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The Case For and Against Import Embargoes on Products of Biotechnology

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This article examines alternative trade policy responses available to an importing country with concerns over innovations in biotechnology. Regardless of the policy response, the importing country may be worse off after a new genetically modified food (GMF) is introduced. While an import embargo may be preferable to allowing free access to unlabelled GMF imports, permitting labelled imports is typically superior to an embargo. Thus, import embargoes on products of biotechnology should not be generally allowed. The paper provides surprising support for the existing WTO provisions on Technical Barriers to Trade, but suggests significant potential problems with the recently negotiated Biosafety Protocol.

Keywords: asymmetric information; biotechnology; genetically modified foods; import embargo; labelling

1. Introduction

Controversies and disputes in agricultural trade have a protracted history. While long-standing issues such as market access, export subsidies and domestic support remain prominent, biotechnology poses a new set of intractable issues. Consumer and more general public concerns over biotechnology have potentially far-reaching consequences for

international trade. In particular, the revolution in biotechnology poses pervasive, although not entirely unprecedented, asymmetric information problems. Especially in Europe, there is mounting evidence that consumers do not treat genetically modified foods (GMFs) and their non-modified counterparts as perfect substitutes. If other things, such as prices, were equal, many Europeans clearly would prefer to consume non-GMFs; they perceive GMFs as lower-quality products. Further, environmental concerns associated with biotechnology may imply that an individual is indirectly, and adversely, affected by both aggregate GMF production and GMF imports regardless of whether the GMF is consumed directly. Thus, there may also be a negative public-good aspect to GMF production and imports.

While biotechnology in general may hold much promise, Plunkett (2000) and Plunkett and Gaisford (2000) show that some of the specific resultant genetically modified foods may be harmful, on balance, to a non-trading society. In this article, we expand the discussion by systematically examining an array of alternative policy responses available to an importing country with consumer and broad public concerns over biotechnology. These alternative responses include (1) allowing unlabelled GMF imports, (2) imposing an import embargo on the GMF, or (3) allowing labelled GMF imports. Import restrictions such as tariffs could be coupled with either the first or third alternatives.

We show that the advent of a GMF may be welfare reducing regardless of which of the three broad responses to GMF imports is selected. When considering the alternatives of unrestricted imports of GMFs versus an outright import embargo, the latter may sometimes be the lesser of two evils. In such cases, however, mandatory labelling of GMF imports will typically represent an improvement over an embargo. Whether a policy of labelled versus unlabelled imports is superior depends on the degree to which GMFs are perceived to be inferior to non-GMFs as well as the magnitude of the labelling and sorting costs. Further, whenever individuals care about the aggregate GMF quantities produced and imported by their country, externalities exist because of differences between private costs and social costs. In such cases, there is an additional case for Pigouvian taxes on GMF production and tariffs on GMF imports that force producers and importers to take account of the additional social, as well as private, costs (Varian,1999, 581).

Along with other recent work (Kerr, 1999a and 1999b; Perdikis et al., 1999), this article also suggests the need for a careful evaluation of international trade rules pertaining to biotechnology. Interestingly enough, the analysis supports the existing World Trade Organization rules on Technical Barriers to Trade and on Sanitary and Phyto-Sanitary measures. On a less auspicious note, the Biosafety Protocol may fall well short of what would be ideal.

The following section of the paper provides some necessary background on the economics of biotechnology, and the third section outlines a simple trade model that can be

used to assess alternative policy responses when there are product quality concerns relating to direct consumption. In sections four through six, we evaluate and compare the relative merits of the various alternative trade policy regimes dealing with the hidden-quality problem. A technical annex formalizes the discussion in these sections using a simple diagrammatic analysis. Section seven broadens the policy discussion to encompass environmental concerns. Finally, section eight provides an assessment of international trade rules pertaining to biotechnology.

2. Economic Features of Biotechnology

While biotechnology has possible applications in many areas, such as medicine, we focus on applications in agriculture and food production. Biotechnology encompasses both within-species modifications and transgenic or interspecies modifications. On the one hand, within-species modification is relatively uncontroversial since it merely speeds up and makes more systematic what could be accomplished by "natural" breeding techniques. On the other hand, transgenics has become extremely contentious in spite of the fact that current scientific evidence often points to the substantive equivalence between a GMF and its corresponding non-GMF (Hobbs and Plunkett, 1999). Public objections to transgenic GMFs can usually be categorized as (a) long-term human health concerns, (b) long-term animal welfare and environmental concerns, or (c) ethical concerns. We accept the legitimacy of consumer preferences and avoid the alternative of paternalism. Although it is clear that advocacy groups on both sides of the biotechnology issue are attempting to affect the preferences of individuals, for simplicity we assume that these preferences are not open to manipulation.

