between export volumes, relative prices and world income, an issue somewhat overlooked in the empirical literature on the subject. This econometric procedure requires variables to be stationary and to have the same order of integration. So in order to avoid inappropriate conclusions about the order of integration of the variables due to the statistical limitations affecting the most popular unit root tests, we apply the most recent second-generation panel unit root test proposed by PESARAN (2007), which is more powerful than the first-generation unit root tests (E.g. those proposed by BREITUNG, 2000 and HADRI, 2000) because it relaxes the hypothesis of cross-sectional independence and takes into account any possible correlation between cross-sections. The null hypothesis of this test is that all series contain a unit root. As noted by CAMPELL & PERRON (1991), the inclusion of many lags in the test equation

[11] Our database considers goods at a high level of disaggregation, given by the 4-digit level of the SITC. Moreover, a recent paper by ESSAJI & FUJIWARA (2012) shows that AUVs and more sophisticated *ad hoc* indicators of goods quality yield the same analytical results. This justifies our decision to use the more commonly used and easier to compute export prices as proxies of goods quality.

may affect the power of unit root tests; for this reason, given that in our analysis the time period comprises twenty-one years (T=21), the maximum selected lag length lies between 2 and 5.[12] The test is made in order to verify the order of integration of export volumes and relative prices (lnX_{it} and $lnRP_{it}$ respectively), given that world GDP is a time series invariant across cross-sections. For this reason, we check for the stationarity of this latter variable by performing two widely used time series unit root tests: the Augmented Dickey-Fuller (ADF) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests (SAID AND DICKEY, 1984 and KWIATKOWSKI ET AL., 1992, respectively).

Tables 4a and 4b about here

Tables 4a and 4b show the results of these unit root tests. They all clearly indicate the non-stationarity of the variables of interest.[13] The ADF and KPSS tests in Table 4b confirm the non-stationarity of world GDP ($lnGDPW_t$). For these reasons, $lnX_{it,}$, $lnRP_{it}$ and $lnGDPW_t$ should be properly considered as I(1) variables.

3.2 Panel cointegration testing

Given the non-stationarity of the variables of interest, we proceed with the implementation of a panel cointegration test to verify the existence of a long-run relationship between them. To this end, we perform the PEDRONI (1999, 2004) panel cointegration test, which extends to panel data the ENGLE-GRANGER (1987) two-stage framework, developed to test cointegration in the case of time series. The idea is to study the residuals of Equation (1), where all variables ($lnX_{it,}$, $lnRP_{it}$ and $lnGDPW_t$) are I(1). If these variables are cointegrated, the residuals will be I(0), but if they are not cointegrated, then the residuals will be I(1). The Pedroni test allows for interdependence across cross-sections together with different individual effects in the intercept and slope of the test equation, in order to define the long-run relationship and to ensure that the

[12] With regard to our dependent variable, as indicated in the notes to Table 4a, lnX_{it}, a lag length of 3 is used for Argentina, Germany and the Netherlands, a lag length of 4 is used for China and Spain, and a lag length of 5 is used for Brazil.

[13] Similar conclusions are also reached by performing the first-generation unit root tests proposed by BREITUNG (2000) and HADRI (2000). These tests are not reported in the paper, but are available from the authors on request.

cointegrating vectors can vary along the cross-sections in the panel. The Pedroni test consists of two different groups of statistics; the first group is composed of four tests (panel *v*, panel *ρ*, panel *pp* and panel ADF-statistics), which pool the residuals along the within-dimension of the panel (panel tests). The second group is composed of three other tests (group *ρ*, group *pp* and group ADF-statistics), which pool the residuals along the between-dimension of the panel (group tests).[14] It is common practice in the literature to reject the null hypothesis of no cointegration if at least four out of seven of these statistics are significant (See, among others, BOTTAZZI & PERI, 2005, 2007; NARAYAN ET AL., 2007; LEE & CHANG, 2008 and BOTTASSO ET AL., 2013).

Table 5 shows the results of the Pedroni cointegration test, performed with the inclusion of the intercept in the testing equation, for each top exporting country.

Table 5 about here

The test confirms the presence of cointegration since five out of seven statistics reject the null hypothesis of no cointegration for all countries.[15] The only statistics that fail to reject the no-cointegration hypothesis are the panel *v* for Canada, France and the USA and the group *ρ* for all countries with the exception of Brazil. In this regard, BOTTAZZI & PERI (2005, 2007) find similar results and note that panel *v*-statistics tend to have the best power relative to the others when the panel is fairly large, which is not the case here. They also find that the group *ρ*-Statistic is undersized in small panels and that it is the most conservative test (See also PEDRONI, 1999).

Ultimately, since the Pedroni test rejects the hypothesis of no cointegration for all countries, we can conclude that a long-run relationship between the variables of our interest exists.

3.3 Panel Granger causality testing

[14] For the within-dimension, weighted statistics have also been calculated. They are not reported in the tables, since they confirm the results of unweighted statistics, but are available on request.

[15] Our cointegration results are robust even when the Pedroni test is performed with the inclusion of a time trend (Details are available on request). The same conclusions are reached using the alternative test proposed by KAO (1999).

Given that our variables are non-stationary and cointegrated, we move on to determine the direction of causality between them by means of the two-step Engle–Granger causality procedure (ENGLE & GRANGER, 1987). In particular, since the aim of the paper is to study export price and income elasticities, we need to find the existence of a long-run causality going from prices and income to export volumes. First, long-run equilibrium coefficients are estimated by applying the panel Mean Group (MG) estimator proposed by PESARAN & SMITH (1995) to Equation (1).[16] From a time-series perspective, the MG estimator is particularly appropriate in the case of non-stationary panels with, 'small-T', where 'small' typically means about 15 time series observations (in our case *T*=21). By construction, fixed effects are captured by the inclusion of an intercept for each panel cross-section (For more details, see EBERHARDT, 2012).

Next, following BRONZINI & PISELLI (2009) and BASHIRI BEHMIRI & PIRES MANSO (2012) among others, we insert the lagged residual from Equations (1) into a Granger causality model based on a dynamic error correction term (HOLTS-EAKIN ET AL, 1988), which is specified as follows:

$$\Delta \ln X_{it} = \alpha^X + \sum_{l=1}^{p} \theta_l^X \Delta \ln X_{i,t-l} + \sum_{m=1}^{q} \eta_m^X \Delta \ln RP_{i,t-m} + \sum_{n=1}^{r} \mu_n^X \Delta \ln GDPW_{t-n} + \omega^X ECT_{i,t-1} + u_{it} \qquad (2a)$$

$$\Delta \ln RP_{it} = \alpha^{RP} + \sum_{l=1}^{p} \theta_l^{RP} \Delta \ln RP_{i,t-l} + \sum_{m=1}^{q} \eta_m^{RP} \Delta \ln X_{i,t-m} + \sum_{n=1}^{r} \mu_n^{RP} \Delta \ln GDPW_{t-n} + \omega^{RP} ECT_{i,t-1} + v_{it} \qquad (2b)$$

$$\Delta \ln GDPW_t = \alpha^{GDPW} + \sum_{l=1}^{p} \theta_l^{GDPW} \Delta \ln GDPW_{t-l} + \sum_{m=1}^{q} \eta_m^{GDPW} \Delta \ln X_{i,t-m} + \sum_{n=1}^{r} \mu_n^{GDPW} \Delta \ln RP_{i,t-n} + \omega^{GDPW} ECT_{i,t-1} + \xi_{it} . \qquad (2c)$$

Equations (2a), (2b) and (2c) are error correction representations of Equation (1) and represent the dynamic behaviour of ΔlnX_{it}, $\Delta lnRP_{it}$ and $\Delta lnGDPW_t$. They allow us to analyze the short term dynamics and to formally test for panel Granger causality between export volumes and the explanatory variables in Equation (1), both in the short and in the long run (See also STRAUSS & WOHART, 2004 and BOTTASSO ET AL., 2013).[17]

[16] In this paper the MG estimator proposed by Pesaran and Smith is preferred to the more commonly used dynamic OLS (DOLS) or to the fully modified OLS (FMOLS) procedures proposed by SAIKKONEN (1991) and PEDRONI (2000) respectively, since this estimator is more appropriate to our datasets characterized by moderate length (*T*=21). Our estimates are computed using the Stata routine proposed by EBERHARDT (2012).

[17] For the same reason as for Equation (1), we estimate Equations (2a), (2b) and (2c) without including a time trend.

In Equations (2a), (2b) and (2c), *Δ* indicates the first difference of the variables, and u_{it}, v_{it} and ξ_{it} are the disturbance terms, which are uncorrelated with zero mean. The variable $ECT_{i,t-1}$ is the lagged residual derived from the long-run cointegrating relationship in Equation (1). The coefficients θ, η and μ in Equations (2a), (2b) and (2c) indicate the short-run responses of the dependent variables. In order to guarantee convergence toward long-run equilibrium, the parameter ω^X needs to be negative. It is common practice in the literature to determine the lag lengths *p*, *q* and *r* using the Akaike or the Schwarz Information Criteria. In this paper we use the Schwarz Information Criterion, which indicates that *p*, *q* and *r* are equal to 1.

Given the possible correlation between the lagged dependent variables and the error terms in Equations (2a), (2b) and (2c), ARELLANO & BOND (1991), ARELLANO & BOVER (1995) and then BLUNDELL & BOND (1998) develop a two-step difference GMM estimator in order to obtain an unbiased estimate of the parameters of interest taking into account all kinds of correlation and endogeneity problems. For this reason, and similarly to COSTANTINI & MARTINI (2010), BASHIRI BEHMIRI & PIRES MANSO (2012) and JAUNKY (2012a,b), we estimate Equations (2a), (2b) and (2c) by applying the system GMM estimator proposed by BLUNDELL & BOND (1998).[18]

In order to test for the existence of a causal relationship between the variables of interest, three different types of causality (short-run, long-run and strong causality) can be analyzed by means of a Wald test. Consider for example Equation (2a): the "*short-run Granger causality*" indicates how the dependent variable reacts to shocks in the short-run and holds if the following null hypotheses are rejected: $H_0 : \eta_m^X = 0$ and $H_0 : \mu_n^X = 0$ for all *m* and *n*. The "*long-run Granger causality*" is evaluated by means of the ECT coefficient, which indicates how fast deviations from long-run equilibrium are eliminated. In this case, the null hypothesis is $H_0 : \omega^X = 0$. Finally, the "*strong Granger causality*" test checks whether the different possible sources of causality are jointly

[18] Diagnostic statistics of our estimates are available from the authors on request. In particular, following ROODMAN (2009a), the explanatory variables are treated as endogenous and the selected valid instruments always satisfy the rule of thumb 'maximum number of instruments = *N*'. Furthermore, the Hansen *J* statistic exhibits a *p*-value greater than, or at least equal to, 0.25. For the sake of parsimony, instruments are also collapsed (See ROODMAN, 2009b). Finally, to control for cross-sectional dependence, time dummies are included in Equations (2a), (2b) and (2c).

significant. In fact, strong casuality shows which variables bear the burden of a short-run adjustment in order to re-establish long run equilibrium, following a shock to the system (OH & LEE, 2004 and COSTANTINI & MARTINI, 2010). In our analysis, the null hypotheses, which should jointly hold for all cross-sections, are $H_0 : \omega^X = \eta_m^X = 0$ and $H_0 : \omega^X = \mu_n^X = 0$. Similar null hypotheses are then tested for Equations (2b) and (2c). It is important to note that long-run and strong causality are more relevant to our analysis.

Table 6 about here

Table 6 reports the results of the Wald tests on the above illustrated coefficients for our eleven countries. In the short run, there is a unidirectional causality from relative prices to export volumes for Australia, Canada, the Netherlands and the USA. World income Granger-causes export volumes in the short-run in Argentina and Australia, and bidirectional causality is found for the USA. More homogeneous results are found for long-run and strong causality. In fact, in the long-run, all countries exhibit a unidirectional causality from relative prices and world income to export volumes. Strong causality is always verified in the case of Equation (2a), to indicate that relative prices and world GDP bear the burden of a short-run adjustment to re-establish long run equilibrium after a shock to the system. In the case of Equations (2b) and (2c), there is no general evidence of causality either in the short or in the long run.[19] In these last two cases, it is important to note that diagnostic statistics do not lead to any conclusions about causality either, because of the violations of some of the econometric requirements given by ROODMAN (2009a). Especially for Equation (2c), this result is also in line with a priori economic principles whereby GDP is an exogenous variable, not dependent on the relative prices and export volumes of any specific industrial sector.

To conclude, our analysis confirms the presence of a unidirectional causality from $lnRP_{it}$ and $lnGDP_t$ to lnX_{it} *in the long run*, which is the time horizon of interest. We therefore proceed to compare the long-run export price and income elasticities of our

[19] Some evidence of strong causality is found in the case of Equation (2b) for export volumes in the Netherlands and for world income in Brazil and the USA; for Equation (2c), strong causality is observed in Australia.

eleven sample countries, using for this purpose Equation (1) as outlined at the beginning of Section 2.

4 Long-run price and income elasticities

4.1. Results for the whole sample of food products

Table 7 reports the previously illustrated long-run price and income elasticities (parameters β_i and γ_i respectively) for each country in our sample.

Table 7 about here

The estimated coefficients for relative prices ($lnRP_{it}$) exhibit the expected negative sign, and are statistically significant for all countries. Price elasticities, considered in absolute values, are lower than 1 in all countries with the exception of Brazil (-1.14). This result is in line with other empirical findings about export function estimates in general. As stated in Section 2 and also pointed out by KRUGMAN (1989), exports of different countries are imperfect substitutes, which implies low price elasticities. This is particularly true for food exports, where international trade concerns necessary goods and many products are perishable. However, some differences are worth noticing. The emerging countries in the sample exhibit the highest price elasticities;[20] the only interesting exception is China, which has a coefficient of -0.77 similar to advanced countries. This evidence confirms the increasing importance of China on world food markets in recent decades, as noted by CARTELL & ROZELLE (2001). Among advanced countries, the USA and Canada record the lowest price elasticities (-0.52 and -0.55 respectively), followed by Germany and France (-0.60 –and -0.63).

With regard to the export income elasticity, it is worth recalling that this parameter depends on different factors. First, it is linked to Engel's law defining the responsiveness of food demand to income, which clearly differs by product type. Second, it is related to mismatches between demands and supplies at national level and

[20] This is because of the lower quality of emerging countries' food exports, and also because of the composition of traded goods. These are characterized by a higher percentage of unprocessed products and commodities, whose price elasticity is higher than that of processed goods (See the following Subsections 4.2 and 4.3).

to world consumers' desire for diversity, which are at the roots of international trade. Finally, as also noted by KRUGMAN (1989), it is the result of the goods and market composition of exports and of their specific features such as variety and quality (See also SCHOTT 2004 and HALLAK, 2006). It is worth noting that in the empirical international trade literature the estimated income elasticity for any country's aggregate export function generally shows a level higher than two (See, among others, ARIZE, 2001). This is compatible with the stylized fact that exports show an average annual growth rate higher than that of GDP. In the food industry, because of the characteristics of agricultural products noted above, the export income elasticity is obviously lower, and typically around one (SERRANO & PINILLA, 2010).[21] Our analysis confirms that this is on average true, even though there is a remarkable heterogeneity across countries, mainly attributable to the different ability of exporting countries to differentiate goods, destination markets and outperform competitors in world trade. Emerging economies (except Australia) as well as Spain show values higher than 2. Some advanced economies (Canada, Germany and Italy) show values above 1 (1.04, 1.52 and 1.31 respectively); Australia, France, the USA and the Netherlands display values below 1 (0.39, 0.44, 0.71 and 0.84, respectively). To sum up, our estimations show that, in general, emerging countries are characterized by higher price and income elasticities than advanced nations. However, a general relationship between price elasticities and AUVs, which according to our working hypothesis would mainly stem from differences in the real or perceived quality of food products according to their country of origin, is not discernible. This may be because the results described in this subsection refer to the entire sample of 119 food products for each selected country, and these include both processed and unprocessed goods.

The distinction between processed and unprocessed goods adopted in this paper follows the classification criterion proposed by ATHUKORALA & JAYASURIYA (2003) and JONGWANICH (2009), where processed goods are identified with reference to the ISIC Section on "The food safety standards". Unprocessed goods are identified by simply subtracting processed goods from our full sample of food products. To complete our classification, used in subsequent analysis, commodities are the sub-set of unprocessed goods, as generally defined by World Bank in the Global Economic

[21] As noted in Footnote 1, in the time period considered, the historical income elasticity of exports is equal to 1.7, while that of food is only 1.1.

Monitor (GEM) on Commodities (2013 Edition).[22] Table A1 in the Appendix reports in detail the food product identification and classification adopted.

Since unprocessed goods (and commodities) are characterized by much lower AUVs than processed goods, countries like the USA, with a strong specialization in the first type of products, may exhibit a low AUV due to this composition effect. In order to take into account, at least partially, this effect, it is necessary to analyze the export function parameters of unprocessed and processed food exports separately. This is also useful in the light of the fact that in recent decades food trade has been characterized by a structural change in its composition, with an increasing importance of processed goods exports compared to the more traditional unprocessed products (JONGWANICH, 2009). As already outlined in Section 2, our basic hypothesis is that processed goods should exhibit a lower price elasticity than unprocessed products and commodities. We expect the inverse relationship between food export price elasticities and AUVs, which is not discernible in the whole sample of goods, should emerge more clearly in the case of processed goods.

4.2. Unprocessed goods and commodities

In this subsection we deal with unprocessed goods, substantially corresponding to raw or minimally processed food products. These are basic goods (such as fruits, leaves, roots, seeds etc.), where harvesting generally depends on time-varying meteorological conditions and which often require preservation and culinary processing in order to be safer and more palatable. They belong to the following groups: cereals, vegetables and fruits, sugar, coffee, tea, cocoa and foodstuff for animals. Inside this set, we identify a further sub-sample of commodities, as defined by the World Bank and listed in detail in Table A1. Using this classification, we re-estimate Equation (1) focusing only on unprocessed goods (N=48) and commodities (N=16). Tables 8 and 9 show our main results.

