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EU and World Agricultural Markets: Are They more Integrated after the Fischler Reform?

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Abstract

This work uses cointegration techniques allowing for structural breaks to assess the extent to which the Fischler reform of the CAP increases price transmission elasticity (PTE) between the world and European corn, wheat, and soybean markets. Results show that the reform increased PTE in the case of corn and wheat, while its impact was negligible for soybeans. However, the long-term relationship (cointegration) between world and European prices can be detected only taking into account – other than the Fischler reform's structural break – also the fact that world commodity markets were interested, in 2003-04 and 2007-08, by price bubbles. In particular the latter affected the world – European corn price relationship in the ascending phase, while the wheat and soybeans markets in the descending phase.

Keywords: cointegration, structural breaks, agricultural commodity prices, Fischler CAP reform

JEL classification:C22, Q02, Q18, O13.

1. INTRODUCTION

The Fischler reform of the Common Agricultural Policy (CAP) was agreed between Member States in 2003 and started to be implemented in 2005-07. The main characteristic of the reform was the progressive introduction of fully decoupled payments to farmers, in order to mitigate trade and market distorting effects of EU policies and re-align European prices to world ones. However, a greater integration of EU markets to the world ones means also a greater exposure of European farmers to price volatility, which can in turn substantially change agriculture's profitability and trigger deep changes in the structure of European agriculture.

Since the late 50s, when the European Union was established and policies in favour of European farmers started, the support evolved in different ways for different products. In the late 60s Common Market Organizations (CMOs) were put in place, each governed by its own basic regulation and governing a particular commodity. The CMOs existed until 2007, when they were formally and substantially unified. Even though different CMOs implied different measures, they all tended to apply the same principles: support the domestic market, protect domestic farmers from imports and favour exports (through subsidies). This system became out-to-date and politically very difficult to defend at the end of the 80s. Europe was overproducing, crops were not being harvested because of overproduction, and European exports were flooding international markets consequently depressing prices. Both the European public opinion and extra-European countries started to heavily criticize European policies. Finally the Union decided to reduce market support measures replacing them with direct payments to farmers, linked to production (MacSharry reform). Between 1993 and 2005 the main channels of support to EU farmers were production-related (coupled or partly coupled) payments. Direct aids replaced market measures because more transparent and less trade and market distorting. Direct payments were still market-distorting since they spurred farmers to maximize production even when market condition would suggest reduce or even cease it. Mainly for this reason the Commission decided, in 2003, to fully decouple payments to farmers from production and the Single Farm Payment (SFP) was put in place. Under the new regime farmers would receive subsidies on the basis of what they have – on average – received during the 2000-2002 period. The aid was guaranteed to farmers irrespective if they produced or not. However they had to fulfil some basic environment and agricultural conditions.

In this context, the aim of this work is to assess whether the price transmission elasticity (PTE, *i.e.* the extent to which world prices are transmitted into domestic markets) from the world market to the European and the Italian ones changed after the implementation of the Fischler reform. In an earlier work we gave indications in this direction but we employed monthly data. This research uses weekly data, which seem more appropriate given the relatively short time span examined. The SFP was officially introduced in January 2005 but member states had time until the end of 2006 to implement it (Cap Monitor, 2009). For this reason January 2007 seems to be the ideal date from to discriminate between the before and after reform period and with respect to which investigate changes in price transmission between the world and the domestic market.

In order to measure PTE between world and domestic prices for corn, wheat, and soybeans cointegration techniques allowing for structural breaks are applied. US prices are considered to be representative of world prices. Prices included in the analysis are Argentinean, French, and Italian in the case of corn, Canadian, French, and Italian for wheat, and *cif* Rotterdam and Italian for soybeans. The *a priori* hypothesis is that the full implementation of the Fischler reform represented a structural break in the long-term relationship between world and European prices. In particular the reform is expected to have increased the extent to which world agricultural prices are transmitted to domestic prices. It also seems reasonable to take into account market perturbations that affected world agricultural markets in the time span taken into consideration: the price bubbles of 2003-04, and 2007-08. Since already the MacSharry and the Agenda 2000 reforms of the CAP addressed the problem of EU market isolation, we expect to find cointegration – that is a certain extent of price transmission – between European and world prices for selected agricultural commodities both before and after the implementation of the Fischler reform and a higher value of the PTE after the reform.

This work is structured as follows. Section 2 is about the methodology used, section 3 describes the dataset, section 4 illustrates the main results, and section 5 concludes and gives some hints for potential further research.

2. METHODOLOGY

The *law of one price* (LOP) states that the same good cannot be sold for different prices in different countries at the same time, taking into account exchange rates (Mankiw, 2001), and net of transport costs. The LOP holds in the long run even if it might not hold in the short run. If a particular good – say corn – had different prices in different locations, in would be profitable for arbitrageurs to buy corn where it is less expensive and then sell it in the country where it is more expensive. However, by doing so, the price in the "cheap" market would rise due to increased demand, while price in the "expensive" market would decrease as a consequence of increased supply. Therefore, in the long run, prices in the two markets will converge to the same value. Nevertheless, a *conditio sine qua non* for the LOP to hold is that no prohibitive trade restrictions are in place between the two countries.

A direct consequence of the LOP is that – in the long run – world price signals are fully transmitted to domestic prices. However, this is always true only in theory since in the real world many factors impede a full transmission of price fluctuations across markets. The most important among these factors is trade policies implemented by governments, which are aimed at favoring domestic producers over foreign. Nonetheless, even if no trade policies are in place, the LOP might still not hold since there may be quality differences between the goods sold in the two countries. When it comes to (agricultural) commodities quality differences are very often quite small and therefore goods are treated as homogeneous in this work.

Historically the validity of the LOP has been assessed using the following type of regression (Baffes & Gardner, 2003):

$$p_t^d = \alpha + \beta p_t^w + \varepsilon_t$$

Eq. 1

Where p_t^d and p_t^w are domestic and world prices for a given commodity at time t, α and β are parameters to be estimated and ε_t is the error term. If the LOP holds, then $\alpha + 1 = \beta = 1$ and Eq. 1 becomes: $p_t^d = p_t^w$, which also means that any price differential at time t is white noise.

When variables are expressed in logs, the slope coefficient β can be interpreted as the *elasticity of price transmission* (EPT) that is the extent to which price signals are passed through from world to domestic markets. The EPT can range between 0 (no transmission/market isolation) and 1 (perfect transmission/validity of the LOP). The EPT is defined as the percentage change in the domestic price in response to a one-percent change in the world price (Thompson & Bohl, 1999). The EPT can also be thought as a measure of trade barriers in place between two markets. The intercept can be interpreted as a measure of transaction costs that – since the equation is written in logarithmic form – are thought to be a constant proportion of prices (Listorti, 2009).

Eq. 1 represents the long-run equilibrium between two markets but in the short-run prices can diverge – also quite substantially – from the long-run equilibrium. However if the long-run relationship holds, there must be a mechanism that drives back prices to equilibrium. For this reason the vast majority of works studying the LOP apply cointegration techniques.

Usually price series (especially when particularly long) are not stationary[1], which means that they cannot be regressed on each other (in order to estimate the coefficients of Eq. 1) without occurring in the spurious regression phenomenon[2]. However, even if two (or more) variables are not stationary, it might exist a linear combination of them that is in fact stationary (Engle & Granger, 1987). When this happens the variables are said to be cointegrated. When two variables are cointegrated Eq. 1 can be safely estimated through OLS without incurring in the spurious regression problem. The cointegrating equation, that is the long-run equilibrium is nothing else than Eq. 1, which in turn represents the LOP.

The presence of a cointegration relationship between two or more variables implies the existence of an error-correction model that describes the short-run dynamics consistently with the long run relationship (Verbeek, 2006). Therefore if Eq. 1 is the long-run/cointegrating equation, the error-correction model (ECM) is of the form:

$$\Delta p_t^d = \delta + \theta \Delta p_t^w + \gamma \varepsilon_{t-1} + u_t$$

Eq. 2

Where θ is the short-run effect that is how much of a given change in the world price is transmitted to the domestic price in the current period, while γ is the error-correction term representing how much of the price difference between the world and the domestic price occurred in the past period is eliminated in each period thereafter (Baffes & Gardner, 2003). ε_{t-1} is the residuals of the long-run equation at time $t-1$.

If one is interested only in pair-wise comparisons and one of the process can be treated as exogenous, both the long-run equation and the error correction equation can be estimated using the two-step procedure illustrated in Engle and Granger (1987). The two-step technique consists in estimating the long-run relationship through OLS (after having verified the price series are integrated of the same order) and then testing for stationarity of the residuals. This can be done using the standard Augmented Dickey-Fuller (ADF) unit-root test with modified critical values (Davidson & MacKinnon, 1993) or the Cointegrating Regression Durbin-Watson test[3]. When

1. [1] (Weak) stationarity means that the series is characterized by constant mean, variance, and co-variances. That is, after a shock, it tends to return to its long-run equilibrium and do not drift apart.
2. [2] The spurious regression problem arises when the OLS estimator finds a significant correlation between two variables even if they are completely unrelated. This might be due to the fact that the two variables (i.e. rabbit population in Italy between 1970 and 2000, and nominal GDP in the USA in the same time span) are both characterized by a similar stochastic trend (Verbeek, 2006).
3. [3] The value of the Durbin-Watson statistic from the cointegrating regression is suggestive for the presence or absence of a cointegrating relationship. Critical values for this type of test are given in Banerjee *et al.* (1993).

the null of no-cointegration is rejected the error-correction model can be also estimated through OLS using the residuals from the long-run equation.

The main issue here is that – when it comes to agricultural prices – we might be in presence of structural breaks that is exogenous shocks that might permanently change price relationships. Classic examples are policy changes or structural reforms. Such shocks may alter the behavior of price series and their relationships in different ways. The shock can cause a shift in the mean of the series, the time trend, or the long run cointegration vector. The presence of structural breaks can undermine both the unit-root tests on the single price series, and the cointegration analysis itself. In other words, disregarding the presence of structural breaks in the cointegration relation may lead to wrongly accept the null of non-stationarity of the liner combination of the series when it might be the case that the residuals are indeed stationary around a broken level or trend (Listorti, 2009).

Choosing break dates *a priori* induces a certain degree of arbitrariness but when one wants to investigate the effect of policy changes and/or structural reforms it is a widely accepted practice. Examples in the literature are many: Baffes and Gardner (2003) examine the degree to which world price signals have been transmitted into domestic prices for some developing countries and ten commodities before and after policy reforms. The countries under study undertook substantial policy reforms during the late 80s and early 90s and the break dates were identified in the reform year. Krivonos (2004) evaluates the impact of coffee sector reforms during late 80s and 90s in the main coffee producing countries. The paper assesses whether the transmission of world price signals into the domestic markets has increased after the implementation of the reforms. Also in this case cointegration allowing for structural breaks was applied, break dates being chosen on the basis of when the policy change did actually take place. Listorti (2009) introduces policy regime changes while testing for price transmission in international soft wheat markets, with special focus to the European Union and its Common Agriculture Policy. Also in this case breaks are indentified *a priori* on the basis of policy changes but the decision has also been "validated" testing for unit-root in the individual series allowing for structural breaks.

In this work the long-run cointegration equation Eq. 1 is modified in order to take into account of the potential structural break corresponding to the first week of 2007. Even if in some countries the reform was implemented earlier, we decided to choose the beginning of 2007 as breaking date to be sure to capture the effects it might have generated.

Allowing for structural breaks and generalizing Eq. 1 becomes:

$$p_t^d = \alpha_1 + \beta_1 p_t^w + \alpha_2 D^{fisch} + \beta_2 p_t^w D^{fisch} + \varepsilon_t$$

Eq. 3

Where all variables are expressed in logs. p_t^d and p_t^w are domestic and world prices at time t, and D^{fisch} is a binary variable, which assumes the value 1 if $t > Jan\ 1st, 2007$ and 0 otherwise. The αs are constants representing transaction cost before (α_1) and after $(\alpha_1 + \alpha_2)$

the reform, while the slope coefficients βs are an estimate of the PTE from the world into the domestic price before (β_1) and after $(\beta_1 + \beta_2)$ the reform, and ε_t is the error term.

The model can be further augmented by adding a (broken) time trend and dummies to take into account perturbations in world commodity markets like the price "bubbles" occurred in 2003-04 and 2007-08.

The corresponding error-correction model, which describes the short-term dynamics, is of the form:

$$\Delta p_t^d = \theta_1 \Delta p_t^d + \gamma_1 \varepsilon_{t-1} + \theta_2 \Delta p_t^w D^{fisch} + \gamma_2 \varepsilon_{t-1} D^{fisch} + \upsilon_t$$

Eq. 4

Where Δp_t^d and Δp_t^w are first differences of the domestic and the world prices and ε_{t-1} are the lagged residuals from Eq. 3. The θs are the short-term (or immediate) responses of the domestic price to movements of the world price before (θ_1) and after $(\theta_1 + \theta_2)$ the Fischler reform, while the γs capture the *pre* (γ_1) and *post* $(\gamma_1 + \gamma_2)$ speed of adjustment to the long-term equilibrium of domestic prices. When the cointegration equation contains a time trend then an intercept is included in the ECM.

After estimating the equations and ascertained the existence of a cointegration relationship between the variables, it is possible to compute the degree of adjustment m of the domestic price, relative to full adjustment, n periods after the change in the world price (Krivonos, 2004):

$$m_n = 1 - \frac{(\beta - \alpha)(1 + \gamma)^n}{\beta}$$

Eq. 5

The higher m, the quicker domestic prices adjust to changes in the world price.

3. DATA

Data used in this work are weekly prices for the three main agricultural commodities used for either food or animal consumption: corn, wheat, and soybeans. This is one of the first works using weekly figures to estimate price transmission elasticity between price pairs being most of the existing literature based on monthly figures.

The time span under consideration is from January 1st 2002 up to September 30th 2011, for a total of 509 observations (except than for Corn Bordeaux and Soybeans Rotterdam, whose series starts in 2005 and are made up by only 348 observations). Even if it were technically possible to obtain data older than 2002 (at least for wheat and corn) it was decided to limit the analysis to 2002 in order to be able to translate all prices in euro. Even though exchange rates between the euro and the US dollar were available also before 2002, it was only after than they were effectively determined by real currency market transactions.

For corn, prices considered are American, Argentinean, French, and Italian ones. The US *fob* price at the Gulf of Mexico (considered to be representative of the world price) and the Argentinean *fob* Up River prices are from the FAO international prices database[4], French price (Bordeaux) is from the *Marché à Terme International de France* (MATIF), and the Italian one from the Chamber of Commerce of Milan.

The world wheat price is considered to be the US No.2, hard Red Winter, always *fob* at the Gulf of Mexico, and it is from the FAO database, the Italian baking wheat price is from the Bologna's *Borsa Merci*, while the Canadian CWRS No1 and the French (Rouen) prices were kindly provided by the Canadian Market Analysis Division of Agriculture and Agri-Food Canada.

Analogously to wheat and corn, also for soybeans the US *fob* at the Gulf of Mexico price provided by the FAO is considered to be the world price. For soybeans EU and Italian prices are respectively the Rotterdam *cif* price for US soybeans and the soybeans price at the Chamber of commerce of Milan.

US prices have been considered to be representative of the world price since the United States heavily dominates global corn (60%) and wheat (25%) exports, and have been for decades the largest soybean exporter (now third-largest behind Brazil and Argentina). Therefore US grain prices are typically quoted as international prices for all grains except rice, where Thai prices are typically quoted (Headey & Shenggen, 2010).

4. RESULTS

After establishing the order of integration of the each price series and that they are cointegration-compatible, it has been tested for cointegration without structural breaks for all price pairs and all commodities using Eq. 1 for the whole sample. For those price pairs for which the null of no-cointegration was not rejected, the presence of cointegration has been tested allowing for a structural break in the cointegration vector corresponding to the full implementation of the Fischler reform in 2007.

Results from the Augmented Dickey-Fuller (ADF) unit root test on the levels of the variables are reported in Table 1. In all the cases it is possible to reject the null of unit root. The same test repeated to the first difference of the variables always rejects the null, meaning that the variables are integrated of order 1 and are therefore cointegration-compatible.

Table 1: Augmented Dickey-Fuller test for unit root in the variables in levels.

4. [4] http://www.fao.org/economic/est/prices?lang=en

Price series	Constant	Trend	Lags	DF statistic	Verdict
Corn fob US	Yes**	Yes**	14	-2.32	do not reject
Corn Argentina	Yes*	Yes**	10	-2.01	do not reject
Corn Bordeaux, FR	Yes**	No	7	-2.08	do not reject
Corn Milan, ITA	Yes**	No	4	-2.16	do not reject
Wheat Hard Red, US	Yes**	Yes*	2	-2.56	do not reject
Wheat CWRS n.1, CAN	Yes***	Yes**	18	-2.71	do not reject
Wheat Rouen, FRA	Yes**	Yes*	10	-2.43	do not reject
Wheat Milan, ITA	Yes***	Yes*	17	-3.15	do not reject
Soybeans fob, US	Yes**	Yes*	17	-2.48	do not reject
Soybeans cif Rotterdam	No	No	12	0.90	do not reject
Soybeans Milan, ITA	Yes***	Yes**	9	-2.67	do not reject

Source: own elaborations.
*, **, ***, indicate respectively 10, 5, and 1% significance level.
Null hypothesis: unit root.

As a robustness check the stationarity of the price series has been checked also with the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) stationarity test (results not reported), which differs from the ADF test because the null hypothesis is the (trend) stationarity of the series. The results from the KPSS test confirm that all the variables in levels are not stationary (the null is always rejected), while the first differences indeed are.

The presence of a long-run/cointegration relationship between the variables has been investigated using the Engle-Granger (1987) two-step procedure: the null of no-cointegration is rejected when the residuals from the OLS estimation of the long-run equation do not contain a unit root. Testing for a unit root in the cointegration equation residuals has been done with the standard ADF unit-root test. However, when testing for no-cointegration, the appropriate critical values are more negative than those for the standard unit-root test. Asymptotic critical values for residual-based cointegration tests are provided by MacKinnon (2010). Critical values also depend on the number of variables included in the cointegration regression: Hassler (2004) states that both step dummies and interaction terms (step dummy times the regressor) should be counted as additional I(1) regressors when it comes to testing.

Table 2 shows the estimates of the cointegration equations calculated over the full sample. Cointegration has been detected only between the Argentinean and the US fob corn prices, and between the Canadian CWRS and the hard red US fob wheat prices. This is like one would expect *a priori* since the Argentinean and the Canadian markets are less protected than the European ones. In both cases the price transmission elasticity is one, meaning perfect price transmission. In the Canadian case the constant is very close to zero and not significant (and was therefore dropped from the equation) meaning zero transaction costs. This can be explained by the fact that the Wheat Canadian board detains the monopoly of the national cereal market: the absence of intermediaries means zero transaction cost. Since the Board will be dismantled in

August 2012[5], it would be interesting to see whether transaction cost will rise or not for Canadian traders.

Table 2: Cointegration equations – Full sample without structural breaks.

Parameters/Price Series	Corn Argentina	Corn Bordeaux, FR	Corn Milan, ITA	Wheat CWRS n.1, CAN	Wheat Rouen, FRA	Wheat Milan, ITA	Soybeans cif Rotterdam	Soybeans Milan, ITA
Constant	-0.22***	1.14***	1.95***			0.61***	0.64***	1.49***
Time trend		-0.0005***	-0.0002**	0.0003***	0.0003***			0.0002***
World price	1.04***	0.84***	0.67***	1.00***	0.96***	0.89***	0.90***	0.76***
T=	509	348	509	509	509	509	348	509
CRDW	0.24**	0.11	0.05	0.19**	0.26**	0.06	0.72**	0.25**
ADF on residuals	-3.46**	-2.48	-2.92	-3.78**	-2.41	-2.80	-3.00	-2.62
Cointegration	Yes	No	No	Yes	No	No	No	No
Source: own elaborations.								
*, **, ***, indicate respectively 10, 5, and 1% significance level.								
Null hypothesis: no cointegration.								

The null of no cointegration was not rejected for any of the price pairs involving a European price, neither for corn, wheat, nor soybeans. It might mean that there is not a long-run relationship between world and European prices or that, more likely, the presence of a structural break modifies the long-run relationship between prices. In other words it might be the case that not allowing for the presence of structural breaks does not allow to reject the null of no-cointegration when in fact there is.

When structural breaks are accounted for, the picture changes (see Table 3). In the case of corn a cointegration relationship is found between the Italian and the world price. Before the full implementation of the Fischler reform, PTE between the Italian and the world corn prices was about 0.42, meaning that, in the long-run, only 42% of a change in the world price is transmitted to domestic prices. After the reform, PTE more than doubled reaching 0.87, meaning a higher degree of integration between the Italian and the world price. After the reform also the value of the constant – a measure of transaction cost – decreased. Before January 2007 it was as high as 3.00, while after reform decreased to 0.77, showing how decoupling payments to farmers from production helped decreasing transaction cost. It must be stressed that the null of cointegration between the Italian and the world price is rejected only if the price bubbles of 2003-04 and 2007-08 are accounted for. The 2003-04 price bubble was triggered by a demand shock: demand (especially by emerging economies) increased so quickly to catch producers unaware. The situation was made worse by low inventory levels. The increase in demand was substantially due to fast macroeconomic expansion in OECD countries as well as in emerging economies such as China and Brazil (Radetzki, 2006).

5. [5] Source: Financial Times, October 19th 2011.

Table 3: Cointegration equation allowing for a structural break (Jan 2007) and accounting for 2003-04 and 2007-08 price bubbles.

Parameters/Price series	Corn Bordeaux, FR†	Corn Milan, ITA	Wheat Rouen, FRA	Wheat Milan, ITA	Soybeans cif Rotterdam†	Soybeans Milan, ITA
Constant	1.36***	3.00***	2.36***	3.20***	1.50***	3.14***
Fischler dummy	-0.14***	-2.23***	-2.59***	-3.07***	-0.62*	-1.44***
Time	0.0004***	0.0002***			-0.0002***	-0.0002***
Time*Fischler				-0.0002***		
World price	0.74***	0.42***	0.48***	0.35***	0.74***	0.45***
World p*Fischler		0.45***	0.56***	0.65***	0.13*	0.30***
2003-04 Dummy		0.23***	0.27***	0.26***		0.07***
2007-08 Dummy	0.35***	0.36***	-0.21***	-0.20***	-0.09***	-0.04***
T=	348	509	509	509	348	509
CRDW	0.26	0.22	0.57	0.22	1.09**	0.30*
ADF on res.	-3.78	-4.90**	-4.55**	-5.55***	-4.76**	-3.40
Cointegration	No	Yes	Yes	Yes	Yes	No

Source: own elaborations.

*, **, ***, indicate respectively 10, 5, and 1% significance level.

†Series start in 2005, therefore the 2003-04 dummy was not included in the estimation.

Corn : 2003-04 dummy= 1 if 23/8/02<t<27/08/04, 0 otherwise. 2007-08 dummy = 1 if 4/5/07<t<18/4/08, 0 otherwise.

Wheat and Soybeans: 2003-04 dummy = 1 if 7/7/2003<t<28/6/04, 0 otherwise. 2007-08 dummy = 1 if 29/9/08<t<31/8/09, 0 otherwise.

The 2007-08 price bubble was also triggered by a sharp and quick increase in demand but worsened by the increasing importance acquired by biofuels – which are mostly produced from agricultural commodities such as corn – and by problems on the supply side. In some regions yields are growing at a much lower rate than used to be in the past (also because of climate change) struggling in meeting new demand needs. In the corn regressions, the 2007-08 dummy represents the ascending phase of the "bubble" (starting in May 2007 and ending in April 2008) that is the period when domestic prices diverged most from the world price. Even accounting for the structural break and the price bubbles, the null of no-cointegration is not rejected for the French price. A possible explanation is that the series is shorter than the Italian one: a long-run relationship might exist but the too short time span considered does not allow detecting it.

The null of no-cointegration – when the implementation of the Fischler reform and the price bubbles are accounted for – is rejected also for the Italian and the French wheat prices with respect to the world price. Before the reform PTE between the French and the world price was about 0.48 meaning a relatively low level of price transmission. Before the reform also the intercept, measuring transaction costs, was quite high (2.36). The Italian market appears to be even less integrated to world one before the reform. The Italian PTE was 0.35 before 2007 and the constant about 3.20. After the implementation of the Fischler reform integration to the world market increased for both France and Italy. After the reform PTE computed between the French and the world price is equal to unity (0.48+0.56 = 1.04) and the constant becomes almost zero. The same happens to Italy: also in this case post-reform PTE is almost unity – meaning perfect transmission – and transaction cost substantially go down after the 2007 (intercept drops from 3.20 to 0.13).

Also in the case of wheat the cointegration equations have been augmented with dummies accounting for the turbulences that affected commodity markets in 2003-04 and 2007-08. However, in this and the soybeans case, the 2007-08 dummy is not the same as in the corn regression. While, in the case of corn the trend of world and EU prices diverges during the ascending phase of the bubble, in the wheat and the soybeans cases, the discrepancy grows in the descending phase. Therefore, the 2007-08 bubble dummy in the wheat/soybeans case ranges from September 2008 up to August 2009 instead than May 2007 – April 2008.

Finally, cointegration equations allowing for structural breaks were computed also for the soybean market. The null of no-cointegration has been rejected for the *cif* Rotterdam series while for the Italian price has been not. Before the reform PTE between the Rotterdam and the world price was already quite high, almost 0.74, meaning that the soybean market was much more integrated than the wheat and the corn ones before the Fischler reform. This might be explained by the fact that Europe is a net importer of the commodity: since there was no need of protecting domestic producers, trade barriers (direct and indirect) have always been low therefore keeping market integration high. Transaction cost was also quite low already before the reform (intercept almost 1.50) with respect to those affecting both corn and wheat markets. Despite all that, the reform did have an effect also on the soybean market. After 2007 PTE increased up to 0.87, a relatively high level but surprisingly lower than unity. If it is true that the European soybean market has historically been more integrated to the world one than those of other commodities, it seems that after the reform it became less integrated than the main cereal ones.

The null of no-cointegration was not rejected for the Italian soybean price. This might be due to the fact that the Italian soybean market is not very developed and prices are not always established on the basis of actual transactions.

Table 4: Error-Correction Models.

Parameters/Price series	Corn Argentina	Corn Milan, ITA	Wheat CWRS n.1, CAN	Wheat Rouen, FRA	Wheat Milan, ITA	Soybeans cif Rotterdam
Constant	n.a.	0.0007	0.0007	n.a.	n.a.	0.0007
Short-run effect	0.76***	0.08*	0.57***	0.1	0.05	0.44***
Short-run effect after Fischler	n.a.	0.08-0.01	n.a.	0.10+0.59***	0.05+0.15***	0.44-0.01
Adj. Coeff.	-0.10***	-0.03	-0.08***	-0.07	-0.01	-0.17*
Adj. Coeff. After Fischler	n.a.	-0.03+0.02	n.a.	-0.07-0.31	-0.01-0.03*	-0.17-0.24
DW	2.21	1.1	1.87	2.32	0.88	2.21
3-month adjustment						
Before Fischler	92%	44%	84%	67%	24%	96%
After Fischler	92%	18%	84%	100%	51%	100%
Source:own elaborations.						
*, **, ***, indicate respectively 10, 5, and 1% significance level.						

When cointegration has been found between a price pair (either with or without structural breaks and bubble dummies) the respective error-correction model (ECM) has been estimated (Table 4). The ECM describes the short-term dynamics of price relationships and gives information on how and how fast prices re-align to the long-run equilibrium after a shock. The ECM contains two important parameters: a short-run and an adjustment coefficient. The short-run parameter gives a measure of how much of a given change in the world price is transmitted to the domestic price in the current period, while the adjustment coefficient indicates how much of the past difference between domestic and world prices is eliminated in each period thereafter. The closer to unity are these two parameters, the higher the speed changes in the world price are transmitted to domestic prices (Baffes & Gardner, 2003). The adjustment coefficient is expected to be negative, since it would imply correction downward if the domestic price exceeds world price at time t and correction upwards when domestic price falls short of world price (Krivonos, 2004). Following Krivonos (2004) it has also been calculated the “amount of adjustment” that takes place after 12 periods, that is three months.

In the case of the Argentinean corn price the short-run effect is 0.76 and the adjustment coefficient -0.10 meaning that the 76% of a change in the world price is immediately transmitted to the domestic market and that in every period 10% of the difference between the domestic and world prices at $t-1$ is adjusted in the current period. After 12 weeks the amount of adjustment that takes place is 92%. Between the Italian and the world corn prices is estimated an ECM allowing for structural break. The short-run coefficient is 0.08 and is significant only at 10%. Moreover it does not change after the Fischler reform. The adjustment coefficient is negative but it is not significant and is decreasing (in absolute value) after the reform, meaning that there might be some problem in the cointegration equation. Nevertheless, the 3-month adjustment has been computed also in this case and turned out to be 44% before the reform and 18% after.

Results concerning wheat markets are better. Both the short-run and the adjustment coefficients estimated for the Canadian market are significant and consistent with the *a priori* hypothesis. The immediate response is 0.57, while the amount of adjustment taking place in every period is 0.08. The three-month adjustment is 84%. In the ECMs for France and Italy the short run coefficient is significant only after the reform and, while it is quite high in the case of France (0.10 before and 0.69 after the reform) it is surprisingly low for Italy (0.05 before and 0.20 after). The adjustment coefficients are both barely significant even though they are increasing in absolute value after reform. Before 2007 the three-month adjustment was 67 and 24% for France and Italy respectively, while after 2007 it increases to 100 and 51%.

The only ECM model estimated for the soybean market is the one regarding the *cif* Rotterdam series. The short-run effect is 0.44 both before and after the reform meaning that the introduction of the new CAP regulations did not affected immediate price transmission mechanisms between the EU and the world price. Also the adjustment coefficient does not significantly change after the reform, being 0.17 both before and after 2007. The amount of adjustment taking place in 3 months is more or less 100% both before and after the implementation of the Fischler reform.

5. CONCLUSIONS

This paper assessed whether the full implementation of the Fischler reform positively affected price transmission elasticity (PTE) between the world and some European agricultural markets and therefore increased market integration. Commodities considered were corn, wheat, and soybeans, the most important for human consumption and animal feed. Whether and the extent to which PTE changed after the Fischler reform has been investigated through cointegration techniques allowing for structural breaks.

The impact of the Fischler reform was greater for corn and wheat markets, while it was negligible for soybeans. The PTE between the world and the Italian corn prices more than doubled after the Fischler reform increasing from 0.42 to 0.87, meanwhile the intercept term (a proxy for transaction costs) decreased from 3.00 to 0.77. The Fischler reform appears to have had a positive effect also on the PTE between the world and both the French and Italian wheat prices. The PTE between the French and the world wheat prices increased from 0.48 to almost unity (meaning perfect transmission) after the reform. More or less the same occurred to the Italian wheat market: in this case PTE before the reform was as low as 0.35, becoming almost 1 after. Also in this case the intercept term decreased from 3.20 to 0.13 meaning a reduction in transaction costs.

The null of no-cointegration was rejected also for the *cif* Rotterdam soybean price, when allowing for a structural break at the beginning of 2007. In this case, however, the reform exerted a much lower effect on the PTE between the world and the European market. The extent to which world price signals were passed through to the EU market was already quite high before the reform (PTE almost 0.74) and transaction cost was already quite low (intercept of 1.50). After the reform the PTE for the Rotterdam price did increase (up to 0.87) but not as much as for wheat. A possible explanation is that Europe has historically been a net importer of the commodity: since there was no need of protecting domestic producers, trade barriers (direct and indirect) have always been low therefore keeping market integration high. Moreover since the soybean market has always been scarcely protected, it was not affected by the Fischler reform.

Cointegration has been detected also between the Argentinean and the US corn prices as well as between the Canadian and the US hard red wheat price. In both cases PTE is almost 1 – meaning perfect transmission – and the intercept is almost zero (no transaction costs).

The null of no-cointegration, even allowing for structural breaks, has not been rejected for the French corn and the Italian soybean prices. In the French corn case, a possible explanation is that the series is not long enough to allow cointegration to be detected, while for the Italian soybean price it is likely that the lack of co-movement between the Italian and the world price is due to the fact that the domestic market is very inefficient and not based on real transactions.

It has to be stressed that in the cointegration equations between the world and various European prices it was needed to take into account the price bubbles of 2003-04 and 2007-08. During these periods the difference between domestic and world prices was substantially higher than in the rest of the time span considered. It might be the case that when turbulences – either due to demand or supply shocks, low stocks, speculating behaviour or bad weather – affect agricultural commodity markets the long-run relationship between the variables changes. If the effect of the 2003-04 bubble was more or less the same for all the variables considered, the 2007-08 one had very different effects. In the case of corn, domestic and world prices substantially differ during the price ascending phase, while in the case of wheat and soybeans during the descending phase. These aspects could represent the starting point for further research, maybe applying cointegration models that allow for asymmetric price transmission.

Finally, when cointegration was found between a price pair, error-correction models were estimated. These models are well specified only for the Argentinean corn price and the Canadian wheat price series. In the case of European prices, for which cointegration is present only taking into account structural breaks and price bubble dummies, the estimated ECMs not always perform well, especially in the case of corn. However, in the case of wheat, they show how the Fischler reform not only increased long-term price transmission between world and European markets but also increased the speed at which domestic prices adjusts to changes in the world price.

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