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Short Communication

On perishability and Vertical Price Transmission: empirical evidences from Italy

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Abstract. Studies on the causes for asymmetries in vertical price transmission date back to decades ago, but the attention of theorists and empirical economists is still vivid. In particular the role of perishability is not fully defined. We investigate the vertical price transmission for a heterogeneous group of fruits and vegetables that differ for their degree of perishability. The error correction model we estimate allows to conclude that asymmetries in vertical price transmission tend to vanish for perishable products.

Keywords. Asymmetries, AVECM, fruits and vegetables, perishability, Vertical Price Transmission

JEL code. Q11, Q13, C32, D40

1. Introduction

The interest in price transmission, and the number of studies focused on these topics, have rapidly increased during last decades (e.g.Griffith and Piggott, 1994; Benson *et al.*, 2008; Santeramo, 2010; Cioffi *et al.*, 2011; Santeramo and Cioffi, 2012a; Santeramo and Cioffi, 2012b; Abdelradi and Serra, 2015; Kinnucan and Zhang, 2015; Santeramo, 2015; Garcia-German *et al.*, 2016): the implications they have on agricultural markets, industrial strategies, producer and consumer welfare are strong. Studies on vertical price transmission (VPT) have preeminently addressed four topics (Vavra and Goodwin, 2005): the magnitude of price shocks transmission along the supply chain, the speed of transmission, the nature of price transmission in term of symmetry and asymmetries, and the direction of transmission (*i.e.* whether a shock is transmitted upwards or downwards). Asymmetries in VPT may be due to imperfect competition (*i.e.* market power), adjustment costs, inventory management, political interventions, or asymmetric information (Meyer and von Cra-

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mon-Taubadel, 2004). A vast majority of studies (and scholars) have analyzed the effects of imperfect competition on VPT (e.g. McCorriston *et al.*, 1998; McCorriston *et al.*, 2001; Bunte and Peerlings, 2003; Lloyd *et al.*, 2006; Tekgüç, 2013; Assefa *et al.*, 2014); the other possible explanations for asymmetries remain quite underinvestigated (few exceptions are Saghaian, 2007; Abbassi *et al.*, 2012; Santeramo, 2015).

We depart from previous studies by focusing on the role of adjustments costs and in particular on the role of perishability on VPT. We use monthly prices of ten products that differ for their degree of perishability. Apart from reviewing the current knowledge on VPT our main contribution is to provide empirical evidence on how perishability and asymmetries are related.

2. What causes Asymmetries in vertical price transmission?

Asymmetric VPT (AVPT) has been motivated in several ways: market power, adjustment costs, inventory management, government interventions, asymmetric information, perishability.

McCorriston *et al.* (1998, 2001) and Lloyd *et al.* (2006) link market power and imperfect VPT. Bailey and Brorsen (1989) point out that there is not an *a priori* explanation on whether market power leads to positive or negative asymmetry. A vast majority of authors (*e.g.* Boyd and Brorsen, 1988; Karrenbrock, 1991; Appel, 1992; Griffith and Piggott, 1994; Mohanty *et al.*, 1995) suggest that market power can lead to asymmetric transmission, most predicting a positive asymmetric price transmission[1]. Peltzman (2000) shows that positive asymmetric price transmission is detected in both concentrated and atomistic markets[2], while Tappata (2009) derives a model of asymmetric price transmission in highly competitive markets.

Another major explanation for asymmetric price transmission (AVPT) is provided by asymmetric adjustment costs[3] arising when firms change the quantities and/or prices of inputs and/or outputs. Bailey and Brorsen (1989) and Peltzman (2000) argue that positive AVPT is consistent with the easiness for firms facing output reduction to disemploy inputs rather than to recruit new inputs in order to increase output. On the contrary, Ward (1982) suggests that AVPT is plausible in markets of perishable products in that retailers might hesitate to raise prices for fear of reduced sales leading to spoilage. Heien (1980) argues that changing prices is less of a problem for perishable products as their prices are more dynamics.

