Modeling differentiated quality standards in the agri-food sector: the case of meat trade in the EU

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Abstract:

This paper looks at trade impacts of quality related standards from the supply side of the exporting country. We argue that food quality standards imposed by an importing country have profound effects on the market structure of the exporting industry, and hence a significant impact on the supply response. For our analysis, we develop a stylized oligopoly model that allows for the co-existence of complying and non-complying suppliers. The model is applied to two alternative policy options to explore different mechanisms an importing county may use to enhance the quality of its imports. We take the Polish meat sector as an empirical example, since after Poland's accession to the EU the tight EU food quality standards indeed apply but the process of adjusting to them is far from complete – particularly in Polish meat production/processing. The simulations show that a subsidy scheme, such as the EU's SAPARD program in Poland, can be an effective instrument to promote the compliance with standards and to upgrade the industry in the exporting country.

JEL classification: Q17, Q18, L1

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1. Introduction

The recent discussion on food quality has been broadened beyond food safety to aspects such as animal welfare and environmental protection, mainly in response to consumer concerns in high-income countries. Due to the specific characteristics of food quality, information asymmetries prevail in the food market. The quality of food product is only revealed after consumption, and even then only imperfectly, while the producer possesses more reliable information. Therefore an information problem exists that may lead to an inadequate provision of quality. To address this market failure, governments of high-income countries have increasingly implemented tighter and mandatory standards in the agri-food sector.

Since food quality standards differ between countries, they may restrict market access and can hence be considered as being non-tariff barriers to trade (NTBs). With the general aim of further liberalizing agricultural trade, agri-food standards and their functioning as NTBs has been widely discussed internationally. The main focus of debate has been on the issue of developing countries' access to markets in industrialized countries that require compliance with certain food quality standards (World Bank, 2005). However, standards also influence trade flows within the European Union (EU) (Nahuis, 2004, Chevassous-Lozza et al., 2005, Hagemejer and Michalek, 2005.). With the recent EU enlargement the issue of community-wide compliance has been prominent in the policy debate, and several measures have been implemented to assist the accession countries in complying with the quality standards of the EU15.

Market and trade effects of standards are usually analyzed by incorporating estimates of their tariff equivalents into trade models. For an overview of recent studies modeling standards and their impact on trade see Ferrantino, 2005. With the tariff equivalents reflecting the costs of complying with the respective standards, standards are considered to merely result in increased trade costs when the compliant product crosses the border. In contrast, we argue

that standards lead to an asymmetric distribution of firms i.e. a modern sector that complies with standards next to a traditional sector that does not. Consequently, common concepts of a continuous supply response curve are not applicable.

The purpose of this paper is twofold. The first objective is to analyze the impact of foreign-imposed standards on the market structure in the exporting country and to derive indicators of market performance in the wake of tightening standards. The second objective is related to policies that aim at supporting producers in exporting countries in meeting stricter standards imposed by importing countries. We whish to gain insight into the efficiency of various policy instruments, including subsidies for quality compliance, whose application donor countries increasingly contemplate so as to help upcoming exporters to achieve access to rich-country markets.

Focusing on the effect of import standards on the market structure in the exporting country, we develop an oligopoly-theoretic framework that allows for the co-existence of complying and non-complying suppliers. This situation is commonly found in developing countries, where a modern segment produces for rich-country markets. But this configuration is also present in the enlarged EU25, where the process of adjusting to the tight EU food quality standards in the new member states is generally far from complete. That is particularly true for Polish meat production/processing (Polish Ministry of Agriculture and Rural Development, 2004). We hence choose the Polish meat sector as an empirical case study for the application of our model.

2. The Model

In the model, we distinguish between firms that comply with the standards required for exporting and those that do not. Complying firms supply their output to two markets i.e. the domestic and foreign market. Their total supply is $q_i = q_i^d + q_i^f$ for i = 1, 2…n^c where q^d and q^f respectively refer to the quantity supplied on the domestic and foreign market and n^c denotes the total number of complying firms. Non-complying firms serve the domestic market

only. Their supply is $q_j = q_j^d$ for j = 1, 2…n^n with n^n denoting the total number of non-complying firms. Total supply to the domestic and the foreign market is respectively given by

$$Q^d = \sum_{i=1}^{n^c} q_i^d + \sum_{j=1}^{n^n} q_j^d \text{ and } Q^f = \sum_{i=1}^{n^c} q_i^f \cdot$$

Since meeting standards leads to compliance costs that only the complying firms have to bear, an asymmetry in cost structures is introduced. That is complying firms incur additional variable and fixed costs, which leads to the following cost function for complying firms:[1]

$$C(q) = C_1(q) + C_2(q^f) + F = C_1(q^f + q^d) + C_2(q^f) + F \quad (1)$$

where C_1 refers to the variable costs of production that are identical for the product no matter whether it is sold domestically or exported. C_2 and F refer to the additional variable and fixed costs when meeting standards.

For non-complying firms that sell on the domestic market only and hence do not incur additional costs, the cost function in equation (1) reduces to $C(q) = C_1(q) = C_1(q^d)$. We shall assume that marginal costs are non-decreasing with increasing levels of output (i.e. there are possibly diseconomies of scale in the variable cost part of the cost function), and that the marginal costs of serving one market depend on the supply to the other market:

$$C'_{1q^d} = C'_{1q^f} > 0;\ C''_{1q^d} = C''_{1q^f} \geq 0; C^{"}_{1q^dq^f} = C^{"}_{1q^fq^d} > 0;$$

$$C'_{2q^f} > 0; C''_{2q^f} \geq 0;$$

$$F \geq 0$$

Each complying firm maximizes profit Π^c by choosing supply to both markets:

$$\text{Max}\,\Pi^c = p^f(Q^f) * q^f + p^d(Q^d) * q^d - C(q) \quad (2)$$

where $p^f(Q^f)$ and $p^d(Q^d)$ are the inverse demand functions for the foreign and domestic market, respectively, with p^f and p^d denoting the relevant prices.

[1] For convenience the subscript i for complying and j for non-complying firms is left out in the following.

We shall assume that demand is downward sloping ($p^{f\,\prime}<0$ and $p^{d\,\prime}<0$). As defined above, q^f and q^d refer to the complying firm's quantity supplied on the foreign and domestic market and $q = q^f + q^d$ to its total supply.

For each complying firm the first order conditions for profit maximization are:

$$\Pi'_{q^f} = p^f + q^f * p^{f\,\prime} - C'_{q^f} = 0 \tag{3}$$

$$\Pi'_{q^d} = p^d + q^d * p^{d\,\prime} - C'_{q^d} = 0 \tag{4}$$

Note that by assumption marginal costs depend on each firm's supply to both markets: $C'_{q^f} = C'_{q^f}(q^f, q^d)$ and $C'_{q^d} = C'_{q^d}(q^f, q^d)$, and equation (3) and (4) therefore constitute a simultaneous system.

The first order condition for the supply to the foreign market given in equation (3) can be written as $\Pi'_{q^f} = p^f + q^f * (\partial p^f / \partial Q^f) * (\partial Q^f / \partial q^f) - C'_{q^f} = 0$. Under the Cournot assumption $\partial Q^f / \partial q^f = 1$, equation (3) is rearranged to[2]:

$$p^f * [1 + q^f / Q^f * 1/\varepsilon^f] = C'_{q^f} \tag{5}$$

where q^f / Q^f gives the quantity market share of one firm on the foreign market and ε^f denotes the elasticity of foreign demand with respect to the foreign market price p^f.

Assuming identical firms, we know that each firm i operating in the foreign market supplies the same quantity in the symmetric Cournot-Nash equilibrium. That is $q^f_i = q^f_k = q^f$ for i, k = 1, 2…n^c. Hence the respective firm's market share is given by $1/n^c$ and can be plugged into equation (5). Going through the same steps for the optimal response on the domestic market, we arrive at an expression analogous to equation (5).

Non-complying firms also determine their supply by maximizing profits: $\mathrm{Max}\,\Pi^n = p^d(Q^d) * q^d - C(q^d)$. Assuming Cournot behavior, we arrive at an expression

[2] Alternative behavioral assumptions could of course be introduced here. For example conjectural elasticities that are different from unity.

linking marginal costs of production for the domestic market to demand elasticity and market share[3]. In the symmetric equilibrium all non-complying firms produce the same level of output $q^d_j = q^d_l = q^d$ for j, l = 1, 2…n^n.

Since on the domestic market (identical) non-complying firms compete with (identical) complying firms, the market share expression is a bit more involved even in the symmetric case. The domestic market share of each firm equals:

$$q^d / Q^d = \frac{q^d}{\sum_{i=1}^{n^c} q^d_i + \sum_{j=1}^{n^n} q^d_j} = \frac{q^d}{n^c q^d_c + n^n q^d_n}$$

where q^d_c and q^d_n denote the equilibrium supply to the domestic market of one complying and one non-complying firm, respectively.

In summary, the following expressions give each firm's first order conditions to the profit-maximizing problem:

$$p^f * [1 + 1/n^c * 1/\varepsilon^f] = C'_{q^f} \tag{6}$$

$$p^d * \left(1 + \left(q^d / n^c q^d_c + n^n q^d_n\right) * 1/\varepsilon^d\right) = C'_{q^d} \tag{7}$$

To ensure market equilibrium, domestic supply equals domestic demand and supply to the foreign market equals export demand:

$$p^d = p^d(Q^d) = p^d(n^c q^d_c + n^n q^d_n) \tag{8}$$

$$p^f = p^f(Q^f) = p^f(n^c * q^f) \tag{9}$$

With equations (6) - (9), we can solve for the $2+2n^c + n^n$ unknowns: p^f, p^d, q^f and q^d.

[3] Alternatively, we might want to specify non-complying firms as a price-taking competitive fringe. In this case their supply will be determined by the equality between price and marginal cost (the term between brackets in equation (7) becomes 1.0). However, since the number of non-complying firms in a typical developing country as well as in our illustrative application for Poland will be very large, equality between marginal cost and price is very likely to be achieved anyway.

The above expressions can already be used to derive some useful (standard) insights. First, increasing the number of firms lets prices converge towards marginal cost, see equations 6 and 7. Secondly, the lower the price elasticity (given n) the higher the price-cost margin (Lerner index). Since export demand for food products is typically more price elastic than domestic demand, one might expect domestic price-cost margins to be higher than those obtained on the export market. However, this depends on the number of firm as well. If the domestic market is populated by a large number of small firms, a competitive fringe, mark-ups on the domestic market will be driven towards zero.

3. Empirical Application of the Model

3.1. Background

With the EU eastward enlargement of the 1st of May 2004, Poland has taken over the entire body of EU rules and regulations in all sectors of the economy (acquis communitaire). Although the alignment of regulations has begun during the preparation period towards EU membership, the implementation and enforcement of the tight EU agri-food standards does not yet meet the requirements at all levels. This is particularly true for meat production/ processing where substantial deficiencies in meeting the EU hygiene and veterinary standards exist (Polish Ministry of Agriculture and Rural Development, 2004).

The EU hygiene and veterinary standards predominantly comprise production/process standards. As opposed to product standards, production standards specify the method of producing food products. Production standards can be further differentiated by product related and non-product related production standards. In the meat sector, the former refer to certain requirements concerning handling and storage, which have a direct impact on the quality and safety of meat products (e.g. temperature control, cleaning of equipment, packaging and veterinary checks). The latter do not influence product characteristics per se. That is they constitute requirements for facility conditions (e.g. separation of “clean” and “dirty” rooms, washing and disinfection facilities), administrative requirements (e.g. record keeping, carcass

classification/labeling) as well as the implementation of the hygiene control system HACCP (Hazard Analysis and Critical Control Points)[4]. For a detailed overview of the entire array of EU standards in meat production/processing see Becker, 2000.

In addition to the EU standards obligatory when producing for the domestic market, enterprises have to fulfill further regulations so as to supply the EU market. These particularly comprise additional requirements concerning product testing, storage and transportation. The standards for slaughterhouses/cutting plants and meat processing firms to be eligible for exporting to other member states are set in the following directives:

- Directive 64/433/EEC on health conditions for the production and marketing of fresh meat[5]:
- Directive 77/99/EEC on health problems in the production and marketing of meat products

However, exemptions exist for small-scale firms that do not prescribe them to fully comply with EU standards. Due to problems in the practical application of the EU hygiene and veterinary standards, they are granted special provisions that allow them to continue producing for the domestic market even without meeting the EU requirements.[6] This particularly concerns administrative matters such as documentation and record keeping, which can constitute a considerable burden for small-scale firms. The possibility of exempting low capacity firms from fully complying with the EU standards is of major importance for the Polish meat sector, which is dominated by small firms (Pieniadz et al., 2003).[7]

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[4] According to Directive 93/43/EEC (OJ L175, 19.7.1993), the HACCP system, which provides a systematic approach to identify, monitor and control issues of hygiene and food safety, is mandatory in the EU meat processing sector.

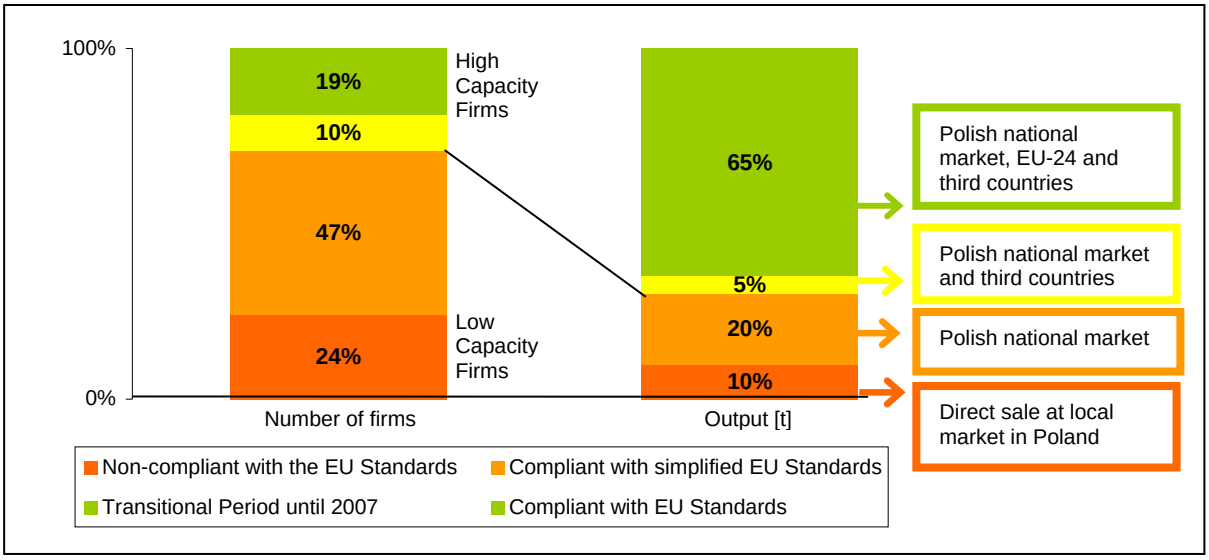
[5] Note that Directive 94/65/EC (OJ L368, 31.12.1994) on placing minced meat and meat preparations on the EU market is not considered in the following, Its required standards are very specific and exceed those of Directive 64/433/EEC (OJ P121, 29.7.1964) and 77/99/EEC (OJ L26, 31.1.1977).

[6] For the fresh meat sector, Directive 95/23/EC (OJ L243, 11.10.1995) defines the production capacity of small-scale enterprises eligible for special provisions as follows: slaughter houses: ≤ 20 livestock units/week and ≤ 1000 livestock units/week; cutting plants: ≤ 5t/week. Meat processing enterprises with a production output ≤ 7.5t/week are considered to be of low capacity (Commission Decision 94/383/EC, OJ L174, 8.7.1994).

[7] Note that according to Directive 2004/41/EC (OJ L195, 02.06.2004) a new "package of hygiene requirements" will be applicable for the EU meat sector from 2006 onwards. This may not necessarily allow for special treatment of low capacity enterprises anymore. The negotiations are still under way.

Figure 1 illustrates the current situation of compliance with the EU hygiene and veterinary standards of Directive 64/433/EEC and 77/99/EEC. Only 19% of the Polish meat firms fully comply with the EU standards and are thus licensed to export to the EU market. Being high capacity enterprises, their output makes up for 65% of the total meat production in Poland. In prospect of their compliance in the near future, 10% of the Polish meat firms have been granted a transitional period. They are allowed to continue producing without meeting the EU standards until December 2007 (European Commission, 2003), but their non-compliant products are only permitted on the Polish market or to be exported to third countries - not to other EU member states.

Figure 1: State of compliance in Polish meat production/processing*



*This refers to slaughterhouses and processing enterprises of pork, beef/veal and poultry meat complying with Directive 64/433/EEC and 77/99/EEC.

Source: own illustration based on Pieniadz and Hanf (2005) and calculation using data source: IERiGZ (2005).

About 70% of the Polish meat firms do not meet the EU standards. With their low production capacity, they fall under the EU's special provision for small-scale enterprises. Complying with the simplified EU standards, 47% of the Polish meat firms are authorized to sell on the Polish national market only. The remaining 24% show the largest shortcomings in meeting the EU standards. In order to account for their difficult situation, a special law that allows these very low capacity enterprises (< 4t/week) to keep up their production has been

enacted just before accession (Pieniadz and Hanf, 2005). According to this law, their non-compliant products are to be sold on the very local market only – i.e. directly to end-consumers.

Complying with standards leads to compliance costs. Depending on the requirements of standards, compliance costs can add to the fixed or variable costs of production. Additional fixed costs occur when firms have to undertake investments so as to meet standards. In the Polish meat sector, especially the large number of low capacity firms has to substantially invest in modernizing production facilities and acquiring new equipment so as to meet the EU standards (Polish Ministry of Agriculture and Rural Development, 2004). Apart from on-site investments, Polish meat firms have to provide training for personnel that have to learn how to handle the new production methods and procedures required. In order to support Polish meat firms in undertaking these serious investments, EU funds have been made available, in particular within the SAPARD scheme[8].

Depending on the firms' initial technology and production efficiency, compliance with standards affects variable costs. In the case of the Polish meat sector, it can be argued that standards advancing production technology by upgrading this rather traditional sector improve the production efficiency and lower average variable costs of production. However, meeting the EU hygiene and veterinary standards, which may result in pro-competitive effects, is likely to increase variable costs, too. Complying firms are to employ additional and possibly more costly inputs and may face a substantial increase in labor costs due to the frequent controls and detailed documentation required. Despite possible advantages of control systems and record keeping, Antle (1998) for example shows that the implementation of the

[8] The EU's SAPARD program (Special Accession Program for Agriculture and Rural Development) assists the agri-food sector in the new member states in adjusting to the EU policies. It particularly focuses on improving the production/processing of agri-food products. Within the SAPARD program, Poland is allocated an indicative budget of 150 636 million Euro/year (at constant 1999 prices) for 2000-2006 (Regulation (EC) 1268/1999, OJ L161, 26.06.1999).

HACCP system leads to higher variable costs even in the efficient US beef industry. On this basis, the variable costs of complying Polish meat firms can be expected to be considerable higher than those of non-complying ones.

To summarize: The state of compliance with the EU hygiene and veterinary standards determines the market possibilities of Polish meat firms. Whereas firms not meeting the EU requirements are only allowed to offer their products at the Polish national or very local market, complying firms in fact serve two different markets. On the one hand, they can sell their products on the Polish national market. On the other hand, they can also export their products to the other EU member countries. Since meeting the EU standards raises production costs (fixed and variable), complying firms face additional costs non-complying firms do not incur.

3.2. Model Specification, Data and Calibration

For the application of our model to the Polish meat sector, we need to specify functional forms for the cost and demand functions. Regarding the cost functions, we incorporate two important notions: First, the distinction between production costs and costs of compliance (both variable and fixed). Secondly, the interdependence in marginal costs between the supply to the domestic and foreign market. A functional form that fulfils these requirements is the quadratic one: $C(q)=a*(q^d+q^f)^2+b*q^f+F$ where q^f and F are zero for non-complying firms.

As regards the demand functions, we use a constant elasticity specification for both markets: $p^d=p^d(Q^d)=B*\left(Q^d\right)^{\varepsilon^d}$ and $p^f=p^f(Q^f)=A*\left(Q^f\right)^{\varepsilon^f}$. That is $p^d(Q^d)$ refers to the Polish domestic demand for Polish meat. Similarly, focusing on Polish meat exports to the EU15 market, $p^f(Q^f)$ represents the export demand function determining the EU15's demand for Polish meat. These demand functions are of course extremely simple, and ignore the intricacies of consumer demand in a market for differentiated products. Consumers might be

able to distinguish between the supplies of complying and non-complying firms. In this case, substitutability between the two types of products has to be introduced.

In order to calibrate the cost and demand functions specified above, we use data from various sources; see table A.1 in the appendix for a summary account and overview of the Polish meat sector in 2004. Concerning data of compliance costs, we use information on investments that are undertaken by Polish meat firms so as to adjust their production to the EU standards as a proxy for the fixed cost component of the compliance costs. The variable costs of compliance are considered to be reflected by the difference between the Polish and EU15 price for meat. Figure A.1 in the appendix illustrates the difference between the meat price in Poland and the EU.

Calibrating the cost functions, we derive point estimates for the parameters *a* and *b*. For non-complying firms we set average costs equal to price in order to obtain an estimate of the parameter *a*. For complying firms we solve simultaneously for the following two conditions to retrieve the parameters *a* and *b*:

1) average variable costs = average unit revenue on the domestic and foreign market

2) marginal costs to the foreign market = marginal revenue on the foreign market (eq.6)

The estimate of the demand elasticity for the domestic Polish meat demand comes from the database of the ESIM model, the one for the demand for Polish meat export to the EU15 from the GTAP v.6 database.[9] Table A.2 in the appendix reports on the parameters used for the simulations. Note that the cost parameter estimates imply that complying firms are more efficient in their production.

3.3. Simulation Scenarios

We conduct two sets of simulations.[10] The first simulation is designed to show the implications of stricter standards on the export market. This is implemented by a shift of the

[9] We are grateful to the ESIM team of the University of Göttingen to provide the elasticity estimates.
[10] The model is solved with GEMPACK 9.

export demand function: the EU15 market demands less of the Polish product. This can also be seen as a proxy of NTBs related to product quality. At any given price, demand is lower than it would be in the absence of the quality-related trade barrier. We simulate a range of demand shifts implemented by changes (-5% to -50%) in the constant term of the export demand function. The second set of simulations pertains to subsidies that lower the fixed costs of compliance as the EU's financial support under the SAPARD scheme does.

For both simulation scenarios, it is useful to specify a long-run equilibrium benchmark. We specify this benchmark using a zero-profit condition with free entry and exit on the market and let the number of complying firms n^c adjust.[11] Note that with this additional constraint, the model is quite similar to a long-run monopolistic competition model. Simulating this benchmark of zero profit and free entry and exit by complying firms, the structure of the industry changes: Table A.3 and A.4 (see appendix) show that the number of complying firms more than doubles, but each firm is about 40% smaller in terms of output than in the base, and total industry supply rises by only 3%. Free entry drives size down. Furthermore domestic and export prices fall significantly, but the export market remains the most profitable alternative for complying firms. They are able to boost their collective export revenues from 97 to 260 million euro. Against this long-run equilibrium benchmark, the aforementioned scenarios are simulated.

4. Simulation Results

4.1. Results of Simulation 1 - Export Demand Shock

The decline of export demand following stricter export standards leads to a decrease of export prices, but also to a decrease of domestic prices as "modern" complying firms shift their supply to the domestic market (see table A.3 in the appendix). Each "modern" firm supplies less to the export market and more to the domestic market. While "modern" firms

[11] The calibration of the model to the base data has positive profits for complying firms. Non-complying firms have zero profits, as their average costs equal price in the base.

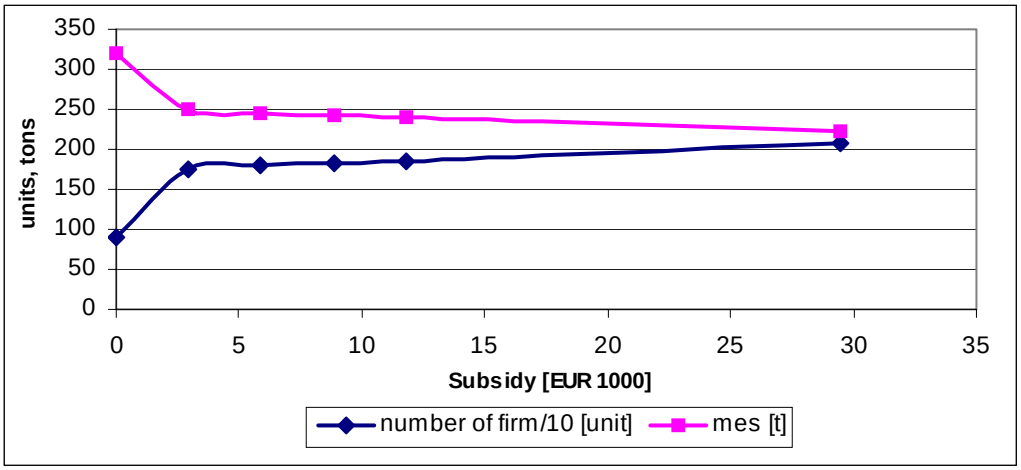
can partly accommodate the lower demand on their most profitable outlet i.e. the export market, “traditional” non-complying firms are unable to do so and consequently contract their output. As a result the combined market share of complying firms on the domestic market increases from 73.9% to 75%, depending on the size of the demand shift.

Lower domestic prices fuel domestic demand to some extent, but as the price elasticity for meat is small (-0.43) the additional demand is limited and the domestic price decreases. Industry revenues fall as well, up to -22% in the simulation with the largest inward shift of demand (simulation number 5). While profits in the meat industry remain zero, Polish consumers gain from the lower price and the increased supply. On balance, the net welfare change is therefore estimated to be positive, between 4 and 16 million euro. However, this is an incomplete measure of welfare changes: Since the supply of complying firms to the Polish market is simulated to rise, more high quality produce will be available. This should ideally be accounted for in the welfare evaluation, which would then require the specification of a more elaborate demand system derived from a utility function that includes quality aspects.

4.2. Results of Simulation 2 - Investment Subsidy for Compliance

The simulation set of an investment subsidy for firms so as to comply with standards reveals drastic changes in industry structure. As opposed to the set of the export demand shocks above, the number of complying firms more than doubles. With the investment subsidy modeled as a reduction of fixed costs, average costs for complying firms are lowered and the minimum efficient scale drops. The relationship between the equilibrium number of complying firms and the minimum efficient scale (mes) is illustrated in figure 2.

Figure 2: Investment subsidy and minimum efficient scale (mes)



Note: MES is calculated as output per firm in the zero-profit equilibrium.

Source: model simulations.

Due to the massive entry of subsidized complying firms, the non-complying firms are almost completely driven off the market. Their market share falls from initially about 30% to merely 5% when the fixed costs of compliance are halved by the subsidy. Total domestic and export supply increase and prices fall, but nevertheless the total sales revenues of the industry increase.

Again, the big winners are Polish consumers, as their consumer surplus increases with lower prices and higher average quality supplied to the market. A second group of winners are EU15 consumers, since they experience increased supplies of compliant Polish meat at lower prices. Of course, the cost of the subsidy needs to be balanced against the gain in consumer surplus and the utility gain from the supply of products of improved quality. Table A.4 (see appendix) shows that the size of the subsidy exceeds the change in consumer surplus if the subsidy increases beyond 15% of the fixed costs of compliance. But of course, this is an illustrative simulation and the numbers should be interpreted with great care.

5. Concluding remarks

This paper looks at the issue of trade impacts of quality related standards from the supply side of the exporting country. More specifically, we show that standards imposed by an importing country have profound effects on the market structure of the exporting industry,

and hence a significant impact on the supply response. For the analysis we develop a stylized model that allows for the co-existence of complying and non-complying suppliers - a situation commonly found in developing countries, where a modern segment produces for rich-country markets. But this configuration is also present in the enlarged EU25, in particular in Polish meat production/processing as our review of its state of compliance shows.

The model is applied to two alternative policy options. The two sets of simulations reflect two different mechanisms an importing country may use to enhance the quality of its imports. The first one is simply a border measure that comes at no budgetary cost to the importer and the second entails a subsidy that may be borne by the importer, as in the case of the SAPARD program in Poland. The simulations show that a subsidy scheme that lowers the fixed cost of compliance can be a very effective instrument to promote the compliance with standards and to upgrade the industry in the exporting country. The border measure, in contrast, mainly leads to shifts of supply towards domestic markets and to increased competition with complying and non-complying firms co-existing, which eventually benefits domestic consumers only. Our model thus provides a structured way to assist donor countries in determining the level and type of assistance they might want to provide to upcoming exporters.

There are obviously a number of extensions of the analytical framework presented. On the theoretical side the most relevant one may be to endogenize the investment decision of non-complying firms to become “modern”. Another improvement concerns the modeling of consumer preferences for differentiated products, and in relation to that the derivation of a more complete welfare measure that accounts for quality changes. On the empirical side, improvements in the estimation of compliance cost rank high on the research agenda.

References

Antle, J. M., 1998. The costs of quality in the meat industry: Implications of the HACCP Regulation. Research discussion paper No.17, Trade Research Centre, Montana State University.

Becker, T., 2000. EU policy regulating meat quality. In: Becker, T. (ed.), Quality policy and consumer behavior in the European Union. Wissenschaftsverlag Vauk, Kiel, 35pp.

Chevassous-Lozza, E., Majkovic, D., Persillet, V., Unguru, M., 2005. Technical barriers to trade in the EU: importance for the new EU members. An assessment for agricultural and food products. Paper presentation at the 11th EAAE congress, Copenhagen.

COMEXT, 2005. Eurostat data. Statistical Office of the European Communities, Luxembourg, 10/2005: available on-line under http//fd.comext.eurostat.cec.eu.int/xtweb.

Ferrantino, M. 2005. Quantifying the trade and economic effects of non-tariff measures. OECD trade policy working paper No.28, Working party of the Trade Committee, TD/TC/WP(2005)26/Final, Paris.

Hagemejer, J., Michalek, J. J., 2005. Standardization union effects: the case of EU enlargement. Paper presentation at the 7th ETSG Annual Conference, Dublin.

IERiGZ, 2005. Stan polskiej gospodarki zywnosciowej po przystapieniu do Unii Europejskiej (in Polish) (State of the Polish agri-food industry after the EU accession). Report 1, Warsaw, 10/2005: available on-line under http://www.ierigz.waw.pl/documents/ Raport_PIB.pdf.

Nahuis, R., 2004. One size fits all? Accession to the internal market – an industry-level assessment of the EU enlargement. Journal of Policy Modeling 26, 571pp.

Polish Ministry of Agriculture and Rural Development, 2004. National development plan for 2004-2006: sectoral operational program - restructuring and modernization of the food sector and rural development 2004-2006. Warsaw, 09/2005: available on-line under http://www.minrol.gov.pl/.

Pieniadz, A., Hanf, J. H., 2005. Agrarmärkte in MOE im Strukturwandel (in German) (Agricultural markets in transition in Central and Eastern Europe). In. F.A.Z.-Institut (ed.), Mittel- und Osteuropa Perspektiven-Jahrbuch 2005/2006. Rödl & Partner & OWC Verlag für Aussenwirtschaft, Frankfurt-Main.

Pieniadz, A., Hockmann, H. and Glitsch, K., 2003. Adoption of EU quality requirements in the Polish meat and dairy sector. Paper presented at the 82nd EAAE Seminar on Quality Assurance, Risk Management and Environmental Control in Agri-Food Supply Networks, University of Bonn.

World Bank, 2005. Food safety and agricultural health standards – challenges and opportunities for developing country exports. Washington DC.

ZMP, 2005. Agrarmärkte in Zahlen - Mittel- und Osteuropa (in German) (Agricultural markets in numbers – Central and Eastern Europe). Zentrale Markt- und Preisberichtstelle für Erzeugnisse der Land-, Forst- und Ernährungswirtschaft GmbH (ZMP), Bonn.

Appendix

Table A.1: The Polish meat sector in 2004

		Compliant firms (Modern)	Non compliant firms (Traditional)	Total	Note/source
Number of firms		397	1693	2090	Pieniadz and Hanf (2005), IERiGZ (2005)
Output	1000 t	231	124	355	ZMP (2005), calculation based on IERiGZ (2005)
Output per firm	1000 t	0.58	0.07	0.17	calculated
Volume domestic demand	1000 t	184	124	309	ZMP (2005) (calculated per cap*pop), for modern firms calculated as residual
Value domestic demand	EUR 1000	247280	166702	413983	calculated
Value Export demand, EU15	EUR 1000	96954	0	96954	COMEXT (2005)
Volume Export demand, EU15	1000 t	46	0	46	COMEXT(2005)
TOTAL REVENUE	EUR 1000	344234	166702	510937	calculated
Price domestic market	EUR/t			1342	EU commission, calculated from EU15/PL price ratio
Unit value export	EUR/t			2088	calculated

Table A.2: Cost and elasticity estimates

		Cost structure per firm	
		Complying firms	Non complying firms
Cost function parameters:			
Variable production cost per unit: *a*		0.001	0.009
Variable compliance cost per unit: *b*		0.897	-
Variable production cost	EUR 1000	338	98
Variable compliance cost	EUR 1000	105	0
Annual fixed cost (linear depreciation, 15 years lifetime)	EUR 1000	59	0
TOTAL COST	EUR 1000	502	98
		Demand elasticities	
Price elasticity domestic market	(1)	-0.429	
Price elasticity export demand PL-EU15	(2)	-7.6	

Notes: source (1) ESIM database, (2) Calculated from GTAP v.6.

Table A.3: Simulation 1 - Export Demand Shock

				Simulations				
				1	2	3	4	5
	BASE level		Zero profit	Percent change relative to zero profit benchmark				
Export demand shifter	31433	EUR 1000	31433	-5	-10	-15	-20	-50
Number of firms								
Complying firms	397	unit	903	0.4	-2.9	-6.1	-9.4	-29.2
Non-complying firms	1693	unit	1963	0	0	0	0	0
Price on domestic market	1342	EUR/ton	814.2	-1.0	-1.2	-1.4	-1.6	-3.6
Export price	2088	EUR/ton	1557.4	-0.5	-0.6	-0.7	-0.8	-1.6
Supply to export market/firm								
Complying firms	117	tons	196.3	-1.9	-3.3	-4.8	-6.5	-19.8
Non-complying firms	0	tons	0	0.0	0.0	0.0	0.0	0.0
Total supply export market	46431	tons	174933	-1.6	-6.1	-10.6	-15.3	-43.2
Supply to domestic market/firm								
Complying firms	464	tons	126.2	0.3	3.8	7.5	11.5	44.4
Non-complying firms	73	tons	44.6	-1.0	-1.2	-1.4	-1.6	-3.6
Total supply domestic market	308474	tons	189458	0.4	0.5	0.6	0.7	1.6
Quantity share of modern firms on domestic market (*)	60	%	73.9	74	74.1	74.1	74.2	75.0
Total supply/firm								
Complying firms	581	tons	319.8	-1.4	-1.7	-2.0	-2.3	-5.0
Non-complying firms	73	tons	44.6	-1.0	-1.2	-1.4	-1.6	-3.6
Total industry supply	354905	tons	354390	-1.0	-4.4	-7.7	-11.1	-31.7
Industry sales revenues				EUR million				
Total export value	97	EUR Mill.	260	267	254	242	229	150
Domestic sales	414	EUR Mill.	321	319	319	318	318	315
Total	511	EUR Mill.	581	586	573	560	547	465
Welfare indicators				EUR million				
Change consumer surplus				4	5	6	7	16
Change industry profits				0	0	0	0	0
Total welfare change				4	5	6	7	16

Note: (*) percent level in simulation, not percent change.

Source: model simulations.

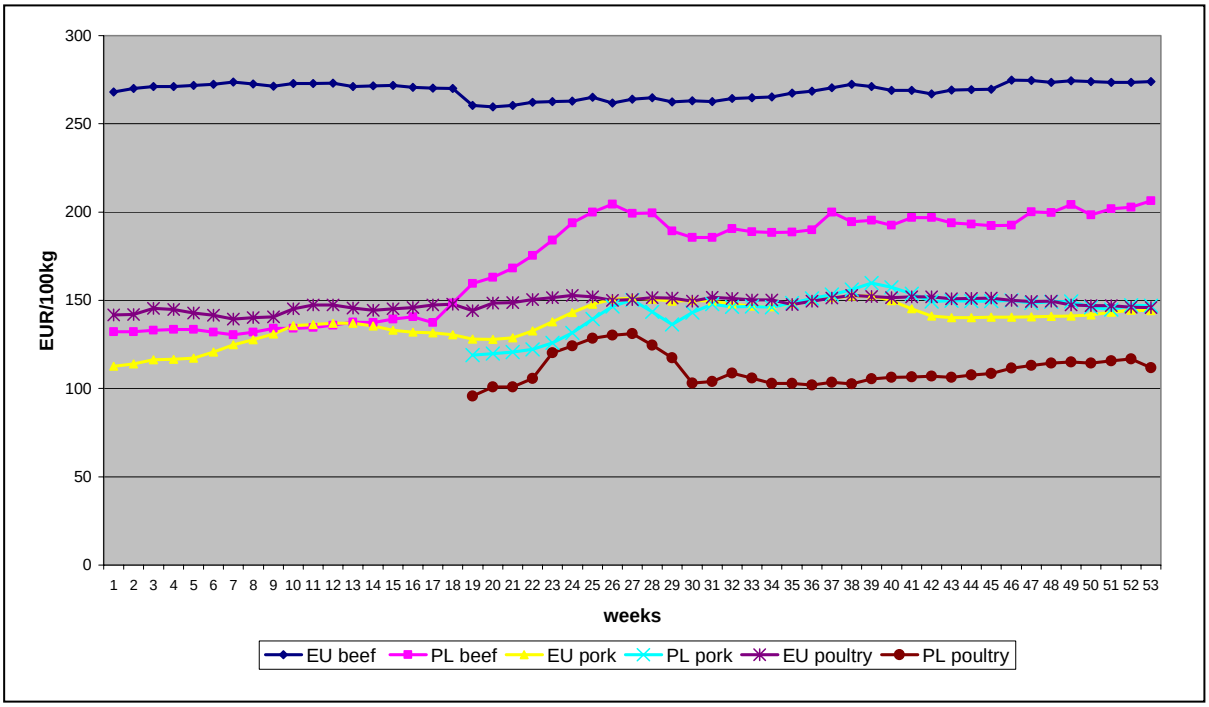
Table A.4: Simulation 2 - Investment subsidy for compliance

				Simulations				
				1	2	3	4	5
	BASE level		Zero profit	Percent change relative to zero profit benchmark				
Fixed cost	59	EUR 1000	0	-5	-10	-15	-20	-50
Number of firms								
Complying firms	397	unit	903	94	98	102	106	129
Non-complying firms	1693	unit	1693	0	0	0	0	0
Price on domestic market	1342	EUR/ton	814.2	-22.2	-23.1	-24.0	-24.9	-30.4
Export price	2088	EUR/ton	1557.4	-11.7	-12.2	-12.7	-13.2	-16.0
Supply to export market/firm								
Complying firms	117	tons	193.6	-5.0	-5.2	-5.4	-5.6	-6.8
Non-complying firms	0	tons	0.0	0.0	0.0	0.0	0.0	0.0
Total supply to export market	46431	tons	174933	89.0	92.7	96.3	99.9	122
Supply to domestic market/firm								
Complying firms	464	tons	126.2	-63.6	-66.1	-68.7	-71.3	-86.9
Non-complying firms	73	tons	44.6	-22.2	-23.1	-24.0	-24.9	-30.3
Total supply to domestic market	308474	tons	189458	9.5	9.9	10.3	10.7	13.0
Quantity share of modern firms on domestic market(*)	60	%	73.9	89.4	90.0	90.7	91.3	95.1
Total supply per firm								
Complying firms	581	tons	319.8	-28.1	-29.3	-30.4	-31.5	-38.4
Non-complying firms	73	tons	44.6	-22.2	-23.1	-24.0	-24.9	-30.3
Total industry supply	354905	tons	364390	43.8	45.6	47.4	49.1	59.8
Industry sales revenues				EUR million				
Total export value	97	EUR Mill	260	460	468	477	485	534
Domestic sales	414	EUR Mill	321	280	279	277	275	265
Total	511	EUR Mill	581	741	747	754	760	799
Welfare indicators				EUR million				
Change consumer surplus				107	111	116	120	149
Change industry profits				0	0	0	0	0
Subsidy				-27	-103	-158	-215	-548
Total welfare change				80	8	-42	-95	-399

Note: (*) percent level in simulation, not percent change.

Source: model simulations.

Figure A.1: Weekly meat prices in Poland and the EU in 2004



Source: European Commission, 2005