

Why Has Poland Avoided the Price Liberalization Trap? The Case of the Hog-Pork Sector

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Price liberalization in the agrifood economy in the transition economies is likely to slip into a trap: food prices rocket up, consumption declines, but food supply does not catch up and even contracts. However, during the transition period following the 1989 price liberalization, the Polish hog-pork sector succeeded in avoiding this trap. By conducting market structure and econometric analysis, this article looks for the reasons for this success.

In the Polish hog-pork sector the restructuring of state-owned enterprises and the emergence of private firms introduced an effective price transmission mechanism between the processing-retailing and farm levels. This mechanism allowed farm supply to respond to changed demand and to take advantage of increased retail prices. Such a relatively efficient marketing system was made possible by a relatively stable macro-economic environment and limited government intervention.

In August 1989, the Polish government removed most price controls and subsidies in the agrifood sector. Immediately after price liberalization, food prices soared, and price margins between processed and raw agricultural products increased considerably. This was predictable because retail food prices had been suppressed under the planning regime to favor urban consumers. Polish policymakers and many international observers worried that escalating retail prices for food would become a driving force of hyperinflation and that state-owned or former state-owned processing enterprises might maneuver to enlarge price margins in their favor. In this event, farms would benefit little from price liberalization, and agricultural production would not improve despite high retail prices for food, which would dampen consumer demand. Concerns that Poland might fall into such a "price liberalization trap" were not without foundation. Reform of the agrifood sector in many transition economies did fall into this trap, and some such as Russia and the Ukraine struggle with this trap even today.

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Seven years after price liberalization, it is of interest to assess the extent to which the Polish agrifood sector has transcended the price liberalization trap. Poland is leading the transition process occurring in former socialist countries, and the experiences of Poland can shed light on reforms in other transition economies still struggling to overcome the price liberalization trap.

The key problem with price liberalization is unresponsive supply, particularly the supply of agricultural products from farms. Two factors may cause a sluggish supply response. First, state-owned or collectively owned farms may not be very sensitive to market signals. Second, the food processing and marketing system and farm input supply industries may be dominated by monopoly forces—squeezing farms between high prices for their inputs but low prices for their outputs. Unlike most other transition economies, agriculture in Poland was dominated by private farms even prior to reform. In 1989 on the eve of reform, private farms worked 75 percent of all agricultural land (World Bank 1994). Therefore, to avoid the price liberalization trap, the primary challenge for Poland lay in the marketing system.

In a marketing system where the transactions across vertical marketing chains—from farmers to processors, processors to wholesalers, and wholesalers to retailers—are not regulated by competitive market forces, changes in consumer demand might not lead to significant changes in farmgate prices. Similarly, changes in farm production and farmgate prices might not be passed on to consumers through changes in retail prices. In the absence of competitive forces in processing and marketing, margins between farmgate and retail prices would be explained not only by processing and marketing costs but also by monopoly interventions. This was the situation in Poland before reform. Then, procurement and retail prices for most important foodstuffs were fixed, substantial subsidies were granted to processors and farmers, and segmentation across vertical marketing levels was high (Kwiecinski and Quaisser 1993). If a marketing system is segmented and the transmission of prices between farmgate and retail is obstructed, price liberalization will not lead to an effective supply response.

This article studies the behavior of hog and pork prices in post-reform Poland in order to determine what factors influenced the margin between the two prices. In particular, we are concerned with evidence of whether or not the Polish marketing system gave rise to an effective mechanism for transmitting prices among hog farmers, processors, and retailers. Although we must be cautious in generalizing to other agricultural industries, we consider the hog-pork industry more typical than atypical. In 1994 the agriculture and food processing industries together accounted for almost 14 percent of Poland's gross domestic product (GDP) and 29 percent of national employment (Central Statistical Office, *Statistical Yearbook*, 1995). Within agriculture, hog production is the single most important commodity, accounting for 20 percent of total agricultural production and 30 percent of marketed production. Within agricultural processing industries, meat processing is the single most important activity, and pork is the dominant meat commodity, accounting for almost 23 percent of the value of

total production (OECD 1995).¹ In addition to its economic significance, the hog-pork sector is among the most competitive agrifood markets in Poland and, in this sense, may be somewhat atypical, yet prototypical. Composed of a large number of private marketing and processing firms, it is subject to only limited government intervention. Examining this sector focuses on the most dynamic aspects of development of the agrifood market in Poland since price liberalization.

Section I examines recent developments in the hog-pork marketing system relevant to the degree of competitiveness. Section II reports results of an econometric analysis designed to test whether the new marketing system has an effective mechanism for transmitting prices among different market players. One reliable indicator of the price transmission mechanism lies in the process of determining the price margin. If there is an effective mechanism for transmitting prices, the movement of the margin between hog and pork prices will be explained by various processing and marketing costs. Section III summarizes the analysis and offers policy recommendations indicated by our results.

I. DEVELOPMENTS IN THE MARKETING SYSTEM AND GOVERNMENT INTERVENTION

Livestock and meat production as a whole declined after 1989 as feed prices increased faster than output prices. The elimination of subsidies increased production costs, and the liquidity crisis of state farms, which occupy 20 percent of Poland's arable land, reduced supply from the state sector (World Bank 1994). On the demand side, decline in real per capita income limited the consumption of most meat products other than pork. In contrast to the general trend of reduced production following price liberalization, Polish hog production increased from 18.8 million head in the first quarter of 1990 to 22.8 million head by the third quarter of 1993. This growth was spurred by higher demand for pork than for other meat and dairy products. Also, hog production traditionally relied heavily on homegrown feeds. Thus it was less influenced by increases in the price for manufactured feeds and by the phasing out of subsidies for feed concentrate. Following drought and very low potato and grain harvests in 1992, pork production collapsed late in 1993. Production on private farms began to recover after 1993, and in 1995 it approached the peak level of 1992, only to decline again in 1996 (Central Statistical Office, *Statistical Yearbook*, 1996). The fluctuation of hog-pork supply indicated that farmers and processors were responsive to market signals at least to some extent. This was largely due to developments in the marketing system.

The Marketing System

The greatest changes in the marketing system were in the processing and retail sector. The privatization of state-owned retail stores and processing firms

1. In 1992 other important agricultural industries were potatoes (15 percent of total production), milk (14 percent), fruit and vegetables (11 percent), wheat (7 percent), poultry and eggs (7 percent), cattle (5 percent), and sugar beets (3 percent).

Table 1. *Ownership Structure of the Agricultural Processing Industry in Poland, 1989–93*

(number of firms of different kinds)

<i>Type of firm</i>	1989	1990	1991	1992	1993
Enterprise	141	279	434	544	671
State-owned	37	59	67	76	71
Private	104	220	367	468	600
Sole proprietorship	18	359	1,467	3,385	7,934

Source: Poland, Central Statistical Office (1991–96a).

and the large number of private processing and marketing firms that entered the agrifood industry brought about changes in the behavior of individual participants and the relationships among them. These changes were at the center of the development of a new market system in Poland.

As the era of central planning drew to a close in Poland, the meat processing subsector was dominated by large state-owned companies. Twenty-five plants were spread evenly throughout the country, and each was a monopoly force in its regional market. Since 1990, the sector has attracted large numbers of smaller, privately owned companies. State-owned firms have been required to undergo privatization or restructuring into separate functional components that are rented out to groups of private individuals. Table 1 describes this transformation up to 1993.

Of the revenue generated by firms that employ more than 50 people, the share of state-owned firms declined from nearly 100 percent in 1989 to 60 percent in 1993. Had small firms with fewer than 50 employees also been included, the share of the state sector would have been less than 50 percent because most small farms are privately owned (Grudzinska 1994). This trend continued after 1993 according to a field investigation we conducted in 1995 (Guba and others 1995).²

The degree of industrial concentration in the meat industry is not high. Of the revenue generated by firms with 50 or more employees, the largest nine enterprises accounted for only 20 percent. The 55 largest enterprises accounted for only 65 percent of revenues, leaving a large share for small private firms (Grudzinska 1994).

Processing firms primarily serve local demand. Nearby markets (within a radius of 100 kilometers) account for 70 percent of sales of the average firm. Thus the domestic market remains largely regionalized. Field visits conducted in 1995 indicate, however, that interregional markets are becoming increasingly important for some processing firms and that private dealers (intermediaries) are becoming a more effective source of raw materials for processors (Guba and others 1995).

2. We interviewed 40 farmers, traders, processors, and retailers on the subject of agricultural marketing in September 1995.

There is one organized livestock auction, which is run by PEKPOL in Radomsko. It has not been successful, and many participants now bypass it. The auction's poor success is partially due to the size of Polish farms. Many farms are so small that owners who visit the auction have few animals to sell.

Competition in hog procurement is growing, and procurement channels for agricultural products have become more diversified since 1989. Direct contact between farmers and processors is the most common channel. A large processing firm typically has its own procurement stations, through which it buys some 60 percent of its requirements. A small, local meat plant may obtain up to 90 percent of its hog supply directly from farmers (Office of International Policy Service and Mitama Ltd. 1995). Whether the procurement agents are independent or associated with a processor, they must be willing to extend the geographical scope of operations in order to obtain their hog supply.

Meat processing plants are often vertically integrated enterprises. The plant will own a slaughterhouse to produce carcasses for further processing. The carcass market itself is very thin and exists only when there are surplus carcasses that a processing plant cannot handle. Processing workshops produce different cuts of meat and other high value added products such as ham. They may also process beef as well as pork.

Many meat processing companies have organized their own wholesale distribution systems in which they sell directly to retailers and sometimes consumers. It is estimated that processing firms control 30 percent of retail sales (World Bank 1994). As plants seek more cost-effective means of distributing their products, direct suppliers have stepped up their activity, operating through small, private outlets.

Most retail outlets in Poland were rapidly privatized at the beginning of the economic transition. In addition, new retail outlets have sprung up. Although retailers can now freely choose their suppliers, they tend to remain loyal to a particular plant once a link has been established.