Inventory management determines how firms adjust to exogenous shocks and thus may lead to AVPT (Balke *et al.*, 1998). Blinder (1982) argues that inventory management leads to positive AVPT: in periods of low demand firms will adjust the quantity produced and increase inventory rather than decrease output prices, increasing prices during periods of high demand (Reagan and Weitzman, 1982).

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[1] According to Meyer and von Cramon-Taubadel (2004), positive price transmission mean that prices react more to price rises than to price falls.

[2] The results by Peltzman (2000) on positive asymmetric price transmission are confirmed by several applied studies in agricultural sectors: pork (Abdulai, 2002; Gervais, 2011); vegetables (Brooker *et al.*, 1997); fruits (Pick *et al.*, 1990), among others.

[3] The adjustment costs are defined as costs associated with changing retail prices and subsequently adapting retail logistics, wholesale costs and sales (e.g. advertisement and relabeling costs, storage and volume discounts, etc.).

Gardner (1975) explains the asymmetries in farm-to-retail price dynamics focusing on the role of government interventions to support producer prices. Kinnucan and Forker (1987), and Serra and Goodwin (2003) provide some evidence for diary products in support of Gardner's thesis.

Kinnucan and Forker (1987) and von Cramon-Taubadel (1998) predict a stronger impact of retail-level demand shifts than of farm-level supply shifts on the farm-retail price spread. According to Kinnucan and Forker (1987) the different impacts imply AVPT, while Von Cramon-Taubadel (1998) underlines that only if one type of shift is predominantly positive or negative AVPT will arise.

Bailey and Brorsen (1989) conclude on the role of asymmetric information in determining AVPT and point out that asymmetries in price series data can result from a distorted price reporting process.

As for perishability, contradictory theories have been proposed. Ward (1982) suggests that in perishable goods markets price decreases are likely to be fully passed on to the retail and producer level sectors while price increases are partially transmitted. Girapunthong *et al.* (2003) confirm Ward's theory for fresh tomatoes markets: wholesale prices react more to falling producer prices than to rising producer prices. Heien (1980) argues that changing prices is less of a problem for perishable products than it is for those with a long shelf life. Sexton *et al.* (2003) suggest that price rises are faster transmitted than price falls which can be avoided by retailers able to exert market power on wholesalers. The empirical literature provides mixed results (Table 1).

3. Perishability and Vertical Price Transmission

In order to understand the role played by perishability on AVPT we proceed in two steps. First (LHS of equation 1) we ask ourselves if price changes at different levels of the supply chain of perishable products (e.g. producer ΔP^1 and wholesaler prices ΔP^2, or wholesaler ΔP^1 and retailer prices ΔP^2 *etc.*) react differently to positive ΔP^1_+ and negative ΔP^1_- price changes. Second (RHS of equation 1), we observe how the degree of perishability (i.e. the expected losses for spoilage) is related with AVPT:

$$0 \neq E\left[\frac{\Delta P^2}{\Delta P^1_+} - \frac{\Delta P^2}{\Delta P^1_-}\right] = f\left(Per.\right) \qquad \textit{(Perishability and AVPT)} \qquad (1)$$

We do not have *a priori* expectations: Heien (1980) argues that changing prices is less of a problem for perishable products than it is for those with a long shelf life, because for the latter changing prices incurs higher time costs and losses of goodwill; on the contrary Ward (1982) hypothesizes that retailers selling perishable goods might be reluctant to raise prices in line with an increase in farm-level prices given the risk that they will be left with unsold spoiled product.

We have extracted monthly prices (at wholesale level, and representative of national prices) for 29 products from the ISMEA Osservatorio Prezzi Ortofrutta database: 14 fresh vegetables (artichokes, carrots, cauliflowers, onions, green beans, fennel, radishes, lettuces, eggplants, potatoes, peppers, tomatoes, spinaches and zucchinis), and 15 fresh

Table 1. Major findings in applied analyses of Vertical Price Transmission in perishable markets

Author	Journal	Year	Product	Frequency	Results
Aguiar & Santana	Agribusiness	2002	Tomatoes	Monthly	Positive Asymmetry
			Onions	“	Symmetry
Bakucs, *et al.*	Studies in Agricultural Economics	2007	Potatoes	Monthly	Symmetry
			Carrots	“	Symmetry
			Parsley	“	Symmetry
			Tomatoes	“	Positive Asymmetry
			Peppers	“	Symmetry
Bernard &Willett	Journal of Agricultural and Applied Economics	1996	Broiler	Monthly	Negative Asymmetry
Bernard &Willett	Applied Economics Letters	1998	Broiler	Weekly	Symmetry
			Broiler	Monthly	Positive Asymmetry
Brooker *et al.*	Journal of Food Distribution Research	1997	Peppers	Weekly	Positive Asymmetry
Hassan &Simioni	Économie Rurale	2004	Tomatoes	Weekly	Negative Asymmetry
			Chicory	“	Negative Asymmetry
Girapunthong *et al.*	Journal of Food Distribution Research	2003	Tomatoes	Monthly	Asymmetry[b]
Hassan &Simioni	Économie Rurale	2004	Chicory	Weekly	Symmetry
			Tomatoes	“	Symmetry
Heien	American Journal of Agricultural Economics	1980	Potatoes	Monthly	Positive Asymmetry
			Apples	“	Symmetry
			Oranges	“	Negative Asymmetry
			Lettuce	“	Symmetry
			Tomatoes	“	Symmetry
Kuiper &Lansink	Agribusiness	2013	Broiler	Monthly	Positive Asymmetry
			Apples	Monthly	Symmetry
			Carrots	“	Symmetry
			Potatoes	“	Symmetry
Pick *et al.*	Agribusiness	1990	Lemons	Weekly	Positive Asymmetry[c]
			Oranges	“	Positive Asymmetry[c]
Powers	Agribusiness	1995	Lettuce	Weekly	Positive Asymmetry

Author	Journal	Year	Product	Frequency	Results
Schertz Willet *et al.*	Agribusiness	1997	Apples	Monthly	Positive Asymmetry
Ward	American Journal of Agricultural Economics	1982	Carrots	Monthly	Symmetry
			Celery	“	Negative Asymmetry
			Cabbage	“	Negative Asymmetry
			Cucumbers	“	Symmetry
			Peppers	“	Negative Asymmetry
			Potatoes	“	Negative Asymmetry
			Tomatoes	“	Negative Asymmetry
Worth	Economic Research Service	1999	Carrots	Monthly	Positive Asymmetry
			Celery	“	Symmetry
			Lettuce	“	Symmetry
			Onions	“	Symmetry
			Potatoes	“	Symmetry
			Tomatoes	“	Positive Asymmetry

[a] Results on symmetry, positive and negative asymmetry depend on time frequency.
[b] Positive asymmetry among wholesaler and retailer prices; Negative asymmetry among wholesaler and producer prices
[c] However, over time price changes appear to be symmetric.

fruits (kiwis, apricots, watermelons, oranges, cherries, clementines, strawberries, tangerines, lemons, apples, melons, pears, peaches and nectarines, plums and table grapes)[4]. We observe prices at three stages of the supply chain - origin, wholesale, and retail – from 2001 to 2011: producer prices are collected on more than thirty collection points, representative markets for volume of production and geographical position; wholesaler prices are collected by Fedagromercati on the main wholesaler markets; retail prices are based on sales from surveys on domestic purchases of Italian families. We selected products in order to include heterogeneous products according to their perishability, avoiding price series with discontinuities and several missing values[5]. The final dataset consists of three *low perishable* vegetables - carrots, potatoes and peppers –four *medium perishable* vegetables – tomatoes, cauliflowers, radishes, eggplants[6], and three *low perishable* fruits - lemons, apples and pears.

In line with several scholars (Griffith and Piggott, 1994; Powers, 1995; Brooker *et al.*, 1997; and Worth, 1999; Girapunthong *et al.*, 2003; Sexton *et al.*, 2003), we assume that producer prices lead wholesale prices, and wholesale prices lead retail prices. We estimated an unrestricted error correction model (von Cramon-Taubadel, 1998; Peltzman, 2000) which allows to capture asymmetries, and long-run and short-run adjustments, and to control for seasonality:

$$\Delta P_t^i = \gamma_0 + \gamma_T T + \gamma_1 \Delta P_{t-1}^i + \gamma_2 \Delta P_{t-1}^j + \alpha^+ ECT_{t-1}^+ + \alpha^- ECT_{t-1}^- + \varepsilon_t \quad (2)$$

and $ECT_{t-1} = P_{t-1}^i - \beta_0 - \beta_1 P_{t-1}^j$ (3)

$\Delta P_t^i = P_t^i - P_{t-1}^i$ the apexes *i* and *j* represent the supply chain level (origin, wholesale or retail), *ECT* the error correction term, $T = 11, \ldots, 12$ controls for α^+ and α^- adjustment coefficients) are statistically different the price transmission is asymmetric.

We test for unit-roots using augmented Dickey-Fuller (Dickey and Fuller, 1981), Philips-Perron (Perron, 1988), and Zivot-Andrews (Zivot and Andrews, 1992) tests. All series are stationary in level or in their first difference (Table 2).

The estimates of the error correction models (Tables 3 and 4) suggest that prices tend to correct their dynamics and converge towards the equilibrium.

The test for asymmetries (Table 5) is in 17 out of 40 (43%) cases in favor of AVPT. However, asymmetries are found in 16 out of 24 (67%) cases for "low perishable" vegetables and for fruits and only in 1 out of 16 (6%) cases for "medium perishable" vegetables. Our evidence favors several theories and empirical studies: Peltzman (2000) observes weaker evidence of AVPT for perishable products; Ward (1982) argues that sellers of perishable goods might be reluctant to raise prices in line with an increase in farm-level prices given the risk that they will be left with unsold spoiled product; Serra

[4] Some of these products are characterized by different market cycles and seasonality in production and consumption, therefore prices cannot be observed throughout the entire year.
[5] In order to avoid bias due to missing values we restricted the analysis to time series for which missing values represent less than 5% of the total sample. The series have been interpolated in order to obtain continuous series.
[6] Our classification of fruits and vegetables according to their perishability relies on a report from the USDA (2009). We consider medium perishable the vegetables incurring in average losses for spoilage during transportation larger than the 10% of the traded volume, and low perishable those for which spoilage is lower.

Table 2. Unit root tests (p-values for ADF, PP tests and test statistics for ZA test).

	LowperishableVegetables			Medium perishableVegetables				*Fruits*		
	Carrots	Peppers	Potatoes	Cauliflower	Eggplants	Tomatoes	Radishes	Apples	Lemons	Pears
Producer										
ADF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	<0.01
PP	<0.01	<0.01	0.047	<0.01	<0.01	<0.01	<0.01	0.044	<0.01	<0.01
ZA	-7.85	-7.54	-4.17	-6.97	-7.51	-7.76	-6.63	-4.10	-5.92	-5.88
Wholesaler										
ADF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.048	<0.01	0.014
PP	<0.01	<0.01	0.013	<0.01	<0.01	<0.01	<0.01	0.164	0.015	0.076
ZA	-7.33	-7.47	-4.54	-6.88	-7.72	-7.47	-7.14	-3.93	-5.24	-4.30
Retailer										
ADF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011
PP	<0.01	<0.01	0.471	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	0.047
ZA	-5.10	-7.92	-4.14	-7.46	-8.01	-7.34	-7.14	-4.91	-5.19	-5.09

The null hypothesis for the ADF and PP tests is unit root. The null hypothesis for the ZA test is stationarity. The number of lags is suggested by Information Criteria.
ZA critical values 1% = 5.57 , 5% = -5.08 , 10% = -4.82.

Table 3. Estimated ECM model for producer and wholesaler prices.

	LowperishableVegetables			Medium perishableVegetables				Fruits		
	Carrots	Peppers	Potatoes	Cauliflower	Eggplants	Tomatoes	Radishes	Apples	Lemons	Pears
$P^w = f(P^p)$										
γ_0	0.051	0.114	0.039	0.029	-0.187	-0.044	0.174	0.058	0.056	0.047
	(0.015)	(0.066)	(0.012)	(0.048)	(0.079)	(0.077)	(0.137)	(0.021)	(0.028)	(0.024)
γ_T	-0.006	-0.009	-0.004	-0.005	0.031	0.011	-0.031	-0.004	-0.004	-0.002
	(0.002)	(0.009)	(0.001)	(0.006)	(0.010)	(0.009)	(0.015)	(0.003)	(0.004)	(0.003)
γ_1	0.225	0.151	-0.018	0.515	0.075	0.393	0.027	0.113	0.141	0.026
	(0.090)	(0.124)	(0.107)	(0.170)	(0.140)	(0.173)	(0.141)	(0.098)	(0.124)	(0.126)
γ_2	-0.022	0.220	0.381	-0.721	0.033	-0.272	0.111	-0.038	0.694	0.094
	(0.070)	(0.220)	(0.133)	(0.245)	(0.186)	(0.186)	(0.208)	(0.164)	(0.341)	(0.168)
α^+	-0.524	-0.530	-0.516	-0.935	-0.177	-0.449	-0.276	-0.795	-0.497	-0.491
	(0.160)	(0.144)	(0.138)	(0.302)	(0.173)	(0.314)	(0.202)	(0.183)	(0.162)	(0.152)
α^-	-0.325	-0.161	-0.123	-0.735	-0.142	-0.204	-0.467	0.069	0.108	0.092
	(0.205)	(0.258)	(0.204)	(0.346)	(0.204)	(0.357)	(0.334)	(0.198)	(0.275)	(0.169)
$P^p = f(P^w)$										
γ_0	0.066	0.031	0.027	-0.027	-0.196	-0.106	0.154	0.002	0.008	0.007
	(0.021)	(0.043)	(0.012)	(0.035)	(0.059)	(0.070)	(0.096)	(0.013)	(0.009)	(0.019)
γ_T	-0.007	-0.004	-0.001	-0.002	0.029	0.015	-0.021	0.000	0.000	0.002
	(0.003)	(0.006)	(0.001)	(0.004)	(0.007)	(0.008)	(0.011)	(0.002)	(0.001)	(0.002)
γ_1	0.044	0.002	0.313	-0.430	-0.036	-0.334	-0.028	0.379	0.136	0.398
	(0.096)	(0.145)	(0.135)	(0.147)	(0.140)	(0.170)	(0.145)	(0.100)	(0.110)	(0.132)
γ_2	-0.238	0.063	-0.246	0.267	0.026	0.315	0.067	-0.046	0.097	-0.180
	(0.124)	(0.082)	(0.109)	(0.097)	(0.105)	(0.158)	(0.099)	(0.060)	(0.040)	(0.099)
α^+	-0.087	-0.115	-0.457	0.415	0.156	0.339	0.008	0.108	-0.026	-0.172
	(0.221)	(0.095)	(0.140)	(0.365)	(0.130)	(0.287)	(0.141)	(0.112)	(0.052)	(0.119)
α^-	0.752	-0.101	0.336	-0.812	0.088	0.222	0.127	0.029	0.240	0.112
	(0.284)	(0.170)	(0.207)	(0.615)	(0.153)	(0.327)	(0.234)	(0.121)	(0.089)	(0.133)
Obs.	124	124	124	124	124	124	124	124	124	124

Standard errors in parenthesis.
P^p and P^w stand for producer and wholesaler price respectively.

Table 4. Estimated ECM model for wholesaler and retailer prices.

	LowperishableVegetables			Medium perishableVegetables				*Fruits*		
	Carrots	Peppers	Potatoes	Cauliflower	Eggplants	Tomatoes	Radishes	Apples	Lemons	Pears
$P^r = f(P^w)$										
γ_0	0.068	0.097	0.105	0.087	-0.182	-0.006	0.166	0.064	0.057	0.078
	(0.022)	(0.079)	(0.025)	(0.049)	(0.064)	(0.063)	(0.106)	(0.025)	(0.030)	(0.036)
γ_T	-0.007	-0.001	-0.007	-0.012	0.031	0.012	-0.027	-0.003	-0.003	-0.006
	(0.002)	(0.009)	(0.003)	(0.006)	(0.009)	(0.008)	(0.013)	(0.003)	(0.004)	(0.004)
γ_1	0.128	0.090	-0.230	-0.037	0.135	0.231	0.521	0.176	0.031	0.272
	(0.128)	(0.158)	(0.089)	(0.154)	(0.180)	(0.193)	(0.155)	(0.127)	(0.142)	(0.166)
γ_2	-0.082	0.225	0.259	0.106	0.026	-0.018	-0.365	-0.085	0.168	-0.221
	(0.153)	(0.161)	(0.174)	(0.138)	(0.173)	(0.187)	(0.129)	(0.165)	(0.134)	(0.221)
α^+	-0.617	-0.602	-0.867	-0.467	-0.333	-0.731	-0.479	-1.221	-0.370	-0.659
	(0.297)	(0.281)	(0.148)	(0.341)	(0.293)	(0.328)	(0.223)	(0.169)	(0.230)	(0.227)
α^-	0.219	0.269	0.346	-0.216	-0.296	0.060	-0.616	0.047	0.221	0.012
	(0.318)	(0.264)	(0.185)	(0.278)	(0.370)	(0.316)	(0.256)	(0.199)	(0.168)	(0.287)
$P^w = f(P^r)$										
γ_0	0.026	0.053	0.030	0.071	-0.257	-0.052	0.076	0.061	0.057	0.048
	(0.019)	(0.071)	(0.015)	(0.054)	(0.067)	(0.068)	(0.129)	(0.024)	(0.033)	(0.029)
γ_T	-0.004	0.003	-0.003	-0.004	0.039	0.016	-0.017	-0.005	-0.005	-0.002
	(0.002)	(0.008)	(0.002)	(0.007)	(0.010)	(0.009)	(0.016)	(0.003)	(0.004)	(0.003)
γ_1	0.156	0.092	0.238	0.026	-0.175	0.105	-0.326	0.274	0.057	0.021
	(0.132)	(0.144)	(0.100)	(0.152)	(0.181)	(0.202)	(0.156)	(0.155)	(0.148)	(0.180)
γ_2	-0.054	0.177	0.043	-0.010	0.281	0.094	0.506	-0.155	0.212	0.060
	(0.110)	(0.141)	(0.051)	(0.169)	(0.188)	(0.208)	(0.188)	(0.119)	(0.157)	(0.136)
α^+	0.338	-0.056	-0.042	-0.320	0.183	-0.183	0.101	-0.514	0.013	-0.304
	(0.257)	(0.251)	(0.085)	(0.374)	(0.305)	(0.353)	(0.270)	(0.159)	(0.254)	(0.186)
α^-	-0.168	0.740	0.113	0.669	0.052	0.441	-0.186	0.237	0.429	0.240
	(0.275)	(0.236)	(0.106)	(0.305)	(0.386)	(0.340)	(0.310)	(0.187)	(0.186)	(0.235)
Obs.	124	124	124	124	124	124	124	124	124	124

Standard errors in parenthesis. P^w and P^r stand for wholesaler and retailer price respectively.

and Goodwin (2003) find asymmetric price transmission in the diary sector while no evidences of asymmetric price transmission along the supply chain of perishable diary products; Kim and Ward (2013, p. 234) state that "*prices higher in the vertical system respond quicker to rising than falling prices, again, except for the most perishables*."

4. Concluding remarks

Asymmetries in VPT may be due to imperfect competition, adjustment costs, inventory management, political interventions, or asymmetric information. Evidences and theories on the effects of perishability on vertical price transmission are mixed. We examined how the degrees of asymmetries in VPT and perishability are related.

Our evidences suggest that VPT is asymmetric for products not affected by large losses for spoilage (e.g. fruits and low perishable vegetables), and tends to be symmetric for more perishable products. Our results are consistent with numerous studies (Ward, 1982; Peltzman, 2000; Serra and Goodwin, 2003) and in contrast with the results of a meta-analysis conducted by Kim and Ward(2013, p 234), who state that "*the perishables are where the most dramatic differences are seen, where falling farm prices are transmitted far faster than rising farm prices. Much of this has to be due to perishability, where rising prices in a highly perishable good can lessen volume sales among goods that have a very short shelf life*". Based on our findings, several policy considerations may be expressed, and in particular it may be inferred on the level at which market crises should be administered in F&Vs markets (Santeramo *et al*., 2014), or on the efficacy of trade policies (Seccia *et al*., 2009; Cioffi *et al*., 2011; Santeramo and Cioffi, 2012; Dal Bianco *et al*., 2016). Deepening on these issues is beyond the scope of the present short note, and is left to future research.

We acknowledge that our findings rely on one time frequency (monthly data), however by adopting monthly data our analysis is directly comparable with the vast majority of empirical studies on price transmission.

Understanding the role of perishability on the VPT seems a promising area of research and it is worth exploring why perishability may induce AVPT: perishability implies larger management costs (i.e. specific logistic, refrigeration, packaging, etc.) and increase uncertainty (i.e. potential losses for spoilage reflected in lower price and/or quantity sold) when the transportation occurs. To the extent that transactions are more and more based on contracts (McDonald, 2015), the uncertainty and the losses for spoilage tend to be reduced. These issues are left for future research.

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Table 5. Asymmetries in F&Vs prices (*p*-values and type of asymmetries).

	LowperishableVegetables			Medium perishableVegetables				Fruits		
	Carrots	Peppers	Potatoes	Cauliflower	Eggplants	Tomatoes	Radishes	Apples	Lemons	Pears
$P^w = f(P^p)$										
α^+	0.001	0.001	0.001	0.002	0.308	0.155	0.176	0.001	0.002	0.001
α^-	0.116	0.532	0.546	0.036	0.487	0.569	0.165	0.729	0.695	0.589
H_0	0.101	0.002	0.007	0.357	0.731	0.501	0.373	0.005	0.006	0.014
Type	APT^+	APT^+	APT^+	SYM	SYM	SYM	SYM	APT^+	APT^+	APT^+
$P^p = f(P^w)$										
α^+	0.695	0.231	0001	0.258	0.234	0.240	0.954	0.335	0.618	0.152
α^-	0.009	0.554	0.107	0.189	0.564	0.498	0.589	0.812	0.008	0.401
H_0	0.144	0.335	0.001	0.389	0.594	0.655	0.731	0.619	0.254	0.141
Type	SYM	SYM	APT^+	SYM	SYM	SYM	SYM	SYM	SYM	SYM
$P^r = f(P^w)$										
α^+	0.040	0.034	0.001	0.173	0.258	0.027	0.034	0.001	0.109	0.004
α^-	0.492	0.309	0.064	0.438	0.426	0.850	0.018	0.814	0.191	0.967
H_0	0.095	0.055	0.001	0.941	0.644	0.168	0.852	0.001	0.100	0.031
Type	APT^+	APT^+	APT^+	SYM	SYM	SYM	SYM	APT^+	APT^+	APT^+
$P^w= f(P^r)$										
α^+	0.190	0.824	0.625	0.392	0.551	0.605	0.707	0.001	0.958	0.104
α^-	0.543	0.002	0.289	0.034	0.892	0.197	0.549	0.207	0.026	0.308
H_0	0.245	0322	0.404	0.048	0.703	0.268	0.558	0.005	0.076	0.104
Type	SYM	APT^-	SYM	APT^-	SYM	SYM	SYM	APT^+	APT^-	SYM

SYM= *Symmetric price transmission* ; APT^+= *positive price transmission* ; APT^-= *negative price transmission*

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