Producer price disparities in the EU agriculture: divergence or convergence?

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Abstract: The issue of price disparities in the EU commodity markets has given rise to a fair amount of empirical and theoretical research. Price convergence studies were generally on the aggregate level, and investigated the convergence of inflation among countries. This s*tudy aims to investigate* the convergence of agricultural price disparities among the EU member states, based on different individual agricultural products. The analysis shows the existence of agricultural price convergence among the EU member states since 1991, even including some countries were not members of the EU. Furthermore, the speed of convergence differs among agricultural products and also between the sub-periods as 1991–2000 and 2000–2008.

Keywords: convergence, EU agriculture, producer prices, integration, agricultural markets

According to the economic theory, the law of one price is the economic principle that identical goods sell for the same price worldwide if international trade is free and without natural barriers, such as transportation costs. It is expected that the prices will converge through the integration process among countries. That prices of a good differ across countries or regions has been explained by the differences in the product attributes and the costs of local inputs, and they also mainly depend on producer prices. In this study, there is investigated the EU Member States' agricultural prices convergence to the mean level, by the producer price side and it is aimed at providing a quantitative estimate of the effect of the European economic integration on the speed of the agricultural prices convergence. The earlier studies about price convergence have focused on consumer prices, however, this study has focused on producer prices. When analysing the EU agriculture, it is important to make a commodity specific analysis. The EU support scheme and its level vary between commodities and also the competitiveness of these commodities differs from each other.

The dispersion of prices across countries is often used as a measure of market integration: large differences in the price levels indicate the existence of barriers to trade, while low price differentials suggest a functioning goods market arbitrage (Sturm et al. 2009). Since the early 1990s, the efforts by the EU to achieve the integration of the national markets have been intensified and the general price level convergence is a widely discussed topic. Some EU member states which are called the transition economies also had implemented extensive reforms to move from the central planning to market economy in the 1990s. Furthermore, agricultural market integration of these countries to the EU has been continued in the accession period and also after becoming the EU member states, to decrease the disparities among regions.

The EU agriculture as a whole is a major player in the world's agricultural markets. The EU member states produce large quantities of agricultural products, and a wide diversity and quality of those products. The integration of the member states' agriculture markets could make a contribution to the EU competitiveness in the world by the convergence process of prices. The EU Common Agricultural Policy also has been shifted from the price support policies to policies which support competitiveness since the McSharry Reform in 1992. Regional income disparities also have been taken into attention more intensively since the beginning of 1990s. However, enlargement towards the transition countries gives rise to a number of challenges as regards the national and regional disparities in the EU. Price convergence between the new member states (mostly transition economies and the Central European Countries) and the old member states has increased the transfers from consumers to producers in the new member states, but these positive effects on farming may be offset by a range of factors undermining the competitiveness of the new member states' agriculture (European Commission 2008).

METHODOLOGY

The analysis about convergence is traditionally based on the Solow's (1956) neo-classical growth model, which predicts that a poor economy tends to grow faster than a rich one. Hereby, the convergence test methodology was developed for studying the convergence of the real GDP per capita for a cross-section of economies in the initial studies. There are huge amounts of studies devoted to economic growth and convergence (Baumol 1986; De Long 1988; Dowrick and Nguyen 1989, Barro and Sala-i-Martin 1991; Mankiw et al. 1992). The literature on price convergence has consisted of testing the law of one price (LOOP). Goldberg and Verboven (2005) focus on one particular sector, the European automobile market, and find a strong evidence of price convergence. Baye et al. (2006) study the impact of the Euro on prices charged by the online retailers within the EU. The analysis covered 28 products (mostly electronics) and found that the introduction of the Euro was associated with an increase, rather than a reduction, in both average and average minimum prices online. Mejean and Schwellnus (2009) study on French export prices at the disaggregated firm and product level evaluates the effect of economic integration on price convergence. The results suggest that the speed of convergence of the international relative prices is by around 40% faster within the EU than outside.

In this study, the empirical analysis builds on a data set of relative agricultural prices (*ap*) of the EU member states. The relative price is calculated as the log differences between a country's agricultural price and the average of all countries. The variables are in the absolute terms.

$$lnap_{ij,t} = \left| lnap_{i,t} - ln\overline{ap}_{ij,t} \right| \quad (1)$$

In calculation of β convergence, the typical estimating equation specifies changes in the international relative prices as a function of the lagged relative price and a country fixed effect. The following regression is a panel analogy to the Barro regression and it is natural to interpret the coefficient of the lagged agricultural price term as a function of the speed of convergence.

$$\Delta lnap_{ij,t} = \alpha_{it} + \beta ap_{ij,t-1} + \varepsilon_{ij,t} \quad (2)$$

Δ is the first-difference operator, α is the country fixed effect and ε is the residual term. β is the convergence coefficient and if convergence holds, it is expected that β coefficient would be negative and statistically significant. β also measures the speed of convergence and it is possible to compare the speed of convergence among different agricultural products' prices. Of β convergence implies a catching-up process in which countries with lower price levels experiences faster subsequent increases in prices than countries with a previously high level of prices (Sturm et al. 2009)

To estimate the speed of convergence (β), firstly it was checked for unit roots in each series and in the panel, because the empirical validity of convergence analysis can be investigated by the unit root tests. Panel unit root tests have been widely used in the test of convergence analysis in recent years. In this study, firstly there is employed the panel unit root methods for evaluating the stationary of the EU Member States' agricultural price dispersion from the mean level. This is due partly to the fact that they are more powerful than the unit root tests for a single time series data as well as to the availability of panel data with a long time span (Li and Huang 2006). The analysis is mainly realized for three periods: the full period (1991–2008), the ex-ante sub-period (1991–1999) and the ex-post sub-period (2000–2008). The first period includes the adaptation of transition countries into the EU economy and the second period includes accession to the EU, in the context of the agricultural producer prices.

The unit root test was applied to price variables and it testifies first whether the price indices are the unit root processes, i.e. the series which contain a stochastic trend or the unit root which makes them to diverge from one another. After rejection of the null hypothesis, that is, the level of price converges to a steady-state value, we turn to the issue of the rate of convergence. Furthermore, the recent literature suggests that the panel-based unit root tests have a higher power than the unit root tests based on the individual time series. In this study, there is applied a widely used panel unit root test proposed by Im-Pesaran-Shin (IPS) panel unit root test which is based on the well-known Dickey-Fuller procedure. Im et al. (2003) proposed a test for the presence of unit roots in panels, that combines the information from the time-series dimension with that from the cross-section dimension, such that fewer time observations are required for the test to have power (Giulietti et al. 2008). It is due to the fact that each individual cross-section is independent and the results are combined using a large sample distribution of t-statistics to investigate the null hypothesis on the panel as a whole. The IPS test possesses a substantially more power than the single-equation ADF (Augmented Dickey-Fuller) test by averaging *N* independent ADF test (Strauss and Yigit 2003).

$$\Delta y_{it} + \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p} \theta_{ij} \Delta y_{i,t-j} + \nu_{it} \quad (3)$$

for $i = 1, \ldots, N$ series. The procedure allows for heterogeneity in ρ and α. The null hypothesis is that $\rho_i = 0$ and the alternative is that a certain percentage of the series has a value of ρ significantly less than zero. The limiting distribution is given as:

$$\sqrt{N}\,\frac{(\bar{t}_{ADF} - \mu_{ADF})}{\sqrt{(\sigma^2_{ADF})}} \rightarrow N(0,1) \quad (4)$$

where the moments μ_{ADF} and σ^2_{ADF} are from the Monte Carlo simulations, and $\bar{t}_{ADF}$ is the average estimated ADF *t*-statistics from the sample. The power to reject the null increases by the $\sqrt{N}$. In a word, IPS procedures address the low power associated with the single series ADF tests by averaging the test statistics across the panel (*N* series).

EMPIRICAL RESULTS

In this study, there are obtained the price data for the selected agricultural products from the U.N. Food and Agriculture Organization (FAO) statistics. It is aimed at the choice agricultural products which have the price data for as much as many countries as possible. The convergence analyses include 17 agricultural products which are of different types, as cereals, live animals, animal products, vegetables and fruits. The data is included from 19 EU Member States to 27 EU Member States (Belgium and Luxembourg are grouped together), such as 19 country for honey and 27 country for animal products. The agricultural price statistics provides information on the process of producer prices of agricultural products and they are calculated in constant term as 1999–2001 International USA Dollar Prices.

Table 1. IPS (Im, Pesaran and Shin W-stat) Panel Unit Root Test Results

Variables	1991–2008	1991–1999	2000–2008
Cattle	–7.7412	–5.0706	–3.0594
Chicken	–8.1008	–7.2689	–2.1511
Pig	–15.4503	–8.1407	–3.0721
Sheep	–5.4297	–4.0461	–7.3044
Wheat	–4.3429	–3.7991	–1.3581
Barley	–5.2772	–4.5326	–1.6839
Potato	–9.6707	–5.1823	–6.0651
Onion	–3.5906	–4.5458	–2.5865
Cabbage	–8.7940	–3.4856	–3.7024
Cauliflower	–7.2408	–3.9194	–2.9762
Carrot	–6.9332	–4.8955	–2.3214
Tomato	–7.2319	–8.7478	–5.0124
Apple	–8.1664	–3.2882	–1.4803
Strawberry	–4.0025	–4.6407	–3.3140
Cow milk	–5.2356	–4.9286	–1.3505
Hen egg	–9.1351	–4.2212	–35.6602
Honey	–4.0025	–2.7615	–2.1900

The first results of this study include the stationarity of variables that is checked by the IPS unit root test. The IPS test evaluates the null hypothesis that all of the series contain unit roots against the alternative hypothesis that none does. The IPS panel unit root test results for the relative agricultural prices of selected products are reported in Table 1. These results show that the null hypotheses of panel unit root in the level of the series are rejected at the 5% significant level. The results of the panel unit root tests confirm that the variables are stationary and it shows that the price convergence exists for all agricultural products. After rejection of the null hypothesis, that is, the level of the relative prices of agricultural converges to a steady-state value, thus, it is possible to turn to the issue of the rate of convergence.

Some econometric concerns should be addressed before the β convergence estimation. The first problem is the choice of the method for estimation based on the panel data: whether one should use the simple pooled least squares model (pooled LS), or the random effects or fixed effects models. The fixed effects model is widely used in the econometric issues (Maddala 1999). Following Islam (1995), a number of papers have tried to estimate the speed of convergence among regions using the panel data sets and the variant of the fixed effect model (Arbia and Piras 2005). The fixed effects panel model estimates suggest favourable state conditions and the convergence model is estimated allowing for the heterogeneity in the constant term (Otero et al. 2008). Thereby, it holds (fixes) the average effects of each country's agricultural price.

The fixed effects panel estimation results are presented in Table 2. In addition, the β convergence is also tested by the random effects panel model which is not shown in the table and there is found the existence of convergence. The fixed and random effects panel model found consistent results. The difference which is found in the analysis is that the speed of convergence is higher in the fixed effects panel model.

Table 2. Results of tests for convergence

Variable	Between 1991–2000				Between 2000–2008				Between 1991–2008			
	β	std. error	*t*-stat	R^2	β	std. error	*t*-stat	R^2	β	std. error	*t*-stat	R^2
Cattle	–0.637	0.037	–17.422	0.72	–0.872	0.074	–11.705	0.52	–0.561	0.029	–19.535	0.57
Chicken	–0.759	0.037	–20.449	0.78	–0.684	0.072	–9.472	0.4	–0.661	0.031	–21.185	0.6
Pig	–0.716	0.035	–20.233	0.79	–0.423	0.064	–6.614	0.3	–0.612	0.027	–22.947	0.66
Sheep	–0.602	0.04	–15.201	0.69	–0.496	0.05	–9.884	0.44	–0.328	0.025	–12.944	0.41
Wheat	–0.535	0.051	–10.563	0.53	–0.706	0.085	–8.293	0.42	–0.477	0.033	–14.34	0.46
Barley	–0.659	0.053	–12.541	0.59	–0.632	0.081	–7.785	0.38	–0.509	0.033	–15.382	0.48
Potato	–0.951	0.065	–14.577	0.63	–0.916	0.071	–12.866	0.55	–0.862	0.046	–18.87	0.54
Onion	–0.962	0.073	–13.217	0.58	0.707	0.068	–10.387	0.53	–0.513	0.045	–11.494	0.37
Cabbage	–0.918	0.07	–13.114	0.56	–0.855	0.08	–10.693	0.46	–0.721	0.046	–15.574	0.43
Cauliflower	–0.946	0.077	–12.24	0.58	–0.744	0.076	–9.791	0.4	–0.657	0.047	–13.933	0.4
Carrot	–0.84	0.068	–12.341	0.56	–0.683	0.073	–9.4	0.41	–0.552	0.043	–12.78	0.37
Tomato	–0.938	0.066	–14.234	0.62	–0.614	0.074	–8.303	0.38	–0.531	0.046	–11.56	0.34
Apple	–0.812	0.067	–12.127	0.53	–0.558	0.081	–6.911	0.3	–0.608	0.047	–12.981	0.37
Strawberry	–0.677	0.059	–11.416	0.55	–0.958	0.088	–10.833	0.49	–0.681	0.047	–14.464	0.43
Cow milk	–0.61	0.037	–16.562	0.72	–0.388	0.056	–6.923	0.39	–0.458	0.025	–18.473	0.58
Hen egg	–0.55	0.07	–7.805	0.32	–1.15	0.077	–14.949	0.59	–0.794	0.05	–15.933	0.43
Honey	–0.698	0.057	–12.136	0.64	–0.48	0.072	–6.705	0.43	–0.545	0.041	–13.24	0.47

As it is seen in Table 2, there are statistically significant and negative values for the parameter β. This means that there is a negative correlation between the initial ratio of the countries' agricultural prices to the mean level. The price disparities have been decreased among countries since 1991. The average speed of (β) convergence for 17 agricultural products from 1991 to 2008 is found 0.58 in the absolute terms. When the period is divided 2 sub-periods, the speeds of convergence differ among agricultural products. The prices of chicken, pig, sheep, barley, potato, onion, cabbage, cauliflower, carrot, tomato, apples and cow milk have higher convergence rates in the sub-period 1991–2000, while the prices of cattle, wheat and strawberry have higher convergence rates in the sub-period 2000–2008.

CONCLUSIONS

The results in this paper suggest that there is a significant agricultural price disparities convergence among the EU member states since 1991. It has been seen that the market integration of agricultural products as the dispersion of prices across countries is often used as a measure of market integration. The EU Common Agricultural Policy has support tools for the low-income farmers and regions. Price increase is also an encouragement for these farmers, but also a more competitive market for the farmers who sell the same product in higher prices. The EU has embarked on important reforms to make the CAP more market orientated and the convergence is also a natural consequence of it.

The EU has had three enlargements since 1990s, which were in 1995, 2004 and 2007. Especially, the last two integration processes involved mostly the transition countries which had a different economic system than the earlier EU member states before the 1990s. As regards trade, the integration with these new Member States started in the early 1990s with bilateral agreements. When the speeds of convergence are compared among the countries, it is found that the convergence speed is higher for 15 of 17 agricultural products in 1990s than 2000s. It shows that, the convergence process had existed even among many countries who were not the members of the EU.

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