Price transmission in the Swiss wheat market: does sophisticated border protection make the difference?

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Abstract

This study deals with horizontal wheat price transmission from the international markets to the domestic Swiss market. The analysis takes into account trade policies implemented at the borders that might shelter the domestic market from international markets fluctuations, as well as the presence of explosive behavior in some of the price series. Furthermore, the Swiss case is peculiar due to the presence of different border policies for wheat according to its domestic use, food or feed. The paper investigates price transmission in this segregated domestic market under the respective different border policies but still acknowledging possible linkages among the two market segments. Vector Error Correction models with structural breaks are estimated, allowing to account for the influence of periods of market exuberance in the international markets as well as of the consequent policy regime changes.

Keywords: Price transmission, price bubbles, cointegration, trade policy
JEL Classification: Q110, C320

1. Price transmission and border policy regimes: objectives of the paper and overview of the literature

The objective of this study is to analyze the horizontal price transmission within the wheat market in Switzerland over the years 2003-2012 and to assess to what extent trade and border policies have an influence. The analysis focuses on the transmission of price shocks across national borders, that is from world and EU markets towards the domestic Swiss market. What makes more interesting the Swiss case is that the domestic market structure implies a market segregation depending on the final use of the product (as food or feed). As this segregation also applies to the imported product, trade policies themselves are differentiated between food and feed use. This evidently conditions how price shocks are transmitted horizontally between the domestic and the international markets, as well as between the domestic food and feed markets.
Eventually, the combination of different trade policy measures and the domestic market segregation makes Swiss border protection on wheat quite a sophisticated policy. One may wonder whether this sophistication really affects the protection performance. Answering this question with a proper econometric analysis is not trivial. In general terms, the approach to this problem starts from the wide literature and rich toolkit on horizontal price transmission, that is, the transmission of price shocks both across different places and commodities. The notion of horizontal price transmission usually refers to price linkages across market places

[♦] *The views expressed in this article are the sole responsibility of the authors and do not reflect, in any way, the position of the FOAG. Although this article is common to both the authors, the authorship can be attributed as follows: Sections 1, 5 and 6 to Esposti; Sections 2, 3, and 4 to Listorti.*

(*spatial price transmission*). *Lato sensu*, however, it can also concern the transmission across different agricultural commodities (*cross-commodity price transmission*). In the former case, the key underlying theoretical explanation of spatial price transmission is the spatial arbitrage and the consequent Law of One Price (LOP) (Ardeni 1989; Fackler and Goodwin 2001). In the case of cross-commodity price transmission, the co-movement of prices is mostly driven by the substitutability and complementarity relations among the products (Saadi 2011), which, in turn, depends on the respective demand functions and on the underlying preferences.

The empirical literature on (imperfect) commodity price transmission across international markets over the last decades is vast and can not be reviewed in detail here. The same remains true even limiting the attention to the specific case of European markets and to the implications of the Common Agricultural Policy and of GATT/WTO agreements in this respect.[1] The interest, here, is more on the methodological ground and, in particular, on those recent improvements providing suitable ways to properly include policy regime changes into price transmission models.

The methodological framework and the econometric implications of horizontal price transmission analysis are well-established in the empirical literature of the last two decades (Ardeni 1989). However, though it represents a "mature" research topic, in recent years the empirical research on agricultural price transmission has gathered considerable attention. Interest in this topic unquestionably increased after the so-called "food crisis" of 2007-2008 in which international agricultural markets were shocked by increased volatility and by the rapid rise and fall of the so-called price "bubbles" (European Commission 2008; Irwin and Good, 2009).

Two aspects, in particular, have attracted increasing attention and are of interest here (Listorti and Esposti 2012). The first issue concerns the development of appropriate econometric models for the quantitative analysis of price transmission during periods of price exuberance. As agricultural markets are also characterized by a high degree of policy intervention, the second issue concerns the actual direct, indirect and unintended effects of specific policy measures on price transmission. How to properly model the influence of these temporary disturbing factors (prices crises and consequent changes in policy regime) on long-term price relationships has become a major challenge for the empirical analysis (Esposti and Listorti 2013; Vasciaveo et al. 2013). With specific reference to the peculiar Swiss wheat market, the present paper aims at contributing on both issues.

This paper is organized as follows. After an introduction to the Swiss wheat market (section 2), data issues are presented (section 3), followed by the presentation of the econometric approach used (section 4). Econometric results are then presented (section 5), while section 6 concludes.

2. Wheat price transmission in the Swiss market

In this section, after presenting the Swiss wheat market peculiarities and policies relevant for our analysis (2.1), the research strategy will be introduced (2.2).

2.1. The Swiss peculiarity and the policies in place

As anticipated, the peculiarity of the Swiss wheat market consists in two domestic segments according to the use: food or feed.[2] This segregation is granted by a normative system that

[1] For an overview of this literature see also Mundlak and Larson (1992), Fackler and Goodwin (2001), van Meijl and van Tongeren (2002).

[2] In the last decade domestic demand increased more than domestic supply for both uses and this opened more space to imported products. However, the market fundamentals of these two cases are structurally quite different (Esposti 2013): most of feed wheat is imported (71% in 2010) while a significant part of food wheat comes from domestic supply (54% in 2010).

imposes the exclusive use on wheat varieties.[3] Such segregation implies not only a domestic regulation, certification and control system but, as it must apply also on imported products, also the implementation of two border policies that, though using similar instruments, are in fact different (see next section).

Provided that this system works properly, the price transmission analysis within the Swiss wheat market could be performed as two distinct analyses carried out in parallel and independently: the domestic food-wheat market and the domestic feed-wheat market. Nevertheless, modeling these two markets as totally separated cases neglects two major aspects that link them together. First of all, both domestic markets are driven by the same international prices. Therefore, also those policy instruments that are linked to the international price (e.g., applied tariffs), though separately applied in the two markets, tend to show some degree of common movement. Secondly, as will be discussed in next section, beside domestic market segregation, some substitution between the two uses is still possible in exceptional times, whenever the declassification of food wheat to feed use is admitted. As a consequence, some degree of price transmission between these two domestic markets cannot be excluded *a priori*. This implies investigating price transmission in two separated markets and under their respective different border policies, but still acknowledging possible linkages among them.

Table 1 describes in details the border policies affecting the Swiss domestic market distinguishing between wheat for food and feed use. Here, we only want to discuss the main features of this set of policy measures. As far as wheat for food use is concerned, the border policy is based on a Tariff Rate Quota (TRQ). The tariff charged above the quota is higher than the one that applies to in quota imports. Imports above the TRQ are, in fact, exceptional. The TRQ volume is fixed by the law but can also be temporarily extended due to specific market conditions, especially to stabilize and lower the domestic price during periods of market turmoil (as it happened during the 2007-2008 price peak). Since October 2008, in compliance with the international (WTO) commitments, an entry price is applied to imports within the TRQ: therefore, the applied tariff is defined (since July 2010, every three months) on the basis of the gap between the import price and the entry price. The entry price system fixes the level of the tariff given the international price and, consequently, the import price unless the gap between the international price and the entry price is too high given the maximum applicable tariff[4]. The applied tariff after the introduction of this entry price system was in general lower than the one applied before.

In the case of wheat for feed use, the border protection system is simpler than for the food case. There is no TRQ and the entry price system is in place since 1995, so over the whole period under consideration in the present analysis. The entry price for feed is set at a lower level than the one for food. The applied tariff for feed use is established on a monthly basis as the difference between the international price (the before-tariff import price) and the entry price, unless this difference exceeds the maximum applicable tariff. In this latter case, the difference between the entry and the import price cannot be entirely compensated and a gap remains between the import and the domestic prices.

Figure 1 provides, for both food and feed uses, a schematic representation on how the entry price and TRQ systems operate under different market conditions and, consequently, on how

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On the overall domestic wheat use, in 2010 the share of feed use has been 37%, the food use has been 63%, therefore the latter traditionally deserves more policy attention and intervention.

[3] It is worth noticing that it is prohibited by law to use for food purposes cereals which are intended as feed; on the contrary, it would be possible, at least in theory, to use for feed cereals which are intended for food purposes. However, this has in practice never been the case, since import tariffs, and then prices, for food cereals systematically turn out to be higher than those for feed cereals.

[4] Applied tariffs have to be below those notified at the World Trade Organization (WTO). The in quota tariff for food wheat is fixed at 35 CHF/100 kg and the one for feed wheat is fixed at 39 CHF/100 kg. In the case of food wheat, the maximum in quota tariff has been defined at a lower level.

they affect the level of import prices and, then, the gap between the international and the domestic price. Figure 1 (part *a*) shows how, according to the level of the international prices (that is, the import price before the application of the tariff), three cases can occur: the international price is above the entry price and, therefore, no tariff is applied; the international price is below the entry price but the difference between the two is lower than the maximum applicable tariff, therefore the tariff is able to bring the imported price at the level of the entry price, i.e., close to the domestic price; the international price is much lower than the entry price, the maximum tariff is applied but this is not enough to fill the gap, therefore the import price will remain below the entry and the domestic price. This representation currently applies, though with different entry prices and applied tariffs, to wheat imported both for domestic food and feed uses.

Table 1 - Relevant policy measures in the food-use and feed-use wheat markets

Policy instruments	Expected Impact	Changes (2003-2012)
	FOOD	
Tariff rate quota (TRQ)	**TRQ not filled** → equilibrium price = import price + in quota tariff **TRQ filled and no overquota imports** → equilibrium price = import price + in quota import tariff + rent. The rent is at most equal to the overquota tariff **TRQ filled and overquota imports** → equilibrium price = import price + overquota tariff.	Since 1998. Administered every six months in 2002 and 2003, and then every quarter.
TRQ auton. extension	Could lower domestic prices.	TRQ increased in 2007 and 2008.
Applied in quota tariff	**TRQ not filled** → the applied tariff determines the height of the import price. **TRQ filled** → The applied tariff only affects the distribution of the rent. If the in quota tariff is fixed according to an entry price system, all the characteristics of this import system hold.	Fixed in 07.007. Since 10.2008 entry price system: applied tariff fixed every six months and, since 07.2010, every quarter. Bound in-quota tariff fixed in 10.2008.
Entry price	**Import price ≥ entry price** → applied in quota tariff = 0 ; the entry price system is de facto not effective **Import price < entry price *and* calculated in quota applied tariff ≤ notified tariff** → import price =entry price **Import price < entry price *and* calculated *in quota* applied tariff > notified tariff** → the difference between entry price and import price cannot be fully compensated If the quota is filled, the entry price system only has an effect on the distribution of the rent.	In place since 10.2008; lowered in 07.2009.
App. overquota tariff	Normally, no overquota imports occur (exception: technical purposes). If the quota is perfectly filled, it corresponds to the maximum value of the rent.	
Declassific. to feed uses	Upward pressure on food prices, downward pressure on feed prices.	Occurred in 2002 -2005 and 2009 - 2011.
	FEED	
Entry price **Applied tariff**	**Import price ≥ entry price** → applied import tariff = 0 ; the entry price system is *de facto* not effective **Import price < entry price *and* calculated applied tariff ≤ notified tariff** → import price =entry price **Import price < entry price *and* calculated applied tariff > notified tariff** → the difference between entry price and import price cannot be fully compensated	Since 1998. Administered every six months in 2002 and 2003, and then every quarter.
Declassific. to feed uses	Upward pressure on food prices, downward pressure on feed prices.	Occurred in 2002 -2005 and 2009 - 2011.

Figure 1 (part *b*) concentrates on the volume of imports and, therefore, on the functioning of the TRQ system; therefore, it only concerns wheat imported for domestic food use. Also in this representation, three cases can occur depending on the level of the Swiss domestic demand not satisfied by the domestic supply (Swiss net import demand curve) and on the level of the in quota and overquota tariffs, which affect the shape of the export supply curve. In the first case, the net import demand is relatively low and fully satisfied by the current TRQ; in such case the in quota tariff applies (which, since October 2008, is fixed according to an entry price system). In the second case, the net import demand increases up to the TRQ limit but not so much to induce imports exceeding the TRQ itself. These imports, in fact, would imply a much higher tariff, therefore a much higher import price. Though the level of imports remains in the TRQ bound and, therefore, the in quota tariff is still applied, the import price increases due to the higher import demand. This can generate the so called TRQ rent. The final case occurs when the net import demand is so high that it induces imports above the TRQ level, and this triggers the much higher overquota tariff (unless, of course, a decision to extend the TRQ is taken).

To complete the picture of the policies in place affecting the gap and the transmission between the import and the domestic price, it must be reminded that, though indirectly, a further mechanism may play a role in this respect. It is the possibility of declassifying wheat originally destined for food use towards the feed use. This declassification is temporary and is established by farmers' organizations whenever there is (an expectation of) oversupply for food use. In such circumstances, declassification aims at moving the downward pressure away from the wheat food price possibly to the wheat feed price thus contributing to restore or to maintain the gap between these two domestic prices.[5]

2.2. The research questions and strategy

Given this set of market policies, the main research question here concerns how and to what extent they affect the wheat price transmission in the Swiss market. Properly modelling the role of these policies in price transmission requires the identification of the short and long-term price patterns of the prices under study and of the possible co-movement between the domestic and international prices and between the domestic food and feed prices. The research strategy and the consequent methodology adopted aims at consistently tackling all these challenges.

Firstly, key prices must be identified and their long-term movements and relationships (linkages) estimated, particularly to assess whether the food and feed-use prices can be considered independent and the respective transmission from international to domestic markets can be investigated separately. Then, relevant policy changes are included within these relationships to assess the direction and magnitude of their role, that is, to what extent policies and policy changes isolate/protect the two domestic markets from international markets especially during the periods of market turmoil.

As will be discussed in the next section, though several different wheat price series can be observed (Esposti, 2013), the domestic food price is here considered the key model variable as it constitutes the main target of the whole policy intervention depicted in the previous section. At the same time, we must still explicitly take into account the domestic market segregation of wheat for food and feed use and, therefore, the presence of two distinct prices. Even though the feed use remains ancillary with respect to the food within the domestic market,[6] a linkage across the two domestic prices cannot be excluded either in the long-run or

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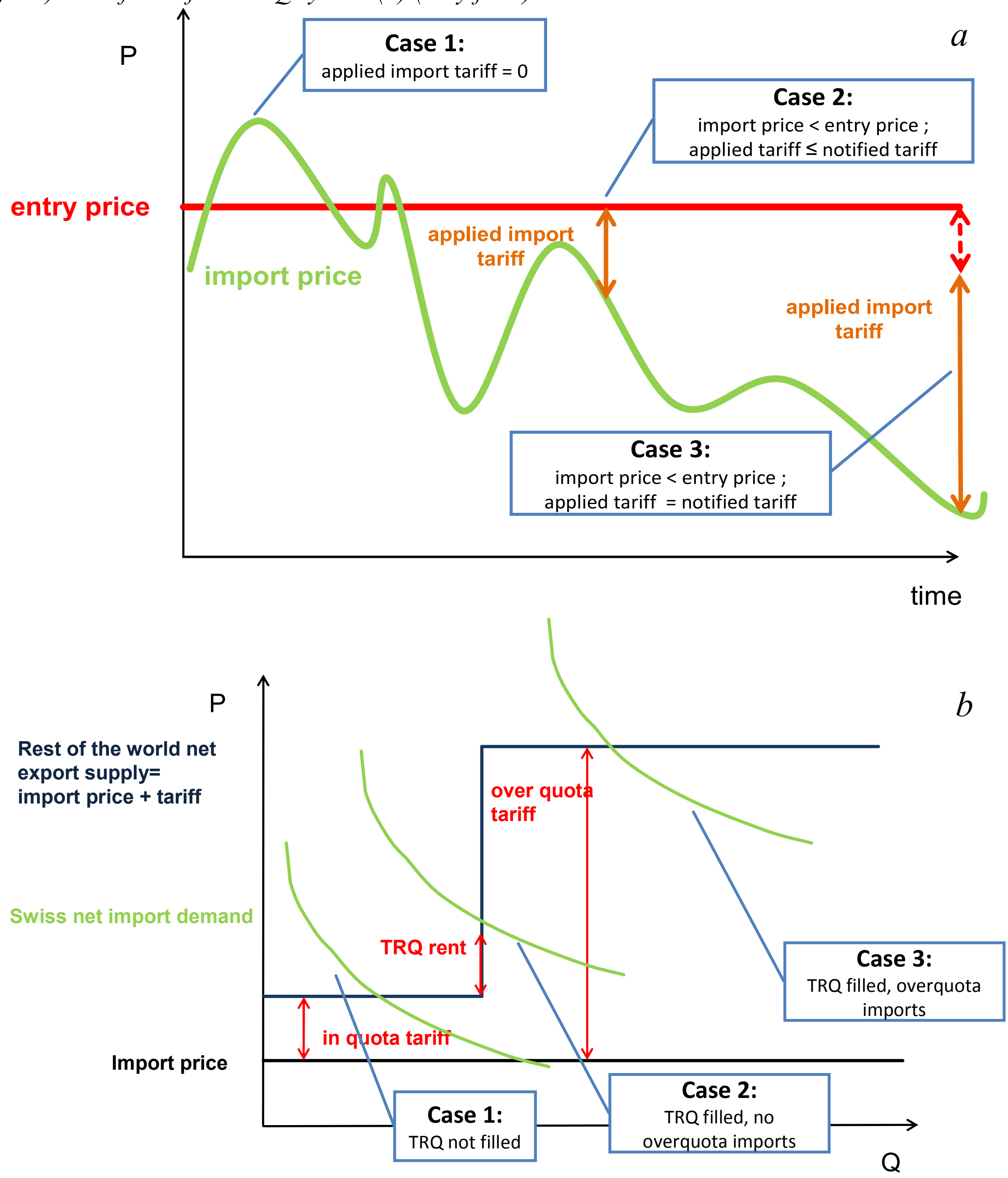
[5] Declassification is at most effective if quantitative restrictions apply to food imports (otherwise it would be profitable to import up to re-establishing the pre-existing price equilibrium), which is indeed the case since a TRQ is in place.

[6] Feed is a minor part of the domestic market and it is mostly imported; in addition, wheat demand for feed use is much more elastic with respect to price than the demand for food use since the former can be used in various combinations with other cereals, so its price changes can be easily adjusted by moving to or from other cereals' use.

in exceptional times. As both domestic prices are driven by the same international price, this latter must be identified among possible candidates and represent another key price to be modelled.
Once the key price series are chosen in order to identify the key price-linkages under study, the methodological approach here adopted consists in three consequent steps. Firstly, the stochastic properties of individual price series are assessed. Secondly, common stochastic trends (cointegration) are formally tested to finally specify and estimate the proper price linkage equations (the VEC models, or VECMs). Thirdly, the role of policy variables within such price linkages is assessed.

Figure 1 – Schematic representation of the functioning of the entry price system (a) (feed and food) and of the of the TRQ system (b) (only food)



3. Data and data issues

The price variables considered in the analysis are reported in Table 2[7]. As quality differentials are neglected,[8] only one price for the food use is considered, which somehow represents a sort of basic quality level (*food_k1*). This is a producer price while the domestic feed price (*feed_farm*) is taken at the end of the food chain, i.e., it is the price paid by farmers purchasing wheat as feed. As international prices (*cif*) we consider those observed in some relevant bordering EU countries (Germany) to express a sort of EU price, and from North-America (Canada at St Lawrence) to express a sort of international-world price. All prices are expressed in Swiss Francs per 100 Kg (CHF/100Kg).[9] The German price (*de*) can be used as a reference price for both the food and the feed case, while the higher quality of the Canadian wheat (*can_stl*) makes it relevant for price transmission in the food market only. We finally consider institutional prices, that is, those established in application of trade policy measures: the reference import price for feed, which is used in combination with the entry price to fix the applied tariff (*feed_i_price*) and the international prices augmented by the applied tariffs (*can_stl_ta*, *de_stl_ta*). Other policy variables enter the econometric models as dummies as they are not continuous, but activated temporarily (they take value 0 when they are not active, 1 when they are activated). This is the case for the *TRQ extension* and for *declassification* from feed to food use. The same treatment is actually applied to another non-policy variable considered in the analysis, that is, the *2007-2008 price bubble*. The entry price (*EP*) enters as a dummy in the food case (taking value 1 from its application) and as continuous exogenous variables in the feed case. Monthly prices are used and the time period covered by the series significantly differs. It ranges from a maximum of 192 monthly observations covering all years from 1997 to 2012, to a minimum of 114 monthly observations ranging from July 2003 to the end of 2012. This latter thus represents the period under investigation here.

Figure 2 compares the movement over time of domestic and international prices. We note that the Swiss price for food use is above the international ones but the gap is apparently shrinking over time. This gap is strongly related to (i.e., covered by) the quite high applied tariff. The Swiss wheat feed and the respective entry price show a common decreasing trend. Import prices are usually below entry prices with the only exception of the 2007-2008 price peak. However, it should be noted that after applying the applied tariff to the international prices, the prices of the imported product almost correspond to the entry prices.

The domestic feed price systematically lies below the domestic food price. As this distinction between food and feed use only exists in Swiss domestic market up to the borders, this permanent price gap seems to strongly depend on the different (higher in the first case) entry price level for food and feed. Especially for wheat for feed use, it is evident that this decline strictly follows the dynamics of the respective entry price.

Moreover, domestic prices are more stable than the international ones (again, this is true especially for feed prices). The price peaks observed during 2007-2008 and 2010-2011 were more intense in the international prices, though still remarkable also for the Swiss domestic prices for food uses: this occurs only very marginally in the case of the feed price. This could

[7] The whole set of wheat prices that have been collected and are, in principle, available, is reported in Annex. For food prices, in general terms, quality increases moving from Klasse III to Top class product. Moreover, prices may refer to different segments of the food market as in the case of the IP-Suisse prices (in terms of quantities, the most important private label in Switzerland for cereals for food use) and the Bio product. For the price of wheat for feed use, the only relevant difference concerns different positions along the supply chain, that is, at the farm level or at the mill. For the latter, unfortunately, not enough observations are available. Several international prices are considered, as explained. We prefer to focus on the international prices at the border and we do not consider the “traded prices” (including transport costs and duties), which would add further elements of complexity that are beyond the scope of the present analysis.

[8] It can be reasonably assumed that the economic relationships under study hold true for all different qualities.

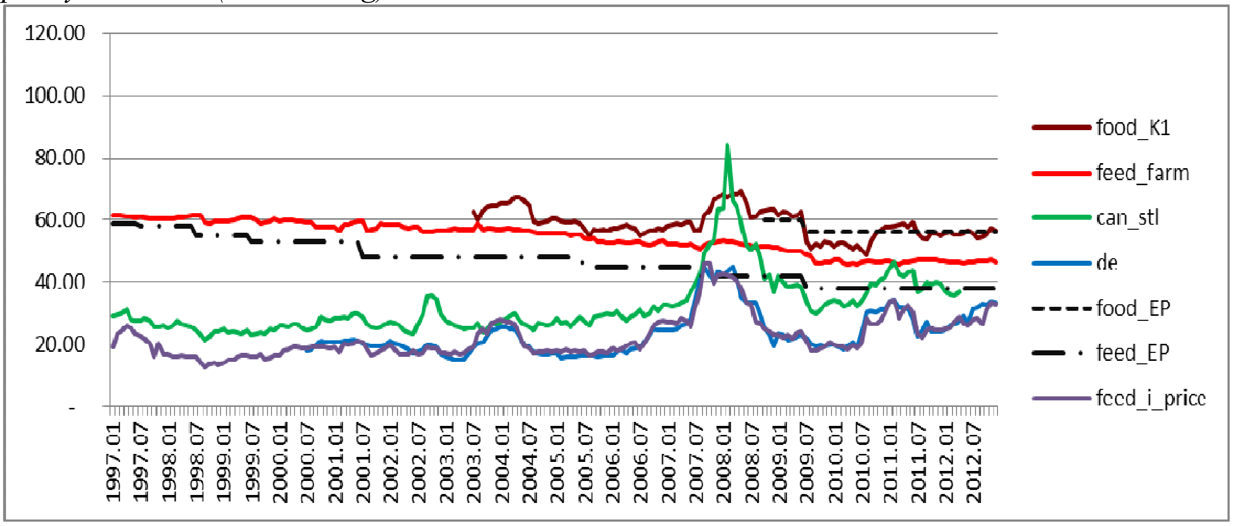
[9] Variations in the exchange rates between CHF and € or US$ are clearly reflected in changes of international prices measured in CHF. This implies that shocks in the exchange rate and real shocks in the international wheat market are in practice indistinguishable.

signal that the price linkages and the role of policies might operate differently during these periods of turbulence.

Table 2 – List of the price variables adopted in the econometric analysis

Code	***Price variable in the model***	***Details***	***Time coverage***
food_k1	Domestic food price	Klasse I wheat; Swiss Federal Office for Agriculture	2003.07- 2012.12 (114 obs.)
feed_farm	Domestic feed price	Feed use; purchasing prices for farmers; Swiss Farmer's Union	1997.01- 2012.12 (192 obs.)
feed_i_price	Reference import price for feed	EU feed quality; Swiss Federal Office for Agriculture	1997.01- 2012.12 (192 obs.)
can_stl	Canadian price	Canada CWRS Wheat – St Lawrence, cif; International Grains Council	1997.01- 2012.04 (184 obs.)
de	EU price	Germany Grade B Wheat – Hamburg, cif; International Grains Council	2000.07- 2012.12 (150 obs.)
can_stl_ta_(fo/fe)	Canadian price + applied tariff	*can_stl* + applied tariff (ta) for food(fo) or feed(fe)	1997.01- 2012.04 (184 obs.)
de_ta_(fo/fe)	EU price + applied tariff	*de* + applied tariff (ta) for food(fo) or feed(fe)	2000.07- 2012.12 (150 obs.)

Figure 2 – Price series behaviour over time: food, feed domestic and international prices, policy variables (CHF/100kg)



Source: Esposti (2013)

4. Econometric issues and the adopted approach

In this section, the analysis of the time series properties of the data (4.1) and the empirical models are presented (4.2). The objective, here, is to specify a reduced-form model satisfying three basic requisites. First of all, it has to properly take into consideration to stochastic properties of the time series under consideration. Secondly, it has to be versatile enough to possibly incorporate the policy regime changes occurring within the sophisticated border policy outlined in section 3. Thirdly, its robust estimation must be feasible given the data availability presented in section 3. The combination of these requirements explain why, though more refined and, in fact, sophisticated conceptual and modelling framework could better capture the border policy under study,[10] the adopted model specification eventually represents a compromise between the need for sophistication and the need of empirical tractability and feasibility given the data.

[10] See Listorti and Esposti (2012) for more details in this respect.

4.1. Time series properties of the data

Throughout the present econometric analysis, the logarithmic transformation of prices is considered as this allows referring to estimated price linkage parameters as transmission elasticities. Henceforth, $\mathbf{p}_i$ indicates the series of the *i-th* price logarithms.

We test in sequence for the presence of unit and explosive roots. A fundamental characteristic of a price series is the persistence of its shocks. If autocorrelation coefficients are equal to 1, shocks will never vanish over time: the series is said to contain a «unit root» or, alternatively, to be integrated of order 1 (I(1)). We run both the ADF (Adjusted Dickey-Fuller) and the PP (Phillips-Perron) tests (Enders 1995), since the latter is more robust under heteroskedasticity which is likely to occur for the presence of periods of market turbulence. In addition, the KPSS test (Kwiatkowski, Phillips, Schmidt and Shin) is performed, since unlike the ADF and the PP tests, here the null hypothesis is that the series is I(0), while in the alternative it is I(1).
In addition, we test for the presence of an explosive root, which might explain the behaviour of "bubbles" that inflate and deflate within a relatively limited period of time. Phillips et al. (2012) propose a test which allows assessing period-by-period the presence of an explosive root within processes that would be otherwise ruled as I(1). Forward recursive ADF tests are computed on a fraction of the sample; in subsequent regressions, the initial data set is recursively supplemented by successive observations. The test of explosiveness considers period-by-period the maximum observed value (SADF) under the null hypothesis of unit root and against the right-tailed alternative hypothesis of an explosive root. By displaying the series of the forward recursive ADF test and checking if and when exceeds the right-tailed critical values of the asymptotic distribution of the standard Dickey–Fuller t-statistic, this test is helpful also to identify the timing of the exuberance.
After the properties of the individual time series have been explored, we test for cointegration between them: *ex ante*, with the conventional Johansen cointegrating rank test (Johansen 1995); *ex post*, by checking the stationarity of the residuals from the long run relation of the estimated VEC models. This letter assessment is particularly useful when policy breaks are to be accounted for, as in these cases the use of the standard Johansen test is not straightforward.

4.2. Empirical models

Horizontal price transmission mechanisms are usually represented within reduced-form models, i.e. based only on price data, the assumption being that prices themselves already include all the information about the underlying market fundamentals (like import levels and the domestic supply/demand).[11] Since Ardeni (1989), cointegration techniques have been extensively used to investigate such mechanisms. They allow the long-run relationships among prices exhibiting nonstationary behavior, even though deviations can be observed in the short run. This kind of relationship is typically specified using VECM.
The basic structure of a VECM can be represented as (Johansen, 1995):

$$\boldsymbol{\Delta}\mathbf{p}_{\mathbf{t}} = \boldsymbol{\alpha}\boldsymbol{\beta}'\mathbf{p}_{\mathbf{t-1}} + \sum_{i=1}^{k-1}\Gamma_i\boldsymbol{\Delta}\mathbf{p}_{\mathbf{t}-i} + \boldsymbol{\varepsilon}_{\mathbf{t}} \tag{1}$$

where $\mathbf{p}_t$ is a vector containing the prices, $\boldsymbol{\beta}$ is the cointegration matrix which contains the long-run coefficients, $\boldsymbol{\alpha}$ is the loading matrix which contains the adjustments parameters, $\boldsymbol{\Gamma}$ are matrixes containing coefficients that account for short-run relations, and $\boldsymbol{\varepsilon}_t$ are white noise errors. Being prices written in logarithmic form, an implicit assumption is that all components which account for price spreads are a stationary proportion of prices.
The coefficients in $\boldsymbol{\beta}$ will provide information on the long run (LR) gap and price transmission elasticity between the prices (an indication on the LOP), while the adjustment

[11] Fackler and Goodwin (2001) provide a common template based on linear excess demand functions and embracing all dynamic regression models from which an estimable reduced-form model can be derived.

coefficients in $\boldsymbol{\alpha}$ on the presence and the speed of the short run (SR) response to the deviations from the LR linkage.
It has been shown that the standard Johansen estimation procedure remains an appropriate empirical strategy even in presence of temporary explosive behaviour (Engsted 2006; Nielsen 2010): equation (1) holds also if any of the series displays an explosive root.
VEC models can also be adapted to the introduction of structural breaks. Johansen et al. (2000) propose a model where breaks in the deterministic terms occur in known points in time as in equation 2:

$$\boldsymbol{\Delta}_1\mathbf{p}_t = \boldsymbol{\alpha}\begin{bmatrix}\boldsymbol{\beta}\\ \boldsymbol{\mu}\end{bmatrix}'\begin{bmatrix}\mathbf{p}_{t-1}\\ t\mathbf{E}_{t-1}\end{bmatrix} + \boldsymbol{\gamma}\mathbf{E}_t + \sum_{i=1}^{S-1}\boldsymbol{\Gamma}_i\boldsymbol{\Delta}_1\mathbf{p}_{t-i} + \sum_{i=1}^{S}\sum_{j=2}^{q}\mathbf{k}_{i,j}\mathbf{D}_{j,t+k-i} + \sum_{m=1}^{M}\boldsymbol{\Theta}_m\mathbf{w}_{m,t} + \boldsymbol{\varepsilon}_t \qquad (2)$$

The time series is divided in q sub-periods, separated by the occurrence of the structural breaks, where j denotes any generic sub-period. $\mathbf{E_t}$ is a vector of q dummy variables that take the value 1 if the observation belongs to the j_{th} period (j = 1, …, q), and 0 otherwise. $\mathbf{D_{j,t+k-i}}$ is a so-called impulse dummy; $\mathbf{w_t}$ are the so-called intervention dummies (up to M). The short run parameters are included in matrices $\boldsymbol{\gamma}$, $\boldsymbol{\Gamma}$, $\mathbf{k}$, and $\boldsymbol{\Theta}$ (VxV). $\boldsymbol{\mu}$ is the vector containing the long run drift parameters and $\boldsymbol{\beta}$ contains the usual long run coefficients in the cointegrating vector. Within this framework, it is possible to allow the parameters of the cointegration vector to vary according to the introduction of structural breaks such as those induced by the policy regime changes and the 2007-2011 price bubbles. These factors might have had an impact in the magnitude and direction of price transmission and can be assumed to affect both the LR price linkage and the SR adjustments, introducing elements of non linearities in the relations. Consequently, if they are assumed to affect the LR price relation, "bubble" and "policy" dummies can be included in the cointegration space as structural breaks (dummies), or exogenous variables (for continuous variables, like EP).
The VECM models of price transmission among prices reported in Table 2 are estimated following specifications (1) and (2). The optimal number of lags is selected according to the conventional information criteria (AIC is here used), up to a maximum of 6. In all cointegration tests and VECM estimates a constant term is included in the cointegration space, accounting for all elements contributing to price differentials not explicitly modelled in the price transmission equation. Each model is estimated both without and with the relevant policy and bubble structural breaks. These are assumed to affect the constant and eventually the price transmission elasticity term inside the cointegration space. Weak exogeneity tests (i.e., conventional t-tests on the coefficients of vector $\boldsymbol{\alpha}$) are performed to assess the direction of transmission of price shocks.
To provide a structured answer to our policy questions, the price series are assigned to the following sub groups: 1) International prices; 2) Wheat for food uses: domestic and international prices; 3) Wheat for feed uses: domestic and international prices; 4) Swiss domestic prices: wheat for food and feed uses.

5. Results

In this section, results of the tests run on the price series (5.1) and of the econometric estimations of the VECM (5.2) are presented.

5.1. Stochastic properties of the series

Table 3 reports unit root tests on the logarithms of the price series, $\mathbf{p}_i$ and on the respective first differences, $\boldsymbol{\Delta}_1\mathbf{p}_i$. The series *food_k1*, both international prices (*de*, *can_stl*), and domestic and import prices for feed (*feed_farm*, *feed_i*) show a unit root. The tests are also repeated on *de* and *can_stl* after having added the applied import tariff for food (*ta_fo*) and for feed (*ta_fe*). According to the ADF test, the series are I(1). However, when the tariff for food is added, the series are I(0) according to the KPSS test; when the tariff for feed is added, they are I(0) according to the PP test. This could be taken as an indication that adding the import tariffs accounts for a sort of stabilising effect. Table 3 includes also the SADF test for explosive roots. We can conclude that a temporary explosive behaviour is manifest only in international prices. Once the applied tariffs are added to them, however, this evidence disappears, with the exception of the series *can_stl_ta_fo*. As explained before, the SADF test may be particularly helpful also to locate the origin and the conclusion of the exuberance. Figure 3 reports this evidence and shows that the price bubble is limited to the months of August – October 2007 for the EU prices, and December 2007 to February 2008 for the Canadian prices.

We can conclude that all the price series that we intend to use for the econometric analysis are I(1). The following step thus tests price cointegration following the standard Johansen cointegration tests. Test results are shown in Table 4. *feed_k1* and *feed_farm* are not cointegrated. When the relations between the domestic and the international prices (*de*, *can_stl*) are studied, no cointegration emerges for *feed_farm*, while *feed_k1* is cointegrated with *de*. *de* and *can_stl* are cointegrated between them. In the case of *feed_k1*, adding the import duty to the international price series does not alter the results: there is always cointegration only with the German price (*de_ta_fo*). In the case of wheat for feed uses, *de_ta_fe* is cointegrated with *feed_farm*. This appears as a first strong evidence of the relevance of the entry price mechanism for the feed wheat. *feed_farm* is not cointegrated with *feed_i_price*. However, the latter is, as expected, cointegrated with *de* and *can_stl*.

Table 3 – Unit-root and explosive-root tests on $\mathbf{p}_{ik}$ and on $\Delta_1\mathbf{p}_{ik}$: Adjusted Dickey-Fuller (ADF)[a], Phillips-Perron (PP) [b], and Kwiatkowski, Phillips, Schmidt e Shin (KPSS)[c] tests (p-values in parenthesis; the values for which the null is rejected are in bold - 10% critical values); Phillips et al. (2009) SADF tests of explosive roots on $\mathbf{p}_{ik}$ [d] (the values for which the null is rejected are in bold: values greater than asymptotic 1% critical values).

Price	$\mathbf{p}_i$			$\Delta_1\mathbf{p}_i$			SADF test (Forward Recursive Regressions)	
	ADF	PP	KPSS	ADF	PP	KPSS	(r=0.1)	(r=0.2)
food_k1	-2.524 (0.110)	-2.208 (0.203)	**0.365**	-2.233 (0.195)	**-9.220 (0.000)**	0.062	-0.105	-0.105
can_stl	-1.484 (0.542)	-1.917 (0.324)	**0.935**	**-4.520 (0.000)**	**-12.948 (0.000)**	0.051	**3.126**	**3.126**
de	-1.523 (0.522)	-2.063 (0.260)	**0.540**	**4.322 (0.000)**	**-8.833 (0.000)**	0.045	**2.037**	**2.037**
feed_farm	-0.085 (0.949)	-0.295 (0.926)	**1.500**	**7.366 (0.000)**	**-14.063 (0.000)**	0.073	0.642	0.642
feed_i_price	-1.849 (0.357)	-2.184 (0.212)	**0.789**	**-4.333 (0.000)**	**-13.021 (0.000)**	0.048	0.058	0.058
de_ta_fo	-1.840 (0.361)	-2.226 (0.197)	0.168	**-3.498 (0.008)**	**-8.067 (0.000)**	0.059	1.893	1.893
de_ta_fe	-1.987 (0.293)	**-3.867 (0.002)**	**1.090**	**-7.863 (0.000)**	**-19.247 (0.000)**	0.043	-0.837	-1.041
can_stl_ta_fo	-2.368 (0.151)	-2.272 (0.181)	0.120	**-3.237 (0.018)**	**-10.420 (0.000)**	0.070	**4.369**	**4.369**
can_stl_ta_fe	-2.235 (0.194)	**-3.411 (0.011)**	**0.725**	**-4.785 (0.000)**	**-17.811 (0.000)**	0.043	-0.665	-0.665
					Asymptotic ritical values (Phillips et al. 2009):		r(0) = 0.1	r(0) = 0.2
					1% confidence level		2.01	1.91

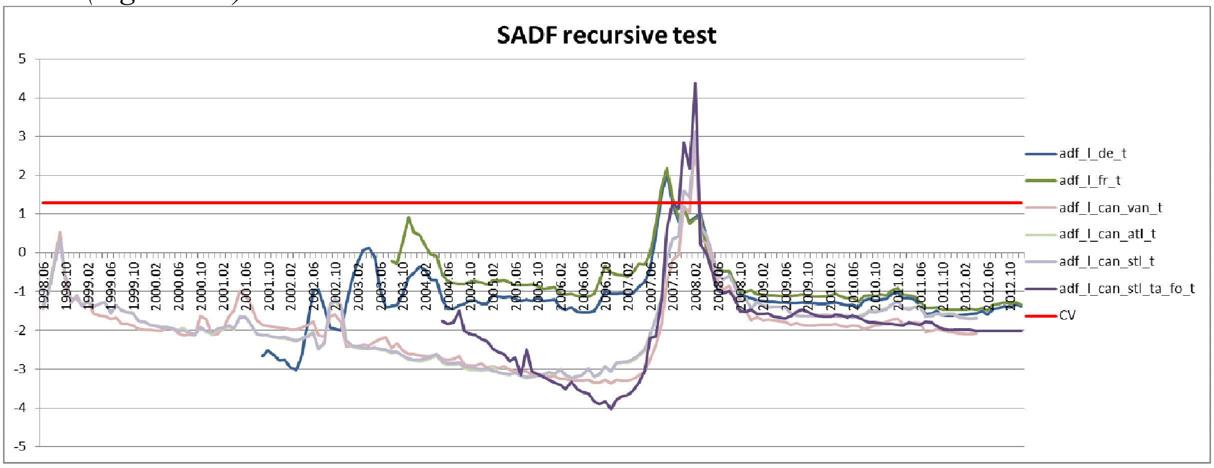
[a] H_0: unit root. The test specification includes a constant term, seasonal dummies and all significant lags "testing down" up to a maximum of 12. The tests have been repeated also withouth including seasonal dummies. Results differs only in a few cases and are available upon request..

[b] H_0: no unit root; tests are performed including a constant term and assuming 12 lags. Results are available upon request.

[c] H_0: no unit root. The test specification includes 12 lags, seasonal dummies and a constant term. The tests have been run also without seasonal dummies. These tests show no difference and are available upon request. The 10% critical value is 0.348.

[d] H_0: no explosive root; tests are performed including a constant term and no lags. The rolling window is differentiated according to time series (0.1 * *n* and 0.2 * *n* , where *n* is the size of the sample).

Figure 3 - Dating the bubble: time series of the forward recursive ADF t- international price series (logarithms)



Source: authors' calculations.

Table 4 –Johansen cointegrating rank test (Johansen 1995). The cases for which the null is accepted are in bold (p-values are reported in parenthesis; 10% confidence level)[a]

Prices		**n. of lags**	**Rank**	
			0	1
food_k1	feed_farm	1	13.055†	3.838
food_k1	can_stl	4	15.490†	5.721
food_k1	de	1	22.157	7.600†
food_k1	can_stl_ta_fo	1	15.601†	2.486
food_k1	de_ta_fo	1	33.218	6.385†
feed_farm	feed_i_price	1	13.691†	3.657
feed_farm	can_stl	1	12.395†	4.128
feed_farm	de	1	10.207†	2.653
feed_i_price	can_stl	1	22.003	3.062†
feed_i_price	de	1	32.916	2.064†
feed_farm	can_stl_ta_fe	1	7.983†	3.106
feed_farm	de_ta_fe	1	43.758	3.759†
can_stl	de	4	27.810	4.862†

[a] Trace test. The test is run in the "restricted constant" case and a number of lags identified according to the AIC. Seasonal dummies have been included. When seasonal dummies are not included in the regressions, results do not vary.
† Accepted rank: lowest rank whose test result is lower than 10% critical values.

5.2. VECM estimates[12]

In this section, the estimated VECM are presented following the classification introduced in section 4: international prices (5.2.1); domestic and international wheat prices for food uses (section 5.2.2); domestic and international wheat prices for feed uses (section 5.2.3); domestic prices for food and feed uses (section 5.2.4).

5.2.1. International prices

Table 5 reports estimates of several VECM including the domestic food price and the international prices with and without the tariff. Focusing on the relationship between international prices, the LR price transmission elasticity is almost equal to one and highly significant. In the short run dynamics, it is interesting to notice that it is *de* that behaves as weakly exogenous. If we include in the cointegration vector the structural breaks, i.e. the corresponding dummies,[13] to test their impact on this LR relation, we observe that the bubble

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[12] The econometric estimates are obtained using the Gretl (http://gretl.sourceforge.net/) and STATA® softwares.
[13] According to the results of the SADF test, the presence of explosive behaviour is mimicked by a dummy variable (*bubble*) which is equal to 1 for all months between August 2007 and February 2008, and 0 otherwise. The suspension of EU import

seems to have increased the distance between the two prices, while the suspension of import duties on cereals implemented by the European Commission to confront the price spikes on international markets had a counter effect, although this latter is not significant. The long run price transmission elasticity reduces to 0.8; *de* always behaves as weakly exogenous.

5.2.2. Food prices

The long run transmission elasticity between *food_k1* and *de* is equal to 0.19 and significant at 10% confidence level (Table 5). The significance and sign of the short run adjustment coefficient of *food_k1* suggest that it is the one which adjusts to the disequilibrium. Since *food_k1* and the *can_stl* are not cointegrated, we did not proceed with the estimation of the VECM. Even after adding the applied import tariffs, while *can_stl_ta_fo* is still not cointegrated with *food_k1*, *de_ta_fo* is once again cointegrated with *food_k1*. The LR transmission between *food_k1* and *de* becomes stronger (0.55), and *de_ta_fo* clearly behaves as weakly exogenous (leader role).

If we introduce the relevant structural breaks for the food use,[14] we observe that the long price transmission elasticity between *food_k1* and *de* becomes 0.21 (Table 5). None of the two prices behaves as weakly exogenous, although the coefficient *de* has not the correct sign. The only dummy which is significant is *EP*, which seems to have contributed to a decrease of the distance between the prices. Although not significant, the sign of *bubble* suggests that the it corresponds to an increase in the distance between the two prices, and that of *TRQ_ext* to a decrease. Given its higher statistical significance, we can let EP have an impact both on the distance and on the long price transmission elasticity. We find that the value of the price transmission elasticity valid in the overall period is slightly lower (0.13), but it increased substantially (by 0.17, up to a value of 0.30) after the introduction of the EP system.

The fact that the replacement of an applied tariff by an entry price system actually increased the price transmission elasticity, can be interpreted as an evidence that the level of the entry price was fixed so as to reduce the resulting level of the applied tariffs. Furthermore, the applied tariffs resulted often capped at the maximum allowed level, *de facto* acting as single tariffs. What we see here is that in addition to lowering the distance between the domestic and the international price, the introduction of an entry price system might also have allowed for a better transmission of price signals. These estimates can also be taken as simple evidence that over the years the domestic price became closer to the international one, and more respondent to its changes.[15]

5.2.3. Feed prices

Table 6 reports the estimates of the VECM between the domestic (*feed_farm*) and the international feed prices (the before-tariff import price, *feed_i_price)*. The cointegration tests reported in Table 4 do not support the hypothesis that these two prices are cointegrated[16]. The results of the VECM estimation confirm this conclusion since the long run transmission coefficient has not the right sign. This conclusion is somehow supported even after the

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duties is represented with a dummy variable (*duty*) which takes the value 1 for all months between January 2008 and October 2008, and zero otherwise (Reg. CE 1/2008, Reg. CE 608/ 2008 and Reg. CE 1039/2008).

[14] The autonomous extension of the TRQ (the dummy *TRQ_ext,* is equal to 1 for all the months between November 2007 and June 2008, and 0 otherwise) and the introduction of an entry price system (the dummy *EP*, which takes the value 1 for all months after October 2008). Although the entry price could also be inserted as such in the cointegration vector, since its value is in practice constant and a limited number of observations are available, for the sake of simplicity we treat it as a dummy variable.

[15] Results obtained using the Canadian price instead of the German price are available upon request.

[16] On the contrary, *feed_i_price* is strongly cointegrated with *de* and *can_stl*, with a close to one long-run elasticity (0.935 and 1.029, respectively, and both statistically significant). These VECM estimates, not reported in Table 6, are available upon request. Therefore, in investigating the linkages with the domestic feed price, the import price, the German and the Canadian price can be used indifferently and, in practice, contain the same information.

introduction of the structural breaks: declassification, discontinuously occurring between 2003 and 2013; the 2007-2008 price "bubble". The entry price for feed use here enters the model as a continuous exogenous variable. With the breaks the cointegration relationship appears even weaker with no significant parameter in the cointegration space and the presence of an unit roots in the residuals of the estimated long-run relationship. Eventually, the only significant variable is the entry price which moves in the expected direction as its increase amplifies the gap between the domestic and the import prices.

Table 5 – Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Canadian and German prices[a]

Cointegrating vector (β)						
food_k1			1.000	1.000	1.000	1.000
can_stl	1.000	1.000				
de	-1.060** (0.111)	-0.824** (0.185)	-0.191 (0.075)		-0.215** (0.062)	-0.126** (0.042)
de_ta_fo				-0.550** (0.089)		
bubble		-1.209** (0.419)			-0.056 (0.103)	
duty		0.214 (0.205)				
TRQ_ext					0.081 (0.070)	
EP					0.122** (0.028)	0.642** (0.289)
EP * de						-0.166* (0.089)
constant	-0.205 (0.347)	-0.923 (0.562)	-3.458** (0.239)	-1.896** (0.351)	-3.442** (0.187)	-3.717** (0.132)
Adjustment vector (α)						
can_stl	-0.115** (0.043)	-0.131**(0.032)				
food_k1			-0.090** (0.027)	-0.162** (0.31)	-0.156** (0.031)	-0.155** (0.033)
de	0.045 (0.042)	-0.036 (0.033)	-0.170 (0.091)		-0.225** (0.110)	-0.367** (0.110)
de_ta_fo				-0.077 (0.069)		
ADF test on residuals of long-run relation [b]	-3.562**	-2.907**	-2.043**	-3.305**	-2.780**	-2.540**

[a] The optimal lag of the VECM has been selected according to the AIC by introducing a "restricted constant" and seasonal dummies in the regressions. 4 lags has been selected. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected in no cases with a statistical significance of 10%.
[b] The ADF test specification includes 12 lags.
**Statistically significant at 5% confidence level.

The independence of the domestic feed price with respect to the international wheat prices is confirmed in other model specifications reported in Table 6. It emerges that the domestic price is not cointegrated with any alternative international prices since the estimated cointegrating price linkage moves in the wrong direction. The easy explanation of the lack of a long-run price linkage between the domestic and the international prices evidently lies in the protection of the domestic market granted by the entry price. Therefore, it is reasonable to assume that shocks are not (or only partially) transmitted from the international to the domestic markets since the tariff absorbs all (or most) of the variations occurring on the international prices. As a consequence, it is reasonable to assume that a long-run relationship occurs between the domestic price and the after-tariff international prices.
To assess this relationship, Table 6 also reports the VECM estimates linking the domestic feed price and the after-tariff international prices. It emerges that the domestic and the after-tariff German price (but the Canadian price could be used, as well) move together with an elasticity of transmission that is statistically very close to 1; the domestic price is endogenous while the international one is weakly exogenous. Different results are obtained by adding the structural breaks to this VECM between the domestic and international prices. The parameter of the cointegrating relationship between *feed_farm* and *de_ta_fe* is statistically significant but it shows the wrong sign. The *ex post* cointegration itself disappears and the impact of the structural break (the "bubble") and of the exogenous variables (the entry price) assume

unreasonable values. Evidently, once the tariff is added, the new variable already "incorporates" the entry price and "absorbs" the impact of structural break. After all, due to the border protection, the "bubble" evidently only appears in international price series while it vanishes in domestic price and in the after-tariff international prices. This seems a further indirect confirmation of the fact that the border protection though tariffs incorporates the entry price and somehow "sterilizes" the international prices against the impact of major shocks.

5.2.4. Food and feed prices

Though the conventional cointegration test (Table 4) is not conclusive in supporting a cointegration relationship between the two domestic prices, VECM estimates (Table 7) seem to suggest the existence of price transmission with quite a high coefficient (0.9) although statistical significance is weak. The signs of the parameters within the adjustment vector are correct and the feed price turns out to be endogenous while the food price is weakly exogenous; therefore, the latter drives the former. Whenever the structural breaks are included, the quality of the results improves and this seems particularly true when the declassification dummies are considered. The *ex post* cointegration test confirms a long-run linkage with a cointegration parameter that is correct in sign and statistically significant, although lower (about 0.75). The dummy declassification is significant. However, the interpretation of its sign is not easy, since it corresponds to a reduced gap between the food and the feed prices. Moreover both prices are now weakly exogenous.

When also the entry price is included as an exogenous variable, the declassification maintains its significance; the long run transmission elasticity in the cointegration vector now becomes unreasonably high but this can be attributed to the role played by the entry price. More generally, the domestic feed price and the entry price are strongly linked, the former being mostly driven by the latter. Therefore, including the entry price within the analysis absorbs most of the movements of the domestic feed price and substantially resizes the role played by all the other potential drivers.

Table 6 – Price transmission between domestic feed and international prices: VECM estimates (standard errors in parenthesis)[a]

Cointegrating vector (β)						
feed_farm	1.000	1.000	1.000	1.000	1.000	1.000
feed_i_price	0.477** (0.162)	-0.038 (0.046)				
can_stl			0.484 (0.159)			
de				0.544* (0.245)		
de_ta_fe					-1.151** (0.094)	8.854** (1.018)
"bubble" dummy		-0.017 (0.030)				-0.005 (0.293)
EP		-0.734** (0.089)				-6.925** (0.891)
constant	-5.522 (0.499)	-1.039 (0.447)	-5.709 (0.547)	-5.789 (0.768)	0.385 (0.355)	-11.130** (2.202)
Adjustment vector (α)						
feed farm	0.005 (0.006)	-0.082** (0.024)	0.003 (0.007)	0.008 (0.005)	-0.040** (0.012)	0.004** (0.002)
feed_i_price	-0.114** (0.044)	-0.191 (0.200)				
can_stl			-0.108** (0.045)			
de				-0.058* (0.031)		
de_ta_fe					-1.042 (0.065)	-0.062** (0.009)
ADF test on residuals of long-run relation [b]	-2.232**	-0.824	-2.819**	-2.028**	-2.028**	-1.477

[a] The optimal lag of the VECM has been selected according to the AIC by introducing a "restricted constant" and seasonal dummies in the regressions. 1 lag has been selected. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected in no cases with a statistical significance of 10%.

[b] The ADF test specification includes 12 lags.

**Statistically significant at 5% confidence level.

Table 7 – Price transmission between domestic feed and food prices with and without structural breaks (standard errors in parenthesis)[a]

Cointegrating vector (β)			
food_k1	1.000	1.000	1.000
feed_farm	-0.901(0.376)	-0.755** (0.205)	-2.949** (0.378)
"decl" dummy		0.136** (0.036)	0.065* (0.018)
EP	-	-	1.826** (0.308)
constant	-0.566(1.477)	-1.133(0.805)	0.663(0.471)
Adjustment vector (α)			
food_k1	-0.034(0.033)	-0.141(0.097)	-0.184 (0.103)
feed_farm	0.030** (0.014)	0.025 (0.046)	0.101** (0.046)
ADF test on residuals of long-run relation [b]	-1.811	-3.878**	-2.273**

[a] The optimal lag of the VECM has been selected according to the AIC by introducing a constant and seasonal dummies in the regressions. 1 lag has been selected. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected at 10% and could be rejected in no cases with a statistical significance of 10%.
[b] The ADF test specification includes 12 lags.
**Statistically significant at 5% confidence level.

6. Concluding remarks: policy implications

Confirming previous results (Esposti and Listorti 2013), the econometric estimates presented in this paper suggests that the long run transmission elasticity among international prices and, in particular, between the North-American and the European prices is very close to 1. Though the Canadian and the European prices are both considered in our estimates, the latter (i.e., German) price appears to be a relatively independent/central market. The domestic Swiss food price shows a limited but no null integration with the international price, therefore suggesting that, although the degree of protection of the domestic market is relevant, this still does not prevent it from responding to international market signals. In the case of the domestic feed price, on the contrary, results indicate no long-run linkage between the domestic feed price and any international prices. Compared to the food case, this may surprise since the wheat used for feed is largely imported. However, compared to the food use, the domestic feed use of wheat can be much more easily substituted by other cereals. Therefore, the domestic demand is more responsive to shocks of international prices thus reducing the responsiveness of the domestic feed price.

It must be reminded that, within the adopted methodology, the temporary change in the policy regime, as well as the temporary market exuberance, do not affect the price transmission elasticity but only affect the gap between international and domestic prices and between food and feed prices. In fact, here we primarily want to emphasize that, whenever these temporary breaks are introduced, the estimates of price transmission elasticity may significantly change. Indeed, it can be also argued that such circumstances (conditions of very high prices or over-quota situations, for instance) might also temporarily change these transmission elasticities. A modeling framework admitting varying elasticities within the cointegration vector, however, significantly increases the complexity of the specification to be estimated and may be unaffordable, in the present case, given data availability. Nonetheless, this definitely represents one possible direction of improvement of the modeling approach here presented.

The observed different response of domestic prices to international price shocks has evidently to do with the different role of policies. Results suggest that in the food case the application of the tariff creates a gap between domestic and international prices but does not prevent the former from at least partially responding to the latter. [17] In the feed price, once the tariff is added, the long run transmission elasticity with the German price is restored and is very close to 1. As the tariff depends, on the entry price, it can be concluded that the prevalent (if not the only) driver of the domestic feed price is the entry price.

The linkage between the two domestic prices is, in fact, another key result of the analysis. The evidence is puzzling also in this case because cointegration tests hardly identify a long-run relationship between them. This may be in part attributed to the fact that food price shows periods of higher volatility that are not observed in the feed case. Nonetheless, if this linkage occurs, price transmission elasticity is remarkable and not far from one. In this respect, it is also confirmed that the declassification from food to feed use in the domestic market may play a role, though very limited in magnitude and duration. Eventually, despite this linkage, the two policy regimes seem to autonomously grant a different degree of protection to the two domestic markets. Achieving stable and converging feed prices and stable but not (too) declining food prices is what eventually justifies the presence of two different border protection systems.

Beside the specific estimation results, we can try to draw some conclusion from this empirical investigation about the appropriateness and effectiveness of the policies in place. Evidently, the objectives behind the cereals' trade policy are multiple and complex. This multidimensionality is unaffordable and well beyond the scope of the present analysis. Nonetheless, we can state that if the main objective of the policy measures here considered is, at least roughly speaking, to make the domestic price gradually converge and be responsive to international prices but still protecting the domestic market with respect to excessive fluctuations, we can conclude that such policy targets have been mostly achieved. A key role in this achievement is played by the entry price system. In the case of feed uses, the combination of a declining entry price and a tariff allow to achieve this twofold result of stabilization and gradual convergence. In the food case the introduction of the EP system coincides with a period of higher transmission of price signals across the border. The extension of the TRQ and the intervention through declassification, though not a policy *strictu sensu*, can be considered coherent integrative measures within this context to be adopted in turbulent times. Still one can wonder whether, despite this positive overall evaluation, these same results can be achieved in a different, simpler and possibly more efficient way. Evidently, if the objectives remain the same, any alternative policy must guarantee a domestic segregation. A deeper investigation on these possible policy alternative represents a second interesting future development of the present study.

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[17] Furthermore, the introduction of an entry price in the food case is more recent and has been implemented in a period of major market crisis; it acts in combination with the TRQ, which is normally filled, adding complexity to the price dynamics; the applied tariff is adapted with a lower frequency than for feed; and the maximum applied tariff is reached regularly.

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Annex: The dataset: group of wheat price series available for the analysis

	Abbreviation	Price	Description	Source	n.obs	Time span	Additional information
FOOD	food_top	Swiss price	Inlandweizen, Klasse Top	FOAG	114	2003.07- 2012.12	"At the mill"; include transport costs.
	food_k1	Swiss price	Inlandweizen, Klasse I	FOAG	114	2003.07- 2012.12	"At the mill"; include transport costs.
	food_k2	Swiss price	Inlandweizen, Klasse II	FOAG	114	2003.07- 2012.12	"At the mill"; include transport costs.
	food_k3	Swiss price	Inlandweizen, Klasse III	FOAG	114	2003.07- 2012.12	"At the mill"; include transport costs.
	food_IPS_top	Swiss price	IPS Weizen, Klasse Top	FOAG	114	2003.07- 2012.12	"At the mill"; include transport costs.
	food_IPS_k1	Swiss price	IPS Weizen, Klasse I	FOAG	114	2003.07- 2012.12	"At the mill"; include transport costs.
	food_IPS_k2	Swiss price	IPS Weizen, Klasse II	FOAG	114	2003.07- 2012.12	"At the mill"; include transport costs.
	food_bio	Swiss price	Bio Weizen, Inland	FOAG	114	2003.07- 2012.12	"At the mill"; include transport costs.
FEED	feed_mill	Swiss price	Price at the mill	FOAG	78	2006.07- 2012.12	Purchasing price at the mill
	feed_farm	Swiss price	Price at the farm level	SBV	192	1997.01- 2012.02	Purchasing prices for farmers
INTERNATIONAL	can_atl	International price	Canada CWRS Wheat - Atlantic	IGC	184	1997.01- 2012.04	cif price (fob + freight rates)
	can_stl	International price	Canada CWRS Wheat - St Lawrence	IGC	184	1997.01- 2012.04	cif price (fob + freight rates)
	can_van	International price	Canada CWRS Wheat - Vancouver	IGC	184	1997.01- 2012.04	cif price (fob + freight rates)
	fr	International price	France Grade 1 Wheat - Rouen	IGC	159	2002.09- 2012.12	cif price (fob + freight rates)
	de	International price	Germany Grade B Wheat - Hamburg	IGC	150	2000.07- 2012.12	cif price (fob + freight rates)
	food_trad_overs	International price	Bio Weizen, Übersee	FOAG	114	2003.07- 2012.12	Traded price "at the mill"; include transport costs and duties.
	food_trad_EU	International price	Bio Weizen, Europa	FOAG	114	2003.07- 2012.12	Traded price "at the mill"; include transport costs and duties.
	food_bio_trad_overs	International price	Brotweizen, Übersee (CWRS)	FOAG	114	2003.07- 2012.12	Traded price "at the mill"; include transport costs and duties.
	food_bio_trad_EU	International price	Brotweizen, Europa	FOAG	114	2003.07- 2012.12	Traded price "at the mill"; include transport costs and duties.
POLICY	feed_i_price	International price	Eu feed quality	FOAG	192	1997.01- 2012.12	cif price used for fixing the applied tariff
	food_i_price	International price	EU food quality	FOAG	14	2008.10- 2012.12	cif price used for fixing the applied tariff.
	food_ta	Applied tariff	1001.9932, reviewed every three months	FOAG	114	2003.07- 2012.12	
	food_tb	Maximum applied tariff	1001.9032	FOAG	51	2008.10- 2012.12	Binding tariff (acts as a cap on the applied tariff)
	food_EP	Entry price	1001.9932, introduced in 2008	FOAG	51	2008.10- 2012.12	
	feed_EP	Entry price	decided by law (tariff code 1001.9939)	FOAG	192	1997.01- 2012.12	
	feed_ta	Applied tariff	decided by law (tariff code 1001.9939)	FOAG	192	1997.01- 2012.12	