Studies in Agricultural Economics No. 106. p. 23-40. (2007)

Price transmission in the Hungarian vegetable sector

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Abstract

In this paper we analyse price transmission for the carrot, parsley, tomato, green pepper and potato markets. Although there is a dual farm structure dominated by small individual farms, our results imply that price information flows from the producer to the retail level for potatoes, parsley and carrots. Our results also suggest that farmers do not merely accept prices, but can actually influence market prices. Tomato and green pepper prices have large transmission elasticities, and causality runs from the retail to producer level. It therefore follows that tomato and green pepper producers tend to accept prices and that the sector's prices are determined by upper market levels (processors, wholesalers, retailers). These results are reinforced by the fact that vegetable producers sell a large share of their production through procurement and processing, and therefore are more dependent on the upstream industries, and thus cannot influence prices. For all vegetables in this study the short-run price transmission is symmetric while on the tomato market the long-run price transmission is asymmetric. Results indicate that the tomato market is not competitive and efficient; therefore processors, wholesalers, and retailers are capable of exercising market power, and can instantly transmit producer price increases while just slowly and partially transmitting producer price decreases.

Key words

Hungarian vegetable sector, producer prices, price transmission

1. Introduction

Two methods are widely used to study how food markets function and to determine the degree of competition in these same markets. These entail measuring the spread in vertical price relationships and analysing the nature of price transmission along the supply chain from the producer to consumer.

Asymmetric price transmission has been studied by numerous authors using different econometric methods. Wolffram (1971) and Houck (1977) used classical methods. Von Cramon-Taubadel (1998) used specification to cointegration methods and Goodwine and Harper (2000) used threshold autoregressive models However, research on price transmission in transition economies is still limited. Exceptions to this are the following: Tóth in 1999; Bojnec and Günther in 2005; Bakucs and Fertő in 2005, 2006; and finally Popovics and Tóth 2006. Price transmission may be a subject particular to transition countries. This is due to pre-1989 distorted markets, poorly developed price-discovery mechanisms and often ad hoc policy interventions. Also one might expect transitional economies to have generally larger marketing margins and more pronounced price transmission asymmetries. Furthermore, while there is a wealth of literature on livestock markets (beef, lamb, pork, milk[2]) studies on horticultural markets are scarce (Ward, 1982; Worth, 1999; Aguiar and Santana, 2002; Hassan and Simioni 2003). Moreover, none of the latter have focused on a transition economy. The paper tries to rectify this problem.

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[2] See e.g. a survey on milk markets by Meszaros and Popovics 2004

More specifically, the aim of the paper is to investigate marketing margin dynamics in selected Hungarian horticultural markets. Section 2 of this paper briefly describes the development of the Hungarian horticultural chain during the last half decade. Section 3 reviews some of the theoretical literature concerning marketing margins and price transmission, while section 4 describes the empirical procedures we apply. Our data and results are reported and discussed in section 5, with a summary and some conclusions presented in section 6.

2. Hungarian agriculture's horticultural sector

This section provides a short description of the Hungarian horticultural chain.

2.1. Vegetable production

In 2005, 2% of total Hungarian agricultural land was used to produce vegetables. Together with potatoes, the vegetable sector uses around 3 per cent of the available agricultural land. Table 1 presents the detailed use of agricultural land in terms of sectors. The potato and vegetable sectors' share of total agricultural land is small (in 2005 0.6 and 2 per cent) and there is now a slight downward trend.

Table 1

Use of agricultural land by sectors (per cent)

Year/Crop	2003	2004	2005
Cereals	68.7	69.9	69.1
Industrial plants	16.2	15.8	17.5
Potatoes	0.8	0.7	0.6
Hay and fodder	6.5	6.2	6.1
Vegetables	2.5	2.3	2.0
Other	5.3	5.1	4.7
Total	100.0	100.0	100.0

Source: Statistical Yearbook of Agriculture, 2003-2005, Hungarian Central Statistical Office, Budapest

The quantity and value of potato and vegetable production does not reflect the decline in the use of agricultural land (Figure 1).When one considers Hungarian agricultural output, it is clear that the vegetable sector's importance is significantly larger. In millions of USD Table 2 presents the total agricultural output, plant production output, and vegetable sector output. Potato production's share compared to the value of total agricultural output is decreasing (1.7 per cent in 2004). However the absolute value of production is fluctuating (99 million USD in 2000 and 140 million USD in 2004). Vegetatable production's share in total agricultural output remains fairly stable at around 10 per cent.

Table 2

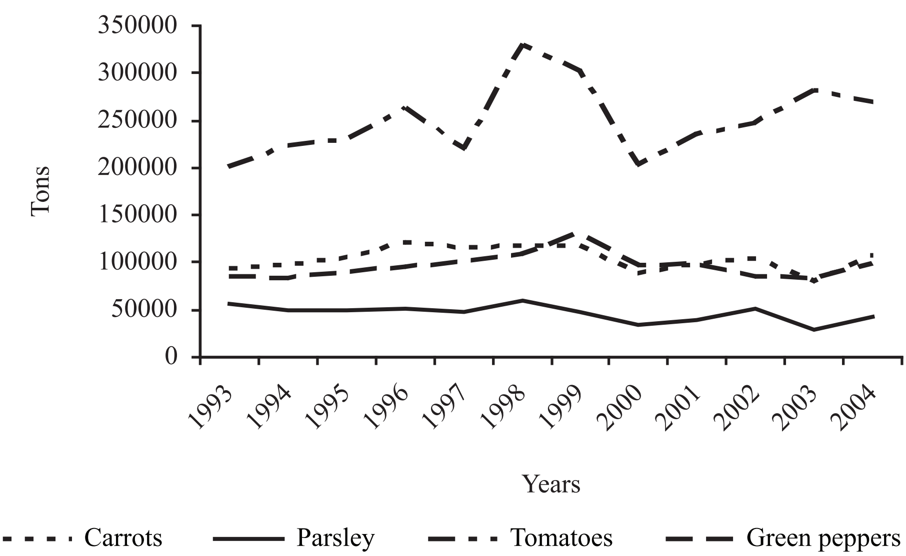
The importance of the vegetable sector in total agricultural production

	1998		2000		2002		2004	
	million USD	per cent	million USD	per cent	million USD	per cent	million USD	per cent
Total	5,387	100	4,533	100	5,737	100	8,156	100
Plant production	2,570	48	2,196	48	2,650	46	4,757	58
Potatoes	176	3.2	99	2.1	106	1.8	140	1.7
Vegetables	560	10.3	453	10	583	10.1	780	9.5

Source: Own calculations from Statistical Yearbook of Agriculture 1998-2004, Hungarian Central Statistical Office, Budapest

Figure 1

Production of selected vegetables



Source: stadat-tables http://portal.ksh.hu/portal, accessed June 15, 2006

Of all the vegetables studied in this paper, green peppers are the ones that are most exported, and this remains true even though the share of production sold abroad decreased from 46 per cent in 2002 to 28 per cent in 2004 (table 3). The import rate for these particular vegetables is generally low, the largest percentage compared to production being for carrots (15 per cent in 2003) and potatoes (13 per cent in 2003).

Table 3

The ratio of production to foreign trade for selected vegetables (per cent)

	2002	2003	2004
Potatoes			
Imports / total production	4.3	13.6	7.2
Exports / total production	0.7	2 per cent	0.8
Carrots			
Imports / total production	6.4	14.9	8.2
Exports / total production	0.2	0.9	0.1
Tomatoes			
Imports / total production	3,0	3,0	4.8
Exports / total production	0.3	0.2	0.1
Green peppers			
Imports / total production	6.8	6.5	6.7
Exports / total production	46.3	38.3	27.9

Source: Author's own calculations from the Statistical Yearbook of Agriculture, 2002-2004, Hungarian Central Statistical Office, Budapest

Table 4 presents areas sown by agricultural enterprises and areas sown by individual farms, and the total sown area for some Hungarian vegetables. From the data comes a picture of a dual farm structure. In Hungary most vegetables are produced on individual farms (69.9 per cent in 2001 and 71.4 per cent in 2005).Tomatoes are exclusively produced on individual farms. However, for certain vegetable species the picture is somewhat different. In 2005 only 5 hectares of green peppers and 10 hectares of potatoes were produced by agricultural enterprises (versus 270 hectares and 3,982 hectares respectively in individual farms). An important indicator of the vegetable sector is the area covered with greenhouses and walk-in plastic tunnels.

Table 4

Sown area of vegetables in terms of legal farm entities (hectares)

	2001		2005	
	Agricultural Enterprises*	Individual Farms	Agricultural Enterprises*	Individual Farms
Potatoes	3,815	32,838	3,440	22,462
Tomatoes	601	5,394	817	2,801
Green peppers	248	4,283	124	2,601
Total Vegetables	27,920	62,649	24,845	62,114

* enterprises + co-operatives

Source: The sown area devoted to major crops on arable land, May 31, 2001. The sown area devoted to main crops on arable land, May 31, 2005, Hungarian Central Statistical Office, Budapest

2.2. The processing sector

In Hungary fruit and vegetable processing is the third largest food industry sector, producing 10 per cent of the total industry output (excluding tobacco). However, sectoral privatisation started late, and in the early nineties did not attract foreign capital. In 1994, foreign capital's percentage of total capital in the industry was 72 per cent, increasing to 89 per cent in 2000. Therefore, the concentration process was late in coming. C5 (the industry's five largest firms) concentration index was only 27 per cent in 1994. However, it went to 53 per cent in 1999 and then shrunk slightly to 49 per cent in 2003. Thus C5 concentration in vegetable processing has a middle rating compared to other food industry branches. C5 concentration has a higher concentration ratio than in wine production or in the bakery industry (29 per cent), but a much lower concentration ratio than in sugar, starch, vegetable oil or breweries (99-100 per cent). In Hungary the number of fruit and vegetables processing firms was 170 in 2000 and 191 in 2004.

Table 5

The ratio of production sold for procurement and processors

	2002	2003	2004
Potatoes	6	8	7
Carrots	19	26	25.5
Parsley	8	10.5	11
Tomatoes	57	82	44.3
Green peppers	25	40	40

Source: Author's own calculations from Statistical Yearbook of Agriculture 2002-2004, Hungarian Central Statistical Office, Budapest

Table 5 shows the proportion of vegetable production sold for procurement and processing. The importance of the processing industry varies for different types of vegetables. Tomato producers are the most reliant on the processing industry, selling up to 82 per cent (2003) of their production through this marketing channel. Green pepper and carrot producers follow with 40 per cent and 25 per cent (2004) of their production sold for procurement and to processors. Parsley and potato growers are at the bottom of the list with only 7 and 11 per cent (2004) sold for procurement or processing.

2.3. The retail sector

Since the late 1990s the Hungarian food retail sector has been dominated by large, mostly foreign owned supermarket chains. However, the small, 'corner' shop network hasn't disappeared and retains a relatively high market penetration (69.9 per cent), frequency of shopping (35.5 per cent). However, the amount spent per shopping trip is rather low at 1000 HUF (Fertő et al., 2005).

Table 6

Number of food retail and specialised shops

	2002	2003	2004	2005
Non-specialised store with food dominance	36,529	35,963	34,805	33,838
Fruit and vegetable shop	3,389	3,489	3,449	3,324

Source: stadat-tables http://portal.ksh.hu/portal, accessed June 15, 2006

Despite the dominance of large supermarkets and discount stores, there are more than 33000 non-specialised food stores operating in Hungary. Because of strengthening competition and increasing concentration, the number of shops is slowly, but constantly decreasing. The number of specialised fruit and vegetable shops increased until 2004, and has been gradually decreasing since (Table 6).

3. Theoretical background

The marketing margin is the difference between the retail and the producer or farm gate price. It represents marketing costs such as transport, storage, processing, wholesaling, retailing, advertising, etc.:

$$RP = FP + M \tag{1}$$

M, the marketing margin, is composed of an absolute amount and a percentage or mark-up of the retail price (Tomek and Robinson, 2003):

$$M = a + b*RP, \text{ where } a \geq 0 \text{ and } 0 \leq b < 1. \tag{2}$$

If the markets are perfectly competitive, then $b = 0$, and the margin becomes the constant a, which can be interpreted as the marginal cost[3]. With the use of logarithmic data, the long-run elasticity between the prices is readily available from the marketing margin model. If prices are determined at producer level, we use the *mark-up* model:

$$lnRP = \alpha_1 + \varepsilon_{FP} lnFP \tag{3},$$

where ε_{FP} represents price transmission elasticity from the farm price (*FP*) towards the consumer price (*RP*). If $\varepsilon_{FP} = 1$, we have perfect transmission, and thus the *mark - up* will be $(e^{\alpha 1} - 1)$. $0 < \varepsilon_{FP} < 1$ indicates that transmission between the two prices is not perfect.

If however, prices are determined at consumer level, then the use of the *mark-down* model is appropriate:

$$lnFP = \alpha_2 + \varepsilon RP\ lnRP, \tag{4},$$

where ε_{RP} represents transmission elasticity between the consumer price (*RP*) and the producer price (*FP*). As before, there is perfect transmissio; if $\varepsilon_{RP} = 1$, and the *mark - down* equals $(1 - e^{\alpha 2})$. Imperfect transmission results if $\varepsilon_{RP} > 1$.

3 As Bojnec and Günther (2005) point out, the constant margin might also depend on various other factors (e.g. existence of returns to scale, mark-up changes, technological or other input cost changes) beyond the farm component of the retail good.

A common perception is that reaction to price increases differ from reaction to price decreases. More exactly, retailers tend to pass on more rapidly price increases to consumers, whilst it takes longer for consumer prices to adjust to producer prices if the latter decrease. There are several major explanations for the existence of price asymmetries. First, asymmetrical price transmission occurs when firms capitalize on quickly changing prices. This is explained by the *search costs* theory (Miller and Hayenga, 2001). This occurs in locally imperfect markets, where retailers are able to exercise their local market power. Although customers have a number of other choices, it might prove difficult to quickly access information about other stores' prices because of *search costs.* Therefore, although firms can quickly raise their retail prices to keep pace with producer price rises, they are much slower to reduce retail prices if upstream prices decline. Second comes the problem of *perishable goods* (Ward, 1982). This prevents retailers from raising prices as producer prices rise. Wholesalers and retailers with perishable goods may be reluctant to increase prices because they risk a lower demand and ultimately being left with the spoiled product. Third, adjustment costs or *menu costs* (Goodwin and Holt, 1999) may underlie asymmetric price adjustments. Menu costs involve those costs occurring with re-pricing and adoption of a new pricing strategy. As with perishable goods, menu costs also prevent retailers from changing prices. Finally, the *exercise of oligopoly power* can encourage asymmetric price transmission. It appears in markets with highly inelastic demand and concentrated supply; many food chains have such market organisation characteristics. It is necessary to state that in the long run such collusive behaviour is rather difficult to maintain, because of the incentive for one firm to cheat the others (Miller and Hayenga, 2001, p. 554). Recent papers have endeavoured to establish the link between price transmission and market power. Using a formal theoretical model Weldegebriel (2004) evaluated the impact of oligopsony power on the degree of price transmission. By using as a benchmark the degree of price transmission in a perfectly competitive market, Weldegebriel showed that oligopoly and oligopsony power do not necessarily lead to imperfect price transmission. Although in some cases this does occur. Indeed, they may counteract each other's impact on the degree of price transmission. The outcomes depend on the functional forms for retail demand and farm supply.

4. Empirical procedure

Over time most macroeconomic time series are not stationary, i.e. they contain unit roots. Over time their mean and variance are not constant. If one utilizes the standard classical estimation methods (OLS), statistical inference can result in biased estimates and/or spurious regressions. In the pertinent literature there are a large number of unit root tests[4] available (see Maddala and Kim, 1998 for a comprehensive review).

Even though many individual time series contain stochastic trends (i.e. they are not stationary at levels), in the long run many of them tend to move together, suggesting the existence of a long-run equilibrium relationship. Two or more non-stationary variables are cointegrated if there are one or more linear combinations of the stationary variables. This implies that the stochastic trends of the variables are linked over time, moving towards the same long-term equilibrium.

[4] Consider the first order autoregressive process, *AR(1)*:
$y_t = \rho y_{t-1} + e_t$, $t = ...,-1,0,1,2,...$, where et is white noise.
The process is considered stationary if $|\rho| < 1$, thus testing for stationarity is equivalent with testing for unit roots ($\rho = 1$). Rewriting to obtain:
$\Delta y_t = \delta y_{t-1} + e_t$, where $\delta = 1 - \rho$, the test becomes:
H_0: $\delta = 0$ against the alternative H_1: $\delta < 0$.

4.1 Testing for unit roots

Maddala and Kim (1998) argued that because of size distortions and poor power problems associated with the commonly used Augmented Dickey-Fuller unit root tests, it is preferable to use the DF-GLS unit root test, derived by Elliott, Rothenberg and Stock (1996).

With structural breaks in the time series, the unit root tests might lead one to incorrectly conclude that there is actually a unit root, when in fact the series are stationary with a break. Several unit root tests were developed to handle the problem. The Perron (1997) test performs an endogenous search for the breakpoints by computing the t-statistics for all possible breakpoints, then choosing the breakpoint selected by the smallest t-statistic, meaning the least favourable one for the null hypothesis.

4.2 Cointegration analysis

The two most widely used cointegration tests are the Engle-Granger two-step method (Engle and Granger, 1987) and Johansen's multivariate approach (Johansen, 1988). The Johansen cointegration procedure is based on estimating the following Vector Error Correction Model (VECM):

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \ldots + \Gamma_{k-1} \Delta Z_{t-k+1} + \Pi Z_{t-k} + u_t \qquad 5),$$

where Z_t = [RP_t, RP_t]', a (2 x 1) vector containing the retail and farm prices, both integrated of order one, Γ_1 ,....Γ_{k+1} are (2x2) vectors of the short-run parameters, Π is (2x2) matrix of the long-run parameters, ut is the white noise stochastic term.

$$\Pi = \alpha\beta' \qquad (6),$$

where matrix α represents the speed of adjustment to disequilibrium and β is a matrix which represents up to (*n - 1*) cointegrating relationships between the non-stationary variables. Trace and maximum Eigen-value statistics are used to test for cointegration. Once (5) is estimated we can proceed to test for weak exogeneity tests. The terms of vector α (factor loading matrix) measure the speed at which the variables adjust towards the long-run equilibrium after a price shock. The α vector of the weakly exogenous variable equals zero. To find the direction of the Granger causality between the two price series, restrictions are tested on the α vectors. If however, the true data generating process contains various regime shifts, then the Johansen test is likely not to reject the no-cointegration null hypothesis.

Gregory and Hansen (1996) introduce a methodology to test for the null hypothesis of no-cointegration against the cointegration alternative with structural breaks. Under the alternative 3 models are considered. Model 2 comes with a change in the intercept:

$$RP_t = \mu_1 + \mu_2\varphi_{t\tau} + \alpha^T FP_t + e_t\, ,\ t = 1,\ \ldots\ , n. \qquad (7)$$

Model 3 is similar to model 2, only contains a time trend:

$$RP_t = \mu_1 + \mu_2\varphi_{t\tau} + \beta t + \alpha^T FP_t + e_t\, ,\ t = 1,\ \ldots\ , n. \qquad (8)$$

Finally, model 4 allows a structural change both in the intercept and the slope:

$$RP_t = \mu_1 + \mu_2\varphi_{t\tau} + \alpha_1^T FP_t + \alpha_2^T FP_t \varphi_{t\tau} + e_t\, ,\ t = 1,\ \ldots\ , n. \qquad (9)$$

Because usually the time of the break is not *a priori* known, models (7) – (9) are estimated recursively allowing T to vary between the middle 70% of the sample:

$$| 0.15n | \leq T \leq | 0.85n |$$

For each possible breakpoint, the ADF statistics corresponding to the residuals of models (7) – (9) are computed, then the smallest value is chosen as the test statistic (as it is the most favourable regarding rejection of the null). Critical values are non-standard, and are tabulated by Gregory and Hansen (1996).

4.3 Asymmetrical error correction representation

Most asymmetry analysis uses the following Ward (1982) specification, which is based on an earlier Woffram (1971) and Houck (1977) specification:

$$\Delta RP_t = \sum_{j=1}^{K} (\beta_j^+ D^+ \Delta FP_{t-j+1}) + \sum_{j=1}^{L} (\beta_j^- D^- \Delta FP_{t-j+1}) + \gamma_t \tag{10}$$

Here, the first differences of the producer prices are split into increasing and decreasing phases by the D^- and D^+ dummy variables. Asymmetry is tested using a standard F-test to determine whether β_j^+ and β_j^- are significantly different.

These approaches do not take into consideration the data's time series properties and many of them suffer serial autocorrelation that usually suggests spurious regression.

With the development of cointegration techniques, attempts were made to test asymmetry in a cointegration framework. Von Cramon-Taubadel (1998) demonstrated that the Wolffram-Houck type specifications are fundamentally inconsistent with cointegration and proposed an error correction model of the form:

$$\Delta RP_t = \sum_{j=1}^{K} (\beta_j^+ D^+ \Delta FP_{t-j+1}) + \sum_{j=1}^{L} (\beta_j^- D^- \Delta FP_{t-j+1}) + \varphi^+ ECT_{t-1}^+ + \varphi^- ECT_{t-1}^- + \sum_{j=1}^{P} \Delta RP_{t-j} + \gamma_t \quad (11).$$

The error correction term, (ECT_t), is in fact the long-run (cointegration) relationship's residual:

$ECT_{t-1} = \mu_{t-1} = RP_{t-1} - \lambda_0 - \lambda_1 FP_{t-1}$; λ_0 and λ_1 are coefficients. The error correction term is then segmented into positive and negative phases (ECT^+_{t-1} and ECT^-_{t-1}), such that:

$ECT_{t-1} = ECT^+_{t-1} + ECT^-_{t-1}$.

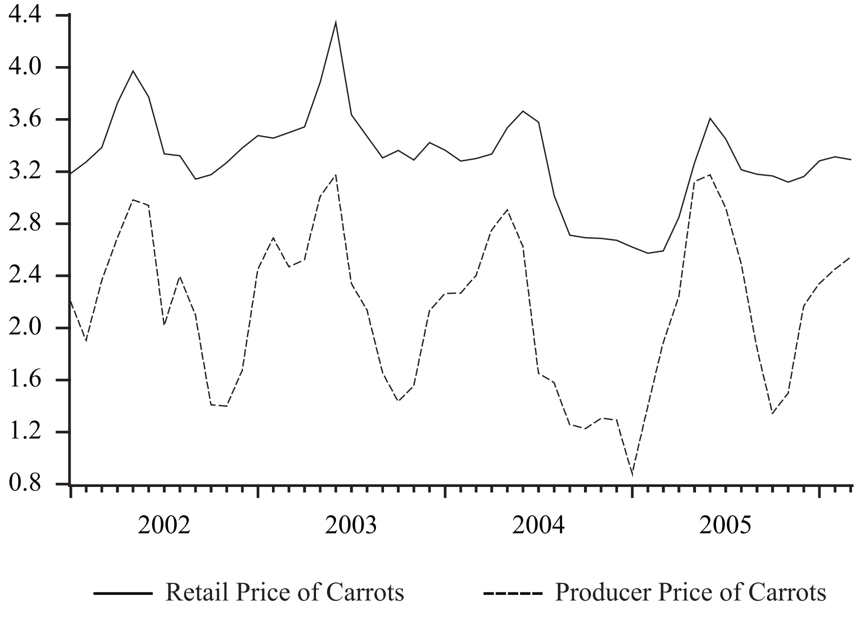
Using VECM representation as in (11), both the short-run and the long-run symmetry hypothesis can hence be tested using standard tests. Valid inference requires one price to be mildly exogenous regarding both the long and short run with respect to the parameters in (11).

5. Price transmission analysis in the Hungarian vegetable sector

Due to processors' and/or retailers' market power, it is usually assumed that farmers have no influence on producer prices, meaning food processors and retailers use their market power to gain the upper hand against farmers. In order to obtain further information on supply chain participants in specific product markets, it is necessary to analyse price transmission. Price transmission is the process where price information flows through the marketing chain in a given direction, and it is transformed through the various economic players' influence in the market. It is quite common for various producer and consumer support groups to contend that asymmetrical price transmission characterizes agricultural and food markets. This perceived asymmetry is usually considered disadvantageous for both consumers and producers. The idea is that food processors, wholesalers, and retailers tend to quickly pass on producer price increases to consumers, while price decreases are only transmitted slowly and sequentially. 51 monthly producer and retail price observations conducted between January 2002 and March 2006 are used for the analysis. The nominal price data provided by the Hungarian Statistical Office was deflated to January 2002 in terms of the Hungarian consumer price index. Figures 2, 3, 4, 5, 6 present producer and retail price evolution for the selected vegetables and potatoes.

Figure 2

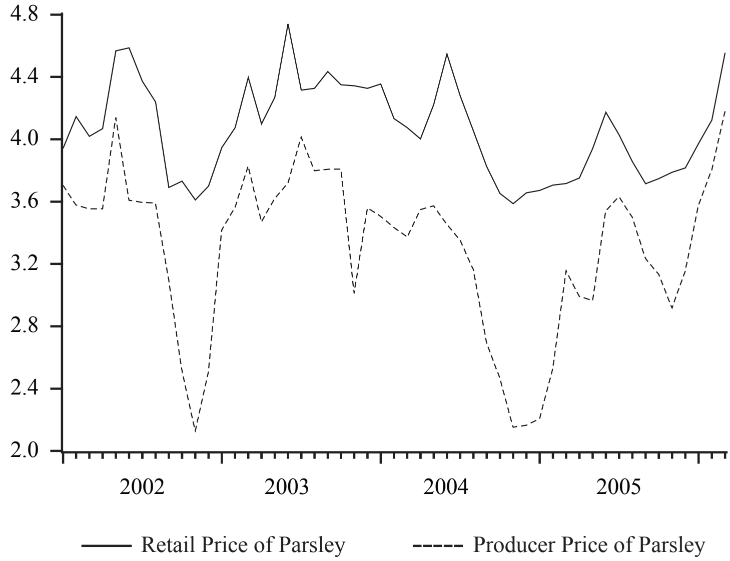
Producer and retail prices of carrots at constant prices



Source: Own calculations based on stadat-tables http://portal.ksh.hu/portal, accessed June 15, 2006

Figure 3

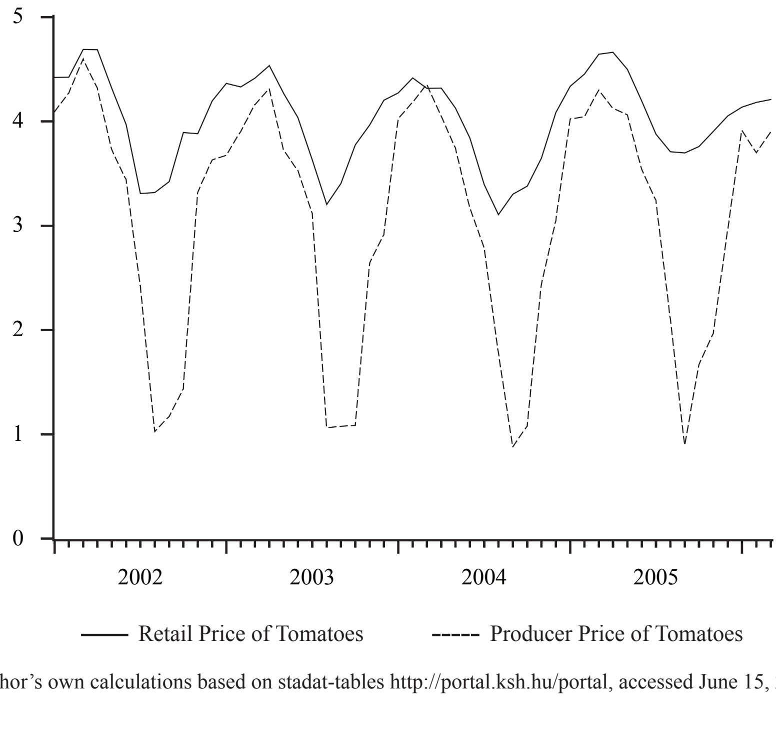
Producer and retail prices of parsley at constant prices



Source: Own calculations based on stadat-tables http://portal.ksh.hu/portal, accessed June 15, 2006

Figure 4

Tomato producer and retail prices at constant prices



Source:Author's own calculations based on stadat-tables http://portal.ksh.hu/portal, accessed June 15, 2006

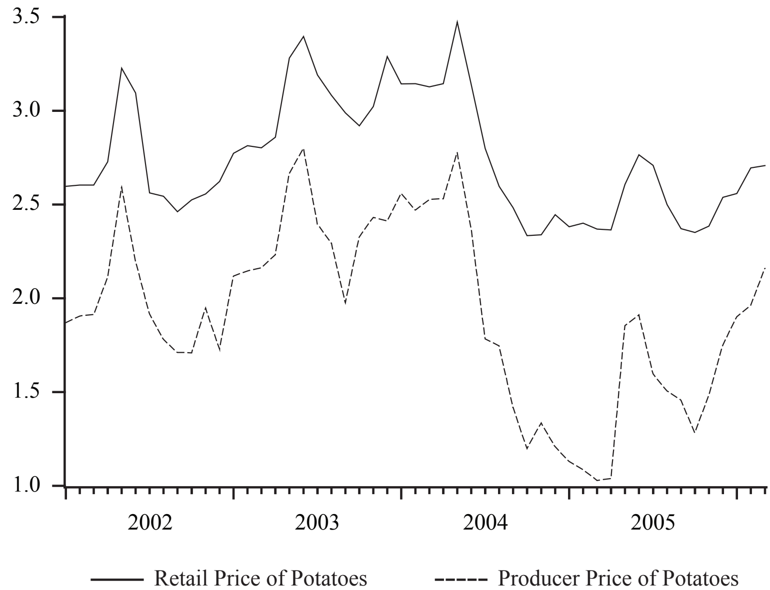
Figure 5

Green pepper producer retail prices at constant prices

Source: Author's own calculations based on stadat-tables http://portal.ksh.hu/portal, accessed June 15, 2006

Figure 6

Potato producer and retail prices at constant prices



Source: Author's own calculations based on stadat-tables http://portal.ksh.hu/portal, accessed June 15, 2006

As expected, seasonality plays a major role in determining the producer and, to some extent, retail prices. Except for potato and perhaps parsley prices (Figure 3 and 6), prices for all other products included in this paper exhibit seasonal patterns. Seasonality is especially obvious for the tomato and green pepper markets (Figure 4 and 5). Graphical examination of green pepper prices indicates that producer and retail prices increase and decrease simultaneously, resulting in a relatively constant marketing margin, and this trend suggests price transmission symmetry. However, Figure 4 indicates that large drops in tomato producer prices are typically followed by much smaller decreases in retail prices while producer price increases instantly appear at the retail level. A priori this indicates asymmetrical price transmission in the tomato market.

For reliable results formal analysis is needed and this requires the use of recent time series econometrics innovations. Unit root tests on the selected vegetables' deflated producer and retail prices reveal that all price series except those for carrots are non-stationary. Therefore we in turn apply cointegration and Vector Error Correction methods to analyse the producer-retail price transmission for potatoes, parsley, tomatoes and green pepper prices. Table 7 presents the results of the cointegration analysis for the non-stationary price pairs.

Table 7

Cointegration analysis (Johansen, 1988)

Model	Lag length	H_0	Trace test		λ_{max} (max Eigen value) test	
			Test statistic	95% critical value	Test statistic	95% critical value
Parsley prices	1	r = 0	*19.57	20.26	*14.16	15.80
		r = 1	5.40	9.16	5.40	9.16
Tomato prices	0	r = 0	28.13	20.26	22.34	15.80
		r = 1	5.79	9.16	5.79	9.16
Green pepper prices	1	r = 0	28.13	20.26	24.29	15.89
		r = 1	5.79	9.16	7.76	9.16

* Significant at 10%
Notes: 11 seasonal dummies were included to account for seasonality

Because after using the Johansen method non-stationary, potato prices did not cointegrate, we used the Gregory and Hansen (1996) procedure to seek cointegration with possible structural breaks. The method identified the cointegrating relationship with a structural break that transpired in June 2004[5], which was similar to equation 7. Since carrot prices are stationary, they were analysed using OLS methods. Slightly exogenous prices (i.e. those that not adjusting to the long-run equilibrium in the advent of exogenous shock) were brought about from cointegration analysis. With slightly exogenous prices within the context of cointegration analysis, Granger direction causality is instantly determined. The Vector Error Correction Models (equation 11) and the Vector Autoregressive Model (for the stationary carrot prices) are estimated next. Table 8 illustrates the result of the short and long-run symmetry tests.

[5] The recursively estimated ADF test statistic is – 6.60, rejecting the no-cointegration null hypothesis at 5% level of significance

Table 8

Short and log-run price transmission symmetry tests

	Potatoes	Carrots	Parsley	Tomatoes	Green peppers
Long-run transmission test statistic	F(1,44) ~ 0.208	NA	F(1,42) ~ 0.043	F(1,38) ~ 7.694*	F(1,40) ~ 0.246
Short-run transmission test statistic	F(1,44) ~ 0.827	F(1,43) ~ 0.001	F(1,42) ~ 0.593	F(1,38) ~ 7.556*	F(1,40) ~ 0.140

* Significant at 1%

Of the five vegetable prices, only tomato prices reject both the symmetrical price transmission null-hypothesis on a short and long-run basis. Table 9 presents estimates regarding transmission elasticity, and a price causality price summary (the dominant market levels that determine industry prices), and long and short-run price transmission. Generally, competitive pricing supposes that transmission elasticity equals 1, and the prices on two market levels are only linked by a constant absolute margin.

Table 9

Elasticity, causality and price transmission results

	Potatoes	Carrots	Parsley	Tomatoes	Green peppers
Elasticity of transmission	0.85 (0.46 after June 2004)*	0.75	0.70	2.40	4.10
Price causality	FP → RP	FP → RP	FP → RP	RP → FP	RP → FP
Long-run transmission	symmetric	-	symmetric	asymmetric	symmetric
Short-run transmission	symmetric	symmetric	symmetric	asymmetric	symmetric

* A structural break occurred in June 2004, which reduced both prices, but increased the margin.

Despite a dual farm structure which is dominated by small individual farmers, price determination flows from the producer to the retail level for potatoes, parsley and carrots. This indicates that farmers do not simply accept prices but also can influence market prices. Tomato and green pepper prices reveal significant seasonality, rather large transmission elasticities, and causality flowing from the retail to the producer level. Therefore, tomato and green pepper producers tend to accept rather than determine prices, and industry prices are determined by downstream market levels (processors, wholesalers, retailers). These results are in line with table 5 data revealing that vegetable producers (whose production is largely sold for procurement and processing) are more dependent on downstream industries and cannot influence prices. For all vegetables in this study short-run price transmission is symmetric, but in the tomato market long-run price transmission is asymmetric. It therefore follows that the tomato market is not competitive and efficient and thus processors, wholesalers and retailers can exercise market power, and instantly transmit producer price increases while only slowly and partially transmitting producer price decreases.

6. Conclusions

The paper investigated the long-term relationship between retail prices and the farm-gate price for Hungarian carrots, parsley, tomatoes, green peppers and potatoes where production structure tends to be dominated by small-scale farmers. The fragmented production structure may have deeper implications for the performance of the horticultural sector. However, its impact on price transmission from the producer to the retail level seems limited. Farmers producing tomatoes and green peppers accept rather than determine prices, and only the tomato market presents price transmission asymmetries. Not surprisingly these markets are characterised by a high share of production sold for processing, perhaps enabling processors to exercise their market power. Seasonality affects most products analyzed, especially tomato and green pepper prices both at the producer and the retail level. Our results (except for the tomato chain) correspond with those of previous research investigating price transmission in the vegetable chain. Worth (1999) concluded that four of the six vegetable products studied do not present reveal transmission asymmetries, Hassan and Simioni (2003) conducted a detailed analysis of price transmission in the French vegetable sector, but their results do not confirm the belief that middlemen are able to exercise market power and profit from fluctuating producer/retail prices. However, Ward (1982) analysed the United States vegetable market with pre-cointegration methods, and found positive price transmission asymmetries, meaning producer price decreases are passed on more quickly and more completely to retail prices than producer price decreases. Due to a lack of other price transmission studies regarding vegetable chains in transition economies, we may only compare the results with other product chains. Price transmission analysis for the pork (Bakucs and Fertő, 2005), and beef (Bakucs and Fertő, 2006) sectors also concluded that even though the production system is fragmented, producer/retail price transmission is symmetric.

Acknowledgements

The authors gratefully acknowledge financial support from the Regoverning Markets Phase 2 research programme.

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