Most GMFs currently in production or under development have input-reducing features, such as pesticide tolerance, that focus on producers. Eventually, many GMFs may be designed with characteristics, such as health benefits, that are desirable for consumers. Such consumer-oriented genetic modifications will pose few informational issues since they will either be directly verifiable to consumers or be credibly revealed to them by producers. In this paper we focus on the current wave of producer-oriented genetic modifications that lead to potential cost reductions. Due to fears of detrimental long-term health effects or ethical concerns, consumers may perceive a non-GMF to be of higher quality than the corresponding GMF. In such cases, consumers would be willing to pay more for the non-GMF than for the GMF if they could differentiate between the two types of products.

Over the supply chain as a whole, information is asymmetric in these producer-oriented cases. Farm-level producers, as well as the producers of biotech inputs themselves, have full information on whether particular crops are or are not genetically modified. In prac-

tice, there is typically a high degree of vertical coordination through contracts between producers of genetically modified inputs and the farms that use them. In the absence of an effective identity preservation system (IPS) involving labelling and certification, however, the co-mingling of product causes information to become progressively more incomplete as it moves downstream through the supply chain from farms to processors and on to distributors and retailers. Although farm-level producers were fully informed on the genetic qualities of their product, the final consumers will often be unable to determine whether a particular batch of a final product contains genetically modified material, whether or not they care.

In the absence of an IPS, the available information will only sustain a single blended market and a *pooling equilibrium.* It is well known that such hidden-type or adverse-selection problems tend to generate markets that are dominated by an inefficient proportion of low-quality products or "lemons" (Akerlof, 1970). This proposition can be extended to pooling equilibria involving GMFs and non-GMFs (Plunkett and Gaisford, 2000; Plunkett, 2000). The asymmetric information problem posed by the advent of a new GMF could potentially be addressed by an IPS (Hadfield and Thomson, 1998; Hobbs and Plunkett, 1999). A fully effective IPS would lead to separate markets for GMFs and non-GMFs and, thus, to a *separating equilibrium.* Of course, perceptions of quality differences between GMFs and non-GMFs may vary significantly across countries. This implies that it is crucial to examine potential hidden-quality issues in an international trade context.

3. A Trade Model With Perceived Quality Differences

We consider a simple two-country world, consisting of Europe and North America, where free trade prevails prior to the introduction of a new GMF. We assume that the new GMF is developed in North America and that any monopoly or oligopoly rents associated with the GMF that are not dissipated by entry accrue entirely in North America. Meanwhile, Europe prohibits domestic production of the GMF and continues to produce only the non-GMF. These two assumptions simplify the analysis by ruling out direct producer-side benefits from biotechnology in Europe. To simplify further, we assume that Europe is small relative to North America. We make this assumption to abstract from the conventional terms of trade effects stemming from import restriction and to focus entirely on quality issues. Consequently, Europe can import as much as it likes without having a perceptible impact on the price.

In principle, the welfare or utility of any European will depend on the quantities of the GMF and non-GMF which are directly consumed as private goods, and may also depend on the aggregate quantities of the GMF produced, consumed and imported. We defer the consideration of the latter negative public-good features to later in the paper. In Europe,

consumers perceive a quality difference between the private consumption of the non-GMF and the competing GMF product. In particular, the GMF is perceived as a low-quality substitute for the non-GMF. Perceived quality differences may arise due to the potential for as-yet-unknown, long-term human health problems or due to ethical concerns. While the marginal benefit of an additional unit of the non-GMF always exceeds that of the GMF, the marginal benefit of consuming the GMF can still be positive. If the price of the low-quality GMF is sufficiently below that of the high-quality non-GMF, Europeans will elect to consume some of the former.

In the absence of credible labelling, an individual will not be able to determine whether a particular unit of product that is consumed privately has been genetically modified or not. Further, the GMF and corresponding non-GMF will typically remain indistinguishable even after consumption has taken place, as Hobbs and Plunkett (1999) point out. Since genetic modification cannot be detected even with experience, it can be seen as a credence characteristic (Nelson, 1971). Consumers, however, may well be able to infer the probabilities of consuming a unit of the GMF versus a non-GMF by observing production and trade data. Thus, we can assume that consumers are aware of the average or expected quality. Of course, the higher the probability of consuming a GMF, the lower the expected quality and the less that Europeans will be willing to pay for any given quantity of the pooled product.

We assume that consumers in North America, unlike their counterparts in Europe, are indifferent between the GMF and non-GMF. Since North America is large relative to Europe, and the GMF can be supplied at a lower price, the GMF completely displaces the non-GMF in North America. This complete switch casts the change in Europe's trading opportunities in the most dramatic possible way. Non-GMF imports are no longer available on the same terms as before and will not be available at all unless they can be certified as GMF-free under a labelling regime.

4. Unlabelled GMF Imports

Suppose that importation into Europe of the new GMF is permitted without any labelling requirement. Europeans will be affected in two opposing ways. First, the superiority of the new technology is likely to result in a reduction in the world price. While the lower world price will adversely affect European producers given that they are not permitted access to the new biotechnology, European consumers will benefit. Since Europe is on an import basis, the quantity consumed exceeds the quantity produced, and the consumer benefit exceeds the producer loss. Thus, Europe experiences a price effect that generates a positive net benefit.

Juxtaposed to this beneficial price effect is a harmful quality effect. Since consumers are unable to distinguish between the GMF and non-GMF, the non-GMF domestic output is pooled with GMF imports in a single market. Consumers will perceive a decline in average quality and be willing to pay less as a result. Thus, the benefits to consumers associated with any given quantity are reduced. The introduction of unlabelled GMF imports, therefore, causes an adverse quality effect. It should be emphasized that the beneficial price effect may outweigh the harmful quality effect. Consequently, Europeans may well gain from allowing unlabelled imports even when they perceive that the GMF is of lower quality.

Unfortunately, the harmful quality effect could also dominate the beneficial price effect, leaving Europe worse off after the introduction of unlabelled GMF imports. We focus on this case, not because it is inevitable or even more likely, but because it poses much greater problems for policy makers. The central issue is whether there are alternative policy responses to the advent of GMF imports that are superior to unfettered access. We now consider the extreme case where a European import embargo is imposed in response to the development of the GMF in North America.

5. A GMF Import Embargo Versus Unlabelled Imports

A European import embargo leads inevitably to a decline in European welfare relative to the initial free trade situation that prevails before the advent of the GMF. The embargo raises the European price, because imports are no longer available. Since Europe is initially an importer where consumption is greater than production, the adverse effect of the price increase on consumers necessarily outweighs the beneficial effect on producers. The price effect of the embargo is harmful. Put simply, the import embargo extinguishes Europe's conventional gains from trade. From the European policy perspective, however, this is a moot point. Since Europe cannot prevent the development of the GMF in North America, the pre-GMF state cannot continue.

The key question is whether the inevitable loss from an import embargo can ever be smaller than the possible loss from permitting unlabelled access. If the adverse effect on perceived quality is sufficiently large in Europe, this could certainly be the case. The import embargo may, therefore, be the lesser of two evils. Consequently, import embargoes would sometimes be warranted in response to a foreign biotech innovation if the only two policy alternatives were an embargo or unlabelled access. The robustness of this conclusion should, of course, be evaluated by introducing other possible policy responses such as the mandatory labelling of GMF imports.

6. Mandatory Labelling of GMF Imports Versus an Embargo

Suppose that Europe continues to ban domestic GMF production and it now imposes a labelling requirement on all GMFs. While North America is still willing to export non-GMF output at the same base price, we assume that it would be prohibitively expensive for North American producers to certify that their product is GMF-free and legitimately avoid the labelling requirement. This assumption represents a worst-case scenario for mandatory labelling, and leads to a very simple separating equilibrium in Europe. There is a high-quality non-GMF market supplied exclusively by European producers and a separate low-quality GMF market supplied exclusively by North American producers. For simplicity we also suppose that Europe is able to fully and costlessly monitor and enforce the labelling requirement despite the apparent incentive for North American producers to misrepresent their GMF product.

The price of the non-GMF product typically rises, because non-GMF imports are no longer available. Nevertheless, the price of the non-GMF rises less under mandatory labelling than under the import embargo, because some European demand shifts to the low-quality GMF substitute product. Since initial European consumption exceeds production, the price increase represents a harmful price effect on the non-GMF market from the policy of mandatory GMF-import labelling. By contrast, the availability of the new low-quality, low-price GMF substitute product provides benefits for European consumers. Whenever the beneficial new-product effect from the GMF market outweighs the harmful price effect on the non-GMF market, Europe gains from the introduction of labelled GMF imports. Of course, it is possible that the harmful non-GMF price effect will dominate, and Europe will be worse off after the advent of the GMF in spite of the mandatory labelling policy with respect to imports.

While a mandatory labelling policy for imports cannot guarantee gains from biotechnological imports, such a policy is typically superior to a GMF import embargo. As we have seen, the price of the non-GMF increases less with mandatory labelling than with an import embargo because some consumer demand is shifted to GMFs. Consequently, the harmful non-GMF price effect is generally smaller with the mandatory labelling of GMF imports than with the import embargo. In addition, there is a new-product benefit that arises when labelled GMF imports are permitted.

Even if Europe would be better off with a GMF import embargo than with unlabelled imports, permitting labelled imports will typically yield higher welfare still. There are two caveats pertaining to this conclusion. First, it should be observed that if the perceived quality difference is sufficiently large, mandatory labelling which identifies the GMF could result in no European purchases of the GMF at the going world price. Thus, in such extreme cases, mandatory labelling will have the same effect on European welfare as the

import embargo because it has the same effect on European imports. Second, it is conceivable that the non-GMF price could rise more with mandatory labelling than with an embargo if some of the costs of the separation of supply chains were borne by the non-GMF market. While this suggests that cases where an import embargo was superior to mandatory labelling might be found, such situations appear to be very remote possibilities. For one thing, it seems likely that certified non-GMF imports would generally continue to enter Europe and forestall particularly sharp increases in the GMF price under the labelling regime.

While a policy of mandatory labelling of GMF imports typically dominates an import embargo, labelling need not always be better than no labelling. Although mandatory GMF labelling policy is generally superior to an import embargo, allowing unlabelled GMF imports may sometimes be superior to an embargo. The costs of labelling GMF imports, and GMF output if domestic production is permitted, are likely to be significant because GMF and non-GMF supply chains would have to be kept separate to prevent the co-mingling of product (Kerr, 1999b). On the one hand, if the perceived quality difference between the GMF and non-GMF is sufficiently small, the labelling and sorting costs of moving to a separating or two-market situation, rather than a pooling or one-market situation, will exceed the benefits. In such a case, labelling should not be required. On the other hand, when the perceived quality difference is large, GMF labelling should be obligatory. In no cases, however, are import embargoes warranted.

7. GMFs as Negative Public Goods

To this point, we have focussed on GMFs exclusively as private goods and shown that the hidden-quality problem posed by GMFs represents a form of market failure that may, or may not, justify a labelling policy. The advent of GMFs, it would seem, poses some additional public-goods issues. For example, some Europeans may be concerned over their aggregate GMF production, consumption and import levels on environmental and animal health grounds as well as human health and ethical grounds. Since aggregate production, consumption and import levels for GMFs may be observable, hidden quality becomes a less important issue. Externalities now take centre stage as a source of market failure. The social costs of GMF production, consumption and imports may well exceed the private costs. In the absence of corrective policy, the over-production, over-consumption and over-importation would be expected.

In the presence of negative GMF externalities, prohibitions on production and/or imports may sometimes improve welfare in comparison with laissez-faire, and occasionally such policies may be optimal. In general, however, such prohibitions are not optimal. Rather, Pigouvian taxes on production and imports would be warranted. Such taxes are set

to cover external costs and bring marginal social costs, rather than private costs, into line with marginal benefits. Suppose that only long-term, as-yet-unknown environmental consequences of a new biotechnology are feared by Europeans. Release of a genetically modified organism (GMO) into the environment, for example, may be a threat to local indigenous species. Further, take the extreme case where these biodiversity fears warrant a prohibitive tax on domestic agricultural use of the new biotechnology in Europe. Even in this case, a prohibitive import tax on the GMF import may not be efficient. While imports may pose a risk of inadvertent or opportunistic release of GMOs into the European environment, this compares with the certainty of release with European agricultural production. While there is a valid argument for permitting corrective taxes on GMF imports, a blanket case for import embargoes cannot be sustained. Even the case for taxation of GMF imports depends on the degree of offshore processing; products with no reproductive potential should not be subject to tax on strict biodiversity grounds.

8. Conclusion: World Trade Law

Biotechnology presents some very serious problems for international trade policy that require careful empirical analysis on a case-by-case basis. The benefits and costs of any particular biotechnology may not be uniform across countries. Even if a new biotechnology is beneficial in North America, it may be harmful in Europe. Perceived differences in GMF versus non-GMF product quality, for example, may be much larger in Europe. Further, due to the nullification of former trade opportunities, Europe may be worse off regardless of the policy stance that it adopts. Some European policy responses, however, are worse than other responses.

While a GMF import embargo may cater to the vested interests of certain European producers, environmentalists or biotechnology firms, such a policy is not in Europe's national interest. Whenever there are hidden-quality issues, a mandatory labelling policy applied to GMF imports would be superior to an embargo. Whether the costly separation of GMF and non-GMF markets through labelling itself is warranted depends on the degree of perceived quality differences. When the perceived quality differences are small, labelling will not be worthwhile. Whenever negative public-goods issues cause a difference between perceived social costs and private costs, Pigouvian taxes on production and imports can be justified. Sometimes the Pigouvian taxes on domestic production may be optimally set at prohibitive levels, but prohibitive import taxes would be optimal less frequently.

In some areas, the existing rules governing international trade seem remarkably well suited, while in other areas there are major problems. While our analysis clearly substantiates the argument in Perdikis et al. (1999) that consumer concerns are likely to drive trade

policy relating to agricultural biotechnology, we contend that the existing World Trade Organization (WTO) rules on Technical Barriers to Trade (TBT) are reasonably well adapted to handle the hidden-quality issues posed by biotechnology. In particular, the TBT rules permit labelling requirements provided that the benefits demonstrably outweigh the costs (Kerr, 1999a). The economic benefit versus cost criterion is precisely what is required to determine the superiority of labelling versus no labelling on national welfare grounds. If the benefits of separating the GMF and non-GMF markets are sufficiently large because the perceived quality differences are great, then indeed the labelling of GMF imports, along with any GMF product produced domestically, is warranted. Consequently, importing countries that impose labelling requirements should stand ready to provide empirical economic evidence that documents the extent of differences in consumer willingness to pay for non-GMFs versus GMFs.

When and if food, animal or plant safety risks stemming from a particular biotechnology, such as allergenic characteristics, become known, the WTO's Sanitary and Phyto-Sanitary (SPS) rules come into play. In the presence of scientifically demonstrable risks, restrictions or prohibitions on GMF imports would certainly be permissible (Kerr, 1999a and 1999b). Moreover, the provisions for Advanced Informed Agreement that are included in the Biosafety Protocol negotiated under the Biodiversity Convention will afford importing countries time to assess the scientific risks of particular genetically modified seed stocks.

The key gap, from the trade law point of view, concerns situations of conjectural environmental risks that have not yet been scientifically demonstrated one way or the other. The Biosafety Protocol (BP) could ideally have addressed this issue, but unfortunately it may fall well short of the mark. It appears that the Biosafety Protocol will provide machinery that duplicates or even contradicts the TBT provisions covering labelling, and it may even allow economically unwarranted import embargoes based on alleged consumer resistance. Pigouvian import taxes rather than prohibition should be permitted, on the basis of an economic assessment of the difference between the marginal social and private costs of imports. In some, but certainly not all instances, the warranted tariff may even be prohibitive. Further, effective import taxes should always be required to be less than or equal to effective production taxes, reflecting the greater risks of releasing genetically modified organisms into the domestic environment through agriculture.

It needs to be emphasized that concrete economic studies on consumer preferences, rather than scientific evidence, should be required to document and support both labelling requirements and import restrictions on GMFs when there are public concerns based on possible, but as-yet-unknown, environmental and health risks. This would give economic substance to the so-called "precautionary principle" that is included in the Biosafety

Protocol, and it would avoid yet another instance of the *fuzzy trade-speak* and legal ambiguity that ferment trade disputes.

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The technical annex to this paper, pages 94-98, is available as a separate document.