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Does Market Structure Influence Price Transmission in the Agro-food Sector? A Meta-analysis Perspective

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Abstract

There exists a large literature on price transmission in agro-food sectors. However, a great majority of empirical studies focus on the existence of asymmetry and, by and large, do not investigate the reason for its presence or absence. This is in sharp contrast to the theoretical literature that provides a number of explanations of why we should expect (a)symmetry. In response, this paper investigates the reasons for asymmetric price transmission in the agro-food chain, using meta-analysis of existing studies. Our focus is on the organizational and institutional characteristics of the agro-food supply chain. Our findings suggest that asymmetric price transmission in farm–retail relationships is more likely to occur in sectors/countries with more fragmented farm structure, higher governmental support and more restrictive regulations on price controls in the retail sector. On the other hand, more restrictive regulations on entry barriers in the retail sector and the relative importance of the sector tend to promote symmetric farm–retail price transmission. The latter is also more likely in the presence of a strong processing industry.

Keywords: *Asymmetric price transmission*; *meta-analysis*; *agro-food supply chain*..

JEL classifications: *Q11*.

1. Introduction

The debate concerning determinants of food prices has a long history in agricultural economics. An important part of this research has focused on the extent to which price changes are transferred along the agro-food chain. The interest that economists

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have shown over the issue of price transmission (PT) can be explained on several grounds. Firstly, changes in prices at different points along the marketing chain may have important consequences for the welfare of consumers and/or producers and are thus of concern to policy-makers (Sexton and Lavoie, 2001).[2] Secondly, in line with long-established arguments, prices convey information about scarcity (Hayek, 1945; Stiglitz, 2000). As a consequence, investigating price movements along the marketing chain could be relevant to understanding whether resources employed in agro-food production are allocated efficiently. Thirdly, the analysis of transmission of commodity price changes through to retail food prices can be informative for the discussion about price competition in the food sector and therefore of interest to competition authorities (McCorriston, 2002).

To better understand the nature of price movements, economists have made some effort to analyse the magnitude, direction and speed with which price movements are transmitted along the various stages of the agro-food chain (from farm to processing and retail levels or *vice versa*). One of the concerns over price transmission is that the pass-through is not perfect and price responses following positive and negative shocks exhibit asymmetry. In fact, it is taken for granted not just by the general public, but often by economists as well, that output prices respond faster to input price increases than to decreases, thus inducing asymmetrical price transmission (APT).

There is now an extensive literature dealing with price transmission (see Meyer and von Cramon-Taubadel, 2004 for a comprehensive overview). While several studies have greatly improved our understanding of the measurement and existence of price transmission, two are especially worth mentioning. Firstly, von Cramon-Taubadel (1998) reconciled PT testing with modern time-series techniques and thus paved the way for others to follow by adopting a similar approach. Secondly, in a much cited work, Peltzman (2000), using an impressive dataset, analysed 77 consumer and 165 producer goods in the United States and concluded that prices rise faster than they fall, boosting new empirical research with respect to PT. With the further evolution of time-series econometrics, new, non-linear approaches have flourished, yet again boosting PT analysis.

The conclusions of empirical research with respect to symmetrical or asymmetrical transmission, however, vary greatly depending on the sector tested, the methodological approach and/or the frequency of data used in the analysis (von Cramon-Taubadel *et al*., 2006). Asymmetries in price transmission have been detected in some countries and sectors but not in others. This leads to a general conclusion that the presence of (a)symmetric price transmission is conditional on local circumstances. It is disturbing though, that the exact mechanisms through which these local conditions affect the nature of price movements remain mostly unknown.

This is somewhat surprising as many papers offer theoretical arguments intended to explain why price transmission in the agro-food sector could be asymmetric. In fact, as far as the causes of price transmission asymmetries are concerned, the recent literature has paid much more attention to theory than empirics. Notable exceptions that tried to explain empirically asymmetric price adjustments along the agro-food marketing chain include Peltzman (2000) and Richards *et al*. (2012). In this paper we

[2]Clearly, the impact of price adjustments on the welfare of consumers is likely to be the opposite of the impact on the welfare of producers. This, however, ultimately depends on the specific nature of price movements along the marketing chain and the characterisation of the food sector (for a discussion see, for example, Sexton and Lavoie, 2001).

contribute to the literature by further attempting to link the presence/absence of price transmission asymmetries to market characteristics in a specific sector. We focus on the role of market structure, a factor which is commonly mentioned as an underlying reason for asymmetries in price transmission (McCorriston *et al*., 1998, 2001; Sexton and Lavoie, 2001). Interestingly, researchers have not reached a consensus with respect to the relationship between market structure and the pattern of price adjustments along the marketing chain. This paper seeks to illuminate this association.

The weak connection between theory and empirical applications is mainly related to the difficulty in incorporating competing theory predictions into empirical analyses. Whilst the theory focuses on both the demand and supply side effects on the speed or magnitude of price transmission, empirical research is largely confined to establishing whether transmission is symmetric or not. This is due to the inherent nature of the econometric PT testing approach, making it rather difficult to directly incorporate potential determinants of PT into models. Most empirical research largely follows the post-cointegration approach, albeit with increasingly sophisticated econometrics, that exclusively uses prices at various stages of the marketing chain to derive (a)symmetric price transmission models. Thus, researchers wishing to establish and empirically test causes for asymmetry are left with three complementary options. One is to build a structural econometric model for a specific sector to analyse the causes of asymmetric price transmission. The second is a two stage estimation adopted by Peltzman (2000). In the first stage, sector-specific degrees of asymmetry are estimated for a (large) number of supply chains to derive a left-hand-side variable (the statistic of the symmetry test or a dummy variable distinguishing between symmetry and asymmetry). This dependent variable is then regressed in a second stage on a set of market-specific explanatory variables. The third alternative is based on a meta regression analysis (MRA) (Stanley and Jarrell, 1989). First used in medical research, this approach, after some initial resistance, has been discovered and adopted as a useful tool by social scientists, including economists (Stanley, 2001). It is based on an analysis of empirical analyses, where the data consist of results and characteristics of the existing studies.

In this paper, we adopt this latter approach and do so for two main reasons. Firstly, compared to the alternative approaches mentioned above, meta-analysis allows us to exploit country/sector variations in market characteristics which would be very difficult to achieve with other approaches. MRA also seems to be much less data demanding as the results of price transmission models come from the existing studies. Secondly, to the best of our knowledge, this paper is the first to empirically link asymmetric price transmission with market structure using a meta-analysis perspective.

The paper closest to our work is the study by Frey and Manera (2007), which uses meta-analysis to link the presence of price transmission asymmetries to methodological characteristics of the identified studies. We differ from this work in two key ways. Firstly, we concentrate on research published after 2002. As a result, our sample has only two common papers with theirs.[3] This could be important, since the results from recent papers are presumed to be based on a more robust methodology, encompassing continuous improvements in time-series econometrics. Thus we aim to reduce the risk of biased results caused by misspecification errors that may have affected earlier price transmission studies. Secondly, Frey and Manera (2007) document only the

[3]While Frey and Manera (2007) include papers analysing food products, their focus is not on the agricultural and food sector. Instead, our sample is restricted to this research area.

relationship between the presence of price (a)symmetry and methodological approaches used in the analysed studies. Instead we link price transmission (a)symmetry to institutional characteristics of sectors/markets under investigation, whilst controlling for methodological differences. This is important as it allows us to relate our results to existing theoretical predictions. Thus, in addition to applying the "old approach" to new data, we also present new results. That said, owing to data limitations, we mainly focus on the structural features of the food chain. More specifically, we draw on theories explaining why market structure may impinge on price transmission. Theory also provides us with other competing explanations of asymmetric pricing. What we uncover therefore is only part of the picture. We nonetheless believe that this approach may still offer some new insights on the phenomenon of (a)symmetric price transmission and thus may provide an additional perspective on the issues in question.

The remainder of the paper is organised as follows. Next we present some of the underlying theories of the causes of APT followed by the discussion of the empirical approach. Section 4 presents the papers, data and variables used in this research. Section 5 presents and discusses our results whilst the last section concludes.

2. Asymmetric Price Transmission – Existing Theories and Empirical Findings

Some research on the characteristics of food markets suggests that these markets are typically oligopolistic (Sexton and Lavoie, 2001; Sheldon and Sperling, 2003), allowing the exercise of market power by downstream industries. It is not surprising that among the arguments[4] that have been provided to account for asymmetric price movements the most commonly cited is the presence of market power in retail and/or processing industries (see, for example, McCorriston *et al*., 1998, 2001). Generally it is expected that downstream food enterprises, being able to exert market power, transmit price movements which threaten their marketing margin faster than price movements which improve it (McCorriston *et al*., 1998; Von Cramon-Taubadel, 1998). More specifically, market power in downstream sectors may affect price transmission by depressing purchasing prices in upstream sectors below the level of a perfectly functioning market, and/or deterring entry or fostering exit. While this explanation is in line with intuition, it should be stressed that it is not self-evident and, as argued in several theoretical and empirical papers, the decisive role attributed to market power with respect to asymmetrical price transmission can be questioned. The risk of losing market share or being punished for deviating from collusive behaviour, as well as the cost structure of a downstream industry, may substantially affect the degree of price transmission in an oligopolistic environment in either direction. Hence, the relationship between market power and degree (and direction) of price transmission is not clear. In a review of papers estimating market power in agri-food chains, Perekhozhuk *et al*. (2012) emphasise that the results of "market structure models designed to test for market power vary considerably with respect to model structure, functional forms and estimation methods". The theoretical model of Tappata shows that "contrary to public opinion and previous work suggesting collusive behavior as the cause of asymmetric pricing … it can well be the outcome in non-cooperative markets"

[4]This list is by no means exhaustive. A comprehensive discussion of types, causes and testing approaches of APT is provided in the survey by Meyer and von Cramon-Taubadel (2004).

(Tappata, 2009, p. 685). Moreover, as showed by Azzam (1999), considering spatially competitive retailers facing concave spatial demand, asymmetric price transmission may also happen in a competitive environment. Similarly, the empirical paper on gasoline market price transmission by Kaufmann and Laskowski (2005, p. 1,595) concludes that "non-competitive behaviors probably are not to blame" for APT. The complexity in the relationship between market power and APT is well illustrated by Peltzman (2000) who uses two proxies for market power (the number of competing firms and market concentration indices) to explain APT and reaches conflicting conclusions. Whilst a lower number of competing firms in a sector increases asymmetries, higher market concentration indices decrease asymmetries. More recently Richards *et al*. (2012) also found results "contrary to the conventional wisdom" that market power induces faster retail price decreases and slower retail price increases. While these mixed results call for more evidence on the relationship between market structure and asymmetric pricing, it should be emphasised that a number of other explanations have been provided. For instance, asymmetric price transmission can also result from search costs (Miller and Hayenga, 2001). In such cases, customers, although having a finite choice of competing retailers, may not be able to find relevant price information because of search costs, enabling retailers to exercise local market power. Thus, firms may quickly raise the retail price as the producer price rises, and reduce them much more slowly should upstream prices decline. Richards *et al*. (2012) test consumer search behaviour on retail price pass-through using retail and wholesale scanner data of ready-to-eat cereals and confirm that consumer search costs cause faster price increases and slower price falls.

Other reasons for asymmetric price transmission include the so-called "menu costs" argument (i.e. costs occurring with the re-pricing and the adoption of a new pricing strategy (see, for example, Bailey and Brorsen, 1989; Levy *et al*., 1997). More recently, Ray *et al*. (2006) provide theoretical and empirical evidence for the wholesale level asymmetric price adjustment "in the small" for goods characterised by inelastic demand. Ray *at al*. (2006, p. 131) conclude that "a small wholesale price increase is more profitable because manufacturers will not lose customers from higher retail prices; yet, a small decrease is less profitable, because it will not lower retail prices; hence, there is no extra revenue from greater sales". Big price changes are however adjusted, since the cost of adjustment is offset by the increase in the revenue of retailers.

Further, the downward stickiness of retail prices may be explained by the presence of inflation (see Ball and Mankiw, 1994). This reasoning is based on the fact that inflation automatically carries out some of the adjustment needed in response to changes in input prices. Chen *et al*. (2008), using retail scanner data, reinforce the results of Ray *et al*. (2006) with respect to asymmetric adjustment "in small" and symmetric adjustment "in large", and also show that inflation may explain some of the transmission asymmetries.

Furthermore, Kinnucan and Forker (1987) suggest that government support is an underlying cause of APT. They argue that government intervention (e.g. floor prices) is common in agriculture, thus processors, wholesalers and retailers may expect that producer price reductions are temporary, whilst increases in farm prices are likely to be permanent, and adjust prices accordingly. Finally, various stock management practices may also generate APT (Reagan and Weitzman, 1982; Wohlgenant, 1985; Balke *et al*., 1998).

We focus on the relationship between market structure and the presence of APT. Thus we refer mainly to the arguments drawing on theories concentrating on the way

that market organisation characteristics may affect market power and consequently determine price transmission. We wish to complement the existing studies by proposing two innovations. Firstly, we proxy the organisation of the retail sector with various regulatory indicators that go beyond the commonly used market concentration ratios. We also complement these measures with variables approximating market structure and/or bargaining power of actors at other stages of the agro-food chain. In this way we link the presence of price transmission asymmetry not only to developments in the retail sector, but also to various characteristics of the agro-food chain as a whole. This is important as one may assume that if market structure matters for price transmission then it is market structure at each stage of the marketing chain (McCorriston, 2002). Secondly, to take advantage of the fact that the market organisation varies considerably across countries and/or sectors, our empirical strategy is based on meta-analysis and draws on the results of recent papers from the price transmission field. By doing so, we aim to complement the existing literature on price transmission by providing some systematic evidence using a method that until now has not been widely used.

We do not aim to test all or even most of the underlying factors of price transmission (a)symmetry found in the theoretical literature. Nor do we test directly the impact of wholesaler/processor or retailer market power upon PT.[5] This is mainly due to severe data limitations. The data on search costs, menu costs and inventory management strategies, if available at all, are rarely consistent between countries. Research on the causes of price transmission asymmetry essentially involves making a trade-off between the possibility of testing the range of alternative theories and the country/sector coverage. As a consequence one has to choose between exploiting within-country variation and testing for different theories and exploiting between-country variation with a focus on a limited number of theories to be tested. Both of these options have their pros and cons. We choose the latter alternative, being aware of potential shortcomings it may have. Nevertheless, we believe that the statistical associations that we document can still be informative for the issues. Our empirical strategy is briefly presented below.

3. Empirical Approach

Based on the existing theoretical literature, the price transmission mechanism can be conceptualised as a function with the form:

$$p_{cs} = F(X_{cs}, ET_{cs}) \tag{1}$$

where p denotes the variable that characterises the presence of price transmission asymmetry, $\boldsymbol{X}$ is a vector capturing the socio-economic and market organisation

[5]There could be several approaches to testing the impact of market power upon PT. Firstly, one could test directly the impact of market power by estimating a large number of country, sector or even processing plant/retail unit specific production and supply functions (e.g. Azzam and Pagoulatos 1990, Bakucs *et al*., 2010 or more recently Perekhozuk *et al*., 2013 using plant level data), followed by the determination of sector- and country-specific market power parameters (theta), later used as a regressor explaining PT. Secondly, a simpler approach is to use concentration ratios of downstream levels industries as proxies for market power included as regressors explaining price transmission (e.g. Peltzman, 2000). Finally, an indirect method is to relax the assumption of constant marginal cost and compare transmission elasticities, as in McCorriston *et al*. (2001).

characteristics, *ET* controls for estimation techniques, number of observations, frequency and paper publication details, both referring to country *c* and sector *s*. *F(.)* is the reduced-form function that aims to capture potentially complex interactions between these two. ***X*** includes, for instance, market structure and the regulatory framework or bargaining power of actors operating at subsequent stages of the agro-food supply chain. With respect to methodological variables included in vector *ET*, it should be clear that they are not the prime focus of our analysis (Frey and Manera, 2007 present an excellent analysis of the impact of methodology upon PT results) and we do not aim to assess whether these methodological approaches were appropriate. Instead we wish to control for the impact of methodological choice on the results – the nature of PT.

Given the fact that the within-country variation in variables included in ***X*** is limited, we focus on exploiting between-country variation. Consequently our dependent variable draws on the results from the existing studies on price transmission (see further), couching our empirical analysis in a meta-analysis framework. Meta-analysis is the quantitative analysis of a body of studies and aims at evaluating the existing empirical evidence (Stanley, 2001). While originally it was used in research areas other than agricultural economics, it is now quickly entering this field as well. Recent "agriculture-oriented" studies that use this approach include Hess and von Cramon-Taubadel (2007, 2008), Gallet (2007, 2010), Johnston and Duke (2009) and Lagerkvist and Hess (2011).

Our empirical strategy is as follows. Based on the literature review, we identify studies that investigate price behaviour in a number of countries and sectors. In line with the MRA approach adopted by Perdiguero-Garcia (2013), we code our dependent variable as a dummy equal to one if a given paper found asymmetric price transmission, and zero otherwise. An alternative approach could be to use as a dependent variable the F-statistic of the symmetry test. This however would greatly reduce our sample and thus bias our results since a large number of papers do not report this statistic.[6] Moreover, using a dummy variable instead of F-stat as a dependent variable helps to solve, at least to some extent, the problem of publication bias to which we refer below. In a second step, drawing on various sources, we collect the data on various institutional and market organisational characteristics of countries and sectors covered by the identified studies. Given the theoretical predictions concerned with price transmission asymmetry, we mainly focus on characteristics that may be related to the organisation of the subsequent stages of the agro-food supply chain. Thus, our focus is on variables approximating market structure and bargaining power of farmers, processors and retailers. In this way we exploit the variation in market characteristics across countries/sectors, helping us to overcome the main shortcoming of "single-sector" studies that cannot measure the impact of market structure on price transmission unless major changes in the organisation of the sector in the given country/sector occur within the study period (Meyer and von Cramon-Taubadel, 2004).

While the approach we follow offers an important advantage, it also creates a major challenge. As mentioned by McCorriston (2002), finding suitable proxies for market structure can be very difficult. On the one hand, this proxy should be uniform and comparable across countries. On the other, it should effectively capture the behaviour

[6]By using F-statistics Frey and Manera (2007) admit losing 41 papers out of 70 included in the original sample.

of farmers/processors/retailers and not just the potential that these actors have to behave in a certain way. We try to address these issues by using various proxies of the market structure at subsequent stages of the agro-food supply chain and follow the literature with respect to the way we define them (see further). While the measures we use may still be subject to the abovementioned critique, we are not aware of any more suitable proxies that are available for such a number of countries/sectors. Thus, while this caveat should be kept in mind when interpreting our results, we nonetheless believe that our findings provide some new insights into the linkage between various characteristics of the agro-food supply chain and price transmission (a)symmetry.

In addition, to address the concern that multiple-results studies may dominate our calculations, we follow Hess and von Cramon-Taubadel (2008) and attach a weight to the importance of each observation which is calculated as a ratio of 1 over the number of observations resulting from the underlying study.

4. Data

Our data on the presence/absence of price transmission are taken from 35 recently published papers. These studies focus on the agricultural sector and investigate the price transmission mechanism for 101 cases (Table 1). To our knowledge, this is the most comprehensive list of studies investigating price behaviour along the agro-food chain compiled in recent years. It was drawn from various scientific databases including Scopus, Science Direct, Emerald, EconLit, Web of Science and Google Scholar.

Next we briefly present some basic information on the studies that we use in our analysis. Most importantly, price transmission asymmetry has been detected in 53 cases whereas in the remaining 48 cases the authors concluded that price behaviour is symmetric. Thus our sample seems to be balanced with respect to the incidence of price asymmetries and symmetries. That said, it should be recognised that our data may still suffer from a sample bias stemming from the fact that studies finding asymmetric pricing may be more easily publishable.[7] We try to mitigate this problem as follows. Firstly, our sample includes not only published studies but also government reports and working papers. Moreover, we control for this fact using relevant dummies in all our regressions (see below). Secondly, we work with a dummy dependent variable distinguishing the presence of asymmetry rather than with the cumulative level of asymmetries. This is because "with publication selection averages of effect magnitudes across the literature will be upwardly biased in magnitude" (Stanley, 2005, p. 311). Finally, in all our specifications we control for the number of observations used in a given analysis. This is done to account for the fact that small sample studies, because of predictably larger standard errors, may be at a disadvantage in identifying statistically significant results. These measures should help to mitigate the publication bias problem. Nevertheless, the question as to whether it still affects our results remains.

While price transmission could be analysed for different pairs of actors operating at various stages of the agro-food supply chain, almost all of the cases that we identified (85) relate to farm–retail price transmission. The remaining observations relate to farm–wholesale (9) and to wholesale–retail (17) relationships. Our sample is not uniformly distributed over geographical regions or countries (Table 2). Most of the

[7]We thank an anonymous referee for making this point.

Table 1

List of identified studies on price transmission in the agro-food chain

Paper	Country	Sector	Frequency	Period
Abdulai (2002)	Switzerland	Pork	Monthly	1988–1997
Adachi and Liu (2009)	Japan	Pork	Monthly	1967–2008
Amador *et al*. (2010)	Austria	Apple	Monthly	1995–2010
Awokuse and Wang (2009)	USA	Milk	Monthly	1987–2006
	USA	Milk	Monthly	1987–2006
	USA	Milk	Monthly	1987–2006
Bakucs *et al*. (2006)	Germany	Pork	Monthly	1996–2004
Bakucs *et al*. (2007)	Hungary	Vegetables	Monthly	2002–2006
Bakucs and Ferto (2005)	Hungary	Pork	Monthly	1996–2002
Bakucs and Ferto (2006)	Hungary	Beef	Monthly	1992–2000
Bakucs and Ferto (2008)	Hungary	Milk	Monthly	1992–2007
Bakucs and Ferto (2009)	Hungary	Pork	Monthly	1992–2005
Ben-Kabia and Gil (2007)	Spain	Lamb	Weekly	1996–2002
Boetel and Liu (2010)	USA	Beef	Monthly	1970–2008
	USA	Pork	Monthly	1970–2008
Bolotova and Novakovic (2012)	USA	Milk	Monthly	1982–2008
Bojnec and Peter (2005)	Slovenia	Pork	Monthly	1990–2000
	Slovenia	Beef	Monthly	1990–2000
Capps and Sherwell (2007)	USA	Milk	Monthly	1994–2002
Cechura and Sobrova (2008)	Czech Republic	Pork	Monthly	1995–2006
Chavas and Mehta (2004)	USA	Milk	Monthly	1980–2001
Fałkowski (2010)	Poland	Milk	Monthly	1995–2006
Gervais (2011)	USA	Pork	Monthly	1980–2006
Guillen and Franquesa (2010)	Spain	Pork	Weekly	2005–2007
	Spain	Beef	Weekly	2005–2007
	Spain	Eggs	Weekly	2005–2007
	Spain	Lamb	Weekly	2005–2007
	Spain	Rabbit	Weekly	2005–2007
	Spain	Poultry	Weekly	2005–2007
Hassouneh *et al*. (2010)	Spain	Beef	Monthly	1996–2005
Jaffry (2005)	France	Fish	Monthly	1989–1999
Karantininis *et al*. (2011)	Sweden	Pork	Monthly	1995–2009
Lass (2005)	USA	Milk	Monthly	1990–2001

Table 1
(*Continued*)

Paper	Country	Sector	Frequency	Period
London Economics (2004)	Austria	Carrot	Monthly	1997–2002
	Austria	Potato	Monthly	1997–2002
	Denmark	Vegetables	Monthly	1985–2000
	Denmark	Bread	Monthly	1985–2000
	Denmark	Flour	Monthly	1985–2000
	Denmark	Eggs	Monthly	1985–1996
	France	Bread	Monthly	1990–2002
	France	Poultry	Monthly	1987–2001
	Germany	Apple	Monthly	1987–2003
	Germany	Potato	Monthly	1993–2002
	Germany	Carrot	Monthly	1993–2001
	Germany	Poultry	Monthly	1993–2002
	Germany	Milk	Monthly	1995–2001
	Germany	Cheese	Monthly	1995–2001
	Germany	Butter	Monthly	1995–2001
	Netherlands	Potato	Monthly	1985–2001
	Netherlands	Beef	Monthly	1994–2002
	Netherlands	Bread	Monthly	1996–2001
	Netherlands	Eggs	Monthly	1990–2002
	Spain	Potato	Monthly	1985–2001
	United Kingdom	Fruit	Monthly	1987–2001
	United Kingdom	Vegetables	Monthly	1985–2001
	United Kingdom	Vegetables	Monthly	1987–2001
	United Kingdom	Beef	Monthly	1986–2003
	United Kingdom	Lamb	Monthly	1986–2003
	United Kingdom	Bread	Monthly	1987–2001
	United Kingdom	Eggs	Monthly	1992–2001
	United Kingdom	Milk	Monthly	1995–2001
Luoma *et al*. (2004)	Finland	Pork	Monthly	1982–2003
	Finland	Beef	Monthly	1982–2003
Reziti and Panagopuolos (2008)	Greece	Vegetables	Monthly	1995–2004
	Greece	Fruit	Monthly	1995–2004
	Greece	Food	Monthly	1995–2004
	Greece	Vegetables	Monthly	1995–2004
	Greece	Fruit	Monthly	1995–2004
	Greece	Food	Monthly	1995–2004
Rezitis and Reziti (2011)	Greece	Milk	Monthly	1989–2009
Serra and Goodwin (2003)	Spain	Milk	Monthly	1994–2000
	Spain	Milk	Monthly	1994–2000
	Spain	Milk	Monthly	1994–2000
	Spain	Milk	Monthly	1994–2000
Shagaian (2007)	USA	Beef	Weekly	1991–2005
Shagaian *et al*. (2008)	Turkey	Poultry	Monthly	2003–2006
Simioni *et al*. (2013)	France	Fish	Monthly	1988–1999
	France	Fish	Monthly	1988–1999
Vavra and Goodwin (2005)	USA	Beef	Monthly	1974–2001
	USA	Poultry	Monthly	1980–2002
	USA	Egg	Monthly	1972–2002

Table 1
(*Continued*)

Paper	Country	Sector	Frequency	Period
Von Cramon-Taubadel *et al*. (2006)	Germany	Poultry	Weekly	1995–2000
	Germany	Lettuce	Weekly	1995–2000
Zheng *et al*. (2008)	USA	Pork	Monthly	1987–2003
	USA	Pork	Monthly	1987–2003
	USA	Beef	Monthly	1987–2003
	USA	Beef	Monthly	1987–2003
	USA	Poultry	Monthly	1990–2000
	USA	Poultry	Monthly	1990–2000
	USA	Egg	Monthly	1991–2000
	USA	Egg	Monthly	1991–2000
	USA	Potato	Monthly	1993–2001
	USA	Tomato	Monthly	1991–2001

Source: Own collation based on sample literature.

Table 2
Number of observations by country

Country	*N*	% of all obs.	% of all cases detecting APT
Austria	5	5.0	5.7
Czech Republic	1	1.0	1.9
Denmark	4	4.0	0.0
Finland	2	2.0	0.0
France	5	5.0	7.5
Germany	10	9.9	3.8
Greece	7	6.9	7.5
Hungary	8	7.9	3.8
Japan	1	1.0	1.9
Netherlands	4	4.0	0.0
Poland	1	1.0	1.9
Slovenia	2	2.0	1.9
Spain	14	13.9	18.9
Sweden	3	3.0	3.8
Switzerland	1	1.0	1.9
Turkey	1	1.0	1.9
USA	24	23.8	35.8
United Kingdom	8	7.9	1.9
Total	101	100.0	100.0

Source: Own calculations based on sample literature.

observations, 73, are for Europe and 24 are for the United States. Moreover, five countries, namely Spain, the United Kingdom, Hungary, Germany and United States account for almost two thirds of the entire sample.

Furthermore, most of the cases under investigation (71) concern livestock products (Table 3). Crop production is represented by 30 observations, and thus accounts for roughly 38% of our sample.

Table 3
Number of observations by sector

Product	*N*	% of all obs.	% of all cases detecting APT
Livestock	71	70.3	84.9
Vegetables	11	10.9	7.5
Fruit	5	5.0	0.0
Food	2	2.0	3.8
Potato	7	6.9	1.9
Cereals	5	5.0	1.9
Total	101	100.0	100.0

Source: Own calculations based on sample literature.

Table 4
Number of observations by methodology

Methodology		*N*	% of all obs.	% of all cases detecting APT
Pre-cointegration	Houck	8	7.9	11.3
Linear cointegration	VECM	55	54.5	35.8
Non-linear cointegration	General-to specific	3	3.0	3.8
	Gregory–Hansen	7	6.9	5.7
	Regime switching	1	1.0	1.9
	TVECM	24	23.8	37.7
	Asymmetric non-linear auto regressive distributed lag model	3	3.0	3.8
	Total	101	100.0	100.0

Source: Own calculations based on sample literature.

Tables 4–6 present some methodological characteristics of the studies under consideration. The majority of cases, 55, couch the analysis in a linear cointegration framework. A non-linear approach is used by 38 observations.

There are a few studies that are based on the earliest methodological approach to investigating price transmission mechanism, namely pre-cointegration techniques (8 cases).[8] Further, the majority of studies use monthly rather than weekly data (Table 5). Finally, of the 78 cases that investigated the direction of price information flow, 33 report the causality running from farm to retail, 8 report the opposite direction, whereas 33 report the causality running in both directions (Table 6).

4.1. Dependent variable

As mentioned earlier, our dependent variable shows the presence/absence of price transmission asymmetry. Accordingly, it is a dummy variable equal to one if the paper detects asymmetric price transmission, and equal to zero otherwise.

[8]As one of the earliest applications of this approach was the study by Houck (1977), in Table 4 we refer to it as the "Houck approach".

Table 5
Number of observations by data frequency

Frequency	*N*	% of all obs.	% of all cases detecting APT
Monthly	91	90.1	88.7
Weekly	10	9.9	12.3
Total	101	100.0	100.0

Source: Own calculations based on the sample literature.

Table 6
Number of observations by direction of causality

Causality direction	*N*	% of all obs.	% of all cases detecting APT
Causality farm to retail	33	42.3	60.0
Causality retail to farm	8	10.3	5.7
Causality wholesale to farm	4	5.1	5.7
Bidirectional causality	33	42.3	28.6
Total	78	100.0	100.0

Source: Own calculations based on the sample literature.

4.2. Independent variables

The selection of explanatory variables included in our regression is a crucial decision. On the one hand the complexity and multi-dimensionality characterising the relationship between price transmission and market structure would suggest the inclusion of many covariates. On the other, inflating the number of variables describing market organisation quickly reduces the degrees of freedom and induces potential multicollinearity in the regression results. Thus, to investigate the effect of the agro-food supply chain characteristics upon price transmission asymmetry, we include a limited number of covariates. We define four groups of explanatory variables.

The first group, similar to Frey and Manera (2007) albeit with less detail, are technical variables, controls for methodology, data frequency, number of observations and a sectorial dummy variable. Variable *Pre-CI* is a dummy distinguishing papers that use the pre-cointegration approach. Variable *Linear_CI* on the other hand is a dummy distinguishing studies relying on vector error correction models. All other papers, i.e. those that rely on non-linear methodologies, act as a reference group. Given that methodological advancements in econometrics allow for a much more detailed scrutiny of the data, we expect the more recent methods, i.e. non-linear, to be more likely to detect some imperfections in the price transmission mechanism and thus the presence of asymmetric price transmission. Further, as mentioned in some studies (e.g. Frey and Manera, 2007; Meyer and von Cramon-Taubadel, 2004; Von Cramon-Taubadel et al., 2006) the outcome of price transmission investigation may depend on the frequency and aggregation characteristics of the data used. More specifically, less frequent data may mask important adjustments (or lack of them) that occur within shorter periods. To address this issue, in our methodological regressions we also include the dummy variable *Monthly* capturing studies with monthly data frequency.

Studies with weekly data act as a reference point. In accordance with the argument presented above, we expect a negative coefficient on this variable suggesting that studies with monthly data are less likely to detect price transmission asymmetry than studies with weekly data. The number of observations used in a particular study is also expected to influence the results, however the expectations are not obvious. Since markets may need some time to return to equilibrium, in the long term the imperfect functioning of markets is less likely, favouring symmetrical transmission results. On the other hand, as mentioned earlier, studies using large samples may be more likely to document statistically significant results (in our case pointing to asymmetric pricing). What should also be noted is that the number of observations is also positively correlated with the data frequency. Potential interactions between our *Monthly* variable and *Observations* variable cannot therefore be excluded. Finally, since 70% of the studies covered in our sample focus on the livestock sector, the last variable in this group is a dummy controlling for possible sector-dependent effects (*Livestock*).

The second group of explanatory variables takes into account the geographical and, to some extent, historical characteristics of sectors/countries covered in our sample whilst also controlling for the sources from which the papers we study originated. We classify countries into two groups: the variable *Europe* takes the value of 1 if the paper is using European data, and 0 otherwise. Moreover, in some specifications we include the dummy *Western* which takes the value of 1 if the study is set in an "old" EU Member State, and 0 otherwise (i.e. for the central European countries) to control for possible historical differences. The next two variables control for the source of the paper, trying to capture possible publication biases. The variable *Journal* takes the value of 1 if the paper has been published in a refereed journal, and 0 otherwise (working paper, OECD publication etc.).The rank of the journal is controlled by the variable *WOS* which takes the value of 1 if the journal is included in the Web of Science (WoS), and 0 otherwise.

The third and fourth groups of covariates in our models contain the variables of key interest in this paper. These control for market organisational characteristics at later stages of the supply chain. Variables in the third group focus on main characteristics of the retail sector. In general, there are two main problems with variables that could be used here. Firstly, the literature is divided with respect to the proxy that one should use to measure the retailers' bargaining power (see e.g. Meyer and von Cramon-Taubadel, 2004). Secondly, even if we assume that the first problem is solved, it is still quite difficult to find the data on a uniform measure that would be available for more than a few countries. Given these problems and the on-going debate, we focus here on regulations governing the retail trade and the relative position of food retailers towards the manufacturing sector. Data for the three regulatory variables come from the OECD and were collected via the OECD Regulatory Indicators Questionnaire (see Conway and Nicoletti, 2006 for a detailed discussion of these variables). More specifically, we look at regulations related to entry barriers, operational restrictions and pricing policies, reflecting the institutional environment within which retailers operate, regardless of their market share. Consequently they should allow us to account, at least partly, for the incentive structure that retailers face and that drives their behaviour, an issue which cannot be captured by a standard downstream market power index. Also note that institutional features, including the regulations governing retail trade, are commonly assumed to be exogenous. This is important from an econometric point of view and presents an additional advantage over a simple market concentration ratio which is likely to be endogenous. Clearly the validity of this

assumption would depend on the extent to which these regulations do not vary over time. While these data point to a number of important aspects of the functioning of the retail sector, it should be noted that the regulatory indicators that we use concern the whole retail sector and not just food retailing as such. This should be kept in mind while interpreting our results. Based on these data we construct three variables: *Entry_barriers*, *Operational_restrictions* and *Price_controls*. Each index is ranging from 0 to 6 with higher values indicating more restrictive regulations. The former variable refers, among others, to restrictions on the establishment of large outlets. As such, they should strengthen the position of small- or medium-scale retailers, compared to large retailers, and thus act in favour of farmers' bargaining position *vis-à-vis* the retail sector. Consequently, we expect this variable to negatively affect the probability of asymmetric pricing.[9] On similar grounds, a negative sign is expected by the variable *Operational_restrictions* which provides information on the flexibility of legislation setting shop-opening hours. The assumption here is that these limits on hours bind predominantly larger outlets.

As far as the expected impact of *Price_controls* on price transmission asymmetry is concerned, it should be positive. This is because limits imposed on the price competition between retailers may result in stronger pressure to use a vertical pricing policy to increase market share. Asymmetric price adjustments can be regarded as an example of such a policy.

In some specifications we also take advantage of a commonly used market concentration ratio (e.g. Peltzman, 2000). More specifically, we define *Retail_CR5* as a variable measuring the share of the top five retailers in total sales. The source of this variable is the Planet Retail database (www.planetretail.com). As a more complex alternative, reflecting not just the situation in the retail sector, but its relative position with respect to the manufacturing sector, we use the variable *Food_retail*. It is defined as a variable measuring the ratio of the average turnover per manufacturing enterprise to the average turnover per retail enterprise. In contrast to the concentration ratio, this variable is defined for a given agricultural sector. The average is calculated over the period 1995–2008.[10] For the European Union (EU), this variable is based on Eurostat data. For the United States, the data come from the US Census Bureau Economic Indicators. Specifications including this variable are based on a somewhat smaller sample as for other non-EU countries the data are not available.

The fourth and final group of independent variables reflects upstream sector market organisational characteristics. We focus only on the EU countries and the USA, since we could not find comparable data for Japan, Switzerland or Turkey. Variable *Share* measures the relative size of the farm sector, captured by the number of farm holdings operating in a given sector (standardised over the total number of farm holdings in a given country). The inclusion of this variable is supported by predictions originating from the political economy literature suggesting that politicians, in order to secure election chances, cannot ignore the interests of those groups that may provide them with the highest numbers of votes. The assumption here is that politicians who cannot

[9]It should be noted, however, that entry barriers shelter incumbent retailers. Therefore, if the market is dominated by a few large retailers, an opposite effect of *entry_barriers* cannot be excluded.

[10]In some cases, however, data were not available for the full period, thus the average calculated over the shorter time span was used.

defy the majority wish need to make sure that their electorate is pleased by their actions and proposals. Given that asymmetric price transmission is often assumed to work in favour of downstream sectors (i.e. not in farmers' interests), this would mean that politicians should look for ways to foster symmetric pricing especially in those sectors where the potential electorate is numerous. To construct this variable, we use the EU Farm Accountancy Data Network (FADN) and US Department of Agriculture Economic Research Service (USDA-ERS) databases.

To further account for the fact that the price transmission mechanism can be related to government intervention, the average value of Nominal Rate of Assistance (*NRA_avg*) (by product during analysed period) is included among the regressors. The NRA measures the total transfer to agriculture as a percentage of the undistorted unit value and comes from the World Bank Agricultural Distortion Database (www.worldbank.org/agdistortions; for more on this database and the NRA see Anderson and Valenzuela, 2008). It captures how much support is given to farmers relative to the value of their production (valued using free market prices, not distorted by the state's intervention). The NRA is positive when agriculture is subsidised, negative when it is taxed, and equal to zero if the net transfers are zero. The rationale for inclusion of this variable in the model is based on Kinnucan and Forker (1987), who argue that retailers/wholesalers may asymmetrically adjust prices in expectation of government intervention on the market. More specifically, downstream sectors are likely not to respond to reductions in producer prices if they expect the government to support farmers. In line with this reasoning, we expect the *NRA_avg* to positively influence the presence of asymmetric price transmission.

Finally, to further control for farmers' bargaining power, we include two other variables aiming to capture the sector's farm structure. On the one hand, we control for the degree of farm fragmentation (variable *Small_farms*). To achieve that, for the

Table 7

Descriptive statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Linear_CI	101	0.08	0.27	0	1
Pre-CI	101	0.54	0.50	0	1
Monthly	101	0.90	0.30	0	1
Livestock	101	0.70	0.46	0	1
Observations	101	5.03	0.51	3.80	6.63
Europe	101	0.73	0.44	0	1
Western	101	0.62	0.48	0	1
Journal	101	0.35	0.48	0	1
WOS	101	0.23	0.42	0	1
Entry_barriers	99	3.10	0.87	0.20	4.02
Price_control	99	1.76	0.91	0.00	4.02
Operational_restrictions	99	2.81	1.10	1.01	4.07
Food_retail	92	23.97	24.37	0.51	119.58
Retail_CR5	99	52.92	19.34	21.43	86
Share	88	0.18	0.19	0.002	0.86
NRA_avg	77	0.47	0.40	0	1.85
Small_farms	93	0.15	0.13	0.002	0.57
Large_farms	93	0.25	0.16	0.01	0.75

Source: Own calculations based on sample literature.

EU countries we employ a proxy for the share of agricultural land utilised by farm holdings of economic size between 0 and 4 ESU. However, the USA has a different classification system for farm structure based on farm sales (Hoppe and Banker, 2010). Following the USDA-ERS classification we define small farms as a share of farms with sales of less than USD 100,000. On the other hand, to also control for the other extreme, we include the variable *Large_farms*. For the EU countries we measure the share of land operated by farm holdings equal to, or larger than 100 ESU. In the USA we apply the share of farms with sales of USD 1,000,000 and more. This variable aims to capture the relative strength of the largest farms. These data also come from the FADN and USDA-ERS. Since it is plausible to assume that a farm's economic size is positively related to its bargaining position *vis-à-vis* the downstream sector, we expect the variable *Small_farms* (*Large_farms*) to have a positive (negative) effect on the probability to observe asymmetric price transmission. Table 7 below displays means and standard deviations of the main variable of interest.

5. Results and Discussion

In order to examine the relationships between asymmetric price transmission and explanatory variables, we estimated various binary models. These are typically estimated by maximum likelihood after imposing distributional assumptions of error term. However, the semi-parametric literature emphasises that parametric estimators of discrete choice models are known to be sensitive to departures from distributional assumptions. Various estimators have been developed for correcting this restrictive nature of parametric models including the semi-nonparametric approach of Gallant and Nychka (1987) and the semi parametric maximum likelihood approach of Klein and Spady (1993). The recent literature emphasises that semi-nonparametric and semi-parametric maximum likelihood estimators substantially dominate the parametric probit maximum likelihood estimator (De Luca, 2008). Therefore, in this paper we employ the semi-nonparametric approach.

Based on equation (1), all four groups of variables listed above were jointly estimated through Models 1 to 4 (Table 8). The baseline specification, with all possible observations included, is reported in Model 1. Models 2, 3 and 4 present specifications with additional covariates, reducing the number of observations available to 72, 68 and 71, respectively. We begin with a brief discussion of the results with respect to the methodological variables. Firstly, in line with our expectations, the probability of detecting asymmetric price transmission is higher for studies using methodological approaches other than linear cointegration (significant in Models 1 and 2). Secondly, asymmetries are more likely to be found in studies using weekly rather than monthly data. This is fully in line with arguments and findings presented elsewhere (e.g. Von Cramon-Taubadel et al., 2006; Frey and Manera, 2007). Thirdly, a larger sample size increases the likelihood of concluding symmetrical PT. Finally, the *Livestock* dummy, positive and significant in Models 3 and 4, shows that asymmetries are found more often for livestock than for crop products.

The second group of explanatory variables considers geographical differences and accounts for the source of studies covered in our sample. Here the results are somewhat less consistent compared to the first group of explanatory variables. The *Europe* dummy is significant in three models, albeit negative in Models 1 and 2, and positive when all covariates are included (Model 4).

Table 8
Price transmission asymmetries – semi-nonparametric maximum likelihood estimator

Variables	Model 1	Model 2	Model 3	Model 4
Linear_CI	–0.85***	–2.06***	0.34	–0.61
Pre-CI	0.62	–0.07	0.51	2.66**
Monthly	–0.69*	–1.84***	–2.19***	–3.08***
Livestock	–0.12	–0.20	2.58***	2.31***
Observations	0.04	–0.61***	–2.51***	–3.75***
Europe	–1.67***	–2.06***	0.50	12.19***
Western	–0.38	–2.42***	–3.94***	–8.17***
Journal	–1.15***	–0.99***	–3.55***	–6.68***
WOS	0.85***	0.78**	–1.97***	–4.53***
Entry_barriers		–1.12***	–1.38***	–2.54***
Price_control		1.41***	1.11***	0.25
Operational_restrictions		0.19	1.19**	2.33***
Food_retail			–0.03***	
Retail_CR5				–0.28***
Share		–0.56	–6.13***	–9.88***
NRA_avg		0.36	1.27*	–0.80
Small_farms			10.33***	19.53***
Large_farms			0.64	–10.27***
N	101	72	68	71
AIC	55.24	52.38	52.31	49.56
BIC	89.24	93.36	98.92	97.08

Source: Own calculations.

The *Western* dummy is negative and significant across Models 2–4, suggesting that studies set in "old" EU Member States are more likely to identify symmetrical transmission than those reported in central-eastern European papers. The *Journal* dummy is significant and negative across estimations. It follows that journal papers are more likely to produce symmetric transmission results. This in turn might point to some publication bias in the data used. The dummy representing whether the paper was published in a journal included in the Web of Science (*WOS)* or not is significant in all four models, but positive in larger sample estimations and negative when the sample size is reduced due to the inclusion of further explanatory variables. A positive coefficient suggests a higher probability of asymmetric results in WoS whereas a negative coefficient implies the opposite. The Akaike and Schwarz–Bayesian information criteria (the last two rows of Table 8) also reach contradictory conclusions, thus the true effect of journal ranking is unclear.

We now turn to the core results of this paper, namely the linkage of the presence of price transmission asymmetries to the market organisational characteristics of the agro-food chain. The main results are reported in the lower two sections of Table 8. Firstly, estimation results for all variables in groups 3 and 4 are consistent and mostly significant (especially in Models 3 and 4). Starting with the impact of regulations affecting the retail sector, we find that asymmetric price transmission is less likely in a scenario where retailers' activities are constrained by *Entry_barriers* regulations and this result seems to be very robust. This result is in line with our expectations. One may assume that entry barriers, if put in place, are mostly directed against large-scale

retailers. This, in turn, should act in favour of smaller retailers, possibly allowing them to increase their market share and thus in favour of farmers whose bargaining position *vis-à-vis* smaller retailers is stronger. Consequently, our results are consistent with the considerations stating that the more balanced the bargaining power of farmers and retailers, the more likely it is that one should observe symmetric price transmission. This argument finds also support in the effect of variables capturing the degree of farm fragmentation/concentration (see below).

Surprisingly, we find some evidence that price transmission is more likely to be asymmetric in the presence of regulations restricting shop opening hours (*Operational_restrictions)*. We would have expected this variable to affect the price transmission mechanism in a similar manner as *Entry_barriers*, and more research into this specific regulation is necessary to explain this discrepancy.

Further, robust results (*Price_control* variable) indicate that price movements tend to be more asymmetric if price competition between retailers is limited (price controls may forbid, for instance, dumping prices/keeping retail prices too low). A possible interpretation for this result is that, as price controls (strongly) limit the set of "horizontal-competition" tools that retailers may use to increase their market share, they may resort to "vertical-competition" tools, i.e. try to increase their market share through delayed and/or asymmetric adjustments in prices along the supply chain.

We next look at the potential impact of the size and concentration of the retail industry. Two alternative variables are used here. In Model 3, the variable *Food_retail* emphasises that farm–retail price transmission asymmetry is less likely to occur when food manufacturing turnover (per enterprise) relative to retailers' turnover is higher. A potential explanation draws on the fact that in the situation where the processing industry plays a dominant role in the supply chain, price asymmetries may appear in farm–processor and processor–retailer relationships. In such cases, farm and retail prices may move together, so symmetric transmission is more likely to be observed. In Model 4, the more conventional concentration ratio of the five largest retailers (*Retail*_CR5) is used instead of the relative weight of manufacturing with respect to the retailing sector (*Food_retail*). At first glance, the significantly negative sign of the explanatory variable looks counterintuitive, suggesting that higher retail concentration leads to symmetrical transmission. However, this result is not unprecedented. Peltzman (2000) finds that, when retail concentration (instead of number of competitors) is used to explain PT, the result is less asymmetry. Swinnen and Vandeplas (2010) discuss the more complex and nuanced effect that retail concentration has on efficiency and rent distribution in supply chains, presenting a number of papers reaching contradictory results. The authors develop a theoretical model and show that the concentration growth has contributed to welfare gains through scale effects, and conclude that "in the presence of market imperfections and contract enforcement problems, efficiency premiums in vertically coordinated contract arrangements may provide additional benefits to farmers" (Swinnen and Vandeplas, 2010, p. 118), i.e. higher concentration does not necessarily translate into the abuse of downstream market power.

