The Estey Centre Journal of
International Law and Trade Policy

Technical Annex

The Case For and Against
Import Embargoes on Products of Biotechnology

James D. Gaisford
Associate Professor, Department of Economics, University of Calgary

(Carol) Lau Chui-Ha
*PhD student, Department of Economics, University of Calgary*

This document is the technical annex to the full paper "The Case For and Against Import Embargoes on Products of Biotechnology," which is available separately.

This annex uses a simple diagrammatic analysis to formalize the hidden-quality problem that faces Europe. We assume highly stylized supply chains in which processors, distributors and retailers are perfectly competitive. For simplicity we also assume that each of these stages is initially costless and remains so unless labelling requirements force the separation of supply chains. Thus, in the absence of labelling, it is as if farm-level producers sell to final consumers. For simplicity, we also assume that all consumer preferences are quasi-linear so that changes in consumer surplus correspond exactly with compensating variation calculations.

Figure 1 provides the basis for analyzing and comparing a policy of unlabelled imports and an import embargo. Europe's supply curve is S and its demand curve is Di prior to the introduction of the GMF. The initial pre-GMF world price is Pi. Consequently, European consumption is equal to DQi and European production is SQi, with imports making up the difference. As a result of the development of a new biotechnology, the GMF imports become available at a price of Pf, and non-GMF imports are no longer available.

To begin with, suppose that European imports of the GMF do not have to be labelled. Consumer willingness to pay falls and the demand curve shifts downward to the pooled demand curve, Dp, as a result of the decline in average quality. Domestic output falls to SQp and domestic consumption settles at DQp. There are two opposing effects on European welfare. On the one hand, the decline in willingness to pay reduces consumer surplus by areas T, V and X at the initial price of Pi. The loss of T+V+X Euro in figure 1

Figure 1 Unlabelled GMF Imports Versus an Import Embargo
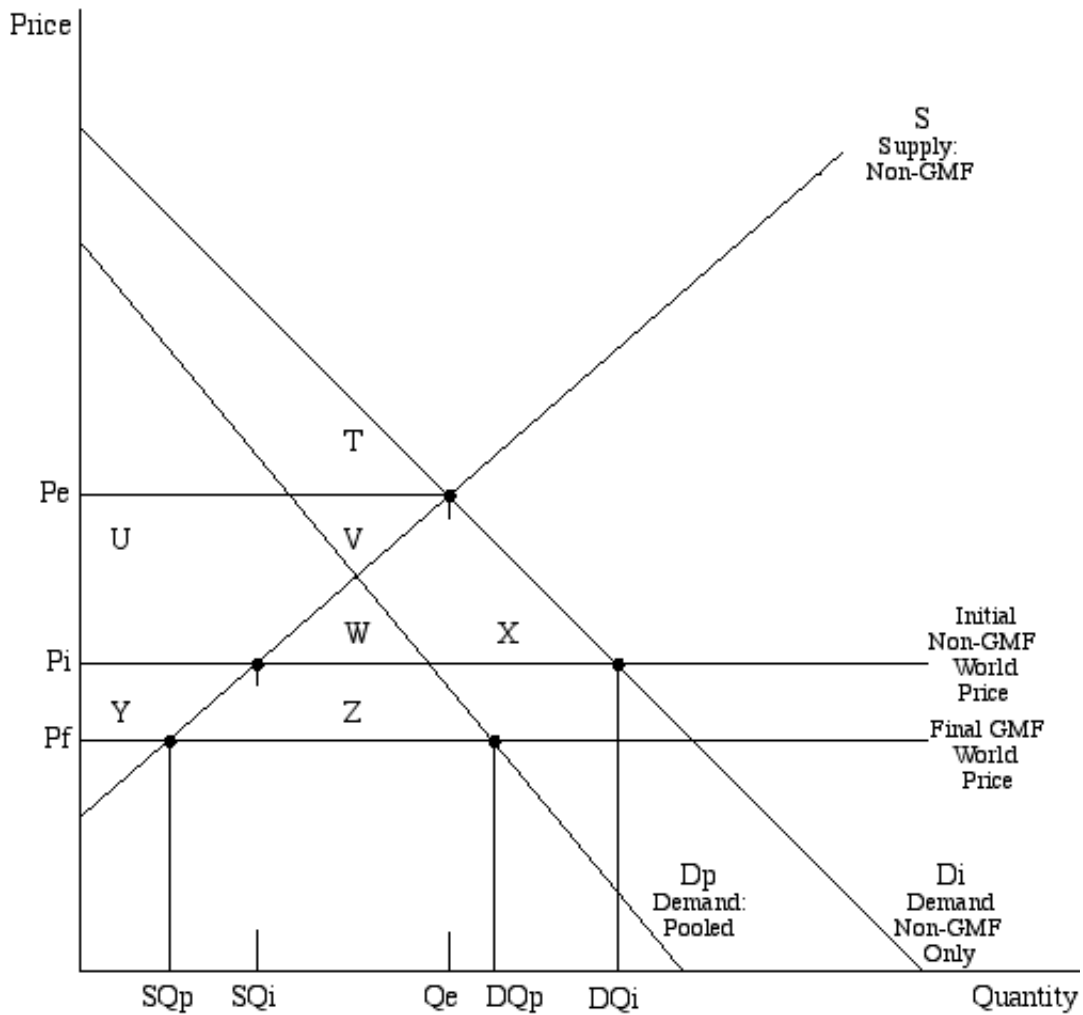
thus represents the adverse quality effect from the introduction of the GMF. On the other hand, the price reduction from Pi to Pf causes an increase in consumer surplus equal to areas Y+Z Euro. Meanwhile, producer surplus falls by Y Euro. Thus, the net price effect is a gain of Z Euro. The overall impact on European welfare, therefore, is equal to Z–(T+V+X) Euro. If the beneficial net price effect outweighed the adverse quality effect, Europe would gain from the new biotechnology. In figure 1, however, the adverse quality effect dominates (i.e., areas T+V+X exceed area Z) and European welfare falls.