Compared with the processing and retail sectors, changes in the farming sector took place in the marketing behavior of farmers rather than in the structure of farm ownership. With 75 percent of agricultural land in private hands even before the reform, privatization of state and collective farms was not as important in Poland as in other transition economies and proceeded rather slowly. The share of land owned by private farms increased from 76 to 80 percent from 1990 to 1994. Private farms are very small in scale, occupying on average about 6.5 hectares of agricultural land (OECD 1996). Hog production mirrors the structure of landholdings. Small farms hold most of the hog population in small herds, and hog production is just one of many kinds of economic activities in which they engage. Large, specialized hog farms are rare. The size of private farms, in terms of both landholding and hog production, changed very little during 1990–95, as shown in table 2. About half of private farms operate with less than 5 hectares of land; about half of private hog farms raise fewer than six hogs.

Table 2. *Size of Private Farms in Poland, 1990–95*
(percent)

<i>Indicator</i>	1990	1991	1995
<i>Area in hectares</i>			
1.01–1.99	17.7	—	20.9
2.00–4.99	35.1	—	33.7
5.00–6.99	14.9	—	13.4
7.00–9.99	14.9	—	13.3
10.00–14.99	11.3	—	10.7
15.00 or more	6.1	—	8.0
<i>Number of hogs held</i>			
2 or less	—	30.3	30.4
3–5	—	21.1	20.3
6–10	—	16.7	16.0
11–20	—	18.2	16.9
21–50	—	11.3	12.2
50 or more	—	2.4	4.5

— Not available.

Source: Poland, Ministry of Agriculture and Food Industry (1996).

It is not surprising that small private farms in Poland do not specialize. A 1993 survey of farms in Poland found that a typical private farm has a small or medium-size tractor and employs three workers with 10 years of education.³ Little hired labor, rented land, or debt financing are used. Farms tend to plant half their land with cereal and use the remaining space for pasture, feed, and cash crops. Farm herds typically contain less than 10 cattle and roughly 10 hogs. The ratio of marketed to total production is greater than 50 percent for crops, 76 percent for hogs, and almost 100 percent for dairy and cattle (Euroconsult and the Centre for World Food Studies 1994). These characteristics have changed very little during the seven years after price liberalization.

However, the dramatic changes that occurred in processing and retail sectors placed private farms in a new market environment and changed their market behaviors. Farmers can now sell their animals to processors in the region, to intermediaries, or at farm markets, depending on which purchaser offers the highest price. There are now four channels for sales: direct sales to slaughterhouses or sales to purchase units, dealers, or wholesale markets. Farmers sell 55 percent of their marketed livestock directly to slaughterhouses, 30 percent through collection stations owned by slaughterhouses or cooperatives, and 15 percent through intermediaries who visit local markets and farms. Less than 1 percent is sold through wholesale animal markets (Office of International Policy Service and Mitama Ltd. 1995).

3. The survey contained 116 households from the Plockie region and 100 from the Pilskie region. Together these two regions are representative of the national agricultural economy. Plockie is above the national average in terms of agriclimate, agricultural production, price of arable land, proportion of population engaged in agriculture, and share of private agricultural land. Pilskie is below the national average in these categories (Euroconsult and Centre for World Food Studies 1994: annex 1.4).

Only a few big farms use formal contractual agreements when selling directly to processing firms. The simplest form of contractual agreement is one in which a farm sells its hogs to the processor at market prices prevailing at the time of sale. More complicated contracts specify the time, price, and quality of what will be delivered, as well as preferential credits provided by the processor such as piglets, concentrated feed, technical services, or transportation. Although formal contracts offer an additional degree of certainty that is attractive to farmers, contracts with supplemental clauses are too costly for many processors to provide.

Hog farmers are price-takers in the market. They can choose whom to sell to but cannot determine the price. Even large hog farms are not able to negotiate prices with buyers. The usual mode of operation is for big processing firms in a region to set procurement prices and for small processors to follow suit.

Overall, Poland's new marketing system for hogs and pig products is diversified and competitive. At each marketing level, there are many choices among channels. Farmers can sell to many different buyers, and retailers can purchase from many different processors.

A relatively competitive market in the hog-pork sector permits prices at both retail and farm levels to fluctuate, leading various market players to adjust their level of activity. At the same time, market fluctuations and diversified marketing channels increase the risk for various market players, especially farmers, leading to discontent among farmers and concern by the government. The Agricultural Market Agency (AMA) has responded by intervening in the hog-pork market with procurement activities aimed at stabilizing farmers' income and preventing further declines in hog procurement prices.

Government Intervention

AMA initiates procurement when it considers market prices too low. Each of eight regional offices can contract with meat processing plants to purchase carcasses, and these plants then purchase live hogs from farmers in an assigned region at designated prices. AMA does not buy directly from farmers. The carcasses it buys are resold when the agency considers prices of retail pork too high. AMA also manages strategic reserves. Every year it sells a portion of what it has bought and stored and then purchases new carcasses to maintain its reserves. Because pig prices are seasonal, dropping to their lowest point in June and peaking from September to December, AMA makes its purchases during the second quarter of the year, when prices are depressed.

AMA's intervention is significant in some regions, in some years, and in some seasons, but not everywhere or all the time. The market mechanism is basically operational because price transmission is effective between the retail and farm level. This judgment is subject to more rigorous econometric verification in the next section.

II. MOVEMENTS OF THE PRICE MARGIN AND ITS DETERMINANTS

The first indication of a competitive market is that prices fluctuate in response to changes in supply and demand. From January 1990 to March 1996, monthly prices for both hogs and pork were driven by inflation and rose steadily,⁴ and the price margin in *nominal* terms between hog and pork increased substantially. Many complained that retail prices rose too fast, the price margin was too large, and both consumers and farmers were suffering as a result of price liberalization. However, if properly deflated, both retail and farm prices declined steadily in *real* terms. Moreover, retail prices fell even faster than farm prices. Contrary to the common impression derived from nominal price movements, the market margin actually declined, not increased, after January 1990, as figure 1 shows.

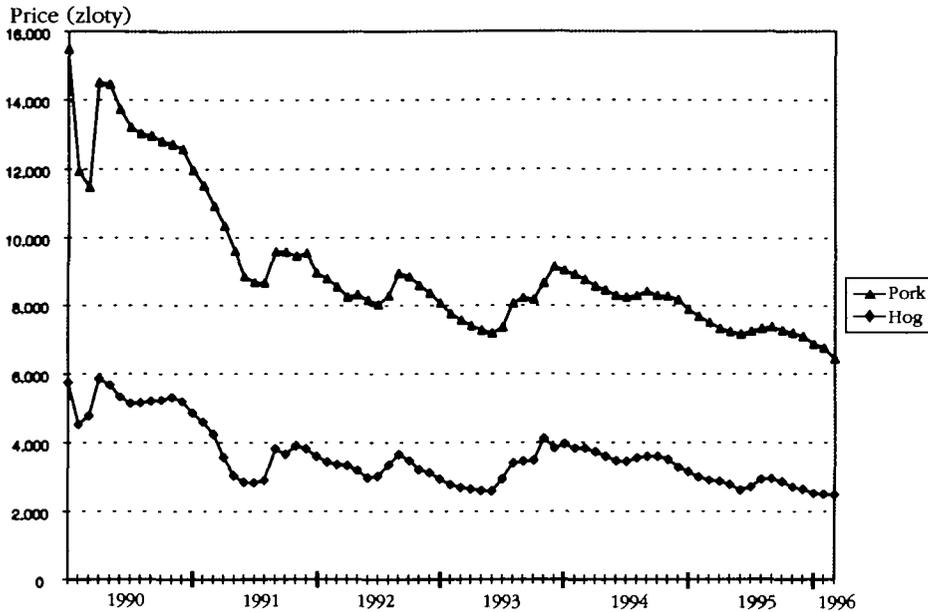
Another important fact embedded in figure 1 is that farm prices moved in the same pattern as retail prices. Almost always, both prices moved in the same direction, although the magnitude of changes might be different. In a separate study, we conducted a cointegration test on the two series using Johansen's full information maximum-likelihood model and found that retail and farm prices were cointegrated. However, because retail and farmgate prices can be cointegrated even if monopoly forces dominate the marketing chain, we turn to an indirect, but more conclusive, test of competitiveness. If there is an effective process for transmitting prices between farmgate and retail, and no monopoly forces manipulate the prices, the margin between pork and hog prices will be determined by the costs of processing and marketing. If such costs cannot explain observed margins, it is likely that monopoly forces are operative, which would impede the price transmission mechanism operating between farmgate and retail and prevent price liberalization from yielding an effective supply response. Moreover, examining the determinants of price margins, besides indicating if there is an effective price transmission mechanism, can shed light on other important considerations. Our study allows us to assess the impact of labor costs, material costs, government intervention, and, most important, market risk on price margins, which can indicate how market efficiency might be further enhanced.

Determination of Price Margins

Starting from the theory that price margins are the sum of marketing services (Tomek and Robinson 1990), we model the hog-pork price differential as a function of processing and marketing costs. In particular we follow the model and empirical work of Brorsen and others (1985).⁵ Assuming that firms exhibit decreasing absolute risk aversion (the more wealthy the firm, the less risk-averse it will be), Brorsen and others (1995) show that the solution of the firm's utility

4. Price data are derived from Central Statistical Office monthly price series. See the appendix for a full explanation of data sources.

5. Some other relevant studies are Buccola (1989), Gardner (1975), Holloway (1991), Kinnucan and Forker (1987), Shroeter and Azzam (1991), and Wohlgenant and Mullen (1987).

Figure 1. *Movements of Real Prices of Hog and Pork in Poland, 1990–96*

Source: Poland, Central Statistical Office (1991–96a).

maximization problem under competitive conditions and plausible assumptions regarding its production function implies that the expected margin, \bar{M} , is a function of w , the firm's initial wealth, q , a vector of input prices, σ , a measure of the uncertainty of the price the firm will receive for its output, and Y , the firm's total output.

$$(1) \quad \bar{M} = M(w, q, \sigma, Y).$$

Moreover, their comparative static analysis shows:

$$(2) \quad \frac{\partial \bar{M}}{\partial Y} > 0$$

$$(3) \quad \frac{\partial \bar{M}}{\partial \sigma} > 0$$

$$(4) \quad \frac{\partial \bar{M}}{\partial q} \geq \text{or} \leq 0$$

Equation 2 implies that output should be positively related to price margin. Equation 3 implies that an increase in output price uncertainty should unambiguously increase the price margin. And equation 4 implies that a change in input price can have either a positive or a negative impact on price margin.

Based on this theoretical model, Brorsen and others (1995) estimate regressions to determine if increases in the uncertainty of free on board (FOB) mill prices and retail prices of wheat flour increase farm-to-mill and mill-to-retail wheat price margins, respectively.

This article adopts Brorsen's framework with certain modifications. Processing and marketing costs are divided into two categories, labor and material cost. This refinement enables us to determine if changes in wages are the driving force behind enlarged price margins. The monthly wage rate published by the Central Statistical Office for the agricultural processing industry is used for labor costs. Because no wage rates for the agricultural processing industry are available for 1990, the wage rate for the whole processing industry is used as an approximation for that year. Exact data are not available for material costs. The price index of fuel and lubricant oil is used as a proxy for material costs of processing and marketing.

To make the measurement of labor cost comparable to material cost, the monthly wage rate is converted into an index using January 1990 as the base. Both the wage and material cost indexes are then deflated by dividing them by the consumer price index (CPI). L denotes the ratio of the wage index to the CPI, and C denotes the ratio of the fuel index to the CPI.

In transition economies, it is likely that macroeconomic risk strongly affects all markets, so that using price uncertainty in a given market may underestimate the real risk that agents face. Macroeconomic risk can reflect uncertainty in input and financial markets as well as in output markets. Also, the correlation between individual output price and macroeconomic risks is likely to be high. For these reasons, macroeconomic uncertainty, instead of pork price uncertainty, is used.

The inflation rate is the most readily available indicator of macroeconomic uncertainty. At time t (a given month) macroeconomic risk is measured as the standard deviation of $(CPI_{t-2}, CPI_{t-1}, CPI_t, CPI_{t+1}, CPI_{t+2})$. In other words, it is assumed that the pork industry's perception of macroeconomic risk is based on the past two months' experiences, current observation, and expectation for the next two months. The magnitude of the standard deviation is positively related to the absolute level of CPI; that is, the standard deviation tends to be large when the CPI is high. But this may not be true for risk measurements, because when the level of CPI is high for the period but the variation is small, the resulting high standard deviation exaggerates the risk the industry actually faces. Following common statistical practices, the standard deviation is divided by the mean of the observations, which gives a coefficient of variation free of the biases caused by variation in the level of the CPI. This measurement is denoted as R .

No data are available for monthly pork production, but monthly hog procurement data are available. Because there is generally a shortage of hogs for pork processors and there is practically no independent market for carcasses in Poland, monthly hog procurement reasonably approximates monthly pork production; therefore, we denote volume of output by Y .

Finally, it is important to include the impact of AMA interventions in hog procurement. A dummy variable is used to represent government intervention. In months when AMA intervened in procurement, the dummy variable is 1; otherwise it is 0.

In sum, the price margin, M , is presumed to be a function of the marketing and processing labor cost, L , material cost, C , macroeconomic risk, R , pork output, Y , and government intervention, I .

$$(5) \quad M_t = f(L_t, C_t, R_t, Y_t, I_t).$$

Table 3 provides basic information on the variables in equation 5. Comparing the minimum with the maximum and the standard deviation with the mean, M , C , L , Y , and R all displayed significant variation between 1990 and 1996. Variation in our measure of macroeconomic risk, R , was particularly great where the maximum was 10 times the minimum. The mean of the ratio of the material cost index to the CPI is less than 1, which means that our proxy for input prices increased slower than the general rate of inflation. Similarly, since the mean of the ratio of the wage index to the CPI is greater than 1, wage rates in agricultural processing industries increased faster than the general rate of inflation. AMA intervened in 21 out of 74 months, consistent with their policy of buying only at certain times, usually during the first half of the year.

Because nonstationarity of variables can lead to spurious results, augmented Dickey-Fuller stationarity tests are conducted on each variable. All are weak-form stationary, meaning that they have finite and constant means and variances.

Assuming that there is a linear relationship between the price margin and the five independent variables, equation 5 can be further specified as:

$$(6) \quad M_t = a + b_1L_t + b_2C_t + b_3R_t + b_4Y_t + b_5I_t + e_t$$

Table 3. *Descriptive Statistics for Poland, 1990–96*

Variable	Mean	Standard deviation	Minimum	Maximum
Price margin in real terms, ^a M	5,461.4	1,177.6	4,245.1	8,784.9
Ratio of fuel index to consumer price index, C	0.698	0.085	0.540	0.920
Ratio of wage rate index to consumer price index, L	1.169	0.092	0.977	1.356
Hog procurement, ^b Y	70.2	15.9	43.4	105.8
Coefficient of variation of consumer price index, R	0.048	0.023	0.010	0.137

Note: There were 76 monthly observations for January 1990 to April 1996. However, construction of the coefficient of variation of consumer price index (R) limited the study to only 72.

a. The unit of price margin is zloty per kilogram. The nominal prices of hog procurement and pork retail are deflated by the consumer price index. The price margins are the difference between the two prices.

b. The unit of hog procurement is 1,000 tons live weight. As discussed in the text, hog procurement is used as a proxy for total pork production.

Source: Authors' calculations.

where a and b are coefficients, and e is an error term. Equation 6 is estimated on the monthly data. Although one month might be long enough for farms or firms at different marketing levels to finish adjusting to market signals, the possibility cannot be excluded that the impacts on price margins of changes in some processing or marketing costs may last more than a month. In this case, certain lagged independent variables should be included. However, there is no indication which, if any, independent variables have effects lasting longer than one month, making dynamic specifications difficult and ad hoc. We follow the suggestion of Pindyck and Rubinfeld's (1991) to use a combined regression–time-series model under such circumstances.

Equation 6 is a structural model, and the error term e in equation 6 may contain some variance in M that is not explained by the five structural variables. An autoregressive and moving average (ARMA) process can be performed on the series of e_t and be incorporated into equation 6. This ARMA process can help explain any variance in M that cannot be explained structurally. The analysis of autocorrelation and partial autocorrelation of the series of e_t suggests that a first-order autoregressive process is sufficient to capture effects not explained by the structural model. The short autoregressive result tends to imply that most of the price transmission between farm and retail is accomplished within a month and is captured by the structural model. In any case, equation 6 is appended as:

$$(7) \quad M_t = a + b_1L_t + b_2C_t + b_3R_t + b_4Y_t + b_5I_t + \eta_t + \theta\eta_{t-1}$$

where $\eta_t + \theta\eta_{t-1}$ is the autoregressive process of e_t in equation 6.

Equation 7 itself is neither a moving average nor an autoregressive process, it is a combination of a structural model and a time-series structure. An autoregressive process is applied to the residuals of equation 6 and is introduced to capture changes in price margins that cannot be explained by the structural variables (L , C , R , Y , and I).

Estimation Results

The estimation of equation 7 takes two steps. First, equation 6 is estimated to obtain the series e_t . Second, equation 7 is estimated using ordinary least squares to estimate simultaneously the structural and time-series part of the model as suggested by Pindyck and Rubinfeld (1991).

This two-step estimation is done first for the whole time period, January 1990 through April 1996. However, price liberalization introduced a big shock, and all variables were highly volatile during 1990–91 but calmed down starting in 1992. Therefore, the time period is split in two—January 1990 through December 1993 and January 1992 through April 1996 (1992–93 is common to both periods). Significant differences between the initial and long-term reactions to price liberalization, if any, should be revealed by differences in the equations estimated for the two time periods.

Diagnoses of residuals of the three estimations show that there is a multicorrelation problem. Ordinary least squares estimators in the presence of multicollinearity remain unbiased and efficient, and the major undesirable consequence is that the variance of coefficients is exaggerated. However, in all three equations, the R^2 for the regression exceeds the R^2 of any independent variable regressed on the other independent variables. For this reason, no further corrective steps are deemed necessary (for a justification, see Kennedy 1993).

The Durbin-Watson statistic cannot be used to test the existence of autocorrelation with the lagged error term included in equation 7. Instead, the Breusch-Godfrey Lagrange Multiplier test is conducted (for the testing procedure, see Maddala 1992). The results appear in the last row of table 3. In all cases, the null hypothesis of no further autocorrelation is accepted at a 1 percent significance level.

All the estimation results are consistent with the theoretical model developed by Brorsen and others (1985); that is, all the coefficients have signs predicted in equations 2 through 4. The coefficient of the lagged error term, θ , is statistically significant in all three cases, which means that some dynamic effects are left out of the structural model. Including the lagged error term improves the explanatory power of the model. The adjusted R^2 of the model without the lagged error term is 0.73 for the whole period, 0.69 for the first period, and 0.59 for the second period.

Results for the whole period, the first period, and the second period are shown in table 4. For the whole period, the coefficients of all independent variables, except material costs, are highly statistically significant, and R^2 for the model is 0.8. The structural variables explain most of the variation in price margins, which implies that the market mechanism is functional.

Most notable, macroeconomic risk, measured by the variation coefficient of the CPI, has a large, highly significant, positive coefficient. The large magnitude of the coefficient suggests that the price margin is very sensitive to macroeconomic risk. If any single factor should be blamed for enlarging price margins after price liberalization, it would appear to be macroeconomic risk.

Pork output, Y , has a positive and statistically significant coefficient, which is also consistent with Brorsen's theoretical model. An increase in quantity marketed is correlated with an increase in the market margin. However, the output coefficient is not significant for the second time period.

The coefficient of labor cost, L , is statistically significant and negative except in the second period. As mentioned before, the wage rate has consistently increased faster than the CPI, driving up processing and marketing costs. Significant negative coefficients of the AMA dummy variable, I , indicate that AMA intervention did reduce the price margins of pork products. AMA procurement interventions raised hog procurement prices at critical junctures, which processors apparently were not able to pass entirely on to consumers, meaning that some degree of competitiveness is evident in pork processing and retailing markets. The coefficient of material costs, C , is statistically significant.

Table 4. *Market Margin Determination of the Hog-Pork Market in Poland, January 1990–April 1996*

<i>Dependent variable</i>	<i>January 1990 to April 1996</i>	<i>January 1990 to February 1993</i>	<i>January 1992 to April 1996</i>
Material cost	500.30 (0.45)	-1,506.5 (-0.67)	1,586.3*** (2.92)
Labor cost	-3,305.1*** (-4.34)	-3,951.6*** (-3.64)	-112.18 (-0.22)
Agricultural Marketing Agency intervention	-459.5*** (-2.93)	-487.1* (-1.75)	-164.4* (-1.96)
Pork output	28.0*** (5.51)	30.9*** (4.60)	3.45 (1.04)
Variation coefficient of consumer price index	18,328.0*** (4.75)	24,436*** (4.04)	8,535** (2.76)
Lagged error term, θ	0.52*** (4.56)	0.57*** (3.75)	0.48*** (4.58)
Constant	6,257.1*** (4.81)	7,952.2*** (4.19)	3,378.7*** (4.48)
Observation	72	45	49
Adjusted R ²	0.80	0.77	0.58
Breusch–Godfrey lagrange multiplier test	0.020***	0.335***	0.275***

Note: *t*-ratios are in parentheses.

* Significant at 10 percent.

** Significant at 5 percent.

*** Significant at 1 percent.

Source: Authors' calculations.

The estimation for the first period produces similar results as that for the whole time period. The sign of all statistically significant coefficients is the same, although the magnitude is somewhat different, as would be expected. However, the estimation for the second period provides rather different results. The coefficient of material cost is positive and statistically significant, while the coefficient of labor costs is no longer significant. The positive coefficient of material cost means that an increase in material costs enlarged market margins in the second period. It might be the case that since consumers' income recovered from the deterioration at the beginning of transition, and the demand for meat products became less price-elastic, processors and retailers were able to pass on the cost increases to retail prices. It is noteworthy that the magnitude of the coefficient of macroeconomic risk is reduced substantially in the second period. It is only one-third of that in the first period. Of course, as economic stability was achieved, macroeconomic risk was reduced. But it also appears that the impact of macroeconomic risk on market margins declined considerably as well. This may be because market players became more able to bear and absorb risk so that market prices and margins were less likely to overreact to risk than before. Or it is possible that the dominance of macroeconomic risk over sectoral markets decreased, so that the measurement of macroeconomic risk covered a smaller proportion of the actual risk facing a hog-pork marketing firm than before.

III. CONCLUSIONS AND DISCUSSION

Price liberalization in the agrifood sector of transition economies is likely to slip into a trap: food prices rocket up, but if higher retail prices are *not* transmitted to higher farmgate prices, food supply does not respond, retail prices remain high, consumer demand declines, and production stagnates or even contracts. Fortunately, the hog-pork market in Poland appears to have avoided this trap. After the 1989 price liberalization, real prices for hog and pork did not increase; they declined. The supply of live hogs and pork kept rising until 1992. After 1993, the hog-pork market adjusted to the impacts of the 1992 drought and the shift of consumers' preference from meat products to vegetables and fruits.⁶ Thus the hog-pork sector safely crossed over the price liberalization trap.

The most important factor contributing to this success would seem to be the restructuring of the pork processing and retailing industries. Private firms blossomed, and state-owned firms were subjected to competitive pressures. Correspondingly, the market behavior of processors and retailers became active, aggressive, and profit-oriented. Second, although most private farms are operated on a small scale, and their degree of specialization and commercialization remains low, once situated in a competitive market they explored diversified marketing channels and reacted actively to market signals.

Emergence of a competitive system allowed price transmission across marketing levels to become a feature of the hog-pork industry in Poland, as confirmed by the results of this article that the price spread between raw and processed pork products was determined mostly by market forces rather than being manipulated by monopoly forces. The smooth price transmission mechanism prevented the farming sector from being isolated from the retail food market. Farms benefited from increased competition in the processing and retail industries and received increases in farmgate prices commensurate with increases in retail prices of pork. Price liberalization succeeded in eliciting increases in farm supply.

Except for AMA procurements, there is little significant government intervention in the hog-pork sector. Our results indicate that AMA intervention does benefit farmers by increasing farmgate prices of live hogs when the supply of hogs is strong, without dominating, much less superseding, the marketing system.

Most important, this study of margin determination showed that the price spread between raw and processed pork products is very sensitive to macroeconomic risk. An increase in macroeconomic risk substantially increases the price spread. Apparently macroeconomic uncertainty has profound cost implications for processing and marketing firms. High risk leads to high costs, and high costs prevent the price transmission mechanism from working efficiently among farmers, processors, and retailers. The Polish government has an effective stabilization program, and the inflation rate declined from 586 percent in 1990 to 70 percent in 1991 and to 22 percent in 1995 (OECD 1996). There is good reason to

6. The share of vegetable fats in total fat consumption increased from 33 percent in 1990 to about 60 percent in 1995 (OECD 1996).

believe that the stable macroeconomic environment made it possible for the marketing system to operate effectively and helped the hog-pork sector to avoid the price liberalization trap. Gains from an even more stable macroeconomic environment should not be underestimated. The case of hog-pork markets in Poland is a concrete example of the benefits of global stabilization policies.

This article focused on vertical marketing chains in the hog-pork sector. Another study analyzes spatial market integration in the hog-pork sector and finds that regional hog-pork markets are well linked. More important, these linkages are well explained by economic variables such as transportation costs and differences in demand and supply among regions, leading to the conclusion that hog-pork markets in Poland are spatially integrated.

The hog-pork sector in Poland is not alone in avoiding the price liberalization trap. Our other studies (Wei and others 1996; Wei, Guba, and Krzyzanowska 1997) show that the marketing system functions fairly well in the wheat, flour, and bread sector and functions very well in the dairy sector—for similar reasons as in the hog-pork sector.

Competitive processing and retail industries, market-responsive private farms, limited and indirect government intervention, and a stable macroeconomy appear to be the major factors that allowed the Polish hog-pork sector to avoid the price liberalization trap. This contrasts sharply with conditions in other transition economies. In the Ukraine, state-owned processing enterprises were privatized very slowly, and little private capital entered the industry. Moreover, although state and collective farms were restructured, the new ownership and management conditions do not produce effective incentives, and farms are still not sensitive to market signals. Finally, the macroeconomic environment in the Ukraine is still very volatile, creating high risks for agrifood enterprises, which this article implied can be a major impediment to effective price transmission. It is hardly surprising that the Ukrainian agrifood sector is still locked in the price liberalization trap.

Although reform in the hog-pork sector in Poland succeeded in avoiding the price liberalization trap, its successes should not be overstated. The hog-pork marketing system continues to be characterized by a large number of very small private farms, underdeveloped intermediary markets, and large, vertically integrated processing enterprises capable of engaging in predatory pricing. Also, the state has demonstrated a continued willingness to intervene. Its favored parastatal (the AMA) continues to enjoy privileged access to finance and an ability to thwart the dynamism of the private sector. And the domestic hog-pork market is still protected by high tariffs.

To achieve a higher level of marketing efficiency, the first step is to overcome the size limitations of small private farms. Recent interviews found that private farmers and, more surprisingly, processors considered that only modest increase in farm size was possible over the next 15 years (Guba and others 1995). Nor can the imbalance in market power between processors and farmers be resolved by decreasing the scale of processing plants. In fact, economies of scale, if any-

thing, warrant further consolidation in the processing industry. One way to resolve the imbalance between size and power would be to develop new farmer cooperatives (usually termed "marketing groups" to avoid unwanted associations with the former system of cooperatives). A few hog farmers are in the process of organizing new cooperatives in order to (a) purchase production inputs collectively, especially feed, (b) sell pigs to processors as a group, (c) share technology among members, and (d) construct feed production facilities for the group.

Organized into marketing and service cooperatives, farmers would be better able to bargain with processors over price and would have better access to market and technical information. Organization could help compensate for the severe size disadvantage presently facing small, individual farms. Meat processing plants complain about the uncertain quality of animals, the timing of supply delivery, and the high unit costs of dealing with so many small farmers, which explains why processors concur with farmers over the desirability of farmer organization. Cooperatives may indeed provide a solution beneficial to both parties. Several processors have even expressed willingness to assist farmers in forming marketing groups.

Primary wholesale markets (from farms to processors) and secondary wholesale markets (from processors to retailers) are absent in the Polish hog-pork marketing system. However, development of wholesale markets is more difficult due to the large number of small production units in both farming and processing. Wholesale markets could put useful pressure on processing firms. The quality and health requirements for products could improve if trade were conducted by multiple participants in primary wholesale markets. Also changes in consumer demand might be communicated to processors more readily by secondary wholesale markets. The quality of market information should also improve. If new farm cooperatives were established and wholesale markets developed, AMA would have less reason to intervene to stabilize the market. Unlike most developed countries where wholesale markets have been created by local governments and operated as nonprofit organizations, there has been little action of this sort in Poland.

Farmers, processors, and traders alike have generally approved of AMA's price stabilization interventions but have been somewhat critical of the price levels chosen and the late timing of interventions. AMA decisionmaking procedures should be improved. Reserve management and intervention activities often run counter to each other and need to be separated. Although the total amount of reserves need not be disclosed to the public, purchase and resale should be more transparent to market participants. In this way, market uncertainty would not be exaggerated by AMA's reserve management interventions. AMA uses preferential credits for its intervention activities and enjoys a *de facto* monopoly on most kinds of bulk and cold storage. These practices should be phased out.

In the beginning of the transition, many analysts and industrialists in Poland argued that imports should be restricted in order to protect a weak domestic

market. More than seven years into the transition, the hog-pork sector has matured and should now be capable of meeting international competition. Poland will join the European Union at some point in the future. Bridging the gap between domestic and international markets, and not delaying until the last moment to do so, is a high-priority task.

APPENDIX. DATA SOURCES

All data used in the analysis come from the Central Statistical Office in Warsaw and cover national and regional procurement prices, retail prices, procurement, production, and consumption volumes, population, and income.

Procurement Data

Monthly procurement data are published regularly by the Central Statistical Office. The first level of aggregation is performed by procurement agents who cover monthly activity. Those agents are defined as "economic units making procurement a part of their commercial activity." As such, they are obligated to report to the local *voivodship* statistical office. Once aggregated, the data are passed to the Central Statistical Office in Warsaw. Procurement units report value and volume of procurement, and this information makes it possible to calculate the weighted average at each aggregation level. This procedure reflects procurement characteristics (value, volume, price) made by local agents, including transactions outside a particular *voivodship*. Twice a year, recalculation is done to present the volume of procurement from local producers.

Retail Data

The Central Statistical Office collects prices on 1,007 consumer goods and services to monitor the inflation rate and calculate the consumer price index. The data collection procedure includes 307 representative regions (cities and *gminas*); 28,000 retail outlets including local markets are selected and monitored once a year. For the purpose of this study, retail data have been updated. Original data used to construct variables came from Central Statistical Office statistical reports.

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