Finally, the fourth group of explanatory variables assesses the impact of upstream (farm) sector market organisational characteristics upon PT. The coefficient of the *Share* variable is persistently negative and in most cases statistically significant. It follows that the bigger the relative size of the sector under investigation, the lower the probability of asymmetric price transmission. As we argued above, a possible

explanation of the negative coefficient might be that a higher share of farms operating in a specific sector with respect to total number of farms reflects the importance of that sector for politicians and regulators. This refers to political economy considerations that put both social as well as voting issues to the fore. Regarding the impact of government intervention, we find weak evidence that is in line with the theory formulated by Kinnucan and Forker (1987). More specifically, we find a positive influence on price transmission asymmetry, suggesting that downstream industries are (perfectly) aware and anticipate government farm intervention when deciding upon pricing strategies. This result however is statistically significant only in one model (Model 3).

The last two explanatory variables provide further insights about the role that farm structure may play in the price transmission mechanism. Asymmetric movements are positively correlated with the share of land operated by the smallest holdings (*Small_farms)* and negatively correlated with the share of land used by *Large_farms*[11] (Models 3 and 4). These results (Table 8) seem to be very robust, suggesting that the presence of asymmetric price transmission is more (less) likely the more fragmented (concentrated) is the farm structure which is fully consistent with expectations.

6. Conclusions

In this paper we investigate the underlying reasons for price transmission (a)symmetries. Our methodology rests on meta-analysis and thus empirical results obtained from a number of studies in the field. More specifically, we try to relate the presence/absence of price transmission asymmetry in farm–retail relationships detected by the existing studies to various characteristics of the agro-food supply chain. Our focus is on factors that are likely to affect the bargaining power of actors operating at subsequent stages of the supply chain. This is motivated by the fact that the presence of market power in the downstream sectors of the agro-food chain is often quoted as the reason for price transmission asymmetries. Yet, notwithstanding its appealing nature, this argument is not self-evident and there are both theoretical and empirical studies that argue that the relationship between market power and asymmetric pricing need not be positive. In response, in this paper we aim at providing some more evidence on this. In addition, we investigate the extent to which the results found in the literature on price transmission are influenced by the methodological approaches that formed the basis for these findings.

Overall, our results are in line with the existing theories predicting that price transmission asymmetries are more likely in the presence of factors negatively affecting farmers' bargaining power. More specifically, we find that asymmetries are present in sectors with higher numbers of fragmented farm producers and less likely to occur with more concentrated farm structures. Interestingly, the price transmission mechanism seems to be symmetric in sectors that are likely to have high political clout. Moreover, and in line with findings from other studies (e.g. Peltzman, 2000), our results point to a positive association between symmetric price transmission and retailers' market power as measured by a seller concentration index. This in turn may suggest that food markets are characterised by imperfections which provide additional

[11]As discussed in the variables description section, the measure of small and large farms is not uniform for Europe and USA.

benefits to farmers (Swinnen and Vandeplas, 2010). Further, price transmission asymmetries seem to be related to the regulatory framework that governs the operation of the retail sector. Our results suggest that asymmetries are less likely in the presence of entry barriers to retail trade but more likely in the presence of operational restrictions that affect shop opening hours. On the other hand, distortions in the price relationship between retailers and suppliers are more likely to occur in the presence of regulations limiting price competition between retailers. Finally, we provide some evidence to show that the farm–retail price relationship tends to be asymmetric in the presence of governmental intervention and symmetric in the presence of a strong processing sector. The latter may be valid if processors are dominant players in the supply chain and thus influence both farm and retail prices.

The main message that comes out of these results is that price transmission asymmetry should not be seen only from the perspective of retailer's market power. Equally, if not more, important seems to be the market structure at other stages of the food chain. Therefore, policy actions that aim at correcting asymmetric pricing could target both upstream and downstream sectors. This seems to be particularly important for countries/settings where considerable structural changes are still expected. That said, and this is the second implication that arises from our work, one should remember that price transmission asymmetries could result from politicians' actions. It follows that the patterns of price adjustments can be seen as an outcome of complex interactions between various motivations of not only actors operating at subsequent stages of the food chain, but also of political elites.

Obviously, our results come with several caveats. First, there is a question as to what extent our results are affected by the so-called omitted variables bias. Note that our data do not provide any information about consumer search costs, stock management practices or menu costs that are factors mentioned as important price transmission determinants in addition to market power. This, in turn, may impact our results. Further, we do not have any direct measure of the bargaining power of agents operating at subsequent stages of the supply chain. Consequently, we have to rely on proxies. This raises the question of whether these proxies are indeed appropriate. While we go beyond the commonly used seller concentration ratios, our measures may still be criticised as capturing only the potential to exercise market power and need not imply this power being actually exploited. Nevertheless, we believe that the approach that we have adopted can help to improve our understanding of the factors responsible for asymmetric price movements. Clearly, much remains to be done. However we hope this paper is a building block towards bridging the gap between theory and empirics with respect to the causes of (a)symmetric price transmission.

Two findings that arise from our work could be especially interesting and worthy of further investigation. Firstly, our results suggest that a fruitful line for future research on price transmission could be to analyse it from a political economy perspective. It seems particularly interesting to analyse to what extent price transmission could be affected by the strategic behaviour of politicians aiming at winning the elections. Secondly, our results suggest that, except for horizontal price competition, downstream sectors in the agro-food chain may use vertical price competition. While intriguing, this point has received relatively little attention in the agricultural economics literature.

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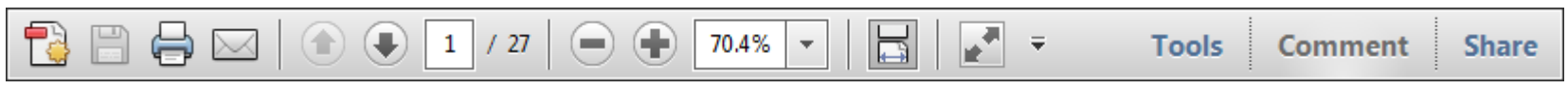
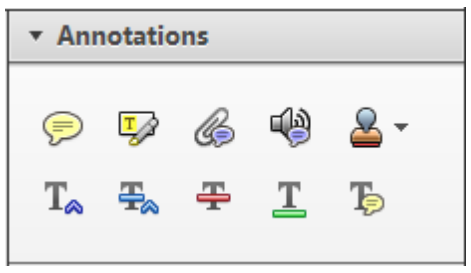
Once you have Acrobat Reader open on your computer, click on the Comment tab at the right of the toolbar:



This will open up a panel down the right side of the document. The majority of tools you will use for annotating your proof will be in the Annotations section, pictured opposite. We've picked out some of these tools below:

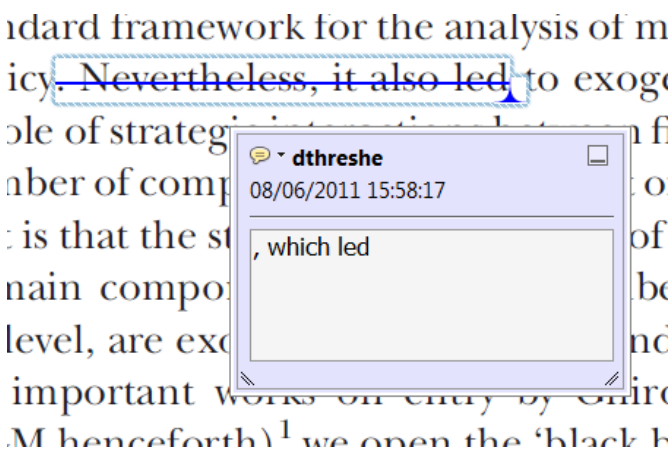


1. Replace (Ins) Tool – for replacing text.

Strikes a line through text and opens up a text box where replacement text can be entered.

How to use it

- Highlight a word or sentence.
- Click on the Replace (Ins) icon in the Annotations section.
- Type the replacement text into the blue box that appears.

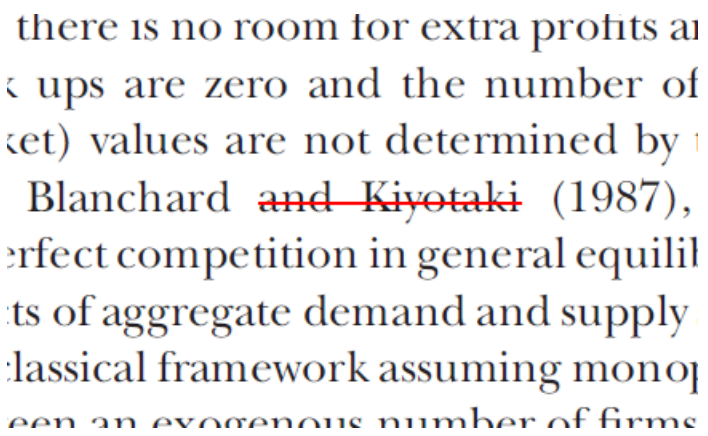


2. Strikethrough (Del) Tool – for deleting text.

Strikes a red line through text that is to be deleted.