Now suppose that Europe imposes an import embargo instead of allowing unlabelled GMF imports. In this case, only non-GMFs remain available and the adverse quality effect does not arise. There is, however, a harmful price effect. The relevant demand curve

remains Di. Since non-GMF imports are unavailable, the quantity produced and consumed in Europe is Qe. Thus, the price rises from Pi to the embargo price, Pe. The price increase raises producer surplus by U+V Euro, but reduces consumer surplus by U+V+W+X Euro. The change in European welfare is equal to –(W+X) Euro, which is an unambiguous loss. European welfare must fall relative to the pre-GMF state due to the harmful price effect of the embargo.

Europe, however, may lose less by prohibiting imports than by allowing unlabelled GMF imports. Recall that the change in welfare with unlabelled access is Z–(T+V+X) Euro and the change in welfare with the embargo is –(W+X) Euro. The embargo is superior, therefore, if area T+V exceeds area W+Z, which happens to be the case in figure 1. Of course, in other situations unlabelled imports will be superior to an embargo.

A third policy alternative, mandatory labelling of GMF imports, can be assessed with the help of figure 2. Initially the GMF is not available, so only market 1 is relevant. The

Figure 2 Labelled GMF Imports Versus an Import Embargo
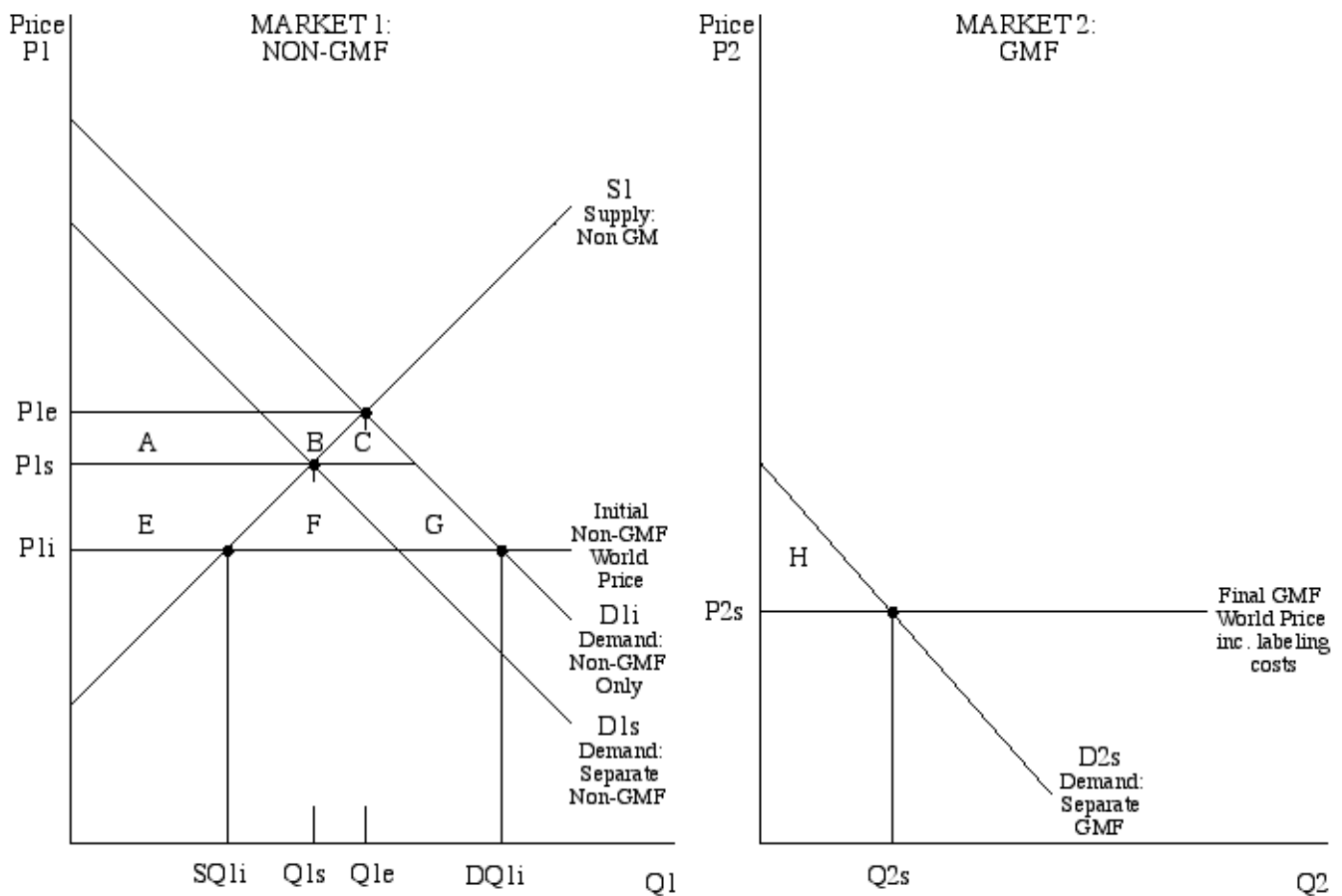
initial European demand curve for the non-GMF is D1i (which corresponds with Di in figure 1), the European supply curve is S1 (which corresponds with S in figure 1) and the initial world price is P1i (which corresponds with Pi in figure 1). Initial domestic consumption is DQ1i (which equals with DQi in figure 1) and initial domestic production is SQ1i (which equals with SQi in figure 1). If an embargo were imposed to block the import of the new GMF, the equilibrium quantity would be Q1e (which equals Qe in figure 1) and the equilibrium price would be P1e (which equals Pe in figure 1). The European welfare loss from employing the embargo response is C+F+G Euro (which equals W+X Euro in figure 1).

Mandatory labelling of GMF imports gives rise to a separating equilibrium. European consumers can choose to buy the high quality non-GMF on market 1, which continues to be supplied by domestic producers. Alternatively, they can buy the low quality GMF on market 2, which is supplied by offshore producers. The GMF price, P2s, exceeds the price at which the GMF can be purchased from North America (i.e., Pf in figure 1) due to labelling and sorting costs. The advent of the GMF, