CHAPTER 5: Beyond trade effects

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 5

A. Overview and learning objectives

Studies aiming at investigating the trade effects of NTMs provide useful results. However, they offer an incomplete understanding of the actual effects of these NTMs on all economic agents concerned – not only producers but also consumers, importers, and governments. Some NTMs may restrict trade but improve welfare if they address market failures. It is therefore important to gain an insight into the impact of NTMs on the well-being of all these economic agents. The welfare impact of NTMs is also of crucial importance for developing countries. It is one thing for them to complain about the trade-reducing effect of NTMs if these NTMs also reduce welfare in the importing country. But their approach to NTMs would have to be very different if it were shown that these NTMs actually raise welfare in the importing country, and possibly by more than they lower it in the developing exporting country. This chapter presents an extension of the framework discussed in Chapter 3 able to provide insights in terms of welfare effects. It then reviews some major contributions to this strand of the literature.

In this Chapter you will learn how to use trade-effect estimates to compute some welfare effects induced by the implementation of an NTM.

B. Analytical tools

1. Welfare impact: conceptual presentation

On the production side, compliance with the NTM usually induces an increase in firms' production costs (changes in input requirements and production schemes, certification, labelling, etc.). However, compliance with the NTM may also force firms to upgrade their facilities and thus reduce their marginal production costs. NTMs therefore have an ambiguous effect on production. Supply may decrease or increase. On the consumption side, the likely effect of meeting the NTM is an increase in demand. Following the improvement of the quality of a good and/or available information on food safety, consumers in the export market increase their consumption.

By showing the supply and demand shifts, simulations provide an evaluation of the welfare effects that are likely to have an impact on consumers and producers following implementation of the NTM. Some weaknesses in this approach should however be acknowledged, including the fact that it does not account for the changes in the demand and supply elasticities and in the complementarity/substitutability of products and varieties of the same product (Korinek *et al.*, 2008).

Renewed analysis of the welfare effects of NTMs has been taken up by van Tongeren *et al.* (2009), who provide a conceptual framework extending the simulations of the welfare effects into a cost-benefit analysis taking into account the market imperfections and market failures affecting the economic agents. Three types of imperfections and failures are analysed: externalities affecting consumers (e.g. imperfect information on food safety), externalities affecting producers (e.g. an animal disease outbreak), and common global issues (e.g. the preservation of ecosystems). These imperfections and failures generate inefficient market outcomes that justify government intervention to bring about improved outcomes from the perspective of society.

The framework offers a comparative assessment of the costs and benefits associated with different regulatory measures (e.g. standards, import bans, etc.) that could be applied by policymakers to address the market failure or imperfection. Furthermore, van Tongeren *et al.* (2009) distinguish the economic agents affected by the market failure or imperfection from those who are not affected, and assess the costs and benefits for each category of agents.

Some assumptions are made by van Tongeren *et al.* (2009) in order to keep their welfare analysis relatively simple. The market good is assumed to be homogenous (i.e. all varieties of similar goods have the same quality attributes) except for a specific characteristic that is potentially dangerous to consumers. This dangerous characteristic pertains to foreign goods only. Therefore, only foreign producers are *de facto* concerned by the reinforcement of an NTM selected by the domestic regulator for reducing consumer risk. This is an analytical simplification that allows a sharper focus on the international implications of NTMs. If the domestic product had that characteristic domestic producers would be equally affected by the reinforcement of the regulation. The harm is not internalized by consumers. On the supply side, a perfectly competitive industry comprised of domestic and foreign firms with price-taking firms is assumed.

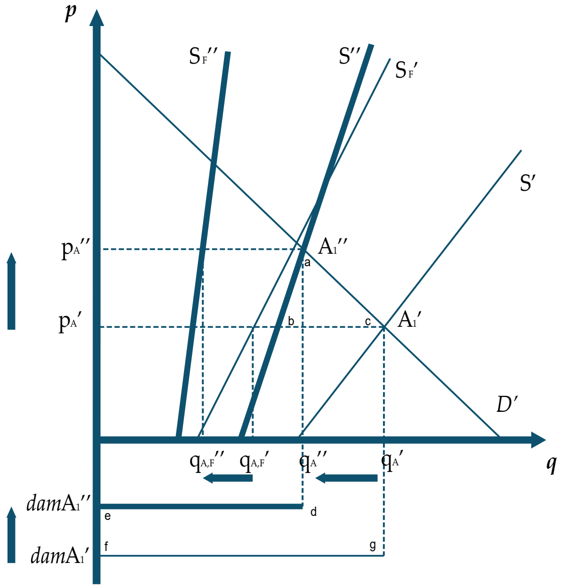
A stricter NTM has two major effects on foreign firms. First, it reduces the proportion of foreign products entering a market because of tougher inspections linked to stricter thresholds. Second, compliance with the stricter NTM brings about an increase in marginal costs and sunk costs (linked to investments that are sunk once undertaken). An increase in marginal costs leads producers to reduce the quantities supplied for each given price. In their analysis, van Tongeren *et al.* (2009) focus only on the first effect, i.e. the reduction in the share of foreign products entering the market.

Figure 13 provides a graphical illustration of the welfare analysis. It shows the domestic demand (D'), foreign supply (S_F'), and total supply (S') (domestic supply is omitted for clarity). The price, p, is located on the vertical axis and the quantity, q, is shown along the horizontal axis. The harm linked to foreign products is not internalized by consumers and therefore does not affect demand. However, the harm should be accounted for in the welfare calculations. Domestic welfare is the sum of domestic producer profits and consumer surplus minus the harm. International welfare is the sum of domestic welfare and foreign producers' profits.

With this initial situation preceding the reinforcement of the regulation, the parameters of the model are calibrated in such a way as to replicate prices and quantities over a period. When a regulation is reinforced, the market allocation is modified, as represented in Figure 13 by new foreign supply S_F'' and total supply S''.

A stringent NTM reduces the proportion of foreign products entering the domestic market. The supply shifts upward from (S') to (S''). The stricter policy increases the price with $p_A'' > p_A'$ and decreases the quantity with $q_A'' < q_A'$. It also reduces the probability of having unsafe products and the overall harm to unaware consumers. The net welfare effect of a stricter NTM – i.e. the comparison between initial domestic welfare and new domestic welfare – suggests a reduction in the harm, illustrated by the move from $damA_1'$ to $damA_1''$. This reduction results from a fall in the probability of consumption of unsafe products following implementation of the NTM. The triangle *abc* represents the standard deadweight loss. As long as the "savings" in the cost of the harm are larger than the deadweight loss, the net welfare impact remains positive, that is, as long as the area defined by $q_A'q_A''defg$ (the reduction in the cost of the harm) remains larger than the area *abc* (deadweight loss).

Figure 13: Welfare analysis: graphical analysis



Source: Fugazza (2013).

An important issue in this welfare approach is the evaluation of failures and imperfections. Consumer valuations could be computed using either of two methods: the willingness to pay approach, or the quality adjusted life years (QALYs) method. The former allows for an assessment of consumer reaction to an NTM by revealing their willingness to pay to avoid harm/illness or to obtain a good with particular qualities. The QALY approach evaluates the monetary benefits associated with an NTM that reduces mortality or morbidity. Producer valuations could be obtained from studies assessing the costs associated with invasive species or the impact of pests and diseases on agriculture and the costs of managing them. Some studies have also tried to combine economic and epidemiological approaches to evaluate the costs of outbreaks and policies (such as quarantine) aiming to address them. Common global issues are more difficult to evaluate. Citizens and governments of various countries usually agree to address such issues but disagree on the methods to be used.

Turning to the empirical evidence, there are as yet only a few studies that investigate the welfare effects of NTMs. The OECD conducted a case study on the welfare effects of border measures protecting human health against contaminants (in particular antibiotics) found in shrimp (van Tongeren *et al.,* 2010). The study focuses on OECD imports of shrimps from three Asian countries

CHAPTER 5

that are among the world's main shrimp producers (India, Indonesia, and Viet Nam) and uses the cost-benefit framework described above. Over the last decade, OECD countries have rejected several import shipments of shrimp on health and safety grounds, imposed temporary import bans, and asked for stronger health and safety controls. OECD countries' NTMs and requirements, motivated by consumer protection, obviously affect developing countries' production and exports of shrimp.

