Analysis and Impact of Sanitary and Phytosanitary Measures[1]

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Abstract

In the recent years the international trade arena has witnessed the growing importance of "within the border" barriers. Standards and technical regulations appear to several commentators as the new critical issue on the international trade agenda. Among these, sanitary and phytosanitary measures occupy a special place because of their crucial aim: safeguard of health and safety of human beings. From the point of view of economic efficiency there are very few circumstances in which it can be accepted a departure from free trade. Sanitary and phytosanitary measures pose a fundamental challenge to this traditional "economic perspective" and in this paper we try to tackle this challenge. Our analysis tries to disentangle the complexity of sanitary and phytosanitary measures that, uniquely amongst "potential trade obstacles", mix elements of genuine protection and elements of disguised protectionism.

The article is divided in four sections. The first section set the stage and introduces the crucial elements that characterise regulations in general and SPS measures. The second presents a synthetic overview of the institutional framework set by the WTO's SPS agreement in order to situate the issue of SPS in its concrete settings outlining the set of rules that bind their use. In the third section, the difficulties posed to "economic analysis" by domestic regulations are tackled and a potential solution will be sketched making use of a partial equilibrium economic model for evaluating the impact of SPS measures. Here the objective is trying to show the complexity that traditional economic reasoning do have when tackling the relationships between regulations-standards and international trade. The final section, improving on recent works (Otsuki and Wilson, 2001, 2000) will present an econometric method to measure the effect of standards and domestic regulations on trade flows taking as example the aflatoxins standards and trade in food between Europe and Latin America. This is a direct attempt to tackle the problem of empirically "quantifying" the impact of some specific domestic standards on international exchange, which is clearly a first step towards the objective of evaluating the trade-off posed by the introduction of standards. Some concluding remarks about the limits of economic "output based" rationality and the need for integrating it with a legal "procedure based" rationality when evaluating SPS measures close the article.

Keywords: Non-trade barriers, SPS, WTO, gravity model

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Introduction

In the recent years there has been a dramatic shift in the focus of trade policy concerns from the barriers that lie “at the border” to the barriers that exist “within the border”. Two main reasons can be identified. Firstly, the success of GATT/WTO in reducing the traditional type of tariff barriers has revealed a new and more subtle category of measures which restrict trade, as metaphorically Baldwin (2000) said this process has been like “draining a swamp” with the “lower water level revealing all the snags and stumps of non-tariff barriers that still have to be cleared away”. Secondly, the “magnification effect of globalisation” amplifies the importance of remaining barriers as the highly integrated and global trading system tends to have low tolerance for “system frictions”.

Among technical regulations and standards, sanitary and phytosanitary (SPS) regulations occupy a particularly relevant place in the regulators’ agenda, because of their primary aim of protecting citizens from everyday food hazards. This has become a virtual minefield for trade policy-makers as national differences in risk perceptions and tolerance can be manipulated or exploited to protect domestic industry from international competition (Howse and Trebilcock, 1999). The central role of SPS measures is revealed by the recent growing concerns associated with imported food products. These increasing concerns about food safety problems are both real because of the new potential food borne risks and perceived, especially in developed countries where demand for health and safety is fuelled by increasing income levels and recent food scares (Henson and Caswell, 1999; Howse and Trebilcock, 1999). When markets fail to supply such safety, a particular type of goods and services, regulators are being asked to provide it (Roberts et al., 1999a).

Standards and regulations in general, and sanitary and phytosanitary measures in particular, involve a mix of protection and protectionist objectives which is very complex to disentangle. This generates a very demanding challenge for the economist used to trade-off costs and benefits in order to evaluate different policy options. This paper is an attempt to tackle this challenge from an economic perspective and develop a model for evaluating and analysing the impact of SPS measures.

Section 1 - Setting the Stage. What SPS Measures are?

By definition regulations are conceptually distinct from trade barriers (Fig. 1). In the past they were exclusively considered a matter of “domestic sovereignty”, but two important elements have transformed regulations in a central issue of the international trade arena[i]: decline of traditional trade barriers, (e.g. tariffs, quota and subsidies) and recognition of the impact that non-tariff barriers can have on trade (Henson et al. 2000; Maskus and Wilson, 2000; Howse and Trebilcock).

FIGURE 1

It follows that regulations can be a "technical barriers to trade" (hereinafter TBT) which can be defined as "*regulations and standards governing the sale of products into national markets that have as their prima facie objective the correction of market inefficiencies stemming from externalities associated with the production, distribution, and consumption of these products*" (Roberts, ***). This definition highlights two crucial and specific features of SPSMs:

1. The reason of being of SPSMs and their main difference with traditional trade barriers is that they address market failures[ii] therefore are not simply welfare reducing. The net effect on welfare, in the cases when these are properly used and not simply disguised protectionist measures, is positive. This feature is crucial to understand the rationale of having SPSMs in place, which *a-priori* cannot be ruled out as "pure and simple obstacles to trade", and also help us to emphasize the fundamental difference between SPSMs and traditional barriers to trade
2. At the same time, this definition acknowledges the possibility of "regulatory capture"[iii] with domestic lobbies able to obtain a technical regulation with questionable legitimacy that basically act as a trade barrier and is welfare reducing for both the foreign producers and the importing country as a whole, even it is welfare enhancing for domestic producers. The possibility of SPSMs having a disruptive impact on trade, generating a loss in the surplus deriving from the international exchange, makes them a potential instrument for protectionism and draws into the debate the trade policy allowing us to analyse them using concepts and insights derived from economic analysis and political economy.

Technically, SPSMs are a subset of regulations that specifically aim to protect human, plant and animal health. Sanitary measures are those related to human or animal health, and phytosanitary measures deal with plant health. The protection of fish and wild fauna, forests and wild flora are included in this definition while the protection, for example of the environment *per se* and animal welfare are excluded. This broad definition is narrowed by the WTO in the SPS Agreement[iv] as any measures applied to:

- Protect human or animal life from risks arising from additives, contaminants, toxins or disease-causing organisms in their food
- Protect human health and life from plant or animal-carried diseases[v]
- Protect animal or plant life from the introduction of pests, diseases or disease causing organisms
- Protect a country from damage caused by the entry, establishment or spread of pests

One of the main problems related to SPSMs, and regulations in general, is that even "well-intentioned" measures may be welfare reducing because of their impact on trade. Crucially this depends not from the mere existence of SPSMs but from their heterogeneity among countries[vi], which imposes costs for producers that must comply with multiple rules and regimes. The harmonisation would be a solution that minimise the trade impact of SPSMs[vii], unfortunately a complete harmonisation would be not just costly but simply impossible and unjustifiable.

Understanding the sources of regulatory heterogeneity is it the a necessary and preliminary step when analysing SPSMs because the costs of harmonisation, and hence whether it is justifiable and achievable, do very much depend on them. Therefore, knowing the sources of differences in regulations provide us important insights about the costs of changing the regulations and the "room of manoeuvre" open to negotiations over SPSMs. With reference to SPSMs we can identify three main sources of this "regulatory heterogeneity" (Roberts et al., 1999b):

i. *Differences in risk factors*. These differences are rooted in one of the three components of risk assessment: identification of hazard, estimation of the probability of introducing the hazard, evaluation of the consequences of the hazard introduction. Basically, there are few disputes and differences related to the identification of hazard except that in the cases of recent technology[viii]. The other two components of risk assessment are more uncertain and differences may arise even among the same expert, especially when the degree of uncertainty is high and the scientific results are partial or non-definitive. Risk assessment results still are very uncertain and the range of these results is often so broad to allow greatly heterogeneous requirements (Antle, 1999).

ii. *Differences in degree of uncertainty or ambiguity about risk factors*: As already mentioned risk assessment models are based on uncertain information which may range from a low degree of uncertainty, in the case of mature scientific issue with high level of accumulated evidence and knowledge, to high degree, in the opposite case. This fact will inevitably cause disagreements among scientists and policy makers that will be translated into substantially different standards and regulations.

iii. *Differences in risk tolerances*: Differences in income, technology level, past experiences, loss function, ambiguity-aversion, are some of the main sources of differences in risk tolerance and demand for regulations (Casella, 1996).

More generally, we can affirm that the systemic sources of heterogeneity in regulatory systems[ix] are rooted in differences in endowments, technology, preferences, coalition formations, that inter-play with path dependent social choices and institutions. At the same time endowments, technology and preferences are commonly identified as sources of a nation's comparative advantages, therefore assuming that regulatory systems differ only because of those we should consider them as legitimate determinants of comparative advantages. In this case any claim of unfairness would clash with the theory of comparativ advantages and harmonisation would generate a welfare loss and push some nations to adopt a less than optimal regime. When the heterogeneity is generated by differences in institutions, coalition formation or pure historic accidents, then the claim of "harmonisation" may be legitimatised at the least on a normative basis, even if not on a pragmatic basis or on the ground of legitimate sovereignty (Leebron, 1996).

Section 2 – The International Institutional Framework of SPS Measures

Before the Tokyo Round, the measures enacted to protect human, animal and plant health were covered only by the Article III and XX of the GATT. Article III establishes the national treatment principle which imposes that "like products" have to be treated alike within the borders of the importing country, and it is potentially applicable also to "facially non-discriminatory" measures because it states that "internal regulation […] should not be applied to imported or domestic products *so as to afford protection to domestic production*". The problem with this provision is that it places a very burdensome onus of proof on the complaining party that is obliged to demonstrate that a regulation was established to protect domestic industry, which is extremely difficult given the lack of criteria offered to make such a demonstration (Howse and Trebilcock, 1999). However, in the case a measure is inconsistent with Art. III, Art. XX provides a number of exceptions allowing measures for protecting human, animal and plant health. This 'exceptional allowance' is subject to certain conditions highlighted in the *chapeau* of the Article: "such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction of international trade". The language of the article implies that the burden of proof falls on the defendant, and in general the article has been interpreted narrowly permitting trade-restrictive policies only if "no-less GATT inconsistent" regulation would be imposed. This "strict interpretation" sets a very high obligation on a defendant because a policy approach that intrudes less on trade than the existing regime is almost always conceivable and therefore in some sense available, which in practice reduces the art. XX to the status of a meaningless exception (Charnovitz, 1991; Esty, 1994).

With the Tokyo Round, as a response to the generally perceived inadequacies of GATT, a plurilateral Agreement on Technical Barriers to Trade was signed: the Standards Code. Even if this was an important step forward, the Standards Code had three big shortcomings: it was ratified only by 39 countries, it basically applied only to product standards and not to production and process standards, and it was based on the weak consensus-based dispute settlement process[x] (Roberts, 1998). Furthermore, the effectiveness of the Standard Code was weakened by the fact that that it did not address the issue of what exactly constitutes an unacceptable standard. This meant that the complaining party had the formidable onus of either having to prove "deliberate protectionist intent" or to demonstrate that the measure went beyond what was "necessary" (Howse and Trebilcock, 1999). The result is that historically between the Tokyo Round and the Uruguay Round, under the Standards Code, any SPSMs has been successfully challenged (Roberts et al., 1999).

The widely perceived failure of the GATT to effectively discipline the application of SPSMs (Roberts et al., 1999b), together with the potential risk of technical standards being resorted after the liberalisation achieved by the Uruguay Round[xi] was perceived by both commentators and negotiators. The challenge before the negotiators of the SPS Agreement was to create a set of rules which would achieve the proper balance between allowing protection while disallowing regulatory protectionism (Roberts, 1998; Sallie, 2000). The problem is that SPSMs tend to normally include at the same time both elements of genuine protection and elements of disguised protectionism and their complexity lays in the fact that a binary discrimination between genuine protective and protectionist measures is not possible as the difference is more a qualitative one or "a matter of grade".

The major objectives of the SPS Agreement are two:

1. Protect and improve the current human health, animal health, and phytosanitary situation of all member countries
2. Protect the members from arbitrary or unjustifiable discrimination due to different sanitary and phytosanitary standards

Indeed, the SPS Agreement may be interpreted as a more sophisticated formulation of the principle of non-discrimination contained in Art. III of the GATT and a more detailed elaboration of Art. XX's set of justifications that must be offered in cases of disparate impact on trade. Although it clearly constrains the ability of countries to adopt regulations that have a disparate impact on imports, it nevertheless leaves substantial room for the exercise of national political sovereignty and policy autonomy both in choosing policy objectives (as long as these are not a sham) and policy instruments (as long as these are not disproportionate to the objective, given their impact on trade) (Howse and Trebilcock, 1999). It can be argued that the requirements of the SPS Agreement, given non purely protectionist intentions, are basically procedural requirements more than substantial benchmark. If countries feel committed to adopting more stringent health safety, consumer protection, environmental or conservation standards for legitimate non-protectionist reasons they remain largely free to do so, subject to demonstrating that there is some rational scientific basis for their actions beyond the impact on international trade, and that such measures do not gratuitously encumber international trade when other less restrictive policy instruments are available to achieve the same objectives (Howse and Trebilcock, 1999). Paradoxically as it may seem, we can even argue that strict procedural provisions may allow a larger "room of manoeuvre" in setting the domestic objectives, especially if these objectives are protective and not protectionist!

The basic structure of the SPS Agreement recalls the structure of the TBT Agreement and Article XX. Firstly, it defines SPSMs the right of any Member to protect human, animal or plant life or health from pests, contaminants, toxins, disease carrying organisms, etc. Article 2 establishes the basic rights and obligations, with Art. 2.1 stating the right of Members to adopt SPSMs, responsible for ensuring that an SPS measure is applied “only to the extent it is necessary” and without “arbitrarily or unjustifiably discriminating between Members where similar or identical conditions prevail”.

The most important innovative and unique feature of the SPS Agreement is the provision imposing the use of ***science*** as criteria for both creating and justifying the SPSMs. The rationale of this provision lies in the very nature of the SPSMs that routinely violate the two basic principles of the national treatment and MFN because it aims at protecting from risk[xii]. On the top of that, income level, tastes, and historic occurrence of incidents will normally affect regulatory decisions. In this context, the suspicion may arise that certain SPSMs are of dubious merit and have been implemented as disguised protectionism. Therefore, to provide a procedural basis to determine the legitimacy of SPSMs, the Art. 5.1 of the Agreement makes it a fundamental obligation to base them on a scientific risk assessment. Furthermore, it is expected that the full and objective characterisation of the risk, scientifically understood as the product of the probability and the consequences of each hazard, will firstly narrow information gaps between importers and exporters, and consequently allow judgements about the necessity and possibility of mitigating the measure concerned. In addition, scientific criteria can provide for greater stability of expectations among trading partners concerning the design of domestic regulations (Bhagwati, 1996). Clearly we must recall that the “scientific paradigm” cannot be considered free of shortcomings and problems[xiii].

The relevant scientific evidence may not always be sufficient to carry an appropriate risk assessment, nevertheless the risk and consequences of the hazard may be serious. In these cases the Art. 5.7 states that Members may adopt SPSMs on provisional basis but while actively “seeking to obtain the additional information necessary for a more objective assessment of risk” and review the measures accordingly “within a reasonable period of time”. This introduces a limited version of the ***precautionary principle*** that can be considered one of the most discussed and unsettled issue of the SPS Agreement..

Not only scientific evidence should be taken into account, but also ***economic factors*** listed in articles 5.2 and 5.3 (i.e. “potential production or sales losses and eradication costs, relevant cost-effectiveness of alternative approaches for limiting the risk”). The “economic test” adds a further complication and seems to venture into an uncomfortable, and eventually unpractical, area of weighing the value of human health against more readily measurable concerns[xiv] (Howse and Trebilcock, 1999; Antle, 1999; Henson and Caswell, 1999). The economic test adds a complex dimension for the evaluation of the SPSMs, nevertheless its absolute relevance may be argued in terms of welfare gains for the entire society.

A further dimension that is questioned, when evaluating the regulatory standards under WTO, is whether the standard chosen is the least disruptive to trade among available policies (Maskus and Wilson, 2000). Unfortunately, the "necessity test" is not straightforward, in fact at least two different interpretations can be considered appropriate and each one will imply different levels of scrutiny. A stringent interpretation where the claim may be that a measure is indispensable, and a less stringent one when the necessity is understood as having been necessary to do something, without the very strong implication that no other choice was available at all. The analysis of the recent WTO Appellate Body (hereinafter AB) sentence on the Asbestos case seems to suggest that the importance of values and interests at stake, will determine the level of scrutiny when a panel is considering a claim that the measure is "indispensable" to achieve a Member's chosen level of protection[xv] (Howse and Twerk, 2001)

The other fundamental institutional innovation of the SPS Agreement are the provisions regarding ***transparency*** requirements which are detailed in the Annex B and include: (a) notification of an enquiry point which is responsible for provision of answers to all reasonable inquires from interested Members; (b) notification of the "notification authority" responsible for informing the WTO Secretariat about a government's SPSMs; (c) notification of new SPSMs, before they are adopted or modified, when this could affect international trade[xvi]. While transparency of the regulatory process does not provide a full guarantee against misuse of technical trade barriers, it can potentially minimise disruptions that new or modified measures cause to trade flows as possible public scrutiny of regulations could raise the political costs of using technical regulations as disguised protection for domestic agriculture (Sykes, 1995)
At the same time, the "prior notification" is designed to allow comments and objections by other Members about pending SPSMs and de facto induce the regulatory processes of Members to acknowledge also foreign exporters as stakeholders in decisions that affect domestic trade policy (Roberts, 1998).

Some sort of ***consistency*** is also required in applying the SPSMs. In fact Art. 5.5 states that "Members shall avoid arbitrary or unjustifiable distinctions in SPS protection levels if such distinctions result in discrimination or a disguised restriction on international trade". As the Appellate Body ruling on the "Hormone Case" declared, in order to establish a violation of the Art. 5.5 three elements have to be proved. The first is that the Member establishing the measure must have done so in several situations; the second is that "those levels of protection must exhibit arbitrary or unjustifiable differences in their treatment of different situations"; and the third is that these differences result in a disguised restriction of international trade (WTO, 1998i).

One of the intentions of the SPS Agreement is to encourage co-operation among countries in policy development, or alternatively said foster the ***regulatory rapprochement***[xvii] (Hooker and Caswell, 1999; Hooker, 1999). This objective is at the basis of the provisions about the harmonisation and the equivalency. The SPS Agreement urges the widest possible ***international harmonisation*** of SPSMs based on internationally recognised standards, guidelines and recommendations. In order to achieve this objective three inter-governmental organisations are identified: Codex Alimentarius Commission (CODEX) for food safety measures, International Office of Epizootic (OIE) for animal health measures, International Plant Protection Convention (IPPC) for plant health measures. As already outlined in section 3 of the previous chapter, notwithstanding the several evident advantages of harmonisation many reasons explain and justify a departure from it. Furthermore, Art. 4 require Members to accept **measures as equivalent** to their own if the exporter objectively demonstrates that its measures achieve the importer's appropriate level of protection. In order to make this provision more effective, the Agreement also encourages them to enter into ***mutual recognition agreements***.

Section 3 – Building an economic framework for analysing SPS Measures

Most international economists tend to agree that as traditional trade protection measures (i.e. tariffs, quotas, VERs) have been eliminated through the 90's, barriers to trade related to the use of domestic technical regulations have become much more important channels through which trade is blocked (Maskus and Wilson, 2000; Baldwin, 2000). The problem is that, even if it is widely agreed that standards and regulations affect trade, it is not yet clear how these measures impact on international production and exchange systems (Roberts et al., 1999). Furthermore, a review of cases brought to dispute settlement at the WTO reveal little economic analysis to underpin decisions. The need for an economic framework is even more urgent because while the approach based on the scientific principles is valuable as a foundation in building the rule of law in trade, reliance on scientific evidence alone to evaluate disputes may not provide for robust guidelines to settle multilateral disputes (Maskus and Wilson, 2000; Neven, 2000).

What is important to notice is that trade economists while easily agree on the proposition that lower tariffs mean freer trade, unfortunately cannot be completely clear about the general effects that changes in particular standards or technical regulations, or the system as a whole, will have on trade. In fact, standards can be a force for good or a force for evil (Hufbauer et al., 2000), as Zuckerman (1997) claims “standards are the clue that will bind the new world order, but when misused they can also present potent protectionist weapons”. Therefore, since they can have either positive or negative effects, standards can be modelled in different ways (Ganslandt and Markusen, 2001). The multidimensionality of standards is reflected in the theoretical literature that appears as a non-homogenous body of models and approaches, each of them useful to describe and analyse the effect of some particular standards but unable to account for other cases.

The economic literature dealing with analysis of SPS measures can be divided in three main strands: microeconomic, partial equilibrium and general equilibrium approaches.

The studies using **microeconomic approaches** compose the richest strand of literature on the effect of standards and regulations on trade and the original sources of this literature are basically twofold, the traditional cost-benefits analysis that found a consistent application in the implementation of regulatory impact assessment (RIA) in public decision-making (Antle, 1999), and the industrial organisation literature models of imperfect competition and strategic interaction. The first source determined studies that tend to focus on the determinants of compliance costs imposed by regulations and on the strategic response of firms to them (Antle, 1999; Baldwin, 2000) . The second group of studies is concerned with the strategic use of standards and regulations by the governments and their impact on market access, international competition and welfare (Oyeijde et al., 2000; Ganslandt and Markusen, 2001; Matoo, 2000; Hufbauer et al., 2000; Holleran et al., 1999; Unneveher and Jensen, 1999; Loader and Hobbs, 1999; Henson and Heasman, 1998; Maskus and Wilson, 2000; Wienert, 1997). Finally it is worth to mention that various studies that tend to concentrate on the benefits of standards and regulations for both producers and consumers. We want to underline that this classification is done for the ease of exposition and some of the studies cross cut it and enter in more than one group.

Worth to mention are also various studies aiming at “translating” the effect of SPSMs into analogous effect of more traditional and better known types of trade barriers. When an SPSM asymmetrically increases the compliance costs of foreign producers, by affecting variable costs standards, it will have a “tariffication” effect, i.e. raise equilibrium price, reduce total demand, reduce imports and increase domestic production, even though no tariff revenue is generated (Hooker and Caswell, 1999; Roberts et al., 1999b). More complex, appear the case of an SPSM affecting fixed costs because it is necessary to distinguish between short and long run equilibrium. In the short-run only the firms with sufficiently low marginal costs remain on the market, therefore export sales may increase for these firms as a result of reduction competition (Oyeijde et al., 2000). The measure acts as a lump-sum tax resulting in an increase of the fixed and total costs of the export good but which leaves the average variable and marginal costs unaffected. Since changes in export supply are a function of changes in the marginal costs the entry costs induced by the measure will not affect the output and export supply in the short run. In the long run, the export firm must cover the increased average total cost of supplying the export market, thus supply will fall and price will rise in the importing country. However, because the firm in the pre-SPS long run equilibrium was earning normal profits, and cannot influence the world price of the export goods, it will not be profitable to continue to produce for the export market hence it will exit the market (Baldwin, 1999). SPSM can also act as a quota[xviii] and this case is analysed by Baldwin (1999) that considers a regulation acting as a temporary quota, the effects are a rise in the price of the domestic good above the world price and a fall in domestic consumption and welfare as total imports fall. The cost of delay also becomes larger if consumers switch between product varieties during the delay period, in which case there are costs incurred to convince consumers to switch to the product that experienced pre-entry delay.

Finally, heterogeneous standards may have the effect of segmenting the market therefore creating monopolistic power. In this case, the effects of SPSM are basically threefold: closing down markets, altering the competition and modifying the terms of trade (Fisher and Serra, 2000; Ganslandt and Markusen, 2001). A crucial important lesson, stemming from this strand of literature, is that standards not only could achieve static market exclusion but also strengthen market power in dynamic terms (Maskus and Wilson, 2000; Antle, 1999).

The group of study, previously mentioned, that as focussing on the strategic use of standards is able to give us a certain number of insights about the reasons and the way governments can make use of SPSM underlining the possibility of a political economy interpretation of food safety regulations.

The central idea is that if firms can raise the costs of foreign rivals by imposing domestic standard requirements they will have a strategic incentive to use this tool (Wallner, 1998). A key assumption of the literature examining strategic incentives for setting standards is that the foreign firms' profits do not contribute to domestic country welfare (Gandal, 2000) therefore the standards set by the government will be stricter than needed to counteract the negative externality, thereby incorporating a protectionist element (Fisher and Serra, 2000). Furthermore, the minimum exclusionary standard is a non-increasing function of the relative size of the domestic market, and the intuition behind it is relevant and straightforward: if the domestic market is small the foreign firms might not want to incur either the fixed cost of producing under two standards or adapting all production to the higher standard of the home country (Fisher and Serra, 2000). This gives us a key for interpreting in political economy terms the reason for the restrictiveness of European standard on aflatoxin that will be analysed in the last section[xix]. A recent study of Ganslandt and Markusen (2001) highlights the potential conflicts of interest with respect to standards and technical regulations governing international trade where in an imperfectly competitive sector two countries with asymmetric size introduce different types of standards either unilaterally or bilaterally. The main insights are that firms in the big/rich country tend to be the main winners in almost all the situations with diverging standards, whilst consumers in both countries are hurt by cost-raising standards[xx]. Two of their findings are directly relevant for developing countries. Firstly, they demonstrate that in the case of “standard war” the small/poor country is worse off, as happens in the case of a tariff war. Secondly, when the standard requires the firms from the small/poor country to incur a joint fixed cost in order to export their products to a large/rich country this give rise to multiple equilibria and co-ordination problems that call for government action to avoid getting blocked in the “deterrence equilibrium” negative for both consumers and producers in the small/poor country. Standards can increase domestic welfare and may be used as a strategic policy instrument, because, assuming imperfect competitive markets, rents can be transferred from the foreign to the local producers.

Therefore, in line with these studies we want to underline the risk that standards can be used intentionally or inadvertently to limit competition, thereby raising costs to consumers and excluding new producers from the market[xxi]. This is generally accepted as the effect of discriminatory standards, but a recent paper of Matoo (2000) shows that also non-discriminatory standards can have discriminatory effects and being set at a level which foreign producers optimally choose not to meet, allowing domestic producer to monopolise the domestic market. Therefore, a crucial lesson for international trade negotiators is that the central problem is not whether a standard is discriminatory per se, but whether it is unilaterally set (Matoo, 2000).

On the other side, as already noticed at the beginning of this section and in the first section, standards can also have positive effects (Hufbauer et al., 2000). For consumers, standards can convey information in a consistent and understandable manner, reduce transaction costs, reduce uncertainty of consumers, facilitate comparison, increase demand for complementary goods and increase elasticity of substitution between similar goods (Maskus and Wilson, 2000). In this perspective, standards act as facilitators of trade and it can be argued that the main aim of standards, as already highlighted in the first section, is overcoming market failures with regard to quality attributes that result from the asymmetry of information between buyers and sellers (Akerlof, 1970). This is an important point to be stressed as, whilst a tariff changes only the price of the goods imported but not its safety or quality attributes, the SPSM tend also to change the product itself[xxii] and increase consumers' willingness to pay (Ganslandt and Markusen, 2000; Thilmany and Barrett, 1997).

The group of studies using **partial equilibrium approaches** fundamentally focused on the impact of SPSM on trade flows, prices and welfare consequences. These studies will be used as building bloc for our model that will be presented at the end of this section Most of them assume that the effect of SPSMs is only "tariff-like" (Sallie, 2000; Hooker and Caswell, 1999; Maskus and Wilson, 2000; Krisoff et al., 1996; Sumner and Lee, 1997), therefore the tariff equivalents can be calculated (Krisoff et al., 1996). Clearly, the net welfare result of a purely protectionist standard is even more negative than an "analogous tariff" because of the "uncollected" tariff revenue (Hooker and Caswell, 1999). At the same time, other researchers considering that the SPSMs can address a production externality, for instance related to the introduction of pests or diseases as consequences of imports, show that the standards have an ambiguous impact on welfare because it allows to avoid the negative production externality but still act as a traditional trade restriction increasing the price of foreign goods (Orden and Romano, 1996; Paarlberg and Lee, 1998; James and Anderson, 1998). Finally, a further group of studies focused on positive "consumption externality" and the consumer reaction to a technical barrier. In this model, the regulation allows the avoidance of a "lemons problem" (Akerlof, 1970) because increase consumers' confidence and eliminate a market failure that is causing the under-provision of "food safety" (Thilmany and Barrett, 1997).

A final group of studies, using a **general equilibrium approach**, has been able to disentangle demand and supply side effects and spillovers (this is impossible with the partial equilibrium models). The impacts of the SPSM are directly on the BP curve whose movement will cause a disequilibrium in external balance (Oyejide et al, 2000). This disequilibrium in the external balance causes changes in the level of income and the domestic interest rate. The implementation of this framework could be tested empirically using the computable general equilibrium models. The importance of a general equilibrium approach lies in the possibility of disentangling the income and spillover effects of SPSM.

The main difficulty of analysing the impact of SPSMs is that these measures are heterogeneous, indeed a-priori and in general the impact of SPSMs on trade flows, prices, consumers and producers is essentially ambiguous and "measure specific"[xxiii]. Therefore, before presenting our economic model is important to distinguish various types of SPSMs on the basis of three main dimensions: scope of the measure, policy instrument or regime (within this consider the regulatory mechanism) and regulatory goals.

i. **Scope of the measure**. SPSMs can apply differently to different producers, and this "selective application" is fully justified because different countries, or even different producers, may carry different risk levels because of their location or productive processes. Based on this dimension we can distinguish 3 types of measures

    - *Uniform*: When the measure affects all the producers, either domestic or foreign. In this case the measure it by definition non discriminatory[xxiv]
    - *Universal*: When the measure affects only the foreign producers without discriminating between countries or firms. This measure is by definition discriminatory and violates the national treatment principle
    - *Specific*: When the measure affects only foreign producers and in particular discriminates among countries or firms. This measure violates both the national treatment principle and the MFN principle[xxv]

[TABLE 1]

ii. **Policy regime or policy instrument**: The regulation of health and food safety can be classified on the basis of the degree to which they reduce the freedom of production and exchange activities (Henson and Caswell, 1999). This is not the only dimension we can take into consideration, in fact different regulatory systems will be preferred depending on the degree of risk consequences, and the degree of uncertainty about the risk.

- *Bans*: When great risks or uncertainties are posed by a hazard, and alternative measures to reduce the risk are technically infeasible than the most restrictive type of technical barrier might be used[xxvi].
  - Total ban: Used normally when the understanding of the risk factors is low
  - Partial ban: Can be seasonal or regional and it is used when the level of knowledge and information about the risk factors is more comprehensive (Roberts et al., 1999b)
- *Safety Standards*: This includes a broad category of policy instruments that basically define certain technical requirements that exports must meet in order to gain access to the domestic market. Although in principle any country and any producer willing to bear the costs should be able to meet such requirements, in practice some firms may be prevented from doing so. Furthermore standards can be written to favour domestic producers, for instance by requiring the use of inputs that are more easily available in the domestic country than abroad[xxvii]. They can be or not subject to prior approval.
  - Specification: can be applied both to products (i.e. products standards) and processes by which those products are made (i.e. process standards) and can take both positive or negative forms[xxviii]
  - Performance: require certain levels of safety to be achieved, but leave the suppliers free to choose the mechanisms through with they meet such level
  - Target: it does not prescribe any specific safety standard but impose criminal liability for pre-specified harmful consequences, therefore it is an implicit general requirement that suppliers should "not knowingly sell a product which is harmful to health" (Henson and Caswell, 1999)
- *Information requirements*: This category of measures is normally used when the externality to be corrected results from information failures. Recently these measures have been seriously debated and considered as appropriate instruments of influencing economic behaviour (Caswell and Mojduszka, 1996; The Economist, 1999a). The main hypothesis underlining the use of information

requirements is that, once well informed, the consumers' choices will provide sufficient incentive for producers to produce the range of quality that consumers are willing to pay and solve the possible "lemon problems" (Akerlof, 1970) without any further intervention. The real advantage of these kind of measures is that they are generally considered to be low cost remedies. The two main arguments against them come from the "pro-free trade" supporters because these measures could create the impression that there is a risk associated with consumption not supported by any scientific evidence (The Economist, 1999a; The Economist, 1999b). On the other side, the critique is based on the argument that public interest should avoid the consumption of food that is perceived as potentially unsafe especially when difficulties in understanding might prevent consumers to make a fully rational choice[xxix].

- Labelling requirements
- Control on voluntary claims

[TABLE 2]

iii. **Regulatory goals**: Two questions must be answered in order to discriminate the SPSMs, first we need to recognise "who's societal interest are protected by the measure", and we identify three broad classes of societal interests: producers, consumers, natural environment[xxx]. The second question focus on the risk reducing impact of the measure does have and namely "risk-reducing" and the "non-risk reducing" measures[xxxi].

[TABLE 3]

Once we have discriminated among the different measures we can present a model that would allow us to predict their trade impact. The backbone of the model presented here is based on the work of Roberts et al. (1999b) that at the same time draws on the contributions of other recent works (Krissoff, Calvin and Cray, 1996; Sumner and Lee, 1997; Orden and Romano, 1996; Paarlberg and Lee, 1998; Thilmany and Barrett, 1997).

The model makes use of analytical tools familiar to trade economists: comparative static partial equilibrium approach. The starting scenario is characterised by the absence of SPSM and is analogue to the free trade scenario with the domestic price equal to international price and the trade flows determined by domestic excess of demand given the price. This section is divided in three parts. Firstly, we will separately present the different components of the model covering all the possible effects of an SPSMs, secondly we will introduce some extra nuances focusing on the relevance of the scope of the measure and the differences between the small and large case as critical determinants of the effects of an SPSMs[xxxii]. We will conclude this section stressing the reasons for choosing to use a partial equilibrium model, its advantages and its shortcomings.

Before describing the model we want to underline an important issue: analysing the effect of technical regulations and standards is more complex than evaluating the effect of traditional protectionist measures therefore considerably more information is needed in order to calibrate appropriately the model. Specifically, a detailed knowledge of the regulations themselves is required, the process by which companies or individuals meet the regulation and the implications of not conforming to these rules.

Protectionist component

The SPSM measure is equivalent to a tariff barrier, target the imports and does not have any positive externality. Foreign producers are required to comply with some regulation that increases their costs. The loss for the importing country is equal to the potential gains from trade. The welfare effects can be decomposed in consumers loss and domestic producers gain[xxxiii]. The net welfare effect is negative. Graphically (Fig. 1), after the introduction of the regulations the foreign supply curve shifts upward and the domestic price increases from P_w to P' and the quantity consumed being reduced from F to F', whilst the imports fall from "F – Q" to "F' – Q' ". This results in a consumer loss, graphically identified by the areas "a, b, c, d", and producer gains identified by the area "d". The net welfare loss is greater than with a "tariff equivalent", in fact this is shown by the classical Harberger's triangle "a" and "c" representing respectively the consumption and the production distortion losses, and by the area "b" representing the forgone government revenue. As it can appreciate graphically this last welfare loss can be very relevant.

[FIGURE 2]

Supply shift component

We have to distinguish two cases, when the imports do have negative production externalities[xxxiv] that are eliminated by the SPSM and when the regulations have a positive impact on the producers.

In the first case, opening the frontiers, without any regulations, has a negative effect on domestic production because for instance imports might introduce a pest which adversely affect productivity of domestic firms or alternatively increase their costs. The introduction of an SPSM avoid the domestic supply curve to shift backward therefore the welfare loss caused by the measure has to be balanced with the positive welfare effect caused by the correction of the negative production externality (i.e. the area "e"). The effect on price and quantity equilibrium is analogous to the previous case. The alternative to the food safety standards could be a ban and in the context of our model the best solution can be determined. In the case, graphically represented (Fig. 3) the ban raises domestic price to higher level than with the standards (i.e. P_A) and its impact has a worse net welfare effect than the standards, even if domestic producers would derive a net gain from it.

[FIGURE 3]

In the second case, the SPSM initially simply increases the costs for foreign producers and the price increases from Pw to P', but it also allows the diffusion of a new process technology and improve resource allocation[xxxv] (Maskus and Wilson, 2000; Hufbauer et al., 2000) which could be a very important effect for smaller economies that do not have the resources to develop their own technologies from scratch.

In this case, the world price decreases from Pw to Pw'' and the domestic price decreases from P' to P'' partially offsetting the negative welfare effect of the measure (Fig. 4). This case, even if theoretically possible in the small country case is not very plausible, while it is more likely to happen when the importing country is a large country imposing a "de facto" international standards with positive impact on the production technology used worldwide. It may be objected that if the benefits of adopting the new technology is higher than its costs the producers would have already adopted. Our answer is that we might normally expect that the gains from the new technology just partially offset its costs which would explain why the foreign producers did not adopted it before (Fig. 4). Furthermore, the evolutionary literature about technological transfer and innovation insisting on the concepts of bounded rationality, tacit knowledge, technological inertia, helps us to explain why a technology may have not been adopted even in cases when in the long run this would generate net gains (Lall and Pietrobelli, 2001).

[FIGURE 4]

Demand Shift Component

While the supply shift component of the model is based on the assumption that a link exists between imports and domestic supply conditions, the demand shift component assumes that a link exists between the imports and domestic demand. This link is created through information imparted by the import regulation or by an increase in quality/safety attributes and causes the domestic demand schedule to shift outward[xxxvi] (Akerlof, 1970; Thilmany and Barrett, 1997). Again there is a trade-off to be evaluated between the consumer benefits and the cost of the measure. The demand shift component allow us to take account of scares, whether or not there is any credible scientific justification this is less relevant to the effect on the demand and consequently on the trade flows. In this case (Fig. 5) the negative effect on trade of the regulation his analogous to the "protectionist case", with the net welfare loss identified by the consumption distortion loss, area "a", production distortion loss, area "c", and the potential government revenue loss, area "b", but there is also a net welfare gain because of the positive consumption externality of the measure which can be graphically identified with the areas "e, f". Therefore, even if the domestic producers gain, the final net effect of the measure is ambiguous and there is no presumption of distortion. When the measure targets an information asymmetry (i.e. labelling scheme) the bottom line is whether the consumers' benefits from the information are greater than the costs of providing that information. This component allows us to analyse regulations that relate to trade in agricultural products taking into account "consumer scares". The important point to be underlined is whether or not there is any credible scientific justification behind the consumers' reaction, the demand for food and agricultural products can certainly be affected by such sentiment (Roberts et al., 1999b).

[FIGURE 5]

The different components of the model previously presented aimed at keeping the analysis at the simplest level, but in order to formulate a model that is useful for the analysis of SPSM we need to introduce some further specifications that need to take into account whenever evaluating a "real regulation".

Taking into account the scope of regulation

Consistently with our classification of the SPSM developed we need to differentiate the measures on the basis of their scope. From the perspective of the exporter two cases should be distinguished. The importer-specific case, when only one importer adopts the regulation, the importer being a small country there will be a trade diversion towards other exporters and the world market will shrink but by a unnoticeable amount. In this case bilateral trade flows are modified and individual firms can be worse off but the aggregate impact is irrelevant[xxxvii]. The importer-universal case is different when all the importers introduce the measure, and the exporter cannot merely switch supply to another market but have to bear the compliance costs of the regulation[xxxviii] (Roberts et al., 1999b). Analogously, from the perspective of the importer two cases should be distinguished. The exporter-specific case, when the measure is applied only to one exporter that has to bear all the compliance costs alone or, when possible, shift to other markets. Different is the exporter-universal case, when the measures apply universally to all exporters and the cost is not falling only on one of them.

Large Country Case

The analysis above assumes that no country is, by itself, large enough to influence the world prices, but when a country is able to influence world prices with its decision to adopt a measure that affects the imports quantity, then the small country assumption is not appropriate. In this case, the terms of trade gain arising because the measure lowers world prices has to be taken into account. This gain depends on the ability of the importing country to drive down the world prices that is determined by the relative price elasticity of world supply and domestic demand (Fig. 6). Intuitively, the more elastic the domestic demand is (i.e. the DD schedule is flatter) and the less elastic is the world supply (i.e. the WS schedule is steeper) the higher will the terms of trade gain (i.e. the coloured rectangle). The terms of trade gain partially offsets the negative welfare effect of the measure, but, unlike a normal tariff is unlikely to generate, by itself, a net positive welfare effect, because technical regulations involve a real resource outlay rather than a financial transfer (Roberts et al., 1999b). This is generally a true conclusion when an SPSM is purely protectionist, but as already seen this is not generally true therefore the possibility of terms of trade gains, when either positive consumption or production is already present, may be crucial in shifting the welfare balance in favour of the measure.

[FIGURE 6]

Advantages and Shortcomings of the model

The model described above can be considered appealing for two main reasons. It is flexible enough to describe and analyse a wide range of SPSMs, once enough information has been gathered on the measure itself. Furthermore, it can be modified to consider market imperfections and dynamic adjustments (Oyeijde et al., 2000). Furthermore, this model can be implemented through single equation econometric methods to provide estimates of effects and ideally provides a simple modelling structure into which to place empirical data for the calculation of the trade impacts and welfare effects. Finally, this model extend the capacity of traditional economic tools (i.e. partial economic analysis) with which international economists are well familiarised in order to evaluate the impact of non traditional type of "potential trade barriers".

At the same time, we need to recognise the shortcomings of the model presented, fundamentally a partial equilibrium approach cannot capture income and spillover effects in the economy (James and Anderson, 1998).

Section 3 – Empirical estimation of impact of SPS measures

In this section we will focus on the "quantitative" analysis of the SPSMs, in particular this will be done presenting an econometric model to measure the effect of standards and domestic regulation on trade flows. We will analyse the aflatoxins (see box 1) standards and trade in food between Europe and Latin America as this case has received an extreme attention thanks to the recent works carried out by scholars at World Bank. In contrast to the World Bank studies, we use an independent dataset, estimate a slightly different model and use a different estimating procedure. The results of our estimation will then be used to calculate the potential export revenue gains and losses with different standards.

Before presenting our econometric model, it is important to describe briefly what have been, to the date, the various approaches to empirically estimate the impact of SPSMs. The estimation of SPSMs impact is indeed a field in its infancy and for this reason different methodologies have been employed. We can distinguish four groups of studies: surveys, case studies, computable general equilibrium models and econometric models.

Surveys have been done mainly by USDA and OECD, the first in 1996 estimated that questionable technical barriers were reported in 62 countries constraining or blocking an estimated trade flow of $5.0 billion[xxxix], the second in 1999 estimated that additional costs costs of complying with foreign standards range from zero to ten percent, with most of the firms falling in the lower tail of the distribution[xl]. The advantages of these surveys is that they tend to give us a good overview of the issue but normally, as these are done only once, it is not possible determine trends and dynamics

Various **case studies**, which normally consists of in-depth analysis of specific cases where a sanitary and phytosanitary requirement constrains the export of one country, have been done. In general, these studies tend to focus on the compliance costs imposed by the sanitary requirements more than on the impact on trade flows. Cato (1998) assessed the costs of upgrading sanitary conditions in the Bangladesh frozen shrimp industry in order to satisfy EU and US standards and estimated that US$ 17.6 million were spent to upgrade production with an average expenditure per plant of US$ 239,630, furthermore to maintain a system of control and monitoring in place he estimated that US$ 2.2 million are spent each year. Fisher and Schuler (1999) analysed the SPS-related projects supported by the World Bank as an indicator of the resources required for the development of SPS controls and estimated that the costs of achieving disease-free and pest-free status to enable Argentina to export meat, fruit and vegetables was about US$ 82.7 million over the period 1991-96. Following the same logic, Wilson (2000) reported that the total World Bank funding in 1999 for projects directly or indirectly related to SPS amounted to US$ 412 million. Henson et al. (2000b) analysed the impact of EU hygiene requirements on Kenyan fish exports and found that the expected costs for modernising the basic infrastructure, such as landing sites, and upgrading laboratory facilities for chemical and microbiological analysis would be about US$ 6.9 million. Furthermore, they estimated that the inability of complying with these requirements had a serious negative impact on Kenyan exports of fresh fish to EU[xli] reducing it by about 69%. Finally, Herath (2001) analysed the impact of SPS requirements on beverages and spices in Sri Lanka, and found that due to the domestic standards being lower than the international ones, the direct loss of potential export due to non-compliance is about 34% of the total exports of spices and beverages yearly in the period 1990-2000. This is equal to US$ 2.9 million every year, about 7% of the total foreign exchange earnings from spices and beverage crops in 2000.

Various **computable general equilibrium model** (CGE) have been estimated in order to quantify the impact of standards and regulation, in particular Gasiorek et al. (1992) modelled the effects of harmonisation in EU after 1992 assuming increasing and considering standards and regulations as “sand in the wheels” with their harmonisation reducing the trade costs by 2.5 percent[xlii]. The outcome of harmonisation is, depending on the scenario and the parameters, either a fully integrated market or still a segmented market and in the first case the welfare gains are particularly relevant: about one percent of GDP in the short run and more in the long run when inefficient firms leave the market. Harrison et al. (1996) extended the work of Gasiorek et al. (1992) stressing that harmonisation of standards and increased information about foreign products raises the elasticity of substitution between domestic and EU goods, this extra effect imply that they are able to estimate larger welfare gains of harmonisation that in the long run these can reach 2.4 percent of GDP. Computable general equilibrium models (CGE) are useful to analyse the effect of change in standards and regulations in various market settings. The main drawback of these studies is that their measures of standards are heavily aggregated and use very crude specifications of standards which are unable of capturing the complexities of specific and heterogeneous standards.

Finally, different **econometric models** have been used in order to determine the effect of standards and technical regulations on trade. All share a common feature which is that they regress the trade flows on a proxy for standards along with other factors that promote or divert trade in order to isolate the impact of standards on trade. At the same time the definition of the "proxy", which clearly is the crucial trick of all these exercise, has varied. Swann (1996) regressed the British imports, exports and net exports disaggregated at 3-digit level for the period 1985-1991 on international standards[xliii] recognised by UK and Germany (i.e. shared standards) and on unilateral standards imposed either by UK or Germany using the number of standards as proxy of the severity of standards. He found that unilateral British standards tend to have a positive effect on both exports[xliv] and imports[xlv], the positive effect on exports lead us to think that domestic standards act as a "signalling device", unfortunately the interpretation of the positive sign on imports is more puzzling effect on imports and is interpreted using the ad-hoc explanation that idiosyncratic British standards raise costs for domestic firms and allow the entry of lower-cost imports. He also found that shared standards tend to have little impact on imports but a positive effect on exports, though smaller than the effect of national standards[xlvi], and finally that the impact of unilateral German standards tend to be positive for British imports[xlvii] and, as expected, negative for British export. Moenius (1999) in a very complete study that covered 471 industries disaggregated at 4-digit level, 12 countries[xlviii] and a period from 1980 to 1995, making use of gravity-type model take as a proxy the number of standards in order to capture their severity and, like Swann, divided the standards into shared and unilateral standards. His main findings are that shared standards tend to have a positive impact on trade[xlix], even this is not robust when testing it for causality as he cannot reject the hypothesis that an expansion of trade generates an higher number of standards[l]; a very interesting in his study is that unilateral standards tend to promote trade in manufacturing sectors, but hinder trade in non-manufacturing sectors such as agriculture. Both the works of Swann (1996) and Moenius (1999) suffer a crucial limitation related to the use of the number of standards as a proxy for their severity, in fact the aggregation of heterogeneous standards may very well confuse the effects of standards that are trade restrictive with others that are trade enhancing, furthermore standards vary in importance across sectors and products, and different standards cannot be expected to have the same effect. Two recent works of Otsuki et al. (2001) and Wilson and Otsuki (2001) have been able to overcome these shortcomings as they fit a gravity model where the proxy that capture the severity of the standard is a direct measure of its severity expressed in maximum allowable contamination. They focussed on some of the sectors particularly affected by this standards and estimate the trade impact of the “aflatoxin standards” on both European imports from Africa and global trade flows and found that the standards tend to be significant in most cases and have a disruptive impact on trade quantified in about 670 million USD of trade with respect to the baseline scenario where the standard used is the international CODEX standard, whilst on a global scale they calculate that the difference between a global harmonisation under the new restrictive European standard compared with a global harmonisation under the international Codex standard would cost, in term of trade flows, more than US$ 12 billion (Wilson and Otsuki, 2001) with a distribution of net gains and losses that would negatively affect only non-OECD countries.

Our model

Following the seminal work of Otsuki et al. (2001) we used an econometric model to estimate the effect of aflatoxins standards on the nuts exported from 21 Latin-American countries[li] to 14 European countries[lii] for the period 1990-1998. Also, in our study we use a gravity mode, which is a classical model and has been extensively used since the 60’s for explaining bilateral trade flows. This model has the double advantage of being based on intuitive foundations, as originally proposed by Tinbergen (1962), Pöyhönen (1963) and Linneman (1966) but could also be formally derived either from both the Heckscher-Ohlin model (Deardoff, 1998) and model based on imperfect competition (Helpman, 1987). In the basic gravity model[liii] equation the trade between two countries depends on two sets of determinants: size of trade partners, normally expressed in terms of their GDP, and trade costs. The intuitive explanation is that the size of the exporting country captures the exporter supply capacity whilst the size of the importing country captures the importer demand capacity. The trade costs can be imagined as “frictions” to trade and the literature suggests various proxies: geographical distance, cultural similarity, adjacency. The rational of geographical distance can be found in the idea that an higher distance between trading partners would, ceteris paribus, lead to higher transport costs and increased differences in preferences. The cultural similarity is normally captured by the use of common language which is expected to be reflected in lower “transaction costs” and closer preferences. The adjacency dummy indicates that two countries share a common border and this is expected to have a positive impact on trade. The basic model can be further sophisticated in order to increase its explanatory power including a number of other variables that influence bilateral trade flows: land for capturing natural resources, population for capturing economies of scale, remoteness of a country measures by the average distance of the importer from its exporting partners weighted by exporters' GDP share in world GDP[liv] (Winters and Soloaga, 2001).

Our original specification is as follows[lv]: $M_{ij} = AY_iY_j(Y/P)_i(Y/P)_jD_{ij}ST_i$ (1)

Where M_{ij} denotes the real imports of nuts in 1995 US dollar of the European country *i* from the Latin-American country *j* and is obtained by the COMEXT database published by EC[lvi]. Y denotes the real GDP in 1995 US dollar and P denotes the population, D_{ij} indicates the geographical distance between the capitals of importer i and the exporter j, ST_i indicates the aflatoxin standard and consists in the maximum aflatoxin level imposed on imports of food products and is obtained from Otsuki et al. (2001) and Wilson & Otsuki (2001). *A* is simply a constant.

The most innovative aspect of our econometric model, in line with the already cited Otsuki et al. (2001), consists in the use of a direct measure and not a constructed indicator as proxy for the severity of the SPSM. In our analysis, using an independent dataset, a slightly different specification and a slightly different estimation procedure we are able to test if this "innovation" is robust as it appears from the recent study of Wilson & Otsuki (2001). Referring to the measure of standard, we used the maximum tolerable level of Aflatoxin B1 being the most restrictive test to be passed (see box 1). It is important to notice that in some cases commodity coverage is not straightforward, this problem is more serious when aggregating various commodities[lvii], therefore we decided in order to minimise it, to focus only on nuts[lviii] which are a homogenous group of commodities for which it was possible to define clearly the relevant aflatoxin standard (Table 4).

Referring to the variables chosen we decided not to include the "adjacency" dummy as none of our pairs of trading partners share a common border. As proxy for geographical distance we used the physical distance between the capitals, which has been traditionally used by gravity models, recently more accurate distances have been proposed like the physical distance between the economic centres of gravity of the respective countries (Winters and Soloaga, 2001). We acknowledge that our measure maybe more inaccurate because the capital does not always coincide with the economic centre of gravity of a country.

Following the usual logarithmic transformation we transform to our basic equation (1) and extend it by adding a dummy for common language[lix], a trend in order to be able of capturing eventual dynamic effects and a white noise stochastic error

Equation (2):

$$\ln M_{ij} = A + \ln Y_i + \ln Y_j + \ln(Y/P)_i + \ln(Y/P)_j + \ln D_{ij} + \ln ST_i + DLang_{ij} + Trend + \varepsilon_{ij}$$

The equation (2) presents the classical double-log specification that is normally used to estimate the gravity-type models and has the immediate advantage that the estimated coefficients coincide with the response elasticities. However, as some observations for endogenous variables assume the value of zero, this causes a problem for the logarithmic transformation. In order to deal with this issue the literature has employed three different procedures. The first procedure consists of getting rid of those “zero” values and using just the positive ones, which is evidently not appropriate because this will disregard important information contained in these zero values. The second procedure consists in substituting these zero values for small values instead of simply disregarding them. The last and appropriate procedure consists in tackling directly the truncated data for the endogenous variable by employing a Tobit model.

We will compare the use of the last two procedures and show, consistently with the findings of other studies (Winters and Soloaga, 2001; Wang and Winters, 1994), that the results are quite similar irrespective of the procedure employed.

Data

The trade flows are obtained by the COMEXT database. The value of imports is expressed in constant US dollars of 1995[lx] and the period analysed is from 1990 to 1998. There are 21 exporting countries, and all from Latin-America, and the 14 importing countries are all from Europe. The GDPs are expressed in constant US dollars of 1995 and are obtained by World Bank Databaselxi, as well as the population values. The standard indicates the maximum allowable level of aflatoxin B1 and is obtained by the studies of Otsuki et al. (2001) and Wilson and Otsuki (2001). It has to be noticed that a lower level of the standard would indicate a more restrictive standard, therefore a positive coefficient on it would imply that more restrictive standards impact negatively on trade. The distance between each pair of country indicates the distance between their respective capitals and is calculated using the "geod" program[lxii].

Results

Following the models developed by Otsuki et al. (2001) and Wilson & Otsuki (2001) a dummy for each of the exporting countries is included in order to control for unobserved time-invariant factors such as production environment, therefore the time-invariant characteristics for the exporting counties are captured by this dummy. Therefore, a fixed-effect model for exporting countries as cross-sectional groups is used since the error is considered to reflect common characteristics within each exporting country.

The results are shown in table 12 and first of all a quantitative difference in the two estimated models has to be noted, this is justified by the high number of zero values for the trade flows. At the same time, it has to be observed that there is not a relevant difference between the two models in terms of significant variables and their signs, therefore in the remaining part of the paper we will focus on the TOBIT estimates only.

The interpretation of the Tobit marginal effects deserves some explanation. When the data are censored, the classical assumption of normally distributed error is not any more valid, therefore we need to make a correction in order to make sure that the “normality assumption” still holds[lxiii]. Normally this is done by defining a latent dependent variable Y* determined by our original set of variables[lxiv] with:

$$Y_i = 0 \qquad \text{when} \qquad Y_i^* \leq 0$$

$$Y_i = Y_i^* \qquad \text{when} \qquad Yi^* > 0$$

Therefore we obtain two different sets of marginal effects. First of all the marginal effects for the latent variable[lxv] and separately the marginal effects for our original dependent variable[lxvi]. The coefficients shown in the table 5 represent this second set of marginal effects computed from the mean of the observations.

As expected the GDP and the GDP per capita of importer have a positive sign and are both highly significant. At the same time the GDP and GDP per capita of the exporter appear to be unexpectedly insignificant, and this is not easily interpreted, especially with regard to the GDP. In fact, with regards to the GDP per capita our result is consistent with the finding of Otsuki et al. (2001) and Wilson & Otsuki (2001), and they explain it by referring to the ambiguous interaction of the counteractive effect of domestic absorption on one side, and the scale effect on production on the other. As expected the geographical distance has a negative sign and is highly significant. The coefficient on the various dummy language is also interesting, with only the dummy for the Portuguese being significant, which could indicate that for our specific set of countries, and the commodities analysed, the importance of "cultural similarities" do not appear too relevant, in contrast to the findings of Otsuki et al. (2001).

Finally, the most interesting result. We found that the aflatoxin B1 standards of importing countries is highly significant and does have a negative effect on trade flows. Precisely, it suggests that a 1% tightening of the standard (i.e. passing from allowing 10ppb to 5ppb) will reduce trade flows by 0.67%.

Simulation

Using the estimated elasticity of trade flows to a change of the aflatoxin B1 standard we calculate the effect on the actual value of trade under two different scenarios. First with the EU imposing a common standard following the proposal previously discussed, with a maximum allowable level of aflatoxin B1 at 2ppb. Second with the EU harmonising its standard under the CODEX guidelines with a maximum allowable level of aflatoxin B1 equal to 9 ppb. In the first scenario there is a trade loss equal to 8 million US$, which corresponds to about the 15% of the value of total European imports from Latin-American countries in 1998. Remarkably, under the less stringent Codex standard the increase of the actual trade flow exceeds 100 million US$, which corresponds to more than 176% of the value of imports in 1998 (Table 6). If we analyse this figure in relative terms, referring to total European imports of nuts[lxvii], we discover that the trade loss in the first scenario is equal to only 0.52%, whilst in the second scenario the trade expansion is equal to 6.10% of the total value of European imports. Therefore it may be argued that from the "importer perspective" the damage generated by the new restrictive EU standard is minimal whilst from the exporter perspective the loss is substantial.

Concluding this section we want to underline that our econometric study, inspired by the recent work of Otsuki et al. (2001), replicated their direct methodology to estimate the trade impact of a specific SPSM and showed its consistency using an independent dataset and focusing on a different set of countries. Our study differs from the previous work of Otsuki et al. (2001) and Wilson & Otsuki (2001) in the use of an original dataset, but even more importantly it differs in the specific function estimated and in the estimating procedure. Following the classical gravity model literature we introduced as explanatory variables both GDP and GDP per capita, whilst in these studies only GDP per capita was included. Furthermore we used a Tobit estimation in order to deal with the problem of left censoring and we found that the difference with a standard OLS estimation is especially important for the value of the coefficients, even if not for the overall signs and significance of the different variables[lxviii]. Interestingly, despite these differences, the estimates and the predicted changes under different type of standards appear to be of analogous order of magnitude.

Conclusion

In this paper we analysed the SPSMs and their impact on trade. A crucial element resulting from our work is that, differently from traditional trade barriers, technical regulations and standards include at the same time elements of genuine protection and elements of disguised protectionism that are strictly interconnected and very difficult to disentangle. The problem is that regulations to ensure health and safety of food can have both a "protective" impact (i.e. benefiting consumers or producers at risk from externalities carried by certain imports) and also a "protectionist" one which benefit producers but hurt consumers by restricting competition and raising prices. A further complication arise when a regulatory barrier is introduced with the declared aim of addressing a health and safety risk, and where different countries make different assessments of the nature of the risk or have different degrees of risk tolerance. In some cases there are differences in the views expressed by experts and in other cases we may essentially be faced with political pressure based on a widespread but not universal public fear.

This multifaceted and subtle nature of SPSMs makes the justification of their existence clear, but also opens the possibility of political capture and disruptive impact on trade. The complexity lies in the fact that a binary discrimination between genuine protective and protectionist measures it is not possible because the difference is more a qualitative one and "a matter of grade". The issue is complicated by the fact that some measures may not be intended as trade barriers but may have that effect.

The WTO has devised a very complex system of rules for deciding when a country has the right to take actions that may disrupt trade in the name of public health or safety. To avoid these decisions being determined by pure political bargaining an alternative procedural rationality, which involves a legal process, has been developed.

In an ideal world we would seek to find a "bright line test" between protectionist and non-protectionist measures. In practice most regulatory measures will have both kinds of effects and there will be a trade-off between removing obstacles to trade and legitimate regulatory sovereignty. As Howse and Trebilcock (1999) point out, from an economist point of view it would be appealing to use cost-benefits analysis. The state of the art for quantifying the impact of SPSMs, as we showed in the specific analysis of the impact of different aflatoxins standard on the European imports of nuts from Latin-American countries, allows us to "quantify" the trade costs that need to be set against health and safety benefits. This is the crucial contribution that economists have made in this field. Unfortunately, on the side of benefits we still lack comparable and precise quantifications (Antle, 1999) and some commentators noticed that benefits and costs might be eventually not commensurable. Indeed, many questions remain open including how to approach the trade-off between appropriate levels of risk to human health and costs of differing levels of protection set in standards to international trade (Otsuki et al., 2001). The case of aflatoxins is exemplar. The new harmonised European standard is expected to reduce health risk by approximately 1.4 deaths per billion a year, but the negative effect on the sole African exports of cereals, fruits, vegetables and nuts will be of US$ 670 million compared with the international standard set by Codex. We estimated that the impact on the Latin-American exports of nuts to Europe might exceeds US$ 100 million. Recent studies reporting the various methods used to infer the value individuals place on risk of death show that the different methods produce a wide range of values of a statistical life from less than US$1 million to tens of millions of dollars (Crutchfield et al., 2000; Antle, 1999). It is clear that the problem of how to weight up costs and benefits of the new aflatoxin standard, and the SPSMs in general, is still a very open and debatable question.

Therefore, when we do not know how to precisely estimate costs and benefits, or even further if we think that these might be incommensurable, we discover that the utilitarian approach of economists based on costs-benefits analysis can break down. At this point, the WTO rationality of insisting on procedural requirements does have a clear appeal. If we cannot measure the benefits, still we can ask whether decision makers have gone through a procedure of genuine evaluation of the health and safety benefits of the measure. Therefore, in a situation where we cannot weigh up the costs and benefits of the outcome of the regulatory decision, if regulators can prove they have fulfilled these procedural requirements, having undergone a process of genuine evaluation of the health and safety benefits, then this may be acceptable even if the trade costs are very high.

In any case it is important to stress that economic analysis has an important contribution to give, even in the light of the institutional framework settled by the SPS Agreement of WTO. In fact, even if it is fair to observe that the use of economics as a framework for evaluating the SPSM is criticised by some commentators that express their concerns because economic analysis tools (i.e. cost benefit analysis) may be inconsistent with the SPS Agreement[lxix] (Sallie, 2000; Buerau et al., 1998; Roberts, 1998) and correctly observe that measures WTO consistent may be economically inefficient (Bureau et al, 1998), which from an economic standpoint is an undesirable possibility. Nevertheless, these remarks cannot let us forget that the SPS Agreement specifies that measures should not be more trade restrictive than required to achieve the appropriate level of protection and the input of economic analysis is explicitly required by the SPS Agreement in the articles 5.4[lxx] and 5.6[lxxi].

BOX 1 - Aflatoxins and the new harmonised European standard

Aflatoxins are a group of structurally related toxic compounds that contaminate certain foods and result in the production of acute liver carcinogens in the human body. The major aflatoxins of concern are designated B1, B2, G1, and G2, and these toxins are usually found together in foods (i.e. corn, groundnuts, cottonseed, milke and tree nuts like brazilian nuts, pecans, pistachio nuts and walnuts), with aflatoxin B1 being predominant and the most toxic (FAO-WHO, 1997). It has to be noticed that aflatoxins have acute and chronic toxicity in animals, however, their toxicity in humans has only been rarely encountered (Otsuki et al., 2001).
In developed countries, aflatoxin contamination rarely occurs at levels that cause acute carcinogens in humans, therefore studies on human toxicity from ingestion of aflatoxins have focused on their carcinogenic potentials. A 1997 report by the joint FAO/WHO Expert Committee on Food Additives (JECFA) concluded that "aflatoxins should be treated as carcinogenic food contaminants, the intake of which should be reduced to levels as low as reasonably achievable" (FAO-WHO, 1997). JECFA analyzed potential human health impact of aflatoxin for two hypothetical levels (10 part per billion (ppb) and 20 ppb). It estimated that reducing the standard from 20 ppb to 10 ppb in countries where percentage of carriers of hepatitis B1 is around one percent (e.g. members of the European community) would result in a drop in the population risk of approximately 2 cancer deaths a year per billion people.

Until 1998 members of the European Union implemented different standards for aflatoxins in foodstuffs (Table 11). In 1997 the European Commission proposed a uniform standard setting the acceptable level of the contaminant in certain foodstuffs, which triggered serious concerns among exporters of food products subject to the proposed directive (WTO, 1998a; 1998b; 1998c; 1998d; 1998e; 1998f; 1998g). For instance, Australia affirmed "the proposed sampling procedure is unduly onerous and likely to be costly" and under the proposed sampling plan it is estimated that up to 75 per cent of lots rejected would be "good lots" (WTO, 1998b). Bolivia argued that the EU's proposals departed from the recommendations of Codex Alimentarius and had considerable social and economic impacts in producing countries. As a result of the objections raised by various trading partners, the EC decided to relax the proposed acceptable levels in cereals, dried fruits and nuts, but still the standard was much more stringent than the one suggested by Codex, especially regarding products for direct human consumption (the total allowable level of aflatoxins was set at 4 ppb and 2 ppb for B1, whilst Codex does set the total aflatoxin level and 15 ppb and assuming that 50-7- percent of it is caused by B1 allows it to be approximately 9ppb).

Table 1: *Classification of SPSMs by scope*

WHO IS AFFECTED BY THE MEASURE?	**SCOPE OF THE MEASURE**			
		Uniform	***Universal***	***Specific***
	Domestic Producers	YES	NO	NO
	Foreign Producers	YES	YES ALL	YES SOME

Table 2: ***Classification of SPS by policy instrument***

BAN		**SAFETY STANDARDS**				**INFORMATION REQUIREMENTS**		
Total	Partial	Specification		Performance	Target	Packaging	Labelling requirements	Control on voluntary claims
		Product	Process					
LOW		DEGREE OF FREEDOM →						HIGH
HIGH		← DEGREE OF RISK CONSEQUENCES						LOW
LOW		← DEGREE OF UNCERTAINTY ABOUT RISK						HIGH

Table 3: ***Classification by Regulatory Goals*** (Source: Roberts et al., 1999b)

Who's societal interests are protected ?	**Is the measure risk reducing ?**		
		YES	NOT
	PRODUCERS	Commercial animal and plant health protection	Compatibility attributes
	CONSUMERS	Food safety	Quality attributes
	NATURAL ENVIROMENT	Protection of natural environment from harmful non-indigenous species	Conservation

Table 4: *Maximum Level of Aflatoxin B1 Allowed – Measured in ppb*
Source: Otsuki et al. (2001); Wilson & Otsuki (2001)

COUNTRY	OLD STANDARD	NEW EU STANDARD	CODEX INTERNATIONAL STANDARD
FRANCE	1	2	9
BELGIUM-LUX	5	2	9
NETHERLANDS	5	2	9
GERMANY	2	2	9
ITALY	5	2	9
UNTD KINGDOM	2	2	9
IRELAND	5	2	9
DENMARK	2	2	9
GREECE	5	2	9
PORTUGAL	25	2	9
SPAIN	5	2	9
SWEDEN	NA	2	9
FINLAND	NA	2	9
AUSTRIA	1	2	9
United States	10		9
Canada	7.5		9
Japan	10		9
Nigeria	20		9
India	30		9
Malaysia	17.5		9

Table 5: *Econometric Results (Number of Observations: 2163)*
"*", "**" and "*** imply statistical significance at the 10, 5 and 1 percent levels respectively

	OLS ESTIMATION WITH FIXED EFFECT			**MARGINAL EFFECT IN THE TOBIT ESTIMATION WITH FIXED EFFECT**		
	Coefficient	**Standard Error**	**P[|Z|>z]**	**Coefficient**	**Standard Error**	**P[|Z|>z]**
GDP Importer	1.558***	0.082	0.000	0.822***	0.0648	0.000
GDP Exporter	3.076	4.670	0.510	1.718	2.439	0.481
GDP per capita importer	1.3849***	0.313	0.000	1.201***	0.186	0.000
GDP per capita exporter	-3.500	4.534	0.440	-1.989	2.379	0.403
Geographical Distance	-3.046***	0.983	0.002	-2.255***	0.480	0.000
Time Trend	-0.1439	0.129	0.265	-0.971	0.066	0.141
Aflatoxin B1 Standard	***1.073****	***0.152***	***0.000***	***0.672****	***0.0817***	***0.000***
Dummy for Portuguese	7.222	1.273	0.000	1.531***	0.422	0.000
Dummy for Spanish	-0.9799	0.328	0.765	0.142	0.146	0.331
Dummy for English	1.183**	0.547	0.031	0.421	0.267	0.115
Adjusted R-squared	*0.517*					

Table 6: *Simulation of trade impacts under different standards for Aflatoxin B1*

		PREDICTED % CHANGE IN THE VALUE OF IMPORT		**PREDICTED CHANGE IN THE VALUE OF IMPORTS**	
COUNTRY	**IMPORT 1998**	*UNDER PROPOSED EU STANDADARD*	*UNDER CODEX STANDARD*	*UNDER EU STANDARD*	*UNDER CODEX STANDARD*
FRANCE	4,607,680	69.70%	557.60%	3,211,553	25,692,424
BELGIUM-LUX	1,235,360	-41.82%	55.76%	-516,628	688,837
NETHERLANDS	13,857,760	-41.82%	55.76%	-5,795,315	7,727,087
GERMANY	11,967,200	0.00%	243.95%	0	29,193,984
ITALY	5,351,360	-41.82%	55.76%	-2,237,939	2,983,918
UNTD KINGDOM	13,657,280	0.00%	243.95%	0	33,316,935
IRELAND	13,440	-41.82%	55.76%	-5,621	7,494
DENMARK	152,320	0.00%	243.95%	0	371,585
GREECE	122,080	-41.82%	55.76%	-51,054	68,072
PORTUGAL	3,028,480	-64.12%	-44.61%	-1,941,983	-1,350,944
SPAIN	2,980,320	-41.82%	55.76%	-1,246,370	1,661,826
SWEDEN	6,720				
FINLAND	1,120				
AUSTRIA	13,440	69.70%	557.60%	9,368	74,941
TOTAL	56,994,560		TOTAL	-8,573,988	100,436,159
			TOT % CHANGE	-15.04%	176.22%

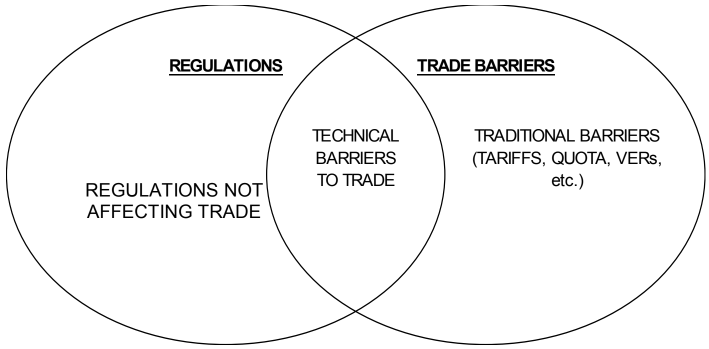

Fig1: *Relationships between trade barriers and regulations*

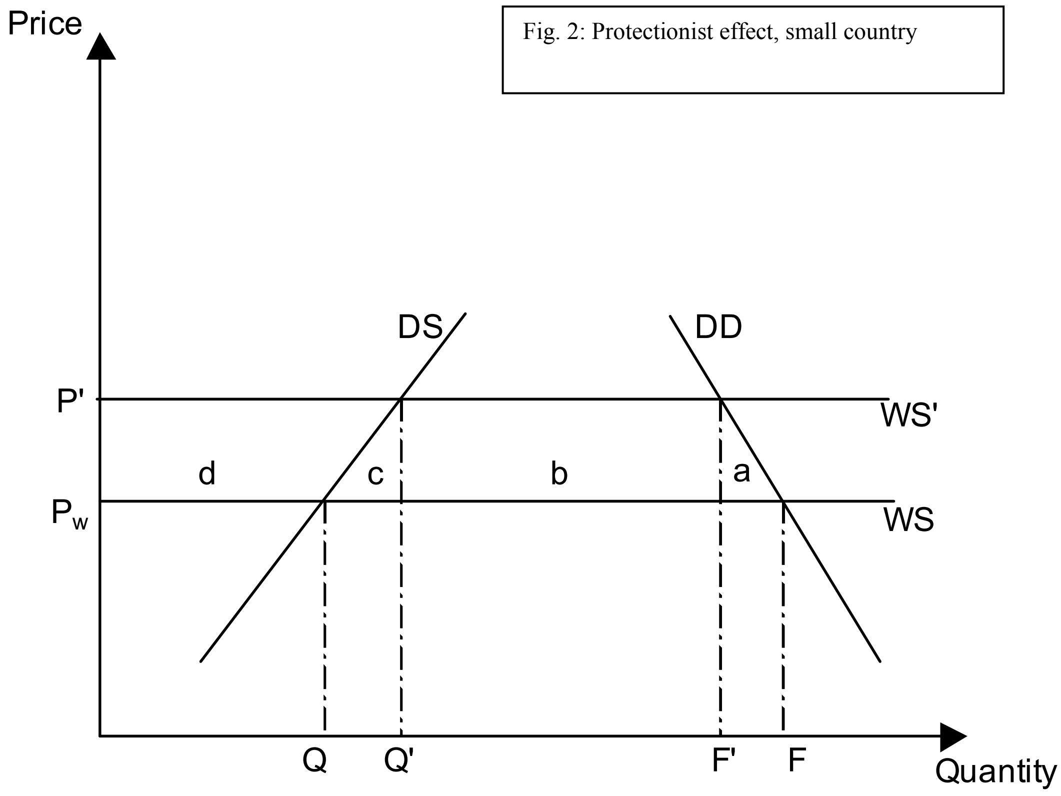

Fig. 2: Protectionist effect, small country

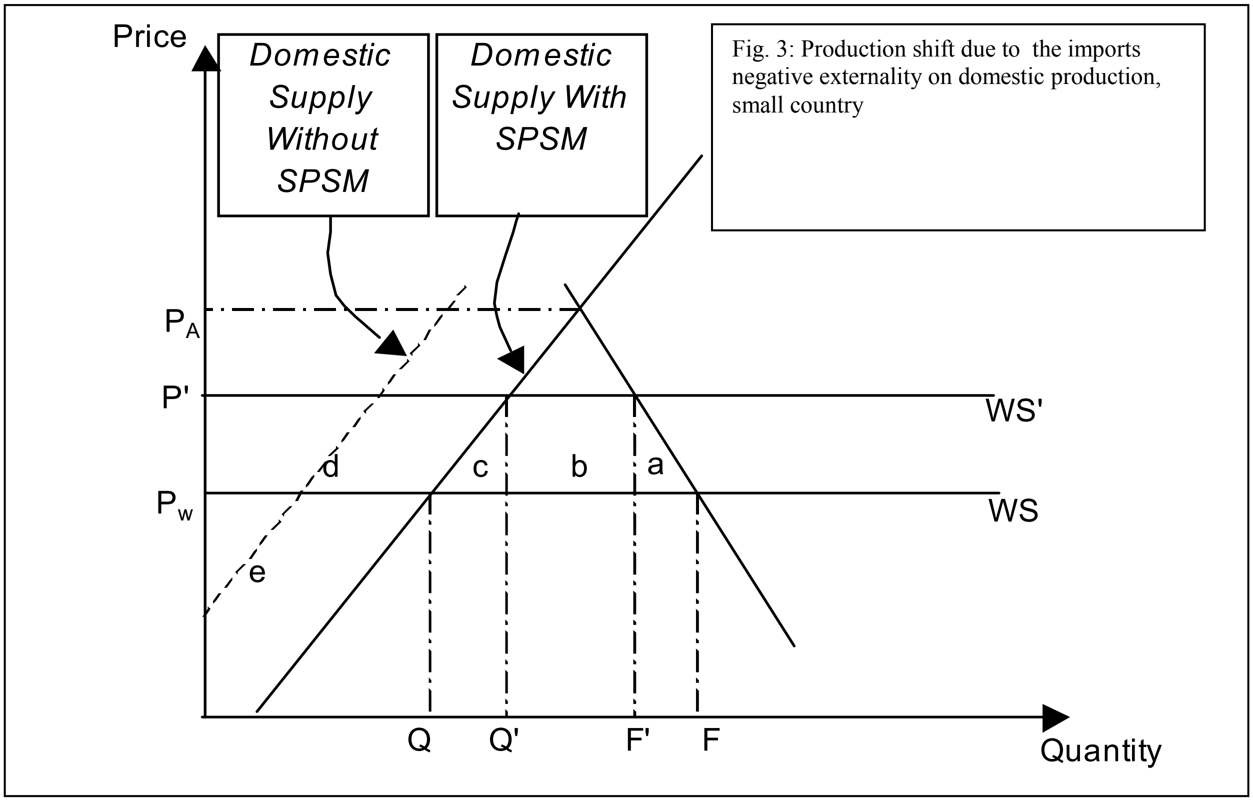

Fig. 3: Production shift due to the imports negative externality on domestic production, small country

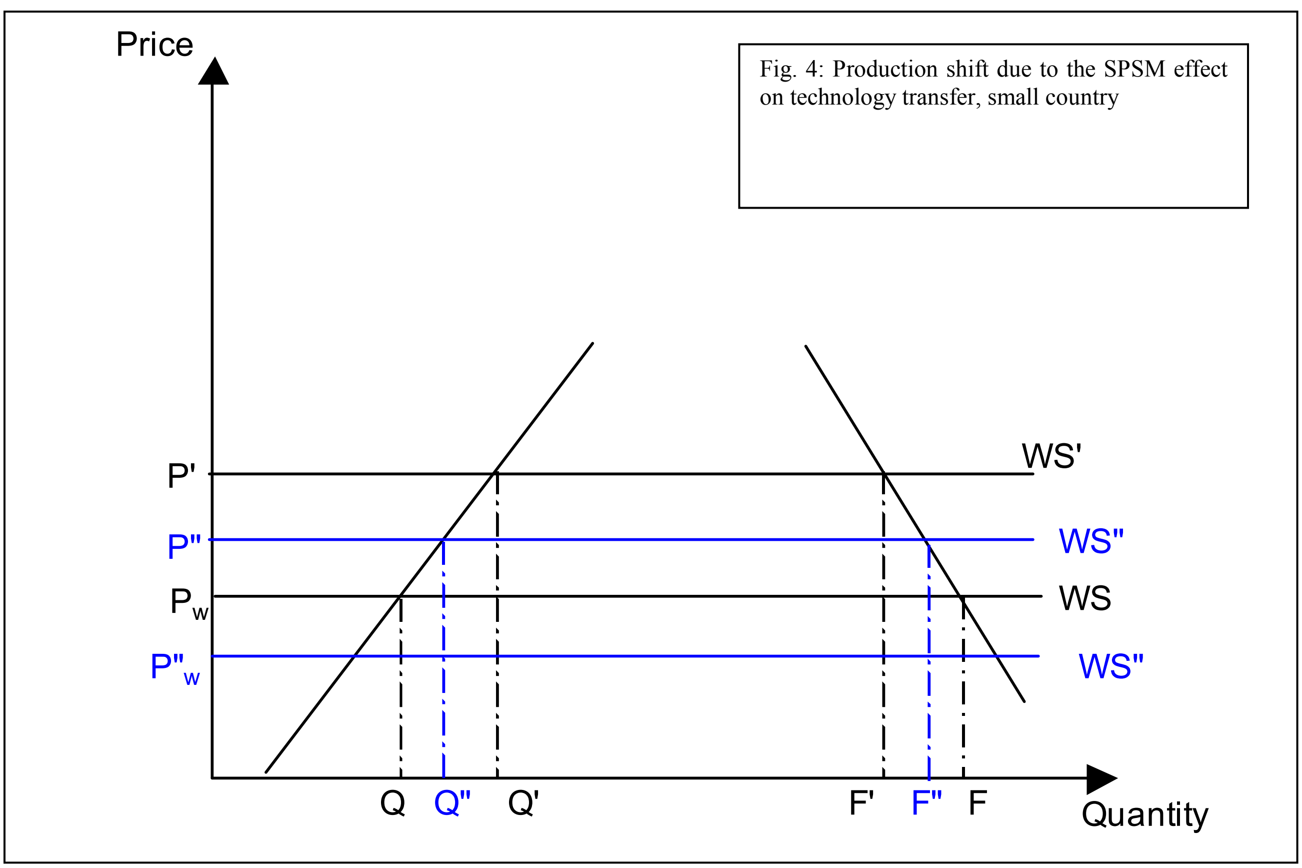

Fig. 4: Production shift due to the SPSM effect on technology transfer, small country

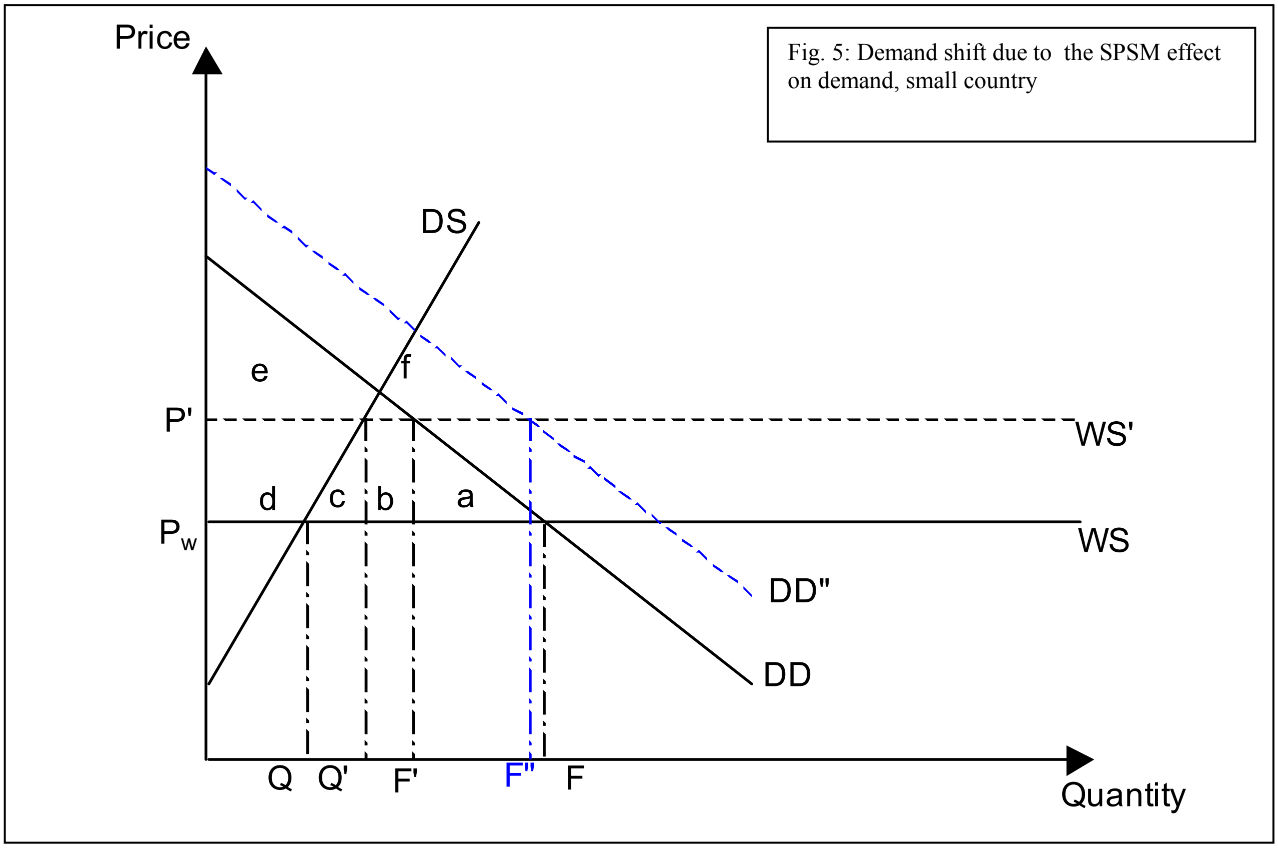

Fig. 5: Demand shift due to the SPSM effect on demand, small country

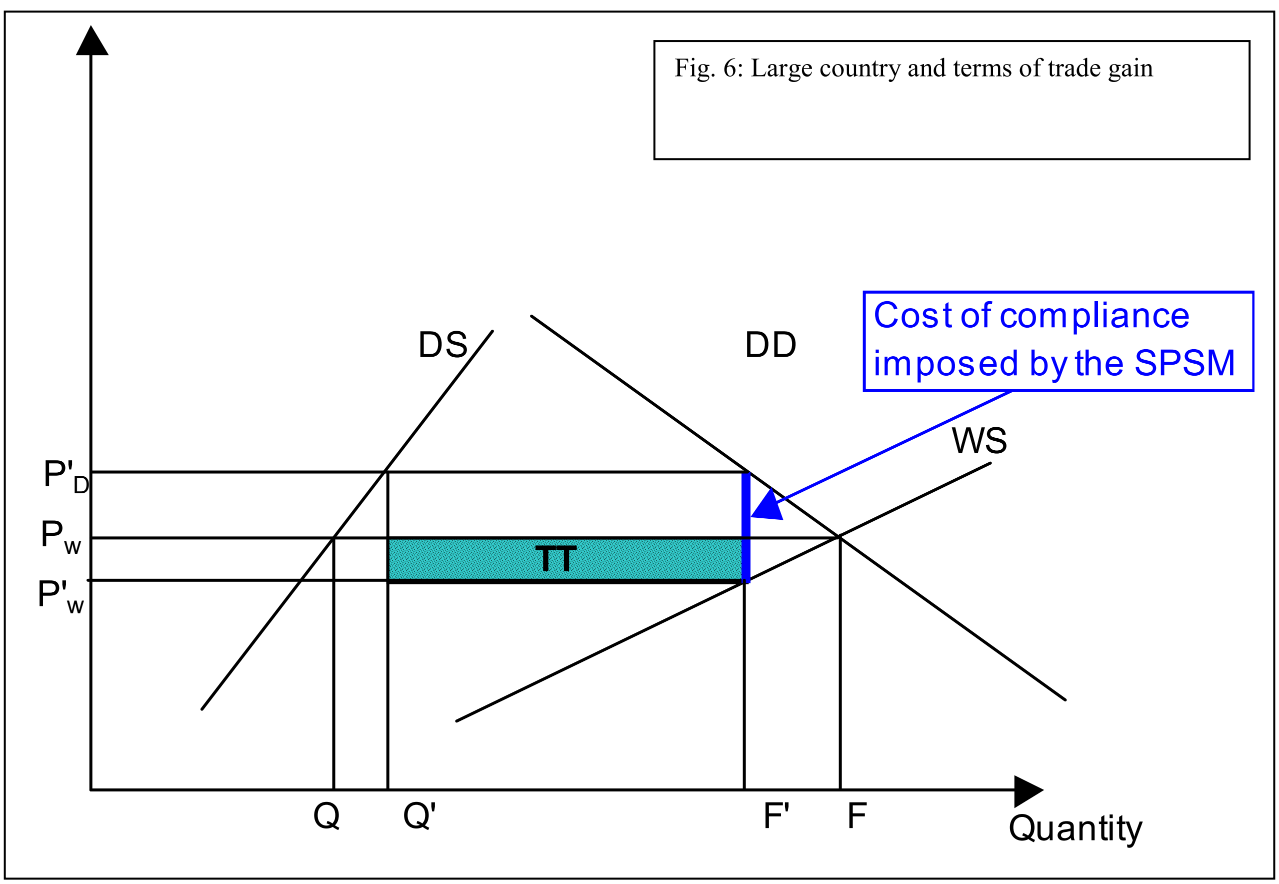

Fig. 6: Large country and terms of trade gain

ENDNOTES

[i] The importance of regulations is a direct consequence of their increasing use and their impact on trade (Henson et al., 2000)
[ii] Negative production externalities (i.e. imported pest), negative consumption externalities (i.e. food scare), asymmetric information, co-ordination failures.
[iii] Capture happens when the relationships between the regulators and the regulated become too close and lead to the de pursuit of the regulated enterprises' interests rather than those of the public at the large (Baldwin and Cave, 1999).
[iv] Agreement on the Application of Sanitary and Phytosanitary Measures (WTO, 1995).
[v] A recent example of this kind of measures is the ban on imports of meat and meat products originating from foot-and-mouth disease regions
[vi] Casella (1996) notices that as standards aim at attaining public goods that a community find desirable, they respond to a well defined demand and to the extent that this demand depends on economic fundamental (i.e. endowments, preferences, information, technology, etc.) we should expect it to be different across societies or groups that differ in terms of these fundamentals.
[vii] For an excellent account of the reasons, the possibilities, the limits and the effects of harmonisation see Bhagwati and Hudec (1996)
[viii] For example GMOs.
[ix] Translated to the "world of SPS measures" the regulatory system can be defined as "standards infrastructure" and break down into three levels: (i) Writing standards; (ii) Conformity Assessment; (iii) Accreditation and recognition system. Hence the heterogeneity can be present at each one of this levels making our analysis even more complex.
[x] It was possible for a single country, the potential non-compliant Member, to block a dispute ruling or a request for a panel.
[xi] As Roberts rightly says the SPS Agreement has to be put into the right context of the multilateral framework emerged during the Uruguay Round to discipline many of the policies that member countries used to protect and support their agricultural sectors. The complementary component of this framework is the Agreement on Agriculture (Roberts et al., 1999b).
[xii] In fact, among other factors, it is self-evident that risks can vary by sources and destinations of products. Even further, if risks vary little across countries regulations may be different, even under the unrealistic assumption of identical preferences, due to differences in access to and use of advances in basic science, detection technology, and mitigation methods (Roberts et al., 1999).
[xiii] For a review of the problems and shortcomings of risk assessment paradigms see Henson and Caswell (1999) and Baldwin and Cave (1999)
[xiv] It may not come as a surprise then the lack of studies developing an economic framework to analyse the impact of SPSMs. This will be addressed, at least partially, in the next chapter.
[xv] In the "Asbestos case" the objective pursued by the measure is the preservation of human life and health through the elimination, or reduction of the well known, and life threatening, health risks posed by asbestos fibres. The value pursued is both vital and important in the highest degree, which justifies the use of the less stringent interpretation.
[xvi] The transparency is compelling for all Members, including least-developed-countries since first January 2001, except when urgent problems arise (Thornsbury, 2000)
[xvii] We can outline basically three strategies for rapprochement, each one with different impact on trade flows (Hooker, 1999):

i. *Harmonisation* or standardisation of regulations in identical form
ii. *Mutual recognition* or acceptance of regulatory diversity as meeting common goals
iii. *Co-ordination* or gradual narrowing of relevant differences between regulatory systems, often based on voluntary international codes of practice

[xviii] An example is an unnecessarily intrusive examination of each import shipment to see if it meets the domestic standard, which results in a s significant backlog of imports and a decrease in their quantity (Hooker and Caswell, 1999).
xix This point will be important in the next chapter when analysing the "afltatoxins case".
[xx] This is idea seems to be confirmed by empirical literature (Wilson and Otsuki, 2001)
[xxi] Based on EU calculations, the OECD has estimated that up to 80 percent of all world trade is affected by standards of some kind (Hufbauer et al., 2000).
[xxii] For instance consider the transformation imposed by quarantine treatment that ensures the risk associated with an imported good is minimised.
[xxiii] This will be further developed in ch. 3.
[xxiv] The fact that the measure is non discriminatory does not rule out the possibility that it can have discriminatory effects (Matoo, 2001)
[xxv] Principle contained in Art. I of GATT essentially meaning that any benefit in connection with exporting or importing given to a product of a most favoured nation has to be given to the like product of all Members without discrimination (Lal Das, 1999).
[xxvi] A ban has to be considered a proper technical measures, in fact even if just implicitly it does define a standards (Howse, 2001)
[xxvii] An example of this kind of standard was the Italy's "pasta purity" regulation, that allowed only products made entirely with durum wheat (grown nearly exclusively in southern Italy) to be labelled under the term of "pasta"
[xxviii] A process standards take a positive form when imposing some particular ingredients or the use of particular production methods, and take a negative from when prohibiting the use of particular ingredients or production methods (Henson et Caswell, 1999)
[xxix] Basically we can inscribe this debate inside the wider debate around the issue of the science against the consumers sovereignty" (Roberts et al., 1999)
[xxx] This distinction will be important when evaluating the effect of the measures because of the different regulatory goals will have different welfare effects that have to be considered.
[xxxi] Our definition of risk takes into account the interplay between the likelihood of the event occurring and the magnitude of the adverse consequences.
[xxxii] Our model will focus initially on the "small country case"
[xxxiii] We can also consider the existence of welfare loss for foreign producers in cases where the market are imperfectly competitive and they are gaining some
[xxxiv] The externalities arising from imports can be measured by the cost of avoiding the pathogen by domestic action, or by the effect of the domestic release of the pathogen. In each case there is a change in the relation between price and quantity supplied depicted by the shift of the supply schedule.
[xxxv] The technology transfer can be facilitated by the standard as this can positively impact on some of the key factors in knowledge and technology transfer (Sung and Gibson, 2001), but the complexity of this process should not be overlooked and need to be carefully assessed in its multidimensionality (Dornelas et al., 2001)
[xxxvi] Consumers benefit from knowing what to expect from the importing goods or from the higher safety/quality of the products
[xxxvii] If the importer wanting to avoid this trade diversion has to bear the costs, and benefits if externalities are present, of its measure.

[xxxviii] This case could also be modelled with the importer being a large country and the measure still importer specific.
[xxxix] 12% of total US agricultural, fishery and forestry exports.
[xl] For instance, very few firms reported the "no-entry" decision caused by expected regulatory costs, and when it happens these firms tended to be the smaller ones
[xli] It is important to notice that the EU imports from Kenya accounts for 59% of Kenyan total exports for fresh fish.
[xlii] Given the assumption of increasing returns even a small reduction in costs makes the EU production and exports rise considerably.
[xliii] He uses a database called PERINORM (http://www.perinorm.com) that focuses on voluntary rather than mandatory standards.
[xliv] The elasticity coefficient is 0.48
[xlv] The elasticity coefficient is 0.34
[xlvi] The coefficient in fact is 0.24
[xlvii] This seems to confirm the interpretation of unilateral standards imposed by the exporter as quality signalling devices
[xlviii] Of these 8 countries are currently in EU, plus Switzerland, Australia, Poland and Turkey
[xlix] The coefficient of the exogenous variable capturing the number of standards is 0.32 and is highly significant
[l] This finding seems to support the idea put forward by Casella (1996) about the endogeneity of standards
[li] Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Guyana, Guatemala, Dominican Republic, Ecuador, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, El Salvador, Trinidad and Tobago, Uruguay, Venezuela
[lii] France, Belgium-Luxembourg, Netherlands, Germany, Italy, United Kingdom, Ireland, Denmark, Greece, Portugal, Spain, Sweden, Finland, Austria
[liii] The gravity model takes its name from its similarity with the formula for the gravitation attraction between two masses
[liv] Intuitively we will expect a pair of countries separated by the same distance but with several other commercial partners close to hand (i.e. Spain and Poland) will tend to trade less than another pair remotely located with respect to other potential commercial partners (i.e. Australia and New Zealand)
[lv] This particular multiplicative functional form may not be obvious but the easier alternative linear form would be in wrong in principle because trade between two countries must surely go to zero as the size of one of them goes to zero (Deardoff, 1997).
[lvi] This data has been kindly provided by Prof. Alan Winters
[lvii] For instance there are normally different standards for fresh and dried fruits.
[lviii] This includes coconuts, brazil nuts, cashew nuts and other nuts fresh or dried which corresponds at the commodities groups 0801 and 0802 of the Harmonised System.
[lix] In reality we will estimate three different dummy languages respectively for English, Spanish and Portuguese
[lx] The conversion from ECU to dollar was done using the average exchange rate from International Financial Statistics Yearbook (IMF, 1999). As price deflactor for imports we used the international price index for agricultural products (www.bls.gov)
[lxi] The original source is Global Development Finance & World Development Indicators
[lxii] This program is part of the "PROJ" system available from the US Geological Survey (http://www.indo.com/distance).
[lxiii] For a detailed analysis see Greene (1993) pp.694-695
[lxiv] $Y_i* = \beta' X_i$ where X_i is a vector of explanatory variables
[lxv] $$\frac{\partial E\left[Y*_i | X_i\right]}{\partial X_i} = \beta$$
[lxvi] $$\frac{\partial E\left[Y_i | X_i\right]}{\partial X_i} = \beta\phi\left(\frac{\beta' X_i}{\sigma}\right)$$
[lxvii] The total value of intra- and extra-European imports of nuts in 1998 was equal to 1,645,585 thousands US$ (Source: Comext Database)
[lxviii] Otsuki et al (2001) as well as Wilson and Otsuki (2001) used a standard OLS estimation and do not account in their papers for the left censoring problem.
[lxix] For instance, they point out the possibility of economic analysis generating different results for different import sources with similar risk status (violating the art. 2.3) or different levels of acceptable protection n different but comparable situations (violating the art. 5.5)
[lxx] "Members should, when determining the appropriate level of sanitary or phytosanitary protection, take into account the objective of minimising negative trade effects"
[lxxi] "Establishing or maintaining sanitary or phytosanitary measures to achieve the appropriate level of sanitary or phytosanitary protection, Members shall ensure that such measures are not more trade-restrictive than required to achieve their appropriate level of sanitary or phytosanitary protection, taking into account technical and economic feasibility"

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