Incentive Compatible Pricing and Quality Adoption: The Case of the Polish Dairy Sector

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ABSTRACT

We construct a model to identify determinants of the diffusion rate of standards in a food chain. We argue that adoption decisions in the food chain are determined by farmers' and processors' economic considerations. Factors such as pricing behavior, compliance costs and market structure, all of which influence the adoption of standards, are identified and discussed in the paper. The findings are used to test an econometric model utilizing data on Polish milk processing firms in the period between 2000 and 2002. The results indicate that input and output prices have a significant influence on the diffusion rate of standards. The dominance of large-scale holdings in the relevant procurement market significantly increases, whereas high compliance costs decrease the diffusion. Small cooperatives were found to face significant problems in procuring high quality raw materials compared to their competitors.

Keywords: product quality, standards, EU enlargement, industrial organization.

1 BACKGROUND

The "quality turn" (ALLAIRE, 2004) has, in recent years, become an ubiquitous phenomenon and has stimulated a significant body of research. However, the current literature on quality issues tends to focus on the competing concepts of 'standards as barriers' and 'standards as catalysts' in the context of food safety regulations and requirements for industrialized countries engaging in international agricultural trade (HENSON, JAFFEE, 2006; JOSLING et al., 2004). Thus far little work has been published on quality issues in transition countries, especially those which have recently joined the European Union (EU). This is astonishing, since EU membership obliges the adoption of the total body of community law accumulated thus far (*acquis communautaire)*. For agri-food businesses based in the current EU-aspirants, this means that all mandatory EU standards concerning food production, processing and retailing have to be met by the day of accession, or after a fixed transitional period. The recent history of the EU's eastward enlargement reveals that especially in countries with a majority of small-scale holdings and processors, the compliance process is relatively slow (BERKUM, 2005; PIENIADZ et al., 2004). Particularly, the adoption of EU hygiene regulations for food of animal origin is one of the biggest challenges, because the regulations contain various obligations for technical equipment and building installations. Moreover, the diffusion of voluntary, private quality standards from Western countries has put additional pressure on agri-business operators in accession countries (HANF, PIENIADZ, 2006). The firms' changing environment, including the reform of official control authorities and ongoing restructuring processes at all stages in the food chain, have caused some delays in the compliance process.

Analyses of quality standards adoption in light of EU accession focus mainly on the economic impact of foreign-imposed standards on the structure of agricultural markets (RAU, VAN TONGEREN, 2006; HOCKMANN, PIENIADZ, 2005). Still, which factors are driving compliance with quality requirements on the micro level remains highly ambiguous, regardless of whether governmental or private standards are considered. Some studies cite compliance costs as the main determinant of standards' adoption. The majority of these studies, however, are either based on the desire to provide policy-makers with basic information about the costs of various new food safety regulations in order to identify cost-effective food safety approaches (UNNEVEHR, JENSEN, 2001; ANTLE, 2000), or to provide information about the costs of implementing and enforcing the *acquis communautaire* in order to assess the need for governmental aid to support the compliance process (KISS, WEINGARTEN, 2003). Thus, while recognizing that the cost side dominates research on the adoption of standards, there is a need for 'rebalancing' the current debate in this area by considering in addition factors influencing the returns of the quality standards adoption.

Our paper aims to fill this gap in the literature by identifying factors that are driving compliance with quality standards at the micro level. We argue that the adoption of standards is guided by the producers' and processors' expected profits before and after improvements in food safety and quality. This implies that the adoption of standards is affected not only by costs but also by additional revenues associated with compliance. Our main hypothesis is that through quality-related payment schemes, downstream firms can significantly affect the diffusion of quality standards in upstream sectors. In the next section we develop a theoretical model to identify the driving factors of the diffusion process. The empirical application concerns the Polish dairy sector prior to transition (2000 – 2002). This market is particularly interesting, since (1) milk is an important product of both EU and Polish agriculture, (2) a wide range of hygiene standards must be implemented during the accession process, and (3) milk production in Poland is dominated by small farms, which causes sluggish diffusion of EU quality standards (PIENIADZ et al., 2004).

2 THEORETICAL CONSIDERATIONS

2.1 Basic assumption

Farmers deliver raw material of various qualities to processors. But manufacturing a high quality consumer good requires a minimum quality of a raw material (q_{min}). If the quality is below q_{min}, the stability of the final products cannot be guaranteed, because both undesirable attributes of the raw material (sensory, microbiological attributes) and problems in the processing stage can cause inferior quality in the final products. The prices of high and low quality products are w_h and w_l, respectively, with $w_h \geq w_l$. Both prices are exogenous, which implies processors on the retail level exhibit price-taking behavior.

Prices received by the farmers are correlated with product quality. High quality raw materials are remunerated by v_h, while the price for low quality raw material is v_l, with $v_h \geq v_l$. Corresponding to the choice of *production techniques*, the farmer can be of two different types: low (t_l) or high (t_h) quality producers. The distribution of raw product quality differs with respect to the applied technique. We assume that technique t_h stochastically dominates t_l to the first order, i.e., $\Phi_h(q) < \Phi_l(q)$, $\forall q$. In addition, we assume that the choice of q_{min} does not allow the exact identification of the production technique, i.e., $\Phi_h(q_{min}) > 0$ and $\Phi_l(q_{min}) < 1$.

Technique t_h requires additional resources or compliance costs (k) such as special animal feed, additional sanitary measures, and investment in building and equipment. We do not distinguish between fixed and variable costs and assume, for simplicity, that these costs are constant for a farmer. Thus, the additional average cost of technique t_h decreases with an increase in the amount of raw material production (x). Moreover, compliance costs are assumed to be the same for all farmers. Thus, farmers differ only with respect to the scale of production. Farm size is distributed according to function f(x).

Because of higher value added, the processor has an incentive to specialize in high-quality production, which requires farmers to deliver the corresponding quality of raw material. This in turn requires sufficient remuneration of the resources allocated to agricultural production. The market for low quality raw milk is assumed to be competitive, since the farmer may choose among various marketing channels. This suggests that the low quality procurement price (v_l) is also given. However, on the market for high quality products, entry restrictions such as high investment requirements can cause the processor to act as a monopsonist. Thus, v_h is the processors' only decision variable. Moreover, v_h influences farm revenues, and thus affects farmers' adoption decisions. After the processor has announced v_h, farmers decide to adopt or not to adopt production technique t_h. We assume that there is a marginal farmer (x*), who is indifferent to adoption or non-adoption. Since adoption costs decrease with farm size, those with higher production than x* will, by definition, be located in the group of high quality raw material producers, while smaller farms will remain with t_l.

The optimal v_h can be found as follows: First, the processor announces a v_h. Second, farmers decide to adopt or not to adopt. The diffusion of the high quality techniques occurs according to the farm characteristics and the price of the high quality raw material. The optimal v_h is found by backward induction. The processor takes the farmers' decision into account and fixes v_h so that profits will be maximized.

2.2 The marginal farmer

A risk-neutral farmer compares expected profits with ($E\pi_h$) and without ($E\pi_l$) adoption of the high quality production technique:

$$E\pi_h = x\,[(1-\Phi_h)\,v_h + \Phi_h\, v_l\,] - k \quad \text{and}$$

$$E\pi_l = x\,[(1-\Phi_l)\; v_h + \Phi_l\; v_l\,].$$

Adoption occurs as long as $E\pi_h \geq E\pi_l$. The threshold is given by

$$x^* = \frac{k}{(\Phi_l - \Phi_h)(v_h - v_l)}.$$

2.3 The processor's decision

The processor's expected profits are:

$$E\pi^p = (1-\Phi_h)\int_{x^*}^{x_{\max}} f(x)dx(w_h - v_h) + \Phi_h \int_{x^*}^{x_{\max}} f(x)dx(w_l - v_l) +$$

$$(1) \qquad (1-\Phi_l)\int_{x_{\min}}^{x^*} f(x)dx(w_h - v_h) + \Phi_l \int_{x_{\min}}^{x^*} f(x)dx(w_l - v_l).$$

Denoting industry output by $X = \int_{x_{\min}}^{x_{\max}} f(x)dx$ (1) can be transformed to

$$(2) \qquad E\pi^p = X\{(1-F(x^*))(w_h - v_h)[(1-\Phi_h) + (1-\Phi_l)] + F(x^*)(w_h - v_h)[\Phi_h + \Phi_l]\},$$

where F(·) is the probability distribution function of farm size, i.e., F(x*) is the share of output produced by farms smaller than x*. The first order condition is:

$$\frac{\partial E\pi^p}{\partial v_h} + \frac{\partial E\pi^p}{\partial x^*}\frac{\partial x^*}{\partial v_h} = 0.$$

The first term is negative and represents profit loss due to an increase in the price of high quality raw materials. The second term is a profits increase because of a reduction in the adoption threshold. Conducting the differentiation and collecting terms provides:

$$(3) \qquad X\left[-(1-\Phi_h) + (\Phi_l - \Phi_h)F(x^*) + k\,\frac{(w_h - v_h) - (w_l - v_l)}{(w_h - v_h)^2}\, f(x^*)\right] = 0.$$

Given that the second order condition holds, the comparative statics are given by the differentiation of (3) with respect to the corresponding factor. The individual effects are:

$$\frac{dv_h}{d\alpha} > 0, \text{ for } \alpha = k, v_l, w_l, \Phi_l, X \text{ and } \frac{dv_h}{d\alpha} < 0, \text{ for } \alpha = w_h, \Phi_h.$$

In the following, we concentrate on the diffusion of the high quality production technique:

(4) $$\frac{d(1-F(x^*))}{d\alpha} = -f(x^*)\left(\frac{\partial x^*}{\partial \alpha} + \frac{\partial x^*}{\partial v_h}\frac{\partial v_h}{\partial \alpha}\right), \text{ with } \alpha = w_h, w_l, v_l, \Phi_h, \Phi_l, k, X.$$

Conducting the indicated differentiation provides:

$$\frac{d(1-F(x^*))}{d\alpha} < 0, \text{ for } \alpha = k, v_l, w_l, \Phi_l, X \text{ and } \frac{d(1-F(x^*))}{d\alpha} > 0, \text{ for } \alpha = w_h, \Phi_h.$$

3 EMPIRICAL IMPLEMENTATION

Our empirical application deals with the Polish dairy sector from 2000 to 2002. The theoretical hypotheses were derived by assuming processors' price-taking behavior for all final products on the consumer market and for low quality raw materials on the procurement market. A monopsony was assumed to characterize the market structure for high quality raw materials. Since the theoretical results would differ with regard to the firms' behavior, we first show that the market structure assumptions are consistent with the situation in the Polish dairy sector.

Given the tradability of manufactured dairy products and the relatively large number of processors in Poland, dairy product prices can be expected to be fixed for the individual processor. On the contrary, processors might be able to exploit considerable oligopsonistic market power on the procurement stage. Perhaps the most important reason for this is the limited tradability of raw milk due to its high risk of deterioration and its high transportation costs. However, since a 'dual standard system' for food quality was possible during the investigated period, the farmers could sell low quality raw milk directly to consumers or to small manufacturers who do not possess the technology to produce high quality products. Both opportunities limit the processors' pricing strategies regarding low quality raw milk.

3.1 Data base

Data on individual dairy processors in Poland were collected from several sources. Our main database was provided by BOSS, Economic Information, Ltd., in Poland, which conducted regular dairy processing company surveys. The available set contains annual data from 2000 to 2002. Since the identity of the individual firms was known, additional information from regional statistics could be included: these are the location of each firm and its ownership status. By utilizing information about the location of a firm, a set of regional variables corresponding to the relevant market of the ith firm/chain have been compiled.

Table 1: Relevance of the investigated sample

	Employees		Revenue		NPM	
	Sample in 1,000	Share in the dairy industry	Sample in millions of USD	Share in the dairy industry	Sample	Dairy industry
2000	12.4	25%	792.7	32%	0.79	0.10
2001	17.5	36%	1496.9	50%	1.98	0.04
2002	14.7	32%	1318.4	47%	2.17	0.45

Sources: BOSS (2004), IERiGZ (var. issues), GUS (var. issues b).
Note: NPM: Net Profit Margins: A ratio of profitability calculated as net earnings divided by revenues.

Since participation in the survey differs between years, only data from dairies with the same number of observations for all variables were used in the analysis. These concern 38 dairies in 2000, 60 in 2001 and 50 in 2002. The three abovementioned sub-samples have been pooled, providing 148 observations. The original goal of the survey was to create a ranking of the Polish dairies. Due to the voluntary participation in the ranking, it is likely that primarily firms with good business performance and prospective are represented in the data set. The higher profit margin of the investigated sample compared to the industry average confirms our presumption (see Table 1).

Most of the firms are large and medium-sized companies, although firm size ranges from 40 employees up to 1,300 in the pooled survey data. The data set is dominated by cooperatives, which accounted for 93% (138) of the investigated dairies. A typical firm in the sample processes a wide spectrum of products (drinking milk, yogurt, cheese, etc.). Thus, the sample is a good representation of the Polish dairy sector.

3.2 Parameterization

The theoretical model suggests strong interactions among expected profits of the dairy company (π_i), diffusion of standards (Q_i) and the prices for raw materials (v_i). Because of these mutual relationships, the appropriate approach is to estimate a simultaneous equation model treating the abovementioned variables as jointly endogenous. One central variable in the diffusion model is the differential in retail prices for high and low quality products (w_h – w_l). Unfortunately, the data set provides only information about average regional prices (w_i). We assume that higher values of w_i are connected to a higher share of quality goods in the consumption bundles of a given regional market, and that they are influenced by consumer income (I_i) and the presence of foreign investors (DP_i) in the ith region. In order to account for these determinants, we incorporate a retail price equation in the model. Thus, the estimated system consists of four equations:

Processors' profit: $\pi_i = \alpha_1 + \alpha_2 Q_i + \alpha_3 v_i + \alpha_4 w_i + \alpha_5 DF_i + \alpha_6 s_i + \varepsilon_{\pi, i}$

Diffusion rate of standards: $Q_i = \beta_1 + \beta_2 v_i + \beta_3 w_i + \beta_4 x_i + \beta_5 k_i + \beta_6 DF_i + \varepsilon_{q, i}$

Procurement prices: $v_i = \varphi_1 + \varphi_2 w_i + \varphi_3 x_i + \varphi_4 k_i + \varphi_5 s_i + \varepsilon_{v, i}$

Retail prices: $w_i = \gamma_1 + \gamma_2 I_i + \gamma_3 DP_i + \varepsilon_{w, i}$

Here, DF_i, s_i, x_i, k_i, represent dairy firm characteristics, regional market share on the raw milk market, average farm size, and compliance costs in the ith region, respectively. The definition and descriptive statistics of all variables used are reported in Table 2.

Table 2: Definition and descriptive statistics of used variables

Symbol	Definition	Mean (SD)	Minimum Maximum
Q	Share of EU-conforming raw milk ("extra" class) in the total milk procurement of the ith dairy	0.637 (0.170)	0.195 0.910
π	Firm-specific earnings before interest and taxes in PLN per kg procured raw milk p.a., deflated by inflation rate	0.018 (0.030)	-0.023 0.230
v	Average procurement price for raw milk in a region, deflated by the country average in the respective year	0.997 (0.065)	0.833 1.139
w	Average retail prices for drinking milk in a region, deflated by the country average in the respective year	0.997 (0.032)	0.943 1.065
x	Farm size, defined as share of farms that own more than 10 cows, of the total number of dairy holdings in a region	0.080 (0.060)	0.002 0.233
k	Proxy for compliance costs in a region, defined as share of "live power" of draft horses in the total draft force resources in a region	0.036 (0.020)	0.008 0.079
s	Relative dairy size, defined as a dairy's share of the procured raw milk quantity in the region	0.112 (0.101)	0.004 0.455
COSM	Dummy variable for a small cooperatives: the variable is set equal to one if the firm procures less than 35 m liters of raw milk p.a., and is 0 otherwise	0.466 (0.501)	0 1
COLG	Dummy variable for a large cooperatives: the variable takes the value of one if the firm procures more than 75 m liters of raw milk p.a., and is 0 otherwise	0.203 (0.403)	0 1
PRIV	Dummy variable for a private dairy	0.067 (0.252)	0 1
DP	Dummy variable for the existence of FDI; the variable is set equal to one if there is at least one foreign dairy in the region, and is 0 otherwise	0.419 (0.495)	0 1
I	Annual gross disposable income per capita in a region, deflated by the country average in the respective year	0.989 (0.181)	0.771 1.412

Source: BOSS (2004), GUS (2001), GUS (2005), GUS (var. issues a), Internet research, telephone survey.
Note: Number of observations: 148.

Profits π are approximated by earnings before interest and taxes (EBIT) per kg of processed milk. EBIT is an adequate indicator of a company's financial performance, since it allows a comparison amongst heterogeneous firms while omitting the effects of firm-specific financing and accounting decisions. Normalization was conducted in order to control for scale effects in the processing. Profits are expected to increase with the diffusion of higher standards, lower procurement costs and higher prices for final milk products ($\alpha_2 > 0$, $\alpha_3 < 0$, and $\alpha_4 > 0$). The variable *DF* was approximated by a firm-specific dummy variable indicating different ownership structures. There is evidence suggesting that private firms perform better than cooperatives. Additionally, large cooperatives are more likely to face financial disadvantages due to their complex governance structures compared to their smaller competitors (FULTON, GIANNAKAS, 2001). Corresponding to this consideration, ownership structure was coded in three binary dummy variables: *PRIV* for private dairy processors, *COSM* for small, and *COLG* for large cooperatives. The expected sequence of the estimates is $\alpha_{PRIV} > \alpha_{COSM} > \alpha_{COLG}$. Furthermore, we expect oligopsonistic market power, captured by the companies' regional market share (*s*), to have a positive impact on the processors' profits ($\alpha_6 > 0$).

Diffusion (*Q*) is captured by the degree of compliance with EU standards within the dairy companies. The dependent variable is defined as the share of EU-conforming raw milk in the total milk procurement of the ith milk-processing firm. According to our theoretical model, higher procurement and product prices, as well as higher farm sizes, have a positive impact on the diffusion of quality standards ($\beta_2 > 0$, $\beta_3 > 0$, and $\beta_4 > 0$). Due to the lack of a more appropriate measure, we proxy the compliance costs, *k*, with an index based on draft force resources in agriculture. A high share of live horsepower in the total draft force resources can be regarded as an indicator of a generally outdated production technique. An obstacle technique requires additional investment and increases compliance costs, and thus decreases the incentives to implement production techniques that promote the production of high quality raw milk. Thus, we expect $\beta_5 < 0$. There are no *a priori* assumptions about the influence of the ownership structure on the diffusion rate of standards. However, it is likely that due to their membership commitment, agents delivering to a cooperative have additional motivation to adopt a given standard. On the other hand, private dairies have more freedom to select high quality producers, which would suggest a higher diffusion rate as far as private firms as integrators are considered.

According to theoretical considerations, high quality raw material prices (v_i) are a function of farm size (*x*), retail prices (*w*) and compliance costs (*k*). The comparative statics yield $\varphi_2 > 0$, $\varphi_3 > 0$ and $\varphi_4 < 0$. In order to account for oligopsonsitic market power, we included regional market share (*s*), in the equation explaining procurement prices. Since this variable corresponds with the processors' bargaining power, and hence its ability to drive prices down, we expect φ_5 to be negative.

As mentioned above, we approximate retail prices by regional disposable income, *I*, as an indicator of demand for high quality products and by the existence of foreign direct investors, *DP*, as an indicator of the supply side. Because of the positive correlation between quality demand and income, $\gamma_2 > 0$ is expected. In general, foreign investors concentrate on the production of high quality products. Thus, the average prices for the final product should differ among regions with and without FDI in the dairy sector. This information has been coded in the corresponding dummy variable, *DP*. We expect a positive effect of *DP* on the average retail price ($\gamma_3 > 0$).

3.3 Estimation and inference

The model was estimated using pooled survey data from the three sub-samples in the years 2000 - 2002. The mutual interdependence of the four equations suggests a 3SLS approach. In all equations the number of excluded exogenous variables is larger than the number of endogenous variables used as regressors; thus, the system is over-identified. The parameters can be estimated without additional restrictions or non-sample information (JUDGE et al., 1985, p. 577).

Table 3: 3SLS estimates of diffusion model for the Polish dairy sector

		OLS	ILS	3SLS			
				Dependent variables			
Explanatory variable	Symbol	Dependent variable	Dependent variable	Profit	Dif fusion	Procur. price	Retail price
		Q	Q	π	Q	v	w
Diffusion	Q	–	–	0.17*** (0.01)	–	–	–
Procurement price	v	0.35 (0.243)	–	- 0.30*** (0.05)	1.50*** (0.22)	–	–
Retail price	w	0.29 (0.47)	–	0.07 (0.10)	1.58*** (0.48)	- 0.24* (0.13)	–
Constant		- 0.04 (0.53)	0.69*** (0.09)	0.12 (0.13)	- 2.46*** (0.60)	1.19*** (0.13)	0.91*** (0.01)
Small cooperative	COSM	- 0.10*** (0.03)	- 0.13*** (0.03)	0.01** (0.01)	- 0.09*** (0.02)	–	–
Large cooperative	COLG	0.02 (0.03)	0.02 (0.02)	- 0.01 (0.01)	0.02 (0.03)	–	–
Private dairy	PRIV	- 0.01 (0.05)	- 0.02 (0.05)	0.04*** (0.01)	- 0.01 (0.05)	–	–
Farm size	x	1.01*** (0.24)	1.18*** (0.20)	–	0.44** (0.20)	0.49*** (0.06)	–
Compliance costs	k	0.05 (0.63)	0.55 (0.56)	–	0.77 (0.51)	0.41** (0.18)	–
Consumer income	I	–	- 0.14 (0.08)	–	–	–	0.07*** (0.01)
Foreign investors	DP	–	0.10*** (0.03)	–	–	–	0.02*** (0.01)
Regional market share	s	–	- 0.17 (0.13)	0.11*** (0.02)	–	- 0.07** (0.03)	–
R^2		0.30	0.37	–			
F-statistic		11.46*** [7,167]	12.72*** [8,151]	–			

Note: ***, **, * indicate that the variable is significant at the 1, 5 or 10 percent level, respectively. Standard errors are given in parentheses. Degrees of freedom for the F-tests are in brackets. We do not report the R^2 values for the profit equation, since the estimation provided negative values.
Source: own estimates

Estimation results are reported in Table 3. For comparison, we also report estimates of the diffusion equation as provided by OLS, and a reduced form estimation of the diffusion equation as provided by indirect least squares (ILS). OLS produces inconsistent estimates because the endogeneity of raw material prices is not accounted for. ILS ignores the influence of procurement prices on diffusion. Moreover, exogenous variables, which have an indirect affect on the structural form, influence the rate of diffusion directly. Thus, the ILS procedure does not allow identification of the structural relationships among the variables. Because of these inadequacies, in the following we focus on interpreting the 3SLS results.

In principle, our hypothesis regarding the impact of the individual variables on the endogenous variables cannot be rejected. The majority of the estimated coefficients yield the expected sign and are highly significant. Nevertheless, estimates providing unexpected results (compliance costs) and determinants, which were supposed to have an ambiguous effect, especially on the diffusion rate (ownership structure), require additional comments.

First, the results do not confirm our assumption about the negative impact of compliance costs on the diffusion of standards. One explanation is that due to its construction, *k* represents the production costs rather than the assumed compliance costs. The estimates of the procurement price equation seem to favor this interpretation, since they show a significant positive impact of the 'cost variable' on procurement prices.

Second, cooperatives seem to face different problems as far as different firm sizes are concerned. The coefficients suggest that small cooperatives have a negative effect on the diffusion rate of standards at the procurement stage. Among large cooperatives, as well as private dairies, no significant influence of ownership on the diffusion rate could be found. This suggests that milk chains with a small cooperative as an integrator face more problems when procuring high quality raw milk. One explanation is that small cooperatives included in the investigated sample are mainly located in highly-competitive regions where a high number of dairies must share the relevant procurement market. Small cooperatives are likely to have lower purchasing power, and hence to lose high quality producers. However, purchasing relatively poor-quality inputs does not seem to affect the performance of the small cooperatives, as suggested by the estimated coefficient in the profit-equation. Thus, while large cooperatives appear to suffer from considerable inefficiencies, small cooperatives are more likely to focus on a core set of activities and did relatively well in the investigated period.

The R^2 is an inappropriate measure of fit in the context of simultaneous systems because the instrumental variable relationships among the endogenous variables are not appropriately considered (LIMDEP, 2007). Thus, we neither report the R^2 values nor the F – statistics for the 3SLS equations. However, the relatively low values of R^2 obtained by ILS and OLS suggest that our analysis may possess low explanatory power. Indeed, the low explanatory power has to be expected since we applied average regional prices and a regional proxy for compliance costs. In addition, due to the lack of appropriate data we could not account for all individual negotiations among the milk producers and the milk-processing firm (i.e., producer-specific payments due to membership in cooperatives or amount of milk delivery).

4 CONCLUSIONS

Our main interest was to analyze the diffusion of EU quality standards in the Polish dairy chains. To account for the interdependencies along the dairy chain, we estimated a multiple equations model (3SLS) treating diffusion rate, processors' profit, procurement and retail price as endogenous variables. The results confirm the theoretical findings and suggest, first of all, that the adoption of standards is an economic activity guided by producers' and processors' cost and benefits calculations. Hence, the farmer will improve a production technique in order to comply with standards only if the purchasers distinguish among the high and low quality producers and are able to remunerate their additional efforts towards higher quality. For the processing firm, a separating solution also seems to be a superior one, especially if an increasing demand for high quality consumer products exists.

The empirical analysis provides that an increase in the price for high quality material fosters adoption. Our results also suggest that larger holdings are more likely to adopt quality standards than small farms. Since Poland faces considerable structural problems in animal production, one opportunity to push forward the diffusion of standards is to increase horizontal integration on the agricultural level. These factors can also be of relevance for other pre-accession countries with a dominance of small-scale holdings, such as Bulgaria and Romania.

The empirical results confirm that the processor should have an incentive to specialize in high quality production, since procuring high quality raw materials c.p. increases profits. More subtly, however, achieving higher profits in large cooperatives is very likely to be hampered by the considerable inefficiencies that result from their governance structures' complexity and low transparency. Thus, depending on ownership status, the performance of milk processing firms is also likely to differ in the future. In addition, it is evident that large cooperatives may even have more competitive disadvantages in the dairy market in the future, while their performance enhancements will be hampered by more efficient private firms on the globalizing dairy market.

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