The study investigates the economic costs of such NTMs on shrimp production. It also examines whether such NTMs could be an incentive, given the size of OECD countries' demand for shrimp, for producing countries to adapt and improve their production. The analysis focuses exclusively on the supply side and estimates the gain for shrimp producers associated with four different scenarios: (a) no change in the production process, (b) an import ban by OECD countries, (c) improved production methods through the implementation of better management practices, and (d) both better management practices and production of a more disease-resistant shrimp variety.

The results suggest that if OECD countries were to ban imports, a substantial profit incentive would exist for producers to adopt improved production methods. Moreover, the adoption of better management practices in combination with the introduction of a disease-resistant shrimp variety (that yields a lower market price at higher production costs) would increase producer profits in Viet Nam and Indonesia. In India, the larger supply elasticity reduces the incentive to adopt better management practices.

Maertens and Swinnen (2009) evaluate the impact of European SPS measures for fresh fruits and vegetables on employment and poverty in Senegal. Since the 1990s, exports of fresh fruits and vegetables from Senegal to the European Union have risen significantly. The authors show that the European measures increase the vertical coordination with buyers and suppliers, and induce a shift from contract farming with smallholders to large-scale integrated estate farms. However, poor households are not excluded from this development and participate as farm workers. This participation allows an increase of their incomes and a reduction in poverty.

2. Welfare impact: an empirical assessment

The welfare quantification of NTMs can be performed through a cost-benefit analysis. Such analysis examines the NTMs' impact on each type of agent (consumers, producers, government, etc.). To precisely measure the welfare effects of NTMs, a proper distinction should be made between supply and demand responses to NTMs in both the exporting and importing countries (Beghin, 2009; Korinek *et al.*, 2008; and Beghin and Xiong 2018). The welfare analysis can of course be performed ex ante. In that case, supply and demand shifts induced by the introduction of NTMs are simulated. Although the studies that develop a welfare analysis of NTMs provide interesting insights, they completely overlook the trade effects of such measures. In a recent contribution, Disdier and Marette (2010) bridge the gap by combining both mercantilist and welfare approaches to exhibit their complementarities. This section describes their empirical analysis and main results. In a context where data linked to border inspections are extremely difficult to collect, the analytical approach used by Disdier and Marette (2010) suggests how to combine the results of a gravity equation with a partial equilibrium model to determine the welfare impact of NTMs.

Disdier and Marette (2010) measure the impact of new NTMs capping residues of chloramphenicol, which is an antibiotic often used in seafood farms in developing countries. It is toxic for human health. The authors evaluate past policies (over the period 2001–2006) but also a future policy with an ex-ante analysis linked to a stringent NTM eliminating all antibiotic residues in seafood. Such a policy could be introduced in the coming years (Ababouch *et al.* 2005). Disdier and Marette (2010) made several assumptions, derived from van Tongeren *et al.* (2009), for their analysis. They assume that the market good is homogenous except for a given characteristic, which is dangerous for consumers. The harm is not internalized by consumers. The NTM aims to eliminate unsafe products from the market and only targets foreign products.[40] A stringent NTM therefore reduces their probability of entering the domestic market.

The empirical analysis is carried out in two steps. First, the authors estimate a gravity equation, where the dependent variable is the log of bilateral imports of the United States, Canada, the European Union, and Japan from all exporters over the 2001–2006 period. The NTM on chloramphenicol, measured as the maximum residue level in parts per billion applied by each importer since 2001, is included among the explanatory variables. The estimated coefficient on the NTM variable therefore measures the forgone trade. The relative variation of exports value linked to the NTM can be rewritten as

$$\frac{\mathrm{d}p}{p} + \frac{\mathrm{d}q}{q} = \beta \mathrm{d}NTM \qquad (5.1)$$

where p is the price of imports, q the quantity imported and β is the coefficient on the NTM variable estimated in step 1.