How to use it

- Highlight a word or sentence.
- Click on the Strikethrough (Del) icon in the Annotations section.

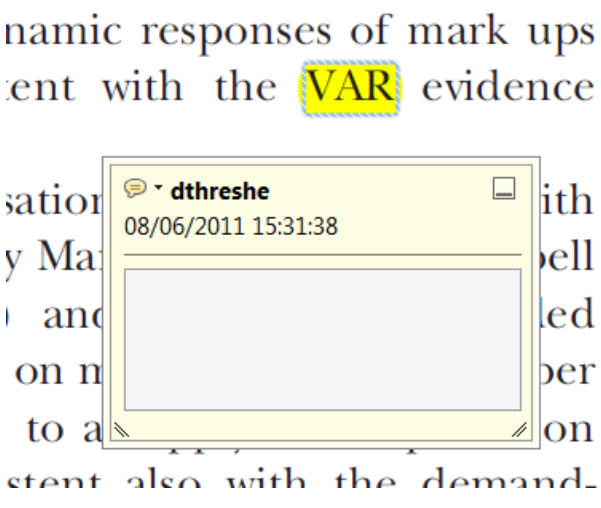


3. Add note to text Tool – for highlighting a section to be changed to bold or italic.

Highlights text in yellow and opens up a text box where comments can be entered.

How to use it

- Highlight the relevant section of text.
- Click on the Add note to text icon in the Annotations section.
- Type instruction on what should be changed regarding the text into the yellow box that appears.

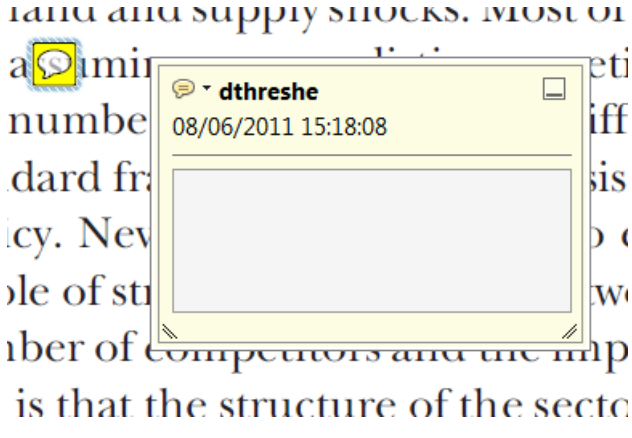


4. Add sticky note Tool – for making notes at specific points in the text.

Marks a point in the proof where a comment needs to be highlighted.

How to use it

- Click on the Add sticky note icon in the Annotations section.
- Click at the point in the proof where the comment should be inserted.
- Type the comment into the yellow box that appears.



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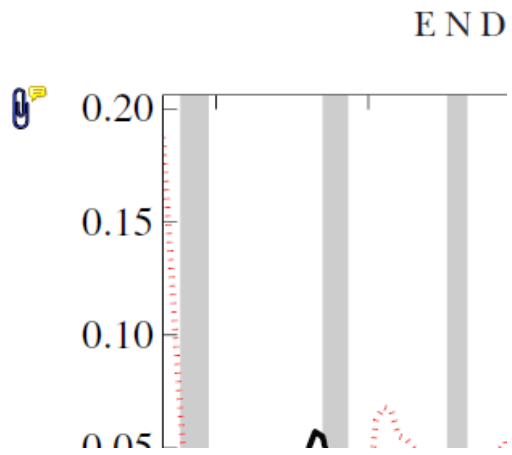
5. Attach File Tool – for inserting large amounts of text or replacement figures.

Inserts an icon linking to the attached file in the appropriate pace in the text.

How to use it

- Click on the Attach File icon in the Annotations section.
- Click on the proof to where you'd like the attached file to be linked.
- Select the file to be attached from your computer or network.
- Select the colour and type of icon that will appear in the proof. Click OK.

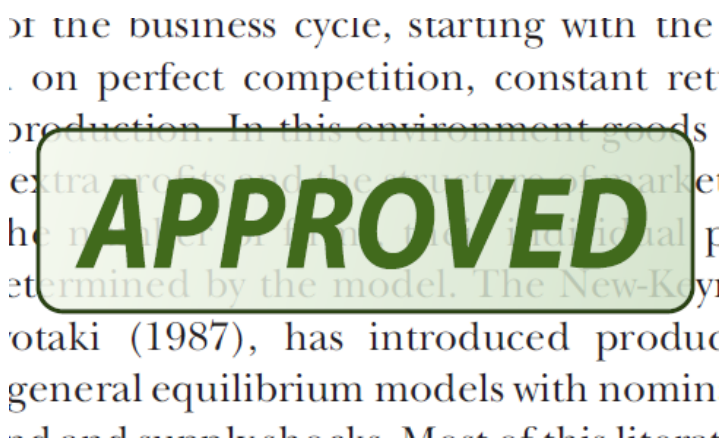


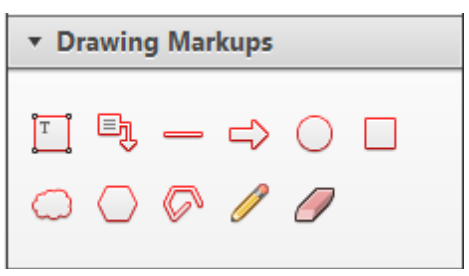
6. Add stamp Tool – for approving a proof if no corrections are required.

Inserts a selected stamp onto an appropriate place in the proof.

How to use it

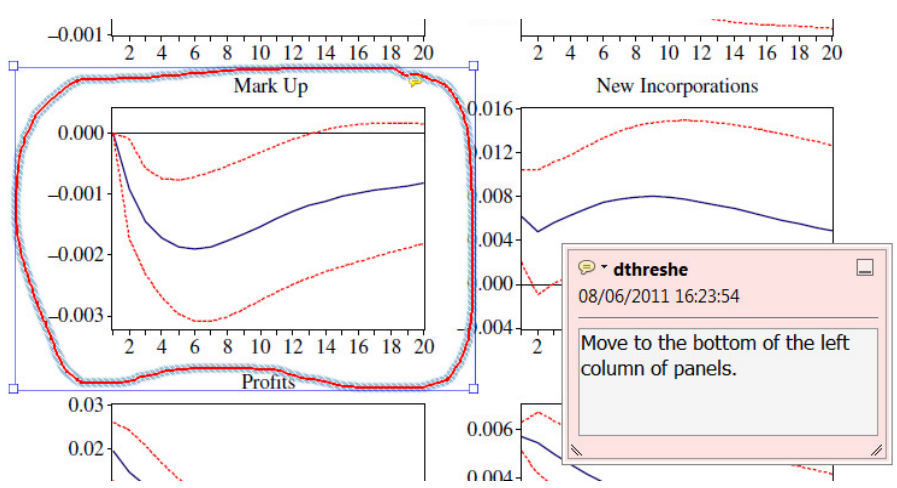
- Click on the Add stamp icon in the Annotations section.
- Select the stamp you want to use. (The Approved stamp is usually available directly in the menu that appears).
- Click on the proof where you'd like the stamp to appear. (Where a proof is to be approved as it is, this would normally be on the first page).





7. Drawing Markups Tools – for drawing shapes, lines and freeform annotations on proofs and commenting on these marks.

Allows shapes, lines and freeform annotations to be drawn on proofs and for comment to be made on these marks..



How to use it

- Click on one of the shapes in the Drawing Markups section.
- Click on the proof at the relevant point and draw the selected shape with the cursor.
- To add a comment to the drawn shape, move the cursor over the shape until an arrowhead appears.
- Double click on the shape and type any text in the red box that appears.

For further information on how to annotate proofs, click on the Help menu to reveal a list of further options: