CAP reform and price transmission in the Italian pasta chain.

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ABSTRACT
During the last several years, wheat-pasta chains have been affected by Common Agricultural Policy (CAP) reforms in the durum wheat sector that have progressively reduced government intervention in the market. Specifically, the mid-term reform, implemented in 2005, represented a deep change in the tools applied in the CAP, with a change from coupled income support to a single decoupled aid where farmers' incomes are directly supported and are no longer linked to levels or types of production. We hypothesize that price transmission along the wheat-pasta supply chain has been affected by CAP reform and other events through greater price volatility for durum wheat and market power exerted by some firms along the supply chain. For the present study, we are particularly interested in examining whether and how CAP reform has altered price transmission in the Italian wheat-pasta chain, from farmer to retailer, including the wholesale stage. We employ the Kinnucan and Forker model, which provides a convenient instrument for analyzing the impact of policy intervention, and adapted its structure to the characteristics and the composition of the pasta supply chain by introducing an intermediate level (wholesale price), represented by semolina producers. The results suggest that pricing behavior has changed after CAP Reform introduction. [EconLit citations: Q110; Q130; L110]. c_ 2016 Wiley Periodicals, Inc.

1. INTRODUCTION

The issue of price transmission along the food chain has attracted considerable interest in the EU (EU 2009, DEFRA 2004) because of the welfare and policy implications that could potentially be generated. According to the empirical literature [1], vertical price relationships are typically characterized by the magnitude, speed and nature of the adjustments to market shocks that are transmitted through the different levels of supply chains (Vavra & Goodwin, 2005). Perfect transmission of price shocks occurs when changes in prices at a given level of the chain are fully and instantaneously transmitted to the other stages. Possible consumer welfare loss may exist if price increases are rapidly transmitted through the supply chain, while price decreases are transmitted more slowly, or incompletely. The great number of empirical studies in which symmetric price transmission was rejected led Kinnucan et al. (2011) to conclude that vertical asymmetric price transmission (APT) appears the rule rather than the exception[2]. Many authors identified the exercise of market power by middlemen, made possible by imperfect competition at the processing and

[1] For reviews on price transmission issues, see Meyer and von Cramon-Taubadel (2004), and Frey and Manera (2007)

[2] Peltzman (2000) finds asymmetric price transmission in almost two thirds of products analyzed. In Meyer and von Cramon-Taubadel (2004) the percentage in which symmetric price was rejected is lower, but still occurred in nearly half the products (reaches 48%).

retailing stage (Peltzman, 2000; Lloyd et al. 2006), as being among the factors that may explain the presence of APT along a food chain. Other explanations include retailer behavior such as menu cost, cost of acquisition and the use of psychological pricing points (Levy et al, 2011). Political regulation including the Common Agricultural Policy (CAP) may play an important role in price transmission mechanisms in European Union markets (Ferrucci et al. (2010)). In the U.S. dairy industry, Kinnucan, (1987), Lass et al. (2001), Lass (2005) and Capps and Sherwell (2007) found that price support in the form of price floors resulted in APT while, Romain et al. (2002) and Bolotova & Novakovic (2012) found empirical evidence of symmetric retail price responses and marketing margin changes to increases and decreases in the Class I fluid milk prices during the period when the New York State Milk Price Gouging Law was in effect (1991-2008).

Italy has the peculiarity of being, at the same time, the main producer and consumer of pasta; thus, pasta represents a strategic product in the Italian agro-food industry. During the last several years, wheat-pasta chains have been strongly affected by CAP reforms in the durum wheat sector that have progressively reduced government intervention in the market. Specifically, the Mid-Term reform, applied to the durum wheat sector at the start of 2005, represented a deep change in the tools applied in the CAP, with a turn from coupled income support to a single decoupled aid where farmers' incomes are directly supported and are no longer linked to levels or types of production. This could have led to a reduction of durum wheat production in areas where it is no longer economically profitable (ISMEA, 2011) and, consequently, partially affected Italian wheat prices. Furthermore, in the wheat-pasta chain, two other events were noteworthy. A case of anticompetitive practices against pasta makers was identified and sanctioned by the Italian Antitrust Authority (Antitrust 2009). Moreover, starting in the spring of 2007 until March 2008, the wholesale and retail stages experienced important production cost increases due to the increase in the price of durum wheat.

We hypothesize that price transmission along the pasta supply chain has been affected by CAP reform and other events. Theoretical models and empirical studies in the literature have demonstrated that agricultural policies such as price floors and deficiency payments allow processors to alter their pricing behavior in order to extract rents from government interventions (Goodhue and

Russo, 2012; Alston and James 2001). Likewise, partially coupled aid to farmers, guaranteeing high production levels of durum wheat available to local markets, could have permitted semolina producers to exert asymmetric price behavior. The introduction of decoupled aid, leading to a reduction in Italian durum wheat production that was not completely replaced by international wheat for pasta production, probably weakened semolina producers who faced difficulties in finding the raw material. This could have resulted in a semolina price adjustment process that differed from wheat price adjustments when compared to the period before CAP reform was applied to durum wheat at the start of 2005. However, in the analysis it is important to consider that oligopsony power in the food system may reduce the benefit from decoupling as theoretically shown by Russo et al. (2007).

CAP reform and commodity price booms have both played important roles in the price transmission between semolina producers and pasta makers/retailers. First, the reduction of Italian wheat production caused by CAP reform has put domestic semolina producers under pressure and their responses have probably been to reduce their margins. Second, high prices that occurred in 2007 represented important production cost increases for industries and retailers, which led to inflation and lower purchasing power for consumers. Finally, in the last several years, some pasta makers began producing semolina at their own mills. In this situation, we hypothesize that pasta makers could have changed their pricing conduct in order to increase their margins and justified that behavior based upon commodity price booms.

This study represents the first step of a research project aimed at analyzing the structure and mechanism of price transmission and, eventually, actors' market power in the wheat-pasta supply chain. In this study, we are particularly interested in empirically examining whether and how CAP reform has altered price transmission in the Italian wheat-pasta chain[3], from farmer to retailer, including the wholesale stage[4].

[3] Carraro and Stefani (2011) have investigated three Italian food chains, including pasta, using a structural break approach.