Tables 8 and 9 about here

[22] However, following the more appropriate classification by ATHUKORALA & JAYASURIYA (2003) and JONGWANICH (2009), all goods in the 011 group (meat of bovine animals, fresh, chilled or frozen) are classified as processed, as they involve some type of production process and/or are differentiated across countries. The same conclusions hold for the goods in the 0461 and 0471 groups (flour of wheat and cereal flours).

It is interesting to note that the export price elasticities (parameters β_i) in Tables 8 and 9 show in general higher values than the corresponding ones in Table 7. In particular for Australia, China and Canada price elasticities rise from -0.94, -0.77 and -0.55 to -1.52, -1.19 and -0,79, respectively. Furthermore, commodity exports generally exhibit the most price-elastic demand in all countries. This is particularly noticeable for Australia (-2.29), China (-1.82), Brazil (-1.78), Italy (-1.34), Argentina (-1.17), Spain (-1.11), the Netherlands (-1.03) and Canada (-0.92). For the USA, the parameter is higher than that for food in general, but remains below 1. The β_i estimates for France and Germany do not vary significantly across different groups of food exports.

These findings confirm our hypothesis that the least differentiated goods, i.e. unprocessed products and commodities, generally exhibit the highest price elasticities. As noted above, this result is of course partially due to the fact that these kinds of products are more homogeneous and thus more exposed to the law of one price, so that international competition is more intense. However, as described in Section 2, the country-of-origin bias and the existence of multiple varieties within the same good trigger differences both in AUVs and in the estimated export function parameters. This justifies using the imperfect substitutes model for these goods too. This result is original with respect to previous literature, where commodities are generally considered as perfect substitutes.

If we consider income elasticities, our estimation results indicate that Brazil, China and Argentina show the highest values in our sample of countries. The lowest income elasticities are observed for the Netherlands, Canada, Germany and Italy, while the coefficient is not statistically different from zero for Australia, France, Spain and the USA. In particular, the income elasticities in Tables 8 and 9 are in general lower than those in Table 7, given the low quality of these kinds of products. The only exceptions are Brazil, Canada and Italy (in the latter case, this holds only for unprocessed goods).

Summarizing our previous findings, our estimated export functions of unprocessed goods and commodities confirm that these goods are more subject to international price competition, resulting in a higher price elasticity and a lower income elasticity.[23]

[23] It is important to note that our results remain unchanged even if we include in the commodity set those controversial goods (such as bovine meat and flour) discussed in Footnote 22.

4.3. Processed goods

Following the food product classification by ATHUKORALA & JAYASURIYA (2003) and JONGWANICH (2009), adopted in this paper, we select 71 processed goods, including fruits and vegetables, poultry, fish and dairy products (See Appendix A1 for details). These products have been the most dynamic component of food exports in recent decades, reflecting a structural change in the composition of food trade. In fact, the shares of processed goods on total food exports have increased in all countries in the considered time period (with Australia as the only exception). This trend is particularly noticeable for Spain, China, Canada and the USA, where national market shares in values rise respectively from 35.9, 52.9, 42.9 and 38.0 per cent in 1992 to 62.2, 69.1, 54.3 and 47.0 in 2012. This phenomenon is driven, on the demand side, largely by the increasing importance of these products in consumption patterns in both developed and developing countries (the 'internationalization of food habits'). It is also driven by improvements in food technology, refrigeration facilities and transportation on the supply side (See ATHUKORALA & JAYASURIYA, 2003).

It is worth noticing that the top food exporters selected in our analysis are also the main exporters of processed food in our time span. In fact, the USA, Germany, the Netherlands, China, France, Belgium, Brazil, Italy, Canada and Thailand are (in this order) the top 10 exporters of processed food in 2012.[24] Spain, Australia, India and Argentina occupy 12th, 14th, 17th and 20th positions respectively. These countries together account for 62.4 per cent of world processed food exports. Table 10 reports the results of our estimates of Equation (1) concerning processed food.

Table10 about here

With regard to price elasticities, by comparing the estimation results reported in Table 10 with those discussed in the two previous Subsections (Tables 7, 8 and 9), we notice that processed goods generally display the most price-inelastic export demand.

[24] New Zealand, Denmark and Poland are also among the top 15 exporters (in 11th, 13th and 15th positions respectively) in 2012, with market shares equal to 3.2, 2.7 and 2.4 per cent. Since these market shares are relatively low, we can conclude that our original set of exporters constitutes a sample of countries significantly engaged in processed food exports. We thus limit our analysis to these countries and exclude New Zealand, Denmark and Poland from our estimates. This also enables us to make correct comparisons between the relevant food export function parameters of processed and unprocessed goods.

There are only a few exceptions, such as France and Germany, which exhibit a uniform price elasticity equal to -0.60 for all types of food exports, and the USA, which presents slightly higher export price elasticities for processed and all food products compared to unprocessed goods. This does not hold for commodities for the USA. The overall results thus confirm our basic hypothesis that processed goods, which are more differentiable, are characterized by a lower export price elasticity.

We now move on to verify whether there exists an inverse relationship between export price elasticities and AUVs for processed goods, for which the quality content is more important. Given the widely recognized difficulty of finding an objective measure of product quality for internationally traded goods, it is common practice in the literature to use AUVs as proxies for quality (AIGINGER, 1997 and SCHOTT, 2004) including the case of food products (See, among others, GELHAR & PICK, 2002 and FISHER, 2010). Since higher quality goods will be less substitutable, countries exporting them will face a more inelastic demand. This also implies a greater market power by exporting countries, because they can set higher export prices, justified by the higher quality content. We thus expect that countries characterized by higher AUVs will generally show a reduced export price elasticity and vice versa. To this end, Figure 1 reports the position of each country in our sample in terms of its own price elasticity (in absolute value on the horizontal axis) and AUV (vertical axis) in the considered time period. The diagram clearly demonstrates the validity of our hypothesis, supported by the following OLS regression concerning the cross-section of our *j* (*j*=1,…,11) food exporters.[25]

$$\underset{}{AUV_j} = \underset{(0.28)}{2.36} - \underset{(0.39)}{1.04}\cdot\beta_j$$
$$R^2=0.44$$

As will be noticed, both the overall regression and the estimated coefficient of price elasticities are statistically significant (at the 95 per cent confidence level). It is also important to underline that in this context an R^2 equal to 0.44 is noteworthy since, as already highlighted in Section 2, export prices also depend on production costs, as well

[25] Standard errors in parentheses. A similar statistically significant regression holds when using 2012 data only. The variable $\cdot\beta_j$ obsviouly indicates the export price elasticity of each country *j*.

as on product quality. The inverse relationship between price elasticities and AUVs could therefore be partly obscured by the influence of production costs.

Figure 1 about here

Interestingly, the graph also shows that Upper Middle-Income countries (Argentina and Brazil) exhibit low AUVs (1.00 and 1.34), associated with high price elasticities (1.10 and 0.86), while Australia, the Netherlands and Canada have the highest AUVs (2.18, 1.96 and 1.88 respectively) associated with relatively low price elasticities (0.54, 0.39 and 0.76 respectively). All other advanced countries, together with China, show intermediate values for both variables, with AUVs and price elasticities varying in an interval between 1.55 and 1.85, and 0.48 and 0.79 respectively. Our analysis thus shows the existence of an inverse relationship between export price elasticities and AUVs for processed food. It also confirms the working hypothesis, put forward in Section 2, that the higher the quality of a good, the lower its substitutability in international markets, and the more inelastic its demand, the higher the market power of the exporting country and thus the higher the export price.

Moving on to examine export income elasticities, the highest values are found for Spain and emerging countries, with the exceptions of Australia, which has a low coefficient of 0.44. China shows the highest income elasticity, with an estimated value of 2.55, followed by Spain (2.40), Argentina (2.28) and Brazil (2.27). The lowest values are recorded by advanced countries, and especially by France (0.50). It is worth remembering that processed goods generally exhibit higher export income elasticities than the other food export groups (all goods, unprocessed products and commodities), with the only exception of Brazil and Canada. It is also worth noting that China and the Netherlands show fairly stable parameters across all groups of food exports.

Together with AUVs and price elasticities, Figure 1 also shows the estimated income elasticities (proportional to the bubble sizes) and the market shares in volumes (in parentheses) for the processed food exports of our 11 sample countries. A joint look at the four variables helps to shed light on the performance and prospects of the selected countries. While the USA and France are the top and the third world exporters in 2012, their low income elasticity should sound a warning regarding future prospects. In fact, China today exports half the volume of the USA, but has higher AUVs, lower price elasticity and, above all, an income elasticity of 2.55, significantly higher than those of the USA and France (0.85 and 0.50 respectively). The Netherlands also has an income elasticity of 0.81 and high AUVs, but international demand for its processed products is relatively elastic, compared with other countries. Different considerations apply to the other advanced countries in the sample, which have income elasticities higher than 1 but different positioning in terms of AUVs and price elasticities (Spain, Germany, Italy and Canada). It is also worth noting that Italy is the country with the highest share of processed food over total food exports (51.2 per cent) in the sample. Australia behaves as an outlier, since it is an emerging country but positioned to the left of all other countries in terms of AUVs, and with a low price elasticity. This could be considered as a sign of quality products, but the country also exhibits a very low market share and the lowest income elasticity. Being a country rich in natural resources, Australia's main specialization can remain centered on commodities, but its income elasticity is also very low for unprocessed food products. Australian policy-makers, then, need to pay more attention to distribution chains, destination markets, and other factors determining their non-price competitiveness.

5. Conclusions and policy implications

This paper aims to estimate and compare the food export price and income elasticities of the top trading countries in the period 1992-2012, by adopting an imperfect substitutes model. The parameters estimated are then used, together with AUVs and market shares, to evaluate the export performance and future prospects of the sample countries and to derive industrial policy suggestions. First of all, a preliminary analysis of causality is conducted in order to assess the possible presence of unit roots and cointegration between export volumes, relative prices and world income. These variables are found to follow an I(1) process and a long-run relationship between them is established. Next, a panel causality test is performed, which shows that in the long-run relative prices and world GDP Granger-cause food exports, so that long-run estimates of a standard export function are performed. Finally, the paper compares the estimated export function parameters of processed and unprocessed food products, with an additional focus on commodities.

Overall, the estimated price elasticities are lower than 1 in the case of food exports in general and of processed goods in particular, reflecting the fact that food products are necessary goods, although imperfect substitutes on international markets. As expected, we find that processed goods are characterized by the most inelastic demand, thanks to their greater quality content and degree of differentiation, compared to unprocessed goods and commodities. It is worth noticing that unprocessed goods and commodities are also characterized by sample differences in both AUVs and price elasticities, due to the country-of-origin bias and the existence of multiple varieties of the same good, so that for these types of products the adoption of the imperfect substitutes model also appears to be justified. These findings are original compared to the standard literature on trade, where commodities are generally considered as perfect substitutes and exporting countries as price-takers on the basis of the outcomes of international exchange markets. Nonetheless, we find that exporting countries can be price makers even with regard to unprocessed goods and commodities, thanks to product differentiation based on diversity and quality standards. Since however price competitiveness is more intense for unprocessed goods and commodities, specialization in these categories is advisable only for countries rich in natural resources, such as Australia, Canada, Argentina and Brazil in our sample.[26] This type of trade specialization is subject to certain disadvantages, such as the more perishable nature of goods, high price volatility,[27] and the influence on their production of uncontrollable factors such as weather conditions and other exogenous variables. For processed foods, prices are less volatile and their supply conditions more stable. These factors, together with their well documented growing world demand (ATHUKORALA & JAYASURIYA, 2003) and their higher value added, also imply that natural-resource rich nations, as well as emerging countries mainly specialized in commodities and unprocessed food exports, should increase their share of processed goods, as suggested by recent literature (UNCTAD, 1997, ATHUKORALA & SEN, 1998, WILKINSON, 2004 and JONGWANICH, 2009).

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[26] See ANDERSON & STRUTT (2014) for a taxonomy of natural-resource rich countries.

[27] The drawbacks from price volatility have been recently emphasized in the energy economics literature (See, among others, DU ET AL., 2011 and MANERA ET AL., 2013).

For advanced nations and natural-resources poor countries, such as China, it appears to be even more advisable to increase their export specialization in processed goods. Processed foods, in fact, are more differentiable, and countries can leverage on quality and reputation, in order to promote their exports, increase their income elasticity and decrease their price elasticity. Moreover, processed goods are characterized by more inelastic international demands, so that exporting countries have greater market power to set high prices than for unprocessed products and commodities. *Ceteris paribus*, higher export prices imply a greater contribution to the trade balance and larger profits, triggering higher investments and growth rates. The growth performance of a country specialized in processed goods would also benefit from the fact that these products make a greater contribution to value added and employment (See among others ATHUKORALA & SEN, 1998),

Finally, our empirical analysis of processed food exports highlights the existence of an inverse relationship between AUVs and price elasticities. Since AUVs can be considered as proxies for quality, this relationship indicates that countries producing higher quality goods can rely on a more inelastic demand, justifying higher market power and profits. An implication of this is that advanced countries could better fight the fierce international competition from emerging countries by enhancing the quality content of processed goods and reinforcing the international reputation of their exports by using appropriate promotion policies and certification procedures, such as country-of-origin labelling.

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References

Aiginger, K., ‘The use of unit values to discriminate between price and quality competition’, *Cambridge Journal of Economics,* Vol. 21, (1997) pp. 571-592.

Anderson, K. and Strutt, A., ‘Emerging economies, productivity growth and trade with resource-rich economies by 2030’, *The Australian Journal of Agricultural and Resource Economics*, Vol. 58, (2014) pp.1-18.

Arellano, M. and Bond, S., ‘Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations’, *Review of Economic Studies,* Vol. 58, (1991) pp. 277–97.

Arellano, M. and Bover, O., ‘Another look at the instrumental variables estimation of error components models’, *Journal of Econometrics,* Vol. 68, (1995) pp. 29–51.

Arize, A. C., ‘Traditional export demand relation and parameter instability. An empirical investigation’, *Journal of Economic Studies,* Vol. 28, (2001) pp. 378-396.

Armington, P. S., ‘A Theory of demand for products distinguished by place of production’, *Staff Papers – International Monetary Fund*, Vol. 16, (1969) pp. 159-178.

Athukorala, P. C. and Jayasuriya, S., ‘Food safety issues, trade and WTO rules: a developing country perspective’, *The World Economy*, Vol. 26, (2003) pp.1395–1416.

Athukorala, P. C. and Sen K., ‘Processed food exports from developing countries: patterns and determinants’, *Food Policy,* Vol. 23, (1998) pp. 41-54.

Bashiri Behmiri, N. and Pires Manso, J. R., ‘Crude oil conservation policy hypothesis in OECD (organisation for economic cooperation and development) countries: A multivariate panel Granger causality test’, *Energy,* Vol. 43, (2012) pp. 253-260.

Blundell, R. and Bond, S., ‘Initial conditions and moment restrictions in dynamic panel data models’, *Journal of Econometrics,* Vol. 87, (1998) pp. 11–143.

Breitung, J.,‘The local power of some unit root tests for panel data’ In: B. Baltagi (Ed.), Nonstationary Panels, Panel Cointegration, and Dynamic Panels, Advances in Econometrics, Vol. 15, (2000) pp. 161-178, JAI, Amsterdam.

Bottasso, A., Castagnetti, C. and Conti, M., ‘And yet they co-move! Public capital and productivity in OECD’, *Journal of Policy Modeling,* Vol. 35, (2013) pp. 713-729.

Bottazzi, L. and Peri, G., ‘The international dynamics of R&D and innovation in the short-run and in the long run’, NBER Working Paper No. 11524, (2005) July.

Bottazzi, L. and Peri, G., ‘The international dynamics of R&D and innovation in the long run and in the short run’, *The Economic Journal*, Vol. 117 (March), (2007) pp. 486–511.

Bronzini, R. and Piselli, P., ‘Determinants of long-run regional productivity with geographical spillovers: The role of R&D, human capital and public infrastructure’, *Regional Science and Urban Economics,* Vol. 39, (2009) pp. 187–199.

Campbell, J. Y. and Perron, P., ‘Pitfalls and opportunities: what macroeconomists should know about unit roots’, In: Blanchard OJ, Fischer S (Eds). NBER Macroeconomics Annual 1991, Vol. 6, MIT Press (1991).

Caporale, G. M., Chiu, M. K. F., ‘Estimating income and price elasticities of trade in a cointegration framework’, *Review of International Economics,* Vol. 7, (1999) pp. 254-264.

Carter, C. A., Rozelle, S., ‘Will China become a major force in world food markets?’, *Review of Agricultural Economics,* Vol. 23 (Autumn-Winter, 2001) pp. 319-331.

Costantini, V. and Martini, C., ‘The causality between energy consumption and economic growth: A multi-sectoral analysis using non-stationary cointegrated panel data’, *Energy Economics,* Vol. 32, (2010) pp. 591-603.

Coyle, W., Gehlhar, M., Hertel, T., Wang, Z. and Yu, W., ‘Understanding the determinants of structural change in world food markets’, *American Journal of Agricultural Economics,* Vol. 80, (1998) pp. 1051–1061.

Crozet, M., and Erkel-Rousse, H., ‘Trade performances, product quality perceptions, and the estimation of trade price elasticities’, *Review of International Economics,* Vol. 12, (2004) pp.108-129.

Du, Xiaodong, Yu, C. L., and Hayes, D. J, “Speculation and volatility spillover in the crude oil and agricultural commodity markets: a Bayesian analysis” *Energy Economics* Vol. 33, (2011) pp. 497-503.

Eberhardt, M., ‘Estimating panel time-series models with heterogeneous slopes’, *The Stata Journal* Vol. 12, (2012) pp. 61-71.

Engle R. F. and Granger, C. W. J., ‘Co-integration and error correction: representation, estimation, and testing’, *Econometrica,* Vol. 55, (1987) pp. 251-76.

Essaji A. and Fujiwara K.,, ‘Contracting institutions and product quality’. *Journal of Comparative Economics,* Vol. 40, (2012) pp. 269-278.

Estevadeordal, A., Frantz, B. and Taylor, A. M., ‘The rise and fall of world trade, 1870-1939’, *Quarterly Journal of Economics,* Vol. CXVIII, (2003) pp. 359-407.

European Commission, Europe 2020: A strategy for smart, sustainable and inclusive growth. Brussels: European Commission, (2010).

Fagerberg, J., ‘Technological progress, structural change and productivity growth: a comparative study’, *Structural Change and Economic Dynamics,* Vol. 11, (2000) pp. 393-411.

Fisher, C., ‘Food quality and product export performance: an empirical investigation of the EU situation’, *Journal of International Food & Agribusiness Marketing*, Vol. 2, (2010) pp. 210-233.

Fontagné, L., Gaulier, G. and Zignago, S., ‘Specialization across varieties and North–South competition’, *Economic Policy* , Vol. 23, (2008) pp. 51-91.

Gelhar, M. and Pick, D., ‘Food Trade balances and unit values: What can they reveal about price competition?’, *Agribusiness: An International Journal,* Vol. 18, (2002) pp. 61-67.

Goldberg, P. K. and Knetter, M. M., ‘Goods prices and exchange rates: what have we learned?’, *Journal of Economic Literature,* Vol. 35, (1997) pp. 1243–72.

Goldstein, M. and Khan, M. S., ‘Income and price effects in foreign trade’. In Jones, R.W. and Kenen P.B. ‘Handbook of International Economics, vol II’, Elsevier Science Publisher 1985, Ch. 20, pp. 1042-1105.

Grossman, G. M. and Helpman, E., ‘*Innovation and Growth in the Global Economy*’ The MIT Press, Cambridge (USA), (1991).

Hadri, K., Testing for Stationarity in heterogeneous panel data. *Econometrics Journal*, Vol. 3, (2000) pp. 148-161.

Hallak, J. C., ‘Product quality and the direction of trade’, *Journal of International Economics* Vol. 68, (2006) pp. 238–265.

Haq, Z. and Meilke, K., ‘The role of income in trading-differentiated agri-food products: the case of Canada, the United States, and selected EU countries’, *Canadian Journal of Agricultural Economics*, Vol. 57, (2009) pp. 343-363.

Hansen, B.E., ‘Efficient estimation and testing of cointegrating vectors in the presence of deterministic trends’, *Journal of Econometrics*, Vol. 53, (1992) pp. 87-121.

Holtz-Eakin, D., Newey, W. and Rosen, H. S., ‘Estimating vector autoregressions with panel data’, *Econometrica,* Vol. 56, (1988) pp. 1371–95.

Irwin, D. A., ‘Long-run trends in world trade and income’, *World Trade Review*, Vol. 1, (2002) pp. 89–100.

Jaunky, V. C., ‘Is there a material Kuznets curve for aluminium? Evidence from rich countries’, *Resources Policy,* Vol. 37, (2012a) pp 296-307.

Jaunky, V. C., ‘Democracy and economic growth in Sub-Sahara Africa: a panel data approach’,. *Empirical Economics,* (2012b) DOI 10.1007/s00181-012-0633-x.

Jongwanich, J. ‘The impact of food safety standards on processed food exports from developing countries’, *Food Policy,* Vol. 34, (2009) pp. 447–457.

Kao, C., ‘Spurious regression and residual-based tests for cointegration in panel data’ *Journal of Econometrics*, Vol. 90, (1999) pp. 1-44

Krugman, P. R., ‘Pricing to market when the exchange rate changes’, In: S. W. Arndt and J. D. Richardson (Eds), *Real Financial Linkages Among Open Economies*. MIT Press, Cambridge, MA (1987).

Krugman, P. R., ‘Differences in income elasticities and trends in real exchange rates’ *European Economic Review, Vol.* 33, (1989) pp. 1031-54.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P. and Shin, Y., 'Testing the null hypothesis of stationarity against the alternative of a unit root: how sure are we that economic time series have a unit root?' *Journal of Econometrics*, Vol. 54, (1992) pp. 159-178.

Lee, C. C., Chang C. P., 'Energy consumption and economic growth in Asian economies: A more comprehensive analysis using panel data', *Resource and Energy Economics*, Vol. 30, (2008) pp. 50-65.

Lucas, R.E., 'On the mechanisms of economic development' *Journal of Monetary Economics,* Vol. 22, (1988) pp. 3-42.

Manera, M., Nicolini, M., and Vignati, I., 'Financial speculation in energy and agriculture futures markets: A multivariate GARCH approach', *Energy Journal*, Vol. 34, (2013) pp. 55-81.

Narayan, P. K., Smyth, R. and Prasad, A., 'Electricity consumption in G7 countries: a panel cointegration analysis of residential demand elasticities', *Energy Policy*, Vol. 35, (2007) pp. 4485-4494.

OECD, Frascati Manual. Proposed Standard for Surveys on Research and Experimental Development. Sixth revision, OECD 2002, Paris.

OECD Science, Technology and Industry Outlook 2010.

Oh, W. and Lee, K, 'Energy consumption and economic growth in Korea: testing the causality relation', *Journal of Policy Modeling*, Vol. 26, (2004) pp. 973–981.

Pedroni, P., 'Critical values for cointegration tests in heterogeneous panels with multiple regressors', *Oxford Bulletin of Economics and Statistics*, Vol. 61, (1999) pp. 653-670.

Pedroni, P., ‘Fully modified OLS for the heterogeneous cointegrated panels’, *Advances in Econometrics,* Vol. 15, (2000) pp. 93–130.

Pedroni, P. ‘Panel cointegration; asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis’, *Econometric Theory*, Vol. 20, (2004) pp. 597–625.

Pesaran, M. H., ‘A simple panel unit root test in the presence of cross section dependence’, *Journal of Applied Econometrics,* Vol. 22, (2007) pp. 265-312.

Pesaran, M. H. and Smith, R. P, ‘Estimating long-run relationships from dynamic heterogeneous panels’ *Journal of Econometrics,* Vol. 68, (1995) pp. 79-113.

Roodman, D. M., ‘How to do xtabond2: an introduction to “Difference” and “System” GMM in Stata’, *The Stata Journal, Vol.* 9, (2009a) pp. 86–136.

Roodman, D. M,. ‘A note on the theme of too many instruments’, *Oxford Bulletin of Economics and Statistics*, Vol. 71, (2009b) pp. 135-158.

Said, E. and Dickey, D. A., ‘Testing for unit roots in autoregressive moving average models of unknown order’, *Biometrika*, Vol. 71, (1984) pp. 599–607.

Saikkonen, P., ‘Asymptotic efficient estimation of cointegration regressions’, *Econometric Theory,* Vol. 7, (1991) pp. 1–21.

Schott, P., ‘Across-product versus within-product specialization in international trade’, *Quarterly Journal of Economics,* Vol. 119, (2004) pp. 647–678.

Schott, P., ‘The relative sophistication of Chinese exports’, *Economic Policy*, Vol. 53, (2008) pp. 5-49.

Serrano R. and Pinilla, V., 'Causes of world trade growth in agricultural and food products, 1951–2000: a demand function approach' *Applied Economics*, Vol. 42, (2010) pp. 3503–3518.

Strauss, J. and Wohart, M., 'The linkage between prices, wages and labor productivity: a panel study of manufacturing industries', *Southern Economic Journal*, Vol. 70, (2004) pp. 920-941.

UNCTAD, *Opportunities for vertical Diversification in the Food Processing Sector in Developing Countries*. Geneva, 1997.

Wilkinson, J., 'The food processing industry, globalization and developing countries', *Journal of Agricultural and Development Economics*, Vol. 1, (2004) pp. 184-201.

TABLES

Table 1 – Share of food on total exports of all commodities, World and selected countries, Beginning-of-Period, End-of-period and Average-of-period percentages

	World	Argentina	Australia	Belgium	Brazil	Canada	China	France	Germany	India	Indonesia	Italy	Netherlands	Spain	Thailand	USA
1992	9.33	61.01	19.15	-	25.53	9.37	11.35	15.27	5.42	17.05	10.19	7.09	21.17	15.19	26.08	10.53
2012	7.47	52.40	11.97	9.12	31.83	10.18	2.75	12.64	5.59	10.29	17.87	7.78	12.89	15.42	13.39	8.93
Average	7.67	49.91	17.44	8.87	28.22	8.08	5.47	11.93	4.98	12.87	12.40	6.84	15.39	14.90	15.97	8.47

Source: Our elaboration on WTO data. For the case of Belgium, data are available only since 1999, so that this country's average values refer to the time period 1999-2012. Average-of-period values may be outside the range between beginning-of-period and end-of-period values because of a U-shaped, or inverse U-shaped, evolution of shares in the time period considered.

Table 2 –Top 15 food exporters: Export Values (Million) in USD and Market Shares (percentages of values) in 2012

	Export Values	Market Shares
United States	138,034	10.04
Netherlands	84,311	6.13
Germany	78,486	5.71
Brazil	77,212	5.61
France	71,910	5.23
China	56,318	4.10
Canada	46,329	3.37
Spain	45,520	3.31
Argentina	42,407	3.08
Belgium	40,688	2.96
Italy	39,013	2.84
Indonesia	33,692	2.45
Australia	30,704	2.23
Thailand	30,704	2.23
India	30,534	2.22
World	1,375,255	61.50

Source: Our elaboration on WTO data.

Table 3 – Export volumes (in tons), average unit values and market shares (percentages of volumes), Beginning-of-Period (1992), End-of-period (2012) and Average-of-period values

	Export volumes			Market shares			Average unit values		
	1992	2012	Average	1992	2012	Average	1992	2012	Average
Argentina	24,793	71,449	44,873	7.05	13.11	9.07	0.21	0.44	0.28
Australia	18,164	39,435	115,001	5.17	7.24	15.19	0.42	0.63	0.41
Brazil	16,243	73,137	38,962	4.62	13.42	7.93	0.45	0.72	0.50
Canada	33,544	39,611	34,461	9.54	7.27	7.15	0.28	0.80	0.50
China	22,910	29,596	24,210	6.52	5.43	5.11	0.34	1.73	0.84
France	48,089	51,257	49,184	13.68	9.40	10.20	0.52	0.90	0.63
Germany	23,582	41,538	32,161	6.71	7.62	6.62	0.77	1.44	0.94
Italy	10,656	15,479	12,669	3.03	2.84	2.62	0.90	1.80	1.24
Netherlands	19,819	39,500	27,724	5.64	7.25	5.74	1.20	1.54	1.18
Spain	8,955	23,141	16,616	2.55	4.25	3.39	0.89	1.47	1.09
USA	124,805	120,889	129,489	35.50	22.18	26.97	0.26	0.82	0.41

Source: Our elaboration on Comtrade data

Table 4a - Pesaran Panel Unit Root Test Statistics for the variable *ln* X_{it} and *lnRP*$_{it}$ respectively

	$ln\ X_{it}$	$lnRP_{it}$
Argentina	-0.39 (0.35)♦	-1.13 (0.13)
Australia	0.79 (0.79)	-0.08 (0.47)
Brazil	0.30 (0.62)*	0.69 (0.75)
Canada	0.56 (0.71)	-1.15 (0.12)
China	-0.36 (0.36)♦♦	-1.18 (0.12)
France	1.34 (0.91)	-0.39 (0.35)
Germany	-0.54 (0.29)♦	-0.02 (0.49)
Italy	0.80 (0.21)	-0.29 (0.38)
Netherlands	1.53 (0.94)♦	1.40 (0.92)
Spain	4.19 (1.00)♦♦	-0.02 (0.49)
USA	0.79 (0.79)	2.30 (0.98)

Notes: Standardised Z-tbar are reported for the Pesaran (2007) unit roots test. p-values are shown in parentheses. Pesaran (2007) tests is calculated by including the intercept in the test equation. Maximum selected lag length is 2. A ♦ (♦♦)[*] indicates a lag length equal to 3, 4 and 5 respectively. The null hypothesis for all tests is "Panels contain unit roots".

Table 4b – Unit Root Tests for the variable *lnGDPW*$_t$

ADF	KPSS
0.24	0.64
(0.97)	[0.46]

Notes: *T*-statistic and *LM*-statistic are reported for Augmented Dickey-Fuller test (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit roots tests. p-values and asymptotic critical values are in parentheses and brackets respectively. Asymptotic critical value of 0.46 corresponds to 5 per cent significance level. ADF and KPSS unit root tests are calculated including the intercept in the test equation. The null hypothesis is "$lnGDPW_t$ has a unit root" for ADF test and "$lnGDPW_t$ is stationary" for KPSS test.

Table 5 – Pedroni Panel Cointegration Test

	Argentina	Australia	Brazil	Canada	China	France	Germany	Italy	Netherlands	Spain	USA
Pedroni test											
Panel *v*-Statistic	-2.00 (0.02)	-2.65 (0.00)	1.33 (0.09)	1.01 (0.16)	1.48 (0.07)	1.10 (0.14)	5.24 (0.00)	3.57 (0.00)	1.69 (0.05)	2.14 (0.02)	1.15 (0.12)
Panel ρ-Statistic	-4.93 (0.00)	-4.89 (0.00)	-7.58 (0.00)	-7.49 (0.00)	-6.67 (0.00)	-6.54 (0.00)	-3.78 (0.00)	-9.04 (0.00)	-5.53 (0.00)	-3.96 (0.00)	-3.51 (0.00)
Panel PP-Statistic	-10.71 (0.00)	-10.66 (0.00)	-15.79 (0.00)	-15.28 (0.00)	-14.16 (0.00)	-14.16 (0.00)	-9.69 (0.00)	-20.29 (0.00)	-12.03 (0.00)	-10.36 (0.00)	-9.52 (0.00)
Panel ADF-Statistic	-12.82 (0.00)	-13.72 (0.00)	-17.26 (0.00)	-16.05 (0.00)	-15.00 (0.00)	-15.45 (0.00)	-11.49 (0.00)	-16.87 (0.00)	-13.11 (0.00)	-10.69 (0.00)	-10.09 (0.00)
Group ρ-Statistic	-0.32 (0.37)	0.67 (0.75)	-1.57 (0.06)	1.27 (0.90)	0.81 (0.79)	0.19 (0.58)	0.11 (0.54)	-0.62 (0.27)	-1.02 (0.15)	2.03 (0.98)	0.80 (0.79)
Group PP-Statistic	-10.02 (0.00)	-11.06 (0.00)	-13.47 (0.00)	-7.88 (0.00)	-10.15 (0.00)	-10.94 (0.00)	-11.88 (0.00)	-15.70 (0.00)	-11.69 (0.00)	-8.75 (0.00)	-8.52 (0.00)
Group ADF-Statistic	-12.41 (0.00)	-13.28 (0.00)	-15.17 (0.00)	-8.47 (0.00)	-10.74 (0.00)	-12.32 (0.00)	-11.79 (0.00)	-14.57 (0.00)	-14.30 (0.00)	-8.75 (0.00)	-10.27 (0.00)

Notes*:* The panel statistics are the within-dimension statistics while group statistics are between-dimension ones. The null hypothesis is no cointegration; p-values in parentheses; User-specified lag length is equal to 1. Trend and intercept options: “no deterministic trend” for all countries.

Table 6 – Panel Granger causality test

		Short-run			Long-run	Strong causality		
		ΔlnX_{it}	$\Delta lnRP_{it}$	$\Delta lnGDPW_t$	ECT_{it-1}	$ECT_{it-1}/\Delta lnX_{it}$	$ECT_{it-1}/\Delta lnRP_{it}$	$ECT_{it-1}/\Delta lnGDPW_t$
Argentina	ΔlnX_{it}	-	0.68	15.14***	25.60***	-	13.17***	28.49***
	$\Delta lnRP_{it}$	1.44	-	1.74	1.26	0.72	-	1.22
	$\Delta lnGDPW_t$	0.11	0.42	-	0.01	0.68	0.92	-
Australia	ΔlnX_{it}	-	3.42*	4.45**	8.71***	-	10.94***	6.81***
	$\Delta lnRP_{it}$	1.22	-	0.12	2.38	1.85	-	1.32
	$\Delta lnGDPW_t$	0.10	2.00	-	0.30	5.67***	9.32***	-
Brazil	ΔlnX_{it}	-	0.49	1.90	36.12***	-	33.45***	18.90***
	$\Delta lnRP_{it}$	2.22	-	9.61***	1.78	1.29	-	5.12***
	$\Delta lnGDPW_t$	1.77	0.52		1.69	0.91	1.23	-
Canada	ΔlnX_{it}	-	5.36**	2.61	18.77***	-	24.78**	14.42***
	$\Delta lnRP_{it}$	0.10	-	1.12	0.43	1.23	-	1.30
	$\Delta lnGDPW_t$	1.47	1.27	-	0.29	1.76	0.91	-
China	ΔlnX_{it}	-	2.62	0.87	13.90***	-	6.99***	6.96***
	$\Delta lnRP_{it}$	3.05*	-	6.57**	3.13*	1.57	-	3.41**
	$\Delta lnGDPW_t$	1.38	0.73	-	0.63	1.03	0.38	-
France	ΔlnX_{it}	-	0.11	0.01	10.78**	-	14.69**	5.46**
	$\Delta lnRP_{it}$	2.15	-	2.18	1.82	1.08	-	2.14
	$\Delta lnGDPW_t$	0.38	1.04	-	1.34	1.85	0.68	-
Germany	ΔlnX_{it}	-	0.32	2.24	42.19***	-	22.22***	21.25***
	$\Delta lnRP_{it}$	0.34	-	1.26	0.45	0.22	-	0.68
	$\Delta lnGDPW_t$	0.37	0.32	-	0.67	0.38	0.34	-
Italy	ΔlnX_{it}	-	2.66	1.66	12.17***	-	7.03***	6.30***
	$\Delta lnRP_{it}$	1.18	-	0.58	2.13	1.25	-	1.08
	$\Delta lnGDPW_t$	0.83	0.39	-	0.64	0.53	0.35	-
Netherlands	ΔlnX_{it}	-	4.24**	0.03	10.90***	-	13.80***	5.45***
	$\Delta lnRP_{it}$	5.93	-	0.51	0.56	3.23**	-	0.35
	$\Delta lnGDPW_t$	1.78	0.12	-	0.44	2.98	0.79	-
Spain	ΔlnX_{it}	-	0.23	1.02	13.18***	-	18.80***	22.14***
	$\Delta lnRP_{it}$	0.00	-	1.15	0.17	0.69	-	0.34
	$\Delta lnGDPW_t$	2.09	2.28	-	0.58	2.36	2.19	-
USA	ΔlnX_{it}	-	1.67***	47.06***	47.06***	-	25.19***	24.63***
	$\Delta lnRP_{it}$	1.48	-	9.27***	1.74	1.08	-	11.92***
	$\Delta lnGDPW_t$	1.20	3.63	-	1.72	1.20	2.23	-

Notes: *F* test statistics are reported. A *(**)[***] indicates significance at 10(5)[1] per cent level.

Table 7 – Long-run estimates of Equation (1): all food goods

	Argentina	Australia	Brazil	Canada	China	France	Germany	Italy	Netherlands	Spain	USA
$lnRP_{it}$	-0.86***	-0.94***	-1.14***	-0.55***	-0.77***	-0.63***	-0.60***	-0.86***	-0.80***	-0.82***	-0.52***
	(0.16)	(0.11)	(0.11)	(0.09)	(0.15)	(0.08)	(0.10)	(0.09)	(0.07)	(0.09)	(0.11)
$lnGDPW_t$	2.00***	0.39**	2.36***	1.04***	2.56***	0.44***	1.52***	1.31***	0.84***	2.05***	0.71***
	(0.29)	(0.18)	(0.36)	(0.17)	(0.25)	(0.13)	(0.13)	(0.15)	(0.14)	(0.19)	(0.13)
Constant	-5.83*	11.80***	-10.01***	5.40***	-10.61***	13.13***	1.51	2.93*	8.92***	-4.79**	10.87***
	(3.10)	(1.90)	(3.77)	(1.78)	(2.75)	(1.40)	(1.38)	(1.62)	(1.49)	(2.08)	(1.37)

Notes: Standard errors in parentheses; *(**)[***] indicates significance at 10(5)[1] per cent level.

Table 8 – Long-run estimates of Equation (1): unprocessed goods

	Argentina	Australia	Brazil	Canada	China	France	Germany	Italy	Netherlands	Spain	USA
$lnRP_{it}$	-0.86***	-1.52***	-1.21***	-0.79***	-1.19***	-0.54***	-0.60***	-0.96***	-0.87***	-0.87***	-0.47***
	(0.21)	(0.22)	(0.17)	(0.13)	(0.29)	(0.13)	(0.21)	(0.14)	(0.13)	(0.14)	(0.18)
$lnGDPW_t$	1.60***	0.32	2.50***	0.94***	2.59***	0.35	1.37***	1.02***	0.89***	1.54***	0.50***
	(0.36)	(0.32)	(0.61)	(0.28)	(0.34)	(0.22)	(0.17)	(0.25)	(0.19)	(0.25)	(0.17)
Constant	-0.57	13.25***	-10.55	6.45**	-10.45***	14.63***	3.50*	6.57**	8.90***	1.33	14.07***
	(3.88)	(3.42)	(6.42)	(3.05)	(3.69)	(2.37)	(1.91)	(2.71)	(2.06)	(2.81)	(1.92)

Notes: See Table 7.

Table 9 – Long-run estimates of Equation (1): commodity goods

	Argentina	Australia	Brazil	Canada	China	France	Germany	Italy	Netherlands	Spain	USA
$lnRP_{it}$	-1.17**	-2.29***	-1.78***	-0.92***	-1.82**	-0.58***	-0.63**	-1.34***	-1.03***	-1.11***	-0.80**
	(0.47)	(0.44)	(0.35)	(0.26)	(0.77)	(0.21)	(0.28)	(0.20)	(0.29)	(0.31)	(0.40)
$lnGDPW_t$	1.67***	0.26	4.78***	1.17***	1.72**	-0.12	1.27***	1.28***	0.83***	0.78	0.23
	(0.59)	(0.80)	(1.46)	(0.35)	(0.80)	(0.37)	(0.43)	(0.48)	(0.29)	(0.49)	(0.37)
Constant	-0.26	15.12*	-34.21**	3.74	-1.29	20.47***	4.48	3.71	8.81***	9.37*	17.64***
	(6.48)	(8.44)	(15.56)	(4.09)	(8.57)	(3.91)	(4.80)	(5.53)	(3.16)	(5.59)	(4.18)

Notes: See Table 7.

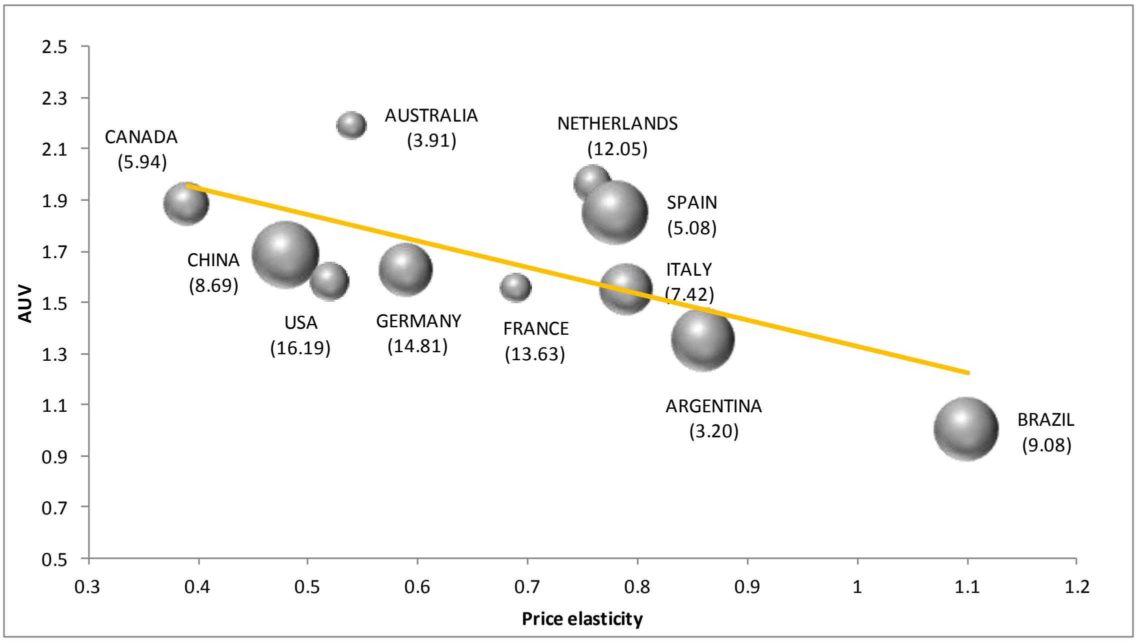
Table 10 – Long-run estimates of Equation (1): processed goods

	Argentina	**Australia**	**Brazil**	**Canada**	**China**	**France**	**Germany**	**Italy**	**Netherlands**	**Spain**	**USA**
$lnRP_{it}$	-0.86***	-0.55***	-1.10***	-0.39***	-0.48***	-0.69***	-0.59***	-0.79***	-0.76***	-0.78***	-0.56***
	(0.23)	(0.10)	(0.14)	(0.11)	(0.15)	(0.11)	(0.09)	(0.11)	(0.09)	(0.12)	(0.13)
$lnGDPW_t$	2.28***	0.44**	2.27***	1.11***	2.55***	0.50***	1.63***	1.51***	0.81***	2.40***	0.85***
	(0.42)	(0.21)	(0.45)	(0.21)	(0.36)	(0.16)	(0.17)	(0.18)	(0.20)	(0.26)	(0.18)
Constant	-9.39**	10.82***	-9.65**	4.68**	-10.72***	12.11***	0.16	0.47	8.93***	-8.92***	8.71***
	(4.45)	(2.21)	(4.62)	(2.17)	(3.90)	(1.71)	(1.92)	(1.96)	(2.09)	(2.83)	(1.87)

Notes: See Table 7.

FIGURE

Figure 1 - Positioning of the sample countries in terms of AUV and price elasticity, years 1992-2012



Notes: The estimated values of price and income elasticities are reported in Table 10. The size of the circles indicates the income elasticities. Average market shares in the period 1992-2012 in parentheses.

APPENDIX

Table A1 – List of selected 4-digit food products

Code	Description	Type
0111	Meat of bovine animals, fresh or chilled	P
0112	Meat of bovine animals, frozen	P
0121	Meat of sheep or goats, fresh, chilled or frozen	P
0122	Meat of swine, fresh, chilled or frozen	P
0123	Meat and edible offal of the poultry of subgroup 001.4, fresh, chilled or frozen	P
0125	Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules or hinnies, fresh, chilled or frozen	P
0129	Meat and edible meat offal, fresh, chilled or frozen	P
0161	Bacon, ham and other salted, dried or smoked meat of swine	P
0168	Meat and edible meat offal, other than meat of swine, salted, in brine, dried or smoked; edible flours and meals of meat or meat offal	P
0171	Extracts & juices of meat, fish/crustaceans, mollusks/other aquatic invertebrates	P
0172	Sausages & similar products, of meat, meat offal/blood; food preparations based on these products	P
0174	Meat & offal (other than liver) of poultry of subgroup 001.4, prepared/preserved	P
0175	Meat & offal (other than liver), of swine, prepared/preserved	P
0176	Meat & offal (other than liver), of bovine animals, prepared/preserved	P
0179	Other prepared/preserved meat/meat offal (including preparations of blood of any animal)	P
0221	Milk (including skimmed milk) and cream, not concentrated or sweetened	P
0222	Milk and cream, concentrated or sweetened	P
0223	Yogurt; buttermilk, curdled, fermented or acidified milk and cream; ice-cream	P
0224	Whey; products consisting of natural milk constituents	P
0230	Butter & other fats & oils derived from milk	P
0241	Grated/powdered cheese, of all kinds	P
0242	Processed cheese, not grated/powdered	P
0249	Other cheese; curd	P
0251	Birds' eggs, in shell, fresh, preserved/cooked	P
0252	Birds' eggs, not in shell, and egg yolks	P
0253	Egg albumin	P
0341	Fish, fresh (live or dead) or chilled (excluding fillets and minced fish)	P
0342	Fish, frozen (excluding fillets and minced fish)	P
0344	Fish fillets, frozen	P
0345	Fish fillets, fresh or chilled, and other fish meat (whether or not minced), fresh, chilled or frozen	P
0351	Fish, dried, salted or in brine, but not smoked	P
0352	Fish, salted but not dried or smoked and fish in brine	P
0353	Fish (including fillets), smoked, whether/not cooked before/during the smoking process.	P
0355	Flours, meals & pellets of fish, fit for human consumption	P
0361	Crustaceans, frozen	P
0362	Crustaceans, other than frozen, including flours, meals & pellets of crustaceans, fit for human consumption	P
0363	Mollusks and aquatic invertebrates, fresh, chilled, frozen, dried, salted or in brine; flours, meals and pellets of aquatic invertebrates other than crustaceans, fit for human consumption	P
0371	Fish, prepared or preserved, caviar and caviar substitutes prepared from fish eggs.	P
0372	Crustaceans, mollusks and other aquatic invertebrates, prepared or preserved	P
0411	Durum wheat, unmilled	U-C
0412	Other wheat (including spelt) & meslin, unmilled	U-C
0421	Rice in the husk (paddy/rough rice)	U-C
0422	Rice, husked but not further prepared (cargo rice/brown rice)	U-C

0423	Rice, semi-milled or wholly milled, whether or not polished, glazed, parboiled or converted (including broken rice)	U-C
0430	Barley, unmilled	U-C
0441	Maize seed	U-C
0449	Other maize, unmilled	U-C
0452	Oats, unmilled	U-C
0453	Grain sorghum, unmilled	U-C
0459	Buckwheat, millet and canary seed; other cereals, unmilled	U
0461	Flour of wheat/of meslin	P
0462	Groats, meal & pellets, of wheat	P
0471	Cereal flours (other than of wheat or meslin)	P
0472	Cereal groats, meal and pellets	P
0481	Cereal grains, worked or prepared in a manner not elsewhere specified (including prepared breakfast foods)	P
0482	Malt, whether/not roasted (including malt flour)	P
0483	Macaroni, spaghetti & similar products (pasta), uncooked, not stuffed/otherwise prepared	P
0484	Bread, pastry, cakes, biscuits and other bakers' wares, whether or not containing cocoa in any proportion; communion wafers, empty cachets of a kind suitable for pharmaceutical use, sealing wafers, rice-paper and similar products.	P
0485	Mixes & doughs for the preparation of bakers' wares of subgroup 048.4	P
0541	Potatoes, fresh/chilled (not including sweet potatoes)	U
0542	Leguminous vegetables, dried, shelled, whether or not skinned or split.	U
0544	Tomatoes, fresh/chilled	U
0545	Other fresh or chilled vegetables	U
0546	Vegetables (uncooked or cooked by steaming or boiling in water), frozen	U
0547	Vegetables provisionally preserved (e.g., by sulphur dioxide gas, in brine, in sulphur water/in other preservative solutions), but unsuitable in that state for immediate consumption	U
0548	Vegetable products, roots and tubers, chiefly for human food, fresh, dried or chilled	U
0561	Vegetables, dried (excluding leguminous vegetables), whole, cut, sliced, broken or in powder, but not further prepared	P
0564	Flour, meal, flakes, granules and pellets of potatoes, fruits and vegetables	P
0566	Vegetables prepared or preserved otherwise than by vinegar or acetic acid, frozen	P
0567	Vegetables, prepared or preserved,	P
0571	Oranges, mandarins, clementines and similar citrus hybrids, fresh or dried	U-C
0572	Other citrus fruit, fresh or dried	U
0573	Bananas (including plantains), fresh/dried	U-C
0574	Apples, fresh	U
0575	Grapes, fresh or dried	U
0576	Figs, fresh/dried	U
0577	Edible nuts (excluding nuts chiefly used for the extraction of oil), fresh or dried, whether or not shelled or peeled	U
0579	Fruit, fresh or dried	U
0581	Jams, fruit jellies, marmalades, fruit/nut purée & fruit/nut pastes, being cooked preparations, whether/not containing added sugar/other sweetening matter, not including homogenized preparations	P
0582	Fruit and nuts, provisionally preserved; peel of citrus fruit or melons	P
0583	Fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen, whether or not containing added sugar or other sweetening matter	P
0589	Fruit, nuts and other edible parts of plants otherwise prepared or preserved, whether or not containing added sugar or other sweetening matter or spirit	P
0591	Orange juice	U
0592	Grapefruit juice	U

0593	Juice of any other single citrus fruit	U
0599	Juice of any single fruit (other than citrus) or vegetable; mixtures of fruit or vegetable juices	U
0611	Sugars, beet or cane, raw, in solid form, not containing added flavouring or colouring matter	U-C
0612	Other beet or cane sugar and chemically pure sucrose, in solid form	P
0615	Molasses resulting from the extraction or refining of sugar	U
0616	Natural honey	P
0619	Other sugars (including chemically pure lactose, maltose, glucose and fructose in solid form); sugar syrups not containing added flavouring or colouring matter; artificial honey (whether or not mixed with natural honey); caramel	P
0621	Vegetables, fruit, nuts, fruit-peel & other parts of plants, preserved by sugar (drained, glace/crystallised)	P
0622	Sugar confectionery (including white chocolate), not containing cocoa	P
0711	Coffee, not roasted, whether or not decaffeinated	U-C
0712	Coffee, roasted	P
0713	Extracts, essences and concentrates of coffee and preparations with a basis of these products or with a basis of coffee; coffee substitutes and extracts, essences and concentrates thereof	U
0722	Cocoa powder not containing added sugar/other sweetening matter	P
0723	Cocoa paste, whether or not defatted	P
0724	Cocoa butter, fat/oil	U
0731	Cocoa powder containing added sugar/other sweetening matter	U
0732	Other food preparations containing cocoa, in blocks, slabs/bars weighing > 2 kg/in liquid, paste, powder, granular/other bulk form in containers/immediate packings of a content exceeding 2 kg.	U
0733	Other food preparations containing cocoa, in blocks, slabs/bars, whether/not filled	U
0739	Food preparations containing cocoa	U
0741	Tea, whether or not flavoured	U-C
0743	Maté; extracts, essences and concentrates of tea or maté, and preparations with a basis of tea, maté, or their extracts, essences or concentrates	P
0751	Pepper of the genus Piper; fruits of the genus Capsicum or of the genus Pimenta, dried or crushed or ground	P
0752	Spices (except pepper and pimento)	U
0811	Hay and fodder, green or dry	U
0812	Bran, sharps and other residues, whether or not in the form of pellets, derived from the sifting, milling or other working of cereals or of leguminous plants	U
0813	Oil-cake and other solid residues (except dregs), whether or not ground or in the form of pellets, resulting from the extraction of fats or oils from oil-seeds, oleaginous fruits and germs of cereals	U
0814	Flours, meals and pellets, of meat or meat offal, of fish or of crustaceans, mollusks or other aquatic invertebrates, unfit for human consumption; greaves	U
0815	Residues of starch manufacture and similar residues, beet pulp, bagasse and other waste of sugar manufacture, brewing or distilling dregs and waste, whether or not in the form of pellets	U
0819	Food wastes and prepared animal feeds	U
0910	Margarine; edible mixtures or preparations of animal or vegetable fats or oils or of fractions of different such fats or oils, other than vegetable fats or oils or their fractions of subgroup 431.2	U
0981	Homogenized food preparations	P
0984	Sauces and preparations therefore; mixed condiments and mixed seasonings; mustard flour and meal and prepared mustard; vinegar and substitutes for vinegar obtained from acetic acid	P
0985	Soups & broths & preparations	P

0986	Yeasts (active/inactive); other single-cell micro-organisms, dead (but not including vaccines of heading 541.63); prepared baking-powders	P
0989	Food preparations	P

Notes: Column 'Type' indicates whether the good is processed (P) or unprocessed (U) and whether it is a commodity (C). Goods 0124 (meat of horses, asses and mules), 0173 (liver of any animals), 0243 (blue-veined cheese), 0354 (fish liver & roes), 0451 (rye, unmilled), 0721 (cocoa beans) and 0725 (cocoa shells & other cocoa waste) are excluded from the sample because of missing records and poor quality of the data.