In discrete terms and referring to Figure 13 notation we thus have,

$$\frac{p''_A - p'_A}{p'_A} + \frac{q''_{A,F} - q'_{A,F}}{q'_{A,F}} = \beta \Delta NTM \qquad (5.2)$$

In the second step, this coefficient is integrated in a partial equilibrium model. The two core theoretical equations are the domestic consumer's utility function and the foreign firm profit function. Only foreign firms are considered as the assumption made is that health hazards only concerns imported quantities. The utility function writes,

$$U(q_F, q_D, w) = a(q_F + q_D) - \frac{b(q_F^2 + q_D^2 + 2\theta q_F q_D)}{2} - I\gamma r q_F + w \qquad (5.3)$$

where q_F and q_D are the respective consumptions of foreign and domestic products. The parameters $a,b > 0$ allow the capture of the immediate satisfaction from consuming foreign and domestic products and w is the numeraire good. The parameter θ measures the degree of substitutability between foreign and domestic products, with $\theta = 0$ for independent products and $\theta = 1$ for perfect substitutes. The expected damage linked to the foreign products is captured by the term $I\gamma r q_F$. The parameter $r \geq 0$ is the per-unit damage and γ is the probability of having a contaminated product with $0 \leq \gamma \leq 1$. Thus, the probability that there is no damage is given by $(1-\gamma)$. The parameter I represents

[40] Chloramphenicol was already banned in many OECD countries before 2001.

CHAPTER 5

the consumer's knowledge regarding the specific characteristic brought by the foreign product. If the consumer is not aware of the specific characteristic, then $I = 0$, and the cost of ignorance, $\gamma r q_F$, is negatively taken into account in the welfare. In other words, the value $-\gamma r q_F$ disappears from the utility (4) when $I = 0$, but is taken into account in the welfare by a regulator accounting for all the characteristics linked to a product. Conversely, $I = 1$ means that the consumer is aware of the specific characteristic and negatively internalizes the damage in her/his consumption.

$$\pi_F = \frac{p}{1+\tau}\lambda q_F - g_F q_F - \frac{c_F q_F^2}{2} - K_F \qquad (5.4)$$

where, c_F and g_F are the variable cost parameters and K_F is the sunk cost linked amongst others to the firm's market entry and compliance with regulations (K_F is usually set to zero for the sake of simplicity). The parameter λ is the proportion of foreign products entering the domestic market when an output q_F is offered before the border inspection. This proportion $0 \leq \lambda \leq 1$ depends on the standard and the inspection policy. Under the assumption of rational expectations, the expected proportion taken into account by the producer corresponds to the effective proportion linked to the policy. The more stringent the standard and the inspection policy, the lower the proportion of products entering the market. The parameter τ is the ad-valorem tariff on imports, implying a price ($p/(1+\tau)$) received by the foreign producers when domestic consumers pay p. Again, in order to simplify calculations but without loss of generality tariffs are set to zero.

Maximization of utility by consumers and profits by firms defines a partial equilibrium supply and demand framework whose graphical representation is comparable to the one discussed in section 1. The model is then calibrated to represent supply and demand for crustaceans.

The calibrated model allows for measuring the impact of a stricter NTM on both foreign exporters' profits and domestic welfare (defined as the sum of domestic producers' profits and consumers' surplus). While the impact of the NTM on trade may be negative, its impact on domestic and/or international welfare may be positive because of a significant reduction in harm. In other words, NTMs can be trade-restricting but welfare-enhancing.

Parameters of the model are initially calibrated so as to replicate prices and quantities for the year 2001 and 2006 in the United States, Canada, Japan and the European Union. The baseline scenario that is before the reinforcement of the standard is characterized by an initial probability of contamination γ of 1 and initial proportion of foreign products entering the domestic λ of 1. The value of the per-unit damage r is obtained using results from Lusk, Norwood, and Pruitt (2006) who elicited consumers' willingness-to-pay (WTP) in order to avoid antibiotics. For each country, the authors apply the domestic price used for the initial calibration, which means that the per-unit damage is equal to $r = 0.767p'_A$ for each country and leads to the cost of ignorance. For a given variation of the Maximum Residue Level (MRL) with $\Delta\text{NTM} = \Delta MRL$, equation (5.2) is solved to determine λ linked to the shift of the foreign supply.

Table 2 presents the ex-post estimations of the relative annual international welfare variation in the United States, the European Union, Canada, and Japan. It focuses on the impact of past MRL reductions specific to each country and observed between 2001 and 2006 (for each country ΔMRL is indicated in the second column of the table). To measure different possibilities regarding the efficiency of the policy characterized by ΔMRL, two cases are distinguished: Case 1, with a probability of contamination $\gamma = 3/4$ (i.e. three-quarters of foreign products are unsafe); and Case 2, with a probability $\gamma = 1/2$. International welfare includes both domestic welfare and foreign producers' profits.

Results show that the profit variation for foreign producers is always negative despite the price increase, since the quantities sold by producers are strongly reduced. For Canada and the European Union, the domestic welfare increase outweighs the foreign producers' losses, leading to an increase in international welfare. Domestic consumers benefit from the reduction in the harm that outweighs the negative effects coming from the price increase linked to the import restrictions. Domestic producers benefit from the increase in the domestic price. The more efficient the regulation (i.e. γ lower), the higher both domestic and international gains linked to the regulation. For the United States, the foreign producers' losses outweigh the domestic welfare increase, leading to a decrease in international welfare. The variations are similar for both columns, since the large variations in MRL lead to the full elimination of foreign imports, which corresponds to a drastic standard. Japan did not change its import standard between 2001 and 2006, leading to the absence of welfare variation. Note that the cost of regulation and inspection linked to the NTM is not accounted for. This cost could be subtracted from international welfare in order to obtain the net social benefit of regulation and inspection.

Table 2: Annual international welfare change linked to a reduction in the maximum residue level in parts per billion between 2001 and 2006 (in per cent, relative variation compared to the baseline scenario)

	ΔMRL (parts per billion, 2001 → 2006)	**$\gamma = 3/4$**	**$\gamma = 1/2$**
United States	ΔMRL= -4.7 (5 → 0.3)	-12.5%	-12.5%
Canada	ΔMRL= -2.2 (2.5 → 0.3)	7.2%	13.1%
Japan	ΔMRL= 0 (50 → 50)	0%	0%
European Union	ΔMRL= -1.2 (1.5 → 0.3)	23.4%	45.3%

Source: Disdier and Marette (2010).

Note: The parameter γ represents the probability of contamination.

Table 3 reports some ex-ante estimations of the welfare effects for 2006 with a MRL equal to zero. The variation to reach zero tolerance is $\Delta MRL = -0.3$ for countries, except for Japan ($\Delta MRL = -50$). Note that as not all the products are inspected two new cases regarding the value of γ are considered. Case 1: $\gamma = 1/2$; Case 2: $\gamma = 1/4$.

Results show large domestic welfare gains for the United States, Canada, and the European Union. Reinforcing the standard towards zero tolerance brings a large gain for consumers via the reduction in harm, while the price effect linked to the import restriction following enforcement of the NTM is relatively low. For Japan, the large adjustment for some foreign producers not complying with pre-existing stringent standards in other countries makes the new regulation costly and explains the decline of international welfare. The variations are similar for both columns, since the large

CHAPTER 5

variations in MRL lead to the full elimination of foreign imports, which corresponds to a drastic standard.

Table 3: Ex-ante simulations (in per cent, relative international welfare change for 2006 with a potential maximum residue level equal to zero)

	$\gamma = 1/2$	$\gamma = 1/4$
United States (ΔMRL= -0.3)	15.3%	32.7%
Canada (ΔMRL= -0.3)	8.1%	16.5%
Japan (ΔMRL= -50)	-52.0%	-52.0%
European Union (ΔMRL= -0.3)	15.0%	31.9%

Source: Disdier and Marette (2010).

Note: The parameter γ represents the probability of contamination.

The approach adopted in Disider and Marette (2010) highlights the importance of examining both the trade and welfare effects of NTMs. First, the gravity estimation determines whether or not a specific NTM really impacts trade by eliciting a statistically (non)- significant effect. Second, the integration of a statistically significant effect in a calibrated model provides a transparent and unambiguous welfare measure of the measure under consideration.

These results for estimating welfare variations particularly help assess the impacts of ex ante regulatory measures, that is to say, before the effective implementation of food, environmental or health policies. The gravity and experimentation/survey results are a basis for anticipating market reactions and help anticipate the regulatory adjustments on markets and achieve quantified analyses directly usable by the public decision-maker when there is a conflict over NTMs.