[4] The wholesale stage refers to semolina producers who represent the first transformation in the wheat-pasta chain. The second transformation stage (pasta makers) was not considered due to the absence of data. Thus, pasta retail price incorporates both pasta makers' and retailers' behaviors into semolina price changes.

In line with these goals, this paper contributes to the literature in two important dimensions. First, it is one of the first attempts to verify the effects of decoupled payments, introduced in Mid-Term Reform, on price transmission along food supply chains. Second, it investigates these effects for the Italian pasta supply chain where market concentration at the food processing stage is high and the Italian Competition Authority has intervened to sanction a case of anticompetitive practices against pasta makers. The remainder of the paper is organized as follows. Section 2 presents the model specification. Section 3 describes the data used in this study and Section 4 presents preliminary specification tests, final estimation results and asymmetry tests. Section 5 concludes and provides a summary of major results.

2. MODEL SPECIFICATION

Price transmission along the food chain is characterized by the speed, magnitude and nature of price changes along different segments of the supply chain. Based on structural characteristics of the pasta chain and preliminary tests on the direction of causality[5], we chose to employ the Kinnucan and Forker[6] (1987) model. The model has provided a convenient instrument for analyzing the impacts of policy interventions on farm-to-retail price transmission, notably in fluid milk markets (see Lass et al. (2001) and Lass (2005)). This model uses the conventional Houck approach that segments the independent variable of interest (eg. durum wheat price) into increasing and decreasing phases in order to identify their individual effects on the dependent variable (e.g. semolina price). Capps and Sherwell (2007) argue that this model might not be ideal for situations where the data exhibit non-stationarity properties. They suggest that when the variables are cointegrated the Asymmetric Error Correction Model (ECM) might be a superior alternative (Bolotova and Novakovic, 2012). We

[5] Granger-causality tests were conducted on the original time series to obtain Wald statistics for the hypothesis that all coefficients on the lags of explanatory variables were jointly zero in the equation for the dependent variable. In order to choose the lag structure in the VAR model preceding the causality test the SBC criterion was used. For the wheat-semolina model, we reject the null hypothesis that wheat prices do not cause semolina prices at the one percent significance level, while we fail to reject the reverse case that semolina prices do not cause wheat prices (the p-value was 0.782). In the semolina-pasta model we safely reject the hypothesis the semolina prices do not cause pasta prices. We fail to reject the hypothesis that retail prices do not cause semolina prices (the p-value was 0.927).

[6] The Kinnucan and Forker method is a modification of the Heien (1980) markup price model. A dynamic distributed lag time-series model is set up to capture the processes of retail price adjustments to both farm rising and falling prices, through the Houck (1977) procedure of estimating nonreversible functions, by including current and lagged values of farm price and marketing indexes.

estimated both the Kinnucan and Forker (K-F) and ECM models to analyze the price transmission in the Italian pasta chain and concluded that the results were statistically similar; therefore, the Kinnucan and Forker model estimations are exclusively reported in this study.

The structure of the K-F model was adapted to the characteristics and the composition of the pasta supply chain by introducing an intermediate level (wholesale price), represented by semolina producers. This leads us to two different model specifications, one that takes into consideration farm-wholesale transmission and another that considers wholesale-retail price relationships. In the former case the specification is:

$$S_t = \alpha T + \sum_{l=0}^{L1} \pi_l^r FR_{t-l} + \sum_{l=0}^{L2} \pi_l^f FF_{t-l} + \beta P_t + u_t \qquad (1)$$

where S_t is the accumulated change in semolina price, T is a time trend variable,

$$FR_t = \sum_{i=0}^{t-1} \text{Max}(\Delta F_{t-i}, 0)$$

measures the accumulated increases in farm price up to period *t*, while

$$FF_t = \sum_{i=0}^{t-1} \text{Min}(\Delta F_{t-i}, 0)$$

denotes accumulated decreases in farm price up to period *t*, and $\Delta F_t = F_t - F_{t-i}$. P_t represents the accumulated price changes for semolina producers' costs and, finally, u_t is a stochastic disturbance. This implies that semolina price could respond differently to rising and falling wheat prices with respect to both the magnitude and speed. In effect, the different superscripts on the summation term of increasing (*L1*) and decreasing (*L2*) variables allows that price transmission does not necessarily require the same number of lags for the two different components.

The pass-through between semolina and pasta retail prices is specified as follows:

$$R_t = \mu T + \sum_{m=0}^{M1} \gamma_m^r SR_{t-m} + \sum_{m=0}^{M2} \gamma_m^f SF_{t-m} + \delta M_t + v_t$$

(2)

Where R_t is the accumulated change in pasta retail price, T is a time trend variable,

$$SR_t = \sum_{i=0}^{t-1} \text{Max}(\Delta S_{t-i}, 0)$$

measures the accumulated increases in semolina price up to period *t*, while

$SF_t = \sum_{i=0}^{t-1} \mathrm{Min}\,(\Delta S_{t-i}\ , 0)$

measures the accumulated decreases in semolina price up to period *t*, and $\Delta S_t = S_t - S_{t-i}$. M_t is the accumulated changes in marketing costs, and, finally, v_t is a stochastic disturbance. Similar to the wheat-semolina model, the semolina-pasta model is presented in a completely general form, which allows different numbers of lagged values to be incorporated.

Neither theory nor empirical studies suggested the exact number of lagged values to include in both models, thus, we evaluated different structures and chose the model that best fit the data. In the wheat-semolina model, we determined that the best lag structure incorporated the current period and two lagged prices both for increasing and decreasing components while, as expected, semolina-pasta prices required more time to incorporate semolina price changes. The slower semolina-pasta adjustment process required the current period and four lags in both the increasing and decreasing components.

The main focus of this study was to identify the presence of asymmetries in price transmission along the different stages of the pasta chain. To determine whether semolina prices responded asymmetrically to wheat price changes, we conducted two different tests. First, we test whether individual parameters for lagged rising and falling price effects were equivalent:

$$H_0: \pi_l^r = \pi_l^f \quad ; \quad H_a: \pi_l^r \neq \pi_l^f \quad \text{for lags } l = 0, 1, 2\,. \tag{3}$$

We then test whether the accumulated effects of rising and falling prices were equivalent:

$$H_0: \sum_{l=0}^{2} \pi_l^r = \sum_{l=0}^{2} \pi_l^f \,; \quad H_a: \sum_{l=0}^{2} \pi_l^r \neq \sum_{l=0}^{2} \pi_l^f \tag{4}$$

Likewise, we test whether price asymmetry occurred in semolina-pasta pricing through the following hypothesis tests:

$$H_0: \gamma_m^r = \gamma_m^f \quad ; \quad H_a: \gamma_m^r \neq \gamma_m^f \quad \text{for lags } m = 0, 1, 2, 3, 4 \tag{5}$$

$$H_0: \sum_{m=0}^{4} \gamma_m^r = \sum_{m=0}^{4} \gamma_m^f \quad ; \quad H_a: \sum_{m=0}^{4} \gamma_m^r \neq \sum_{m=0}^{4} \gamma_m^f \tag{6}$$

Hypothesis tests (3) and (5) are sometimes referred to as short-run tests of asymmetry and are performed on the individual parameters. These hypothesis tests focused on the equality of transmission rates during the same period for increasing and decreasing upstream prices. In other words, we assessed whether asymmetry in the speed of adjustment existed and "…prices rise faster than they fall…" (Peltzman, 2000, p. 466) when the increasing coefficient is statistically greater than the decreasing coefficient. In the second sets of hypotheses, equations (4) and (6), all lagged variables were incorporated both for increasing and decreasing components of the models to test whether the downstream prices, semolina in the former specification and pasta in the latter, returned to same level after responding to equivalent increases and decreases in the upstream prices. This second test is often referred to as a test of long-run asymmetry.

3. DATA

Price data were available monthly from January 2000 to April 2011 for Italy. Istituto di Servizi per il Mercato Agricolo Alimentare (ISMEA) made available both the wheat and semolina prices, which were collected by Datima[7]. The pasta retail prices were obtained from household panel data collected by ISMEA-Nielsen. All prices are in Euro per Kg and relate to the aggregated product categories. Figure 1 shows the general movement of these three time-series over the analysis period. Before 2007, the data indicated a slight alternating trend, where short upward movements were followed by smooth downward periods. On June 2007, there was a considerable increase recorded first in the wheat price and, afterwards, in semolina and pasta prices. Then, beginning April 2008 the wheat and semolina prices reversed the trend and returned to the levels at which they began their rather dramatic increases. However, the pasta price did not return to the same pre-2007 level suggesting asymmetry.

Figure 1

The National Institute for Statistics (Istat) provided indexes for the variables that represent proxies for processing and marketing costs. These indexes include prices for labor, energy and transportation

[7] Datima is a collection of statistical databases including foreign trade and agricultural markets data.

inputs employed in processing and marketing (Figure 2). However, transportation costs were measured quarterly. Moreover, transportation costs were not included in both models to avoid multicollinearity problems and the related difficulties. Because the indexes for transportation, labor, and energy input costs were so closely associated, the indexes for labor and energy input costs will include transportation cost effects. The Common Agricultural Policy (CAP) reform, applied in the durum wheat sector, was implemented at the start of 2005. Given that sufficient data were available, we proceeded to estimate separate specifications for both models before (January 2000 through December 2004) and after Cap Reform (January 2005 through April 2011)[8].

Figure 2

4. RESULTS

4.1. Stationarity and Cointegration Tests

Prior to estimating equations (1) and (2), we performed both unit root tests and cointegration tests for all variables present in the two specifications, before and after CAP Reform. If the variables were not co-integrated, then the linear methods applied in these models could lead to spurious results. Two alternative tests, the augmented Dickey-Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test (Kwiatkowski et al., 1992), were conducted to determine whether accumulated semolina and pasta price changes, accumulated farm price decreases and increases, accumulated semolina price decreases and increases, and accumulated labor and energy cost changes were stationary.[9]

Table 1

While in the former the null hypothesis was that of a unit root, in the latter the null hypothesis was of stationarity. In the Wheat-Semolina model (Table 1), for accumulated semolina, accumulated farm price decreases and increases, and accumulated labor and energy cost both before and after CAP

[8] A preliminary test was conducted to determine whether structural change occurred between the pre-Cap and Post-Cap periods in both models. The null hypothesis was that no structural change occurred between the two periods. For the farm-wholesale model the calculated F statistic was 3.18, greater than the critical value: $F(0.01, 6, 123)= 2.95$. In the wholesale-retail model, although we fail to reject the null hypothesis at the conventional level of significance, we have included the two different models because the results for two periods were different, as Carraro and Stefani (2011) suggest.

[9] We test both models using J-Multi software. In the ADF model, the tests were conducted including both the number of lags that were suggested by AIC score and trend if evident in the data. Likewise, KPSS tests were assessed through the same lag structures.

reform, we fail to reject the null hypothesis in the ADF test, while we reject the null (stationary series) at the 5% level in the KPSS test and conclude that the accumulated price change variables were non-stationary. Accumulated semolina changes, accumulated wheat increases and decreases, and accumulated labor and energy changes were co-integrated[10] in both periods.

Likewise in the semolina-pasta model we found all variables were non-stationary, even though in the KPSS test some accumulated semolina changes were significant only at the 10% level of significance. Accumulated pasta changes, accumulated semolina increases and decreases, and accumulated labor and energy changes were co-integrated in Pre-CAP and Post-CAP period. Thus, co-integration test results guarantee consistency of the estimates by excluding the risk that they may lead to spurious results.

Table 2

4.2. Farm-Wholesale Price Models: Pre-Cap and Post-Cap Reform

The models were estimated by generalized least-squares using Prais-Winsten[11] methods due to serial correlation of the errors. Table 3 shows the estimated parameters for the wheat-semolina price models for the pre-CAP period and post-CAP period. In the Pre-CAP period, the model presents a fast upward adjustment of semolina price in response to wheat price increases. The current period effect was statistically significant at the five percent level of significance and was the coefficient estimate with the greatest magnitude. In the subsequent two months, first a negligible and insignificant downward movement occurred followed by an additional increase with magnitude of about a quarter of the current period effect, the two-month lag effect was significant at the ten percent level. The effects of price decreases on semolina price were much lower in magnitude than the effects of increases. The current and one-month lagged decreases had coefficients that were

[10] Co-integration tests were conducted by implementing the Granger and Engle procedure. It relies on unit-root test of residuals derived from the structural model estimated by least squares. If the residuals are stationary we reject the null hypothesis and conclude the series are co-integrated. Both for wheat-semolina and for semolina-pasta models, the values of test statistic of ADF (4.862 and 5.282) and KPPS (0.123 and 0.088) reassure us about the stationarity of the residuals.

[11] The estimates were done using STATA 11 and the Prais command without specifying the Cochrain option to avoid the loss of information in the first observation that could affect the efficiency of the regression. Specifically, the errors are assumed to follow a first-order autoregressive process.

statistically significant and of similar magnitude, while the upward correction for the two-month lagged decreasing farm price was not significant. The processing cost increases were estimated to have positive effects on semolina price, but only changes in the energy cost index were statistically significant.

Table 3

The Post-CAP model (Table 3) shows an interesting difference in the semolina price adjustment process to wheat price changes when compared to the Pre-CAP model. In particular, the effect of price increases in the current period is slightly greater than in the Pre-CAP period. Both the one-month and two-month lagged rising price effects are negligible and insignificant. However, the most remarkable differences can be seen in the farm price decrease effects. When compared to the Pre-CAP period, the Post-CAP wheat-semolina model can also be characterized as having rapid downward adjustment of semolina price in reaction to wheat price decreases. Indeed, the current period effect of wheat price decreases has a coefficient similar in magnitude to the wheat price increase effect. In the subsequent month there is an upward adjustment to wheat price decreases (insignificant), which is then followed by an additional downward correction that is statistically significant at the ten percent level. The changes that occurred in the wheat-semolina model before and after CAP Reform implementation can be compared using the aggregated current and lagged coefficients. Both the sums of rising and falling coefficients are statistically significant and show similar magnitudes in the Post-Cap period.

A useful way to illustrate semolina price response is to capture the accumulated current and lagged effects, holding all other effects constant, by simulating equivalent wheat price increases and decreases (Figure 3). An initial semolina price of €0.32 per kilo is assumed. After two months, we assume a wheat price increase of €0.10 per kilo and allow these effects to fully impact the semolina prices without introducing any other changes until the fifth month (this allows all estimated lagged increases to fully impact the semolina price). For the pre-CAP model, the semolina price increases to €0.42 per kilo in the current period, followed by a slight downward movement and a further, but less marked rise in the second month. The net increase is €0.15.

Figure 3

Considering the net effect of about €0.15 we can argue that the transmission rate of a farm price increase on semolina price was about 150%. After the adjustment process was complete, we introduce an equivalent wheat price reduction of €0.10 per kilo. Semolina prices decrease steadily the current period and subsequent month; the semolina price decreases by about €0.065 per kilo during these two periods. The final two-month lagged estimate produces a slight increase of €0.011. As a result, the final semolina price fails to return to the initial level remaining at about €0.41 per kilo, illustrating the asymmetry of price transmission for the pre-CAP period.

For comparison purposes, we set up the same simulation illustrating the partial effect of €0.10 per kilo wheat price increases and decreases on semolina price for the post-CAP period. In this case, the semolina price immediately increases until reaching €0.45 per kilo, but in subsequent months there is little change and the semolina price remains around the same value. Thus, the transmission rate of a wheat price increase on semolina price was 133% slightly lower than before the CAP reform.We then examine the impact of a farm price decrease of €0.10 per kilo. The initial (current month) effect causes a large decrease in the semolina price, which returns to a value close to its original price. This is followed by an upward movement in the subsequent month (one-month lag) and a further downward adjustment in the last month of our analysis (the two-month lag effect). The final result was €0.321 per kilo, which is virtually at the initial semolina price. The aggregate partial analysis provides an interesting comparison of the two periods, with a strong indication of long-run asymmetry in the pre-CAP reform period, which then disappears with the introduction of decoupling support in the post-CAP period.

4.3 Processing-Retail Price Models: Pre-Cap and Post-Cap Reform

The empirical exploration of the relationship between processor prices and retail prices was conducted by employing the same generalized least-squares methods. The different lag structure needed to complete the adjustment process with which retail prices respond to processing price changes requires estimation of a larger number of coefficients. In the pre-CAP model (Table 4) the current period semolina price increase has a positive effect, although statistically insignificant. This is then followed by alternating downward and upward adjustments for additional lag effects, which are estimated to have approximately the same magnitudes. However, only the last two coefficients (three and four month lags) are statistically significant at the ten percent level of significance. The estimated effects of price decreases on retail price indicate greater magnitudes with most coefficients statistically significant. The current period decrease is estimated to decrease pasta price, but is followed by a much greater increase in pasta price (the one-month lag effect). This is then followed by two months of downward adjustments and, in the final month, one last increase in pasta price due to the semolina price decrease. The sum of rising semolina price effects is not statistically significant and slightly greater than the sum of the falling semolina price effects. The resulting net difference is also not statistically significant. The marketing cost indexes present more moderate impacts on retail prices; only the labor cost coefficient is statistically significant, although the sign on the estimate is not anticipated.

Interesting results emerge regarding the post-Cap period. First, retail adjustments in pasta prices that occur in response to wholesale price variations seem to be more cautious than in the pre-CAP period, particularly in response to wholesale price decreases. For wholesale price increases, the estimated current period effect has a positive value, but is not statistically significant. The initial increase in pasta price is followed by two more months of upward movements, but again these are not statistically significant. The estimated three-month lag effect suggests a reduction in pasta prices, which is statistically significant at the ten percent level. In the final period, the four-month lag effect, we find the greatest and most significant retail price increase.

The estimated effects of wholesale price decreases on retail price show a current period and one month lag with negative coefficients, meaning upward adjustments to wholesale price decreases. However, both are statistically unimportant. In the third month, retail price decreases slightly, followed by a further increase and, finally, we observe in the greatest reduction in the fourth month, which is statistically significant at the five percent level. The sum of the rising coefficients is significant and significantly greater than sum of the falling coefficients, at the ten percent level. The marketing cost indexes continue to have modest effects on retail price, with energy cost having a significant positive effect.

Table 4

The general picture that emerges from our results is not easily seen from the coefficients. A partial effect analysis similar to the wheat-semolina analysis (Fig. 4) illustrates the eventual long-run asymmetries. We review these asymmetries before moving on to appropriate tests of asymmetry in the next section. To examine the estimated retail price reaction to accumulated effects for equivalent wholesale price increases and decreases, holding the other effect constant, we proceed to simulate equivalent semolina price increases and decreases of €0.10 per kilo (see Figure 4). The initial pasta retail price was assumed to be €1.00 per kilo. In the pre-CAP period, the effects of the €0.10 per kilo increase suggest an oscillating pattern through the observation period. The retail price reaches €1.039 per kilo, an estimated transmission rate of about 39%. Introducing a wholesale price reduction of €0.10 per kilo, we observe an irregular adjustment process with continuous retail price changes until the final retail price of €1.016 after all lagged effects have been included, which is not statistically different from the initial price. While there appears to be substantial variation in retail prices and potential profit taking due to the semolina price increases and decreases, the retail pasta price ultimately returns to a value close to the initial value. In the post-Cap period, the wholesale-retail price adjustment process is clearly smoother than in the pre-CAP period. A gradual upward movement was observed during the months after the introduction of the semolina price increase, until the retail price reached €1.079 per kilo. Therefore, the post-cap model estimated a rise of €0.079 per kilo, a transmission rate for the price increase of 79%. The introduction of an equivalent wholesale price decrease causes, at first, two increasing adjustments in retail price, then a modest downward correction in the second month followed by an increase in the third month, and, finally, the greatest reduction in the fourth month. The final retail price simulated is €1.064, a retail price level greater than that observed for the pre-CAP period suggesting evidence of long-run wholesale to retail price asymmetry in the post-CAP period.

Figure 4

4.4 Hypothesis Tests of Asymmetry

The empirical analysis shows interesting changes due to price transmission along the pasta chain with the introduction of CAP reform. The next step is to test whether the observed asymmetric price transmission behavior we found for wholesale prices in the pre-CAP period and in retail prices after the reform are statistically significant. We apply two different hypothesis tests. In the first test (short-run asymmetry), the null hypothesis is the equality of transmission speed of adjustment during the same period for upstream price increases and decreases. If we reject the null hypothesis, we are able to assert the existence of short-run asymmetry and, in specific periods (current or lagged month) downstream price responds differently to upstream price increase than to upstream price decrease.

The second test, referred to as long-run asymmetry, provides statistical evidence about whether downstream price returns to the same level after equivalent upstream price increases and decreases. Rejection of the long-run asymmetry null hypothesis provides evidence that net changes in prices will be statistically greater, or lower, following equivalent increases and decreases in upstream prices.

Table 5

Farm-wholesale model results are shown in Table 5. As can be seen, in the pre-CAP period the current-month effect of increasing wheat price was significantly greater than the estimated effect of decreasing wheat price. [12] In the following months, we fail to reject the null hypothesis of no difference for one-month lag effects while we reject at the ten percent level of significance the null hypothesis for two-month lag effects. We conclude that asymmetric speed of adjustment exists in the current month and more moderately in the second month. In the post-CAP period, the calculated F-statistic for the current period effect is lower than the critical value and we conclude there is no

[12] Tests were conducted as F-test of the equality between the estimated parameters for increasing upstream prices and decreasing upstream prices. Respectively, for Farm-Wholesale model critical values were 4.03 in pre-Cap and 3.98 in post-Cap while in Wholesale-Retail model 4.05 and 3.99.

current period short-run asymmetry. While we do find significant differences in the one and two month lag effects, economically these effects are small.

Moving to the long-run tests, the results show a change occurred after the CAP reform in how wholesale prices respond to farm price increases and decreases. We conclude there is long-run asymmetry in the pre-CAP period. However, in the post-CAP period we do not find statistical evidence of long-run price asymmetry.

Table 6 shows test statistics for the Wholesale-Retail models. In the pre-CAP period there is no evidence of short-run asymmetric transmission behavior in retail price for the current period or two-month lag effects. However, we do find evidence of asymmetric behavior for the one month lag and in the last two month lag effects. After CAP reform, we find no evidence of short-run asymmetries in any period. As we previously noted, retail price responds to other determinants including menu cost, cost of acquisition and the use of psychological pricing points (Levy et al, 2011), as well as input price shocks, which could lead retailers to follow strategic behavior in the short-run. Thus, long-run tests assume a greater importance in the wholesale-retail price transmission framework. CAP reform seems to have completely changed the behavior of how retail price responds to semolina price changes. While in the pre-CAP period we easily fail to reject long-run asymmetric price transmission, we find significant evidence of long-run asymmetric retail price behavior in the post-CAP period. As shown in Figure 5, retail prices do not return to their original levels following equivalent wholesale price increases and decreases.

Table 6

5. Summary and conclusions

Based on the importance of domestic consumption (Italian per capita consumption is 26 kg annually) and the magnitude of production at each stage, pasta clearly represents a strategic product in the Italian agro-food industry. Recent CAP reform, introduced in the wheat sector in 2005, has further reduced government intervention in the market with a decoupled aid scheme, which directly supports farmers' incomes regardless of levels or types of production. This work offers a contribution to the analysis of CAP reform impacts on price transmission mechanism in the Italian wheat-pasta chain; specifically our study investigates both farm-wholesale and wholesale-retail price transmission.

The results suggest that pricing behavior has changed after CAP reform. Before 2005, wheat-semolina (farm-wholesale) price transmission was characterized as rapid upward adjustment of semolina price in reaction to wheat price increases. Wheat price decreases were transmitted more slowly and not completely to semolina price. Hypothesis tests provided evidence of short-run asymmetry (current and two-month lagged price effects) and long-run asymmetry. After 2005, the wholesale price responds to farm price decreases with the same speed and magnitude that it reacts to wheat price increases for current period effects. We find differences in speeds of adjustments for one and two-month lags, but we conclude these effects "balance out;" there is no long-run asymmetric wholesale price behavior.

An opposite result seems to characterize wholesale-retail price transmission. Before CAP reform, retail price adjustments to wholesale price changes suggest some differences in the speed, but, in the end, the effects of wholesale price decreases equalize the effects of wholesale price increases. Statistical tests of asymmetry lead to the conclusion that short-run asymmetry (first, third and fourth month effects) exists while there is no evidence of long-run asymmetry. The Post-Cap results show a different dynamic characterized by similar speeds for increasing and decreasing changes for all lags. However, retail price does not return to the same level following equivalent wholesale increases and decreases. While tests do not provide evidence of statistical short-run asymmetry, we conclude there is significant asymmetric long-run retail price behavior.

The results show a sharp structural break in price transmission along the wheat-pasta chain after 2005. CAP Reform, by introducing completely decoupled support to farmers, no longer linked to levels or type of production, might have played a significant role in the relationship between farmers and semolina producers. The reduction of durum wheat production in areas where it is no longer economically profitable has certainly reduced Italian wheat supply. The contraction of domestic wheat supply as well as the increasing competition of semolina imports may have weakened domestic mills' market power and resulted in their passing wheat price decreases downstream. However, the results should be interpreted cautiously after taking into consideration the considerable increases recorded in wheat prices between 2007 and 2008[13], and the antitrust sentence that imposed fines on pasta makers for anticompetitive practices during the same period. This is most important when interpreting the results of the semolina-pasta model, where retail price reaction incorporates both pasta makers' and retailers' behaviors into retail price changes. After CAP reform, problems related to durum wheat supply could have weakened the position of semolina producers with respect to the other stakeholders. This could have allowed downstream supply chain actors (pasta makers and retailers) to undertake collusive practices aimed to recover profit margins by using oligopolistic power in the retail market. These results suggest that future research on the wheat-pasta supply chain should include a structural model, within the New Empirical Industrial Organization (NEIO) methods, in order to assess whether these observed changes in price transmission can be associated with changes in supply chain actors' market power and strategies.

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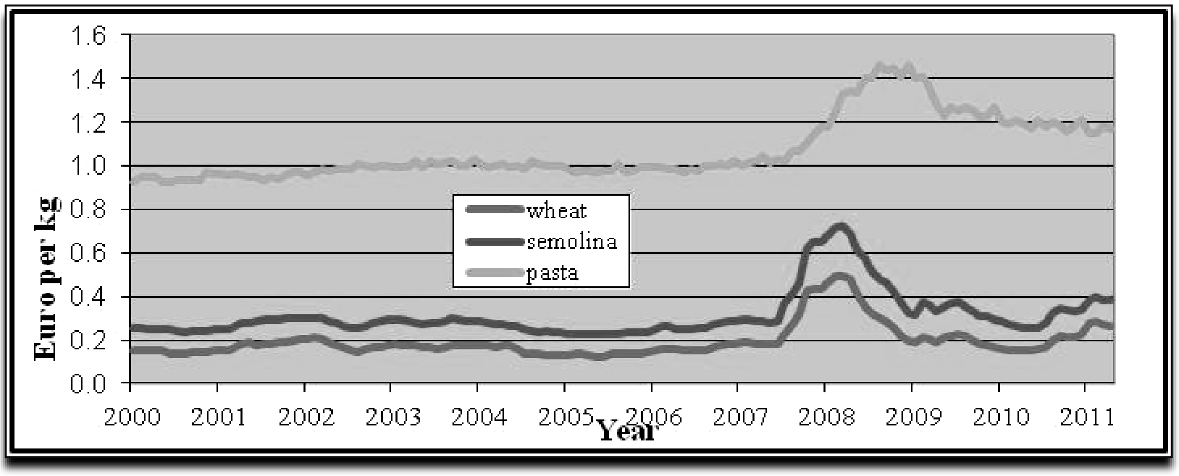

Figure 1. Wheat, semolina and pasta prices from Jan 2000 to April 2011.
Source: ISMEA

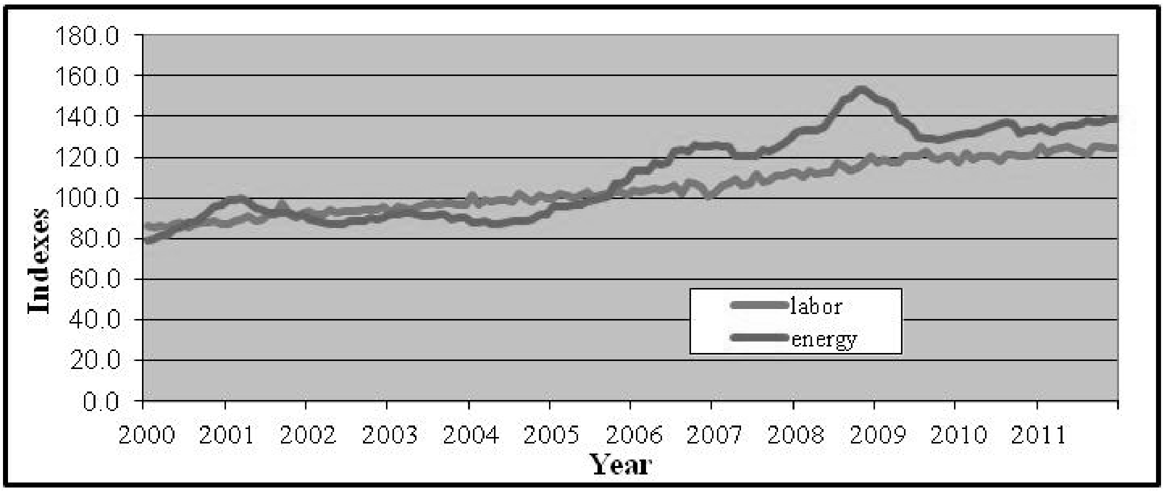

Figure 2. Labor cost and energy cost indexes from Jan 2000 to April 2011.
Source: ISTAT

Table 1. Stationarity tests: wheat-semolina model.

	Pre-Reform		Post-Reform	
	ADF	KPSS	ADF	KPSS
Semolina (S_t)	-1.496	0.464*	-2.334	0.215*
Rising wheat price				
Current period (FR_t)	-0.800	0.598*	-1.948	0.321*
One month lag (FR_{t-1})	-0.906	0.563*	-2.013	0.345*
Two month lag (FR_{t-2})	-1.063	0.518*	-2.009	0.374*
Falling wheat price				
Current period (FF_t)	-2.682	0.219*	-1.741	0.352*
One month lag (FF_{t-1})	-2.582	0.248*	-1.704	0.351*
Two month lag (FF_{t-2})	-2.500	0.265*	-1.410	0.348*

Labour cost index	-1.037	0.104**	-0.329	0.301*
Energy cost index	-0.639	0.119**	-2.162	0.151**

*Statistically different from zero at level of significance 5%; **statistically different at level of significance 10%.

[2] In the ADF test, the null hypothesis is of a unit root while in KPSS it is stationarity.

Table 2. Stationarity tests: semolina-pasta model.

	Pre-Reform		Post-Reform	
	ADF	KPSS	ADF	KPSS
Pasta (R_t)	-0.547	0.142**	-1.091	0.207*
Rising Semolina price				
Current period (SR_t)	-1.490	0.333*	-2.799	0.183*
One month lag (SR_{t-1})	-1.668	0.283*	-2.798	0.199*
Two month lag (SR_{t-2})	-1.945	0.233*	-2.779	0.216*
Three month lag (SR_{t-3})	-2.020	0.189*	-2.750	0.233*
Four month lag (SR_{t-4})	-2.252	0.155*	-2.713	0.249*
Falling semolina price				
Current period (SF_t)	-1.887	0.515*	-1.432	0.687*
One month lag (SF_{t-1})	-1.884	0.515*	-1.351	0.683*
Two month lag (SF_{t-2})	-1.878	0.517*	-1.089	0.676*
Three month lag (SF_{t-3})	-1.590	0.521*	-1.023	0.663*
Four month lag (SF_{t-4})	-1.534	0.525*	-0.951	0.648*
Labour cost index	-1.037	0.104**	-0.329	0.301*
Energy cost index	-0.639	0.119**	-2.160	0.151**

*Statistically different from zero at the 5% level of significance; **statistically different at the 10% level of significance.

In the ADF test, the null hypothesis is of a unit root while in KPSS it is stationarity

Table 3. Estimated wheat-semolina price models

	Pre-Reform		Post-Reform	
	Estimates	tcalc	Estimates	Tcalc
Rising wheat price				
Current period (FR)	1.207	7.79 *	1.303	11.76 *
One month lag (FR_{t-1})	-0.019	- 0.1	0.103	1.03
Two month lag (FR_{t-2})	0.314	1.93**	-0.074	-1.07
Falling wheat price				
Current period (FF_t)	0.301	2.20 *	1.253	9.77 *
One month lag (FF_{t-1})	0.338	2.28 *	-0.391	- 1.14
Two month lag (FF_{t-2})	-0.108	-0.84	0.461	1.69 **
Labour cost index	0.0001	0.19	0.0002	0.28
Energy cost index	0.0001	1.71**	0.0005	1.81**
Trend	-0.0026	-3.69*	0.0014	-1.16
Aggregate Lagged Effect				
Sum of Rising Coefficient	1.502	9.24*	1.332	31.24*
Sum of Falling Coefficient	0.531	3.81*	1.323	29.66*
Difference	0.971	3.77*	0.010	0.2
Sample	60		75	

*Statistically different from zero at the 5% level of significance; **statistically different at the 10% level of significance.

Table 5. Hypothesis tests of asymmetric Wholesale Price Response for Pre-CAP and Post-CAP Model			
	Hypothesis	Pre-CAP Reform	Post-CAP Reform
Rising Farm price coefficients vs. Falling Farm price coefficients	$H_0 \quad \pi_0^r = \pi_0^f \; ; \; H_a \quad \pi_0^r \neq \pi_0^f$	15.86*	0.08
	$H_0 \quad \pi_1^r = \pi_1^f \; ; \; H_a \quad \pi_1^r \neq \pi_1^f$	2.09	3.78**
	$H_0 \quad \pi_2^r = \pi_2^f \; ; \; H_a \quad \pi_2^r \neq \pi_2^f$	3.37**	10.00*
Sum of Rising coefficients vs. Sum of Falling coefficients	$H_0 \quad \sum_{i=0}^{2} \pi_i^r = \sum_{i=0}^{2} \pi_i^r$ $H_a \quad \sum_{i=0}^{2} \pi_i^r \neq \sum_{i=0}^{2} \pi_i^r$	14.23*	0.06

Test statistics are calculated F-statistics.
*Statistically different from zero at the 5% level of significance; **statistically different at the 10% level of significance.

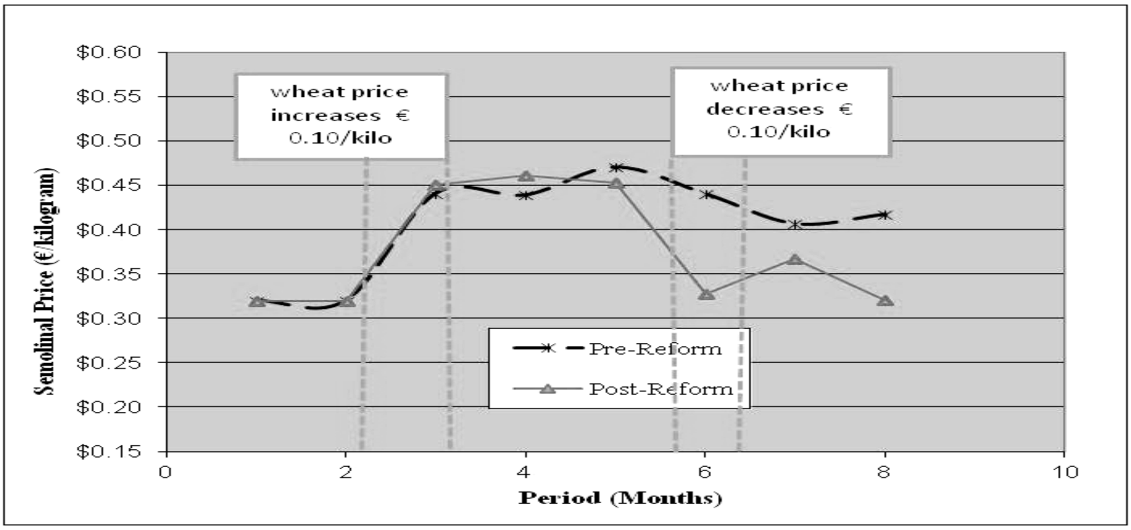

Figure 3. Estimated partial effects of equivalent wheat price increases and decreases on Semolina price.

Table 4. Estimated semolina-pasta price models: pre- and post-CAP reform.				
	Pre-Reform		Post-Reform	
	Estimates	tcalc	Estimates	tcalc
Rising semolina price				
Current period (SR_t)	0.360	0.93	0.268	1.65
One month lag (SR_{t-1})	-0.326	-0.95	0.086	0.44
Two month lag (SR_{t-2})	0.355	0.65	0.236	1.3
Three month lag (SR_{t-3})	-0.871	-1.68**	-0.324	-1.7**
Four month lag (SR_{t-4})	0.817	1.88 **	0.523	3.13*
Falling semolina price				
Current period (SF_t)	1.228	1.98 **	-0.342	-1.1
One month lag (SF_{t-1})	-2.134	-2.53 *	-0.205	-0.49
Two month lag (SF_{t-2})	0.555	0.61	0.160	0.38
Three month lag (SF_{t-3})	1.566	2.21 *	-0.244	-0.58
Four month lag (SF_{t-4})	-1.043	-2.90*	0.773	2.38*

Labour cost index	-0.002	-1.96**	0.001	0.4
Energy cost index	0.000	0.44	0.005	4.79*
Trend	0.002	0.63	0.007	-4.33*
Aggregate Lagged Effect				
Sum of Rising Coefficient	0.335	0.14	0.788	7.30*
Sum of Falling Coefficient	0.172	0.19	0.141	1.19
Difference	0.163	1.05	0.647	1.87**
Sample	60		75	

*Statistically different from zero at the 5% level of significance; **statistically different at the 10% level of significance.

Table 6. Hypothesis tests of asymmetric Retail Price Response for Pre-CAP and Post-CAP Model

	Hypothesis	Pre-CAP Reform	Post-CAP Reform
Rising Wholesale price coefficients vs. Falling Wholesale price coefficients	$H_0\ \ \gamma_0^r = \gamma_0^f\ ;\ H_a\ \ \gamma_0^r \neq \gamma_0^f$	1.14	2.58
	$H_0\ \ \gamma_1^r = \gamma_1^f\ ;\ H_a\ \ \gamma_1^r \neq \gamma_1^f$	3.99*	0.38
	$H_0\ \ \gamma_2^r = \gamma_2^f\ ;\ H_a\ \ \gamma_2^r \neq \gamma_2^f$	0.05	0.03
	$H_0\ \ \gamma_3^r = \gamma_3^f\ ;\ H_a\ \ \gamma_3^r \neq \gamma_3^f$	6.94*	0.03
	$H_0\ \ \gamma_4^r = \gamma_4^f\ ;\ H_a\ \ \gamma_4^r \neq \gamma_4^f$	5.96*	0.4
Sum of Rising coefficients vs. Sum of Falling coefficients	$H_0\ \ \sum_{i=0}^{4}\gamma_i^r = \sum_{i=0}^{4}\gamma_i^r$ $H_a\ \ \sum_{i=0}^{4}\gamma_i^r \neq \sum_{i=0}^{4}\gamma_i^r$	0.04	32.27*

Test statistics are calculated F-statistics.
*Statistically different from zero at level of significance 5%; ** statistically different at level of significance 10%

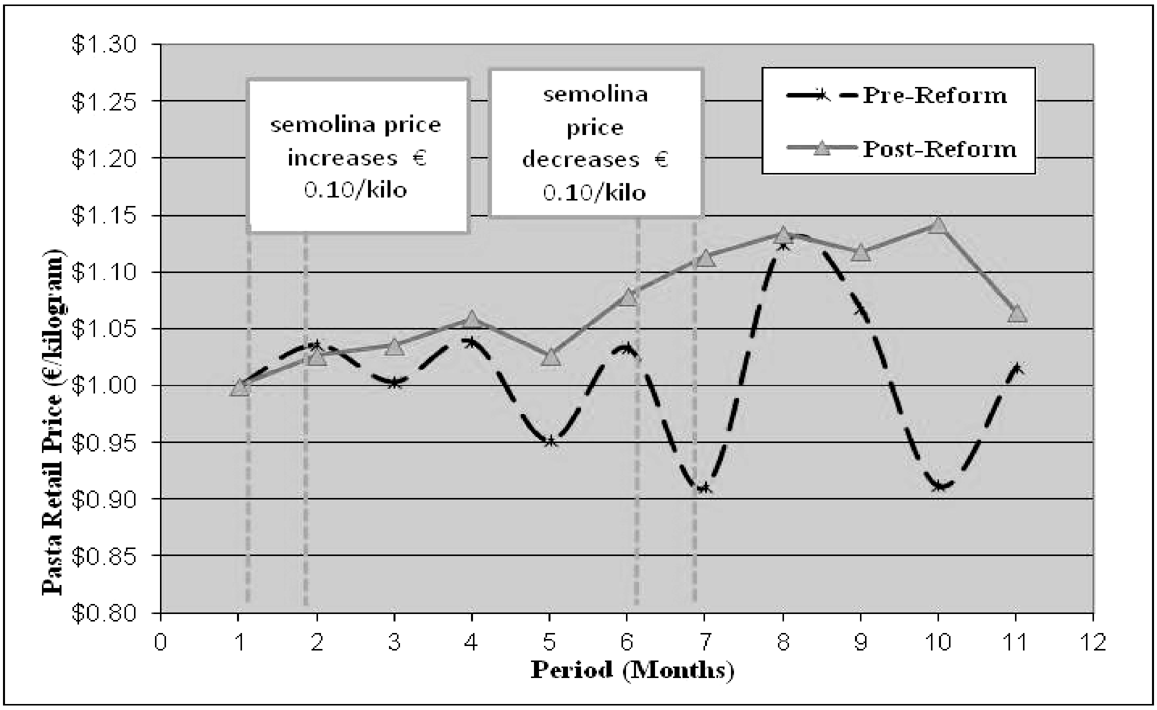

Figure 4. Estimated partial effects of equivalent semolina price increases and decreases on Pasta retail price.