Validity of PPP for producer meat prices in EU; Some evidence

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Abstract

Market integration and the introduction of single currency has arisen the issue of the validity of the Purchasing Power Parity (PPP) hypothesis in EU within the last few decades. In most cases the surveys involve consumer prices and in particular the consumer price indices for the whole economy. Though, a few surveys focus on commodity prices and even less to producer prices. The present survey makes an effort to examine the behaviour of the real exchange rates based on producer meat prices for different EU countries. The role of CAP seems to be pivotal in our results, since no methodology employed could confirm stationarity and consequently, a mean reverting behaviour to a steady state for our data.

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Key words; Nonlinear unit root tests, Panel Unit root tests, producer meat prices, EU

1. Introduction

The research on the volatility of agricultural prices has been a subject of survey with different methodologies and conflict results. Especially within EU, as a result of market integration, common currency and the implementation of Common Agricultural Policy (CAP), a common behavior especially in the producer prices of agricultural is expected to be valid. The market integration as expected with the CAP resulted in the facilitation of the free movement in either capital or goods. Additionally the establishment of common EMU may well lead to a significant reduction in exchange rate volatility as well as in risk associated with trade. In particular, recently, some EU farm prices have experienced a significant decline, resulting in considerable financial stress to producers. Though, there are a few cases, where, price movements of a similar magnitude,

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or even in the same direction, were not experienced at the wholesale and/or the food retail levels. The present work examines the validity of Purchasing Power Parity for the producer prices of meat for different countries in EU. As numeraire country we employ the US, before and after the advent of the euro. Standard as well as nonlinear unit root tests are employed on the time series dimension. Unit root tests reject PPP and the highest half-lives are observed after the introduction of the single currency. Panel unit root (Hadri 2000 and Im et al, 2003) tests that take into account cross-sectional dependence are also estimated. The results remain inconclusive as different panel stationarity tests fail to support PPP for the time period employed. Finally, the present survey employs the BBC test where the hypothesis of unit root cannot be rejected with exception the case of France. The innovation of the particular study stands on the fact that the aforementioned theory is surveyed for the case of producer meat prices for which the change of the regime from the price supporting mechanism to decoupling is expected to cause changes in the behaviour of the meat producer prices and especially to the deviation from the equilibrium as expressed by the real exchange rates based on the meat producer prices. What has been concluded in the past, is the fact that price alignment for identical or comparable products even in the case of neighbouring countries cannot be confirmed (Emanouilides and Fousekis, 2012; Borchert and Reineke, 2007; European Commission, 2004)

2. Price volatility in the producer prices

Producer prices especially in the case of food tend to be less volatile than those of energy industries while the behavior of the respective consumer prices is not equivalent. Factors that may drive the producer prices are involved with costs structure, competition, seasonality, inflation and attractive pricing (Dias et.al, 2007). A number of different structural factors may well account for meat price differentials among different European countries. The most important and worth mentioning are the following;

- the extent of co-operative marketing;
- the degree of product handling, storage and processing;
- share of raw material in end product value;
- legislative and regulatory frameworks;
- market shocks; and,
- the degree of self sufficiency and cross border trade.

Overall, the very high degree of variation in explanatory structural, market and product characteristics between EU Member States makes it extremely difficult to draw conclusions for the EU as a whole. What must be mentioned is the effort made to ensure an improvement in the producers’ relative position within the price determination process. This effort is reflected to the increase in the relative market or ‘countervailing’ power within the supply chain and/or to the finding of a new niche or differentiated markets. What also must be mentioned is that a higher degree of competition is associated with more flexible prices and that higher inflation is positively correlated with a higher frequency of price adjustment. In addition the high correlation among producer prices of different countries is an interesting issue that can be attributed to similarity in production processes. On the other hand based on the findings of Dhyne et al. (2006), the heterogeneity across product categories dominated heterogeneity across countries. Furthermore, due to the implementation of the EU’s Common Agricultural Policy, the same agricultural products are required to become spatially integrated within and between all member states. Actually, in an integrated market, price information related to the production costs should also be efficiently transmitted between the member states. In practice, perfect price transmission is not realistic, especially for small open economies, and a high degree of integration with other member states in production costs is also known to be unrealistic, as the production costs for many countries are substantially higher than in the main agricultural areas of Europe. Consequently in a few cases, the costs cannot, be integrated with the competitive production costs and product prices in the EU. As a result, price transmission models are mostly used to provide important implications as to how changes in either supply or demand in one market will transmit to another.
Generally, price interactions can reflect the extent of market integration and the extent of market efficiency. Thus, in analysing the efficiency of the meat market, a fundamental issue is the extent to which the domestic meat market responds to changes in the European price. The issues of market efficiency and the extent of price transmission of market information have attracted considerable attention during the last couple of years, as the price of food in Finland has dramatically increased. Many questions have arisen about price transmission between the new entries in the EU market, and questions such as whether farmers in these countries have benefitted from the price increases need to be carefully addressed.

3. Literature Review
Testing empirically the validity of PPP has been a major issue of study since the beginning of our century either in the form of producer price indices or in the form of consumer price indices (concerning the whole economy), either in terms of sectors (validity of PPP in commodity index) or in terms of individual products (validity of law of one price). An analytic review of the methodologies employed in the particular theory are presented in Sarno and Taylor (2002), Taylor (2002), and Sarno (2005).

Within the last few decades the influence of the European economic integration process on price convergence and the stationarity of real exchange rates has become a subject of a recent study. For instance, Koedijk et al. (2004), by using the Augmented Dickey-Fuller (ADF) unit root test in the context of Seemingly Unrelated Regression (SUR) methodology, test the PPP hypothesis within the Euro Area. Evidence of PPP is only detected between the Euro Area and Switzerland, when heterogeneous mean reversion is assumed, while the assumption of homogeneous mean reversion presents evidence in favour of PPP for the full panel. Gadea et al. (2004), using the ADF procedure, as well as unit root tests with structural breaks, study the evolution of the US dollar real exchange rate vis a vis the EU currencies during the recent floating regime, before and after the birth of the euro, over the period 1974-2001. They argue that the omission of some structural breaks which affect the behaviour of the real exchange rates may cause the unit root hypothesis to be accepted, resulting in the apparent lack of evidence in support of PPP and allow for three breaks; the first at the beginning of the 1980’s, the second around 1985, while the third break appearing in 1996. According to their findings they conclude that a weaker version or quasi long-run PPP holds. Stronger support for PPP is provided by Zhou et al. (2008), using the nonlinear unit root test proposed by Kapetanios et. al (2003) to the bilateral real exchange rates of both European and other industrial countries, with the French franc and German mark (and the euro after 1998), as well as the US dollar as numeraire currencies. They suggest that convergence towards PPP between the EU countries, especially the Euro Area countries, tends to be nonlinear, because of factors such as transportation costs and trade barriers, as well as official interventions in the foreign exchange market (see also Taylor et al., 2001).

Overall, Zhou et al. (2008) suggest that PPP tends to hold well within the EU even before the adoption of the euro, while there is no evidence that the use of the euro has played an essential role for better performance of the PPP hypothesis within the Eurozone.

Regarding the validity of PPP in terms of agricultural products or alternatively the Law of One Price has been a subject of extended survey especially in EU. Important studies on the particular subject are those of Sanjuan and Gil (2001) that assessed market integration for pork and lamb using weekly data, over 1988–95 from seven EU countries, with the assistance of multivariate cointegration tests. Their findings confirmed multiple cointegrating vectors in both markets, a result that indicates a certain degree of integration; they did not, however, tested for the LOP. In addition, Sosvilla-Rivero and Gil-Pareja (2004) examined the weak version of the LOP in 12 EU members using yearly price indexes from 14 broadly defined consumption items over 1975 to 1995 and panel unit root tests. According to their findings they confirmed the weak version of the LOP for tradables.

Fousekis (2007) assessed the validity of the LOP for pork and poultry using monthly data over 1995 to 2006 from 14 EU members with the application of multivariate cointegration tests. He found some evidence of the LOP (especially in its weak version) in the pork markets but limited evidence of it in the poultry markets.
In almost every aforementioned empirical studies on the LOP, conventional unit root and cointegration tests have been employed which implicitly assume that the relations of interest are linear. Though, spatial price relationships, are likely to be nonlinear due to transaction costs (for instance Barrett and Li, 2002; Goodwin and Piggott, 2001; Serra et al., 2006). Actually, Serra et al. (2006) by using both the parametric TAR (Threshold Autoregressive) and the nonparametric Local Linear Regression (LLR) models found some empirical evidence of nonlinearities (different price transmission regimes) in European pork markets. The conventional tests when applied to nonlinear series are well known to have low power (Kapetanios et al., 2003; Michael et al., 1997; Taylor et al., 2001).

In this context, the primary objective of the present paper is to make an effort to survey the validity of PPP in the producer meat prices with linear and non linear tests as well as with panel unit root tests

4. Data – Methodology

4.1 Data

Monthly data of producer meat prices for the EU countries were derived from Eurostat for the time period 1998/01-2008/12. Monthly data of producer meat prices for USA were derived by USDA, while the nominal exchange rates are taken by the International monetary Fund (IMF). All the data are transformed in logarithmic form.

4.2 Methodology

An ample of methodologies are employed in the present survey aiming to detect the existence of a unit root in terms of univariate tests as well as in terms of panel data tests.

Regarding the unit root or stationarity univariate tests we employed a non linear univariate unit root test known as BBC test. The BBC test examines the unit root against a stationary three regime SETAR alternative. In terms of panel data we employed the Im, Pesaran and Shin (2003) that takes the cross sectional dependence into account and Hadri (2000) panel data stationarity test. In the following paragraphs are presented analytically the methodologies presented above.

BBC test

The particular test aims to survey the null of a unit root against a stationary three regime SETAR process. As it is well known a SETAR(1) process though studied extensively for the last decade, is of little empirical interest due to the serial correlation exhibited by most economic time series. On the other hand, the SETAR(p) models as confirmed by Balke and Fomby (1997), have a better economic relevance. Particularly in the case of our study we performed the supLR unit root test. Given the assumption that the inaction band is symmetric around 0, the real exchange rate data used for the TAR estimation are demeaned. In the second step and for the series that we reject the null hypothesis, we test the null of linearity using the supWald statistic corresponding to the hypothesis \( \alpha_i = \alpha, \mu_i = \mu, \) and \( \rho_i = \rho \forall i = 1, 2, 3, \) in the model presenting in the following equation:

\[
\Delta y_t = \begin{cases} 
  a_1 \Delta y_{t-1} + \mu_1 + \rho_1 y_{t-1} + \sigma \epsilon_t & \text{if } y_{t-1} \leq -\lambda \\
  a_2 \Delta y_{t-1} + \mu_2 + \rho_2 y_{t-1} + \sigma \epsilon_t & \text{if } |y_{t-1}| < \lambda \\
  a_3 \Delta y_{t-1} + \mu_3 + \rho_3 y_{t-1} + \sigma \epsilon_t & \text{if } y_{t-1} \geq \lambda
\end{cases}
\]  

(1)

Under the null hypothesis the model is a single equation;

\[
\Delta y_t = a \Delta y_{t-1} + \mu + \sigma \epsilon_t
\]  

(2)

where;
\( \varepsilon_t \sim iidN(0,1) \)

**The Hadri (2000) test [HAD]**
The HAD test is similar to the KPSS test (Kwiatkowski, Phillips, Schmidt and Shin, 1992). The null hypothesis is that of no unit root in any of the series in the panel. Similarly to the KPSS test, the HAD test is based on the residuals from the individual OLS regressions of \( q_{i,t} \) on a constant:

\[
q_{i,t} = a + u_{i,t}, u_{i,t} = \phi_i u_{i,t-1} + \varepsilon_{i,t} \quad (3)
\]

Under the assumption that the residuals are \( I(0) \) and for all \( i \) i.i.d \( \sigma^2 \) and cross-sectionally independent, the null hypothesis of the test is the following:

\[
H_0 : |\phi_i| < 1 \quad \forall i
\]

Given the residuals, the HAD test is defined by the equation that follows:

\[
LM = \frac{1}{\hat{\sigma}^2 N T^2} \sum_{i=1}^{N} \sum_{t=1}^{T} S_{i,t}^2 \quad (4)
\]

where \( S_{i,t} \) denotes the partial sum of the residuals and \( \hat{\sigma}^2 \) is an estimate of the long run variance of \( q_{i,t} \).

HAD shows that under mild assumptions, may well follow the typical normal distribution:

\[
Z = \frac{\sqrt{N(\Lambda M - \xi)}}{\zeta} \rightarrow N(0,1) \quad (5)
\]

where the values for \( \xi \) and \( \zeta \) are 1/6 and 1/45 respectively. Consequently, we should use the right-hand tail of a standard normal distribution for critical values of Hadri’s test. Following Hobijn et al. (2004) we employed the quadratic spectral kernel method.

**The Im, Pesaran and Shin (IPS test) test (2003)**
The IPS test is based on the following equation:

\[
\Delta q_{i,t} = a_i + b_i q_{i,t-1} + \sum_{j=1}^{p_i} \phi_{i,j} \Delta q_{i,t-j} + \varepsilon_{i,t} \quad (6)
\]

where \( i=1, 2, \ldots, N \) cross-section units or series, observed over periods \( t=1, 2, \ldots, T \).

The null hypothesis of a unit root tested is given by the following condition:

\[
H_0 : b_i = 0
\]

while the alternative hypothesis allowing stationarity for some of the individual time series is the following:

\[
H_1 : \left\{ \begin{array}{l}
b_i < 0 \quad \text{for} \quad i = 1, 2, \ldots, N_i \\
b_i = 0 \quad \text{for} \quad i = N_0 + 1, \ldots, N \quad \text{with} \quad 0 < N_0 \leq N
\end{array} \right.
\]

This condition implies that the particular test evaluates the null hypothesis that all series contain a unit root while the alternative accepts some of the time series to be stationary.

To be more specific initially the separate ADF regressions are estimated and then the average of the \( t \)-statistics for the \( b_i \) coefficients, derived by the individual ADF regressions is estimated. The average \( t \)-statistic is denoted by \( \bar{t}_{NT} \) and is provided by the following formula;
\[ \hat{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT_i} \]  

(7)

The generated statistics converges to a normal distribution given that the assumption of cross-sectional independence is taken into consideration. Consequently, IPS propose a standardized statistic, denoted \( W_t \). The particular statistic is based on the theoretical means and variances of \( t_{iT_i}, E(t_{iT_i}) \) and \( Var(t_{iT_i}) \) respectively.

5. Results

The first test applied on our data is the BBC test and the results of this test are provided in table 1.

<table>
<thead>
<tr>
<th>Country</th>
<th>BBC test (max LR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>qita</td>
<td>8.410211</td>
</tr>
<tr>
<td>qaustria</td>
<td>9.138375</td>
</tr>
<tr>
<td>qfinland</td>
<td>15.01518</td>
</tr>
<tr>
<td>qfr</td>
<td>20.60997</td>
</tr>
<tr>
<td>qirel</td>
<td>11.93658</td>
</tr>
<tr>
<td>qlux</td>
<td>11.91609</td>
</tr>
<tr>
<td>qdan</td>
<td>7.919205</td>
</tr>
<tr>
<td>qport</td>
<td>7.329716</td>
</tr>
<tr>
<td>qger</td>
<td>6.976743</td>
</tr>
<tr>
<td>qswed</td>
<td>7.751853</td>
</tr>
<tr>
<td>quk</td>
<td>8.816494</td>
</tr>
<tr>
<td>qbelg</td>
<td></td>
</tr>
</tbody>
</table>

As it becomes evident by the results provided in table 2 the null hypothesis cannot be rejected with exception the case of France. Other procedures selected in order to survey the stationarity of the real exchange rates based on the producer meat prices in terms of panel data is the Im et al (2003) unit root test as well as Hadri (2000) stationarity test. The results of the two alternative tests are provided in the following tables 2 and 3 respectively;

<table>
<thead>
<tr>
<th>IPS</th>
<th>( \hat{t}_{NT} )</th>
<th>-1.7190</th>
</tr>
</thead>
<tbody>
<tr>
<td>( W_T )</td>
<td>(0.76926)</td>
<td>(0.2209)</td>
</tr>
</tbody>
</table>

The optimal lag length is based on SIC. IPS, denotes the Im, Pesaran and Shin (2003). Corresponding
According to the results of table 3, the null hypothesis of unit root cannot be rejected for 5% level of significance. Last but not least we implemented the Hardi (2000) stationarity test the results of which are presented in table 3.

Table 3. Hadri stationarity test

<table>
<thead>
<tr>
<th>HAD</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19.5042</td>
</tr>
<tr>
<td></td>
<td>(0.000**)</td>
</tr>
</tbody>
</table>

Notes: The optimal lag length is based on SIC. HAD denotes the Hadri (2000) test y. Corresponding p-values in parentheses, **, * indicate rejection of the null hypothesis at 5% and 10% significance levels, respectively.

On the other hand according the results of Hadri stationarity test, the null hypothesis of stationarity is rejected for 5% level of significance.

6. Conclusions

The present survey makes an effort to investigate the validity of Purchasing Power Parity in terms of a commodity index in EU. To be more specific we surveyed the behavior of the real exchange rates based on the producer meat prices vis a vis the US dollar and the US producer meat price. As it is well known the Common agriculture policy intends to create an integrated market and consequently the behavior of every member state is expected to be similar to that of the others. Generally CAP trade frictions seems to be responsible for our findings. What is worth mentioning is the fact that the results remain the same in case the nonlinearities are taken into consideration (results of BBC stationarity test) as well as in case the cross sectional dependence is taken into consideration (panel data unit root tests). What can be considered as a limitation for the present survey is the fact that the structural breaks were not taken into consideration while as a subject of further research is to use EU countries as bench mark and not US, in order to become able to get an insight to the EU market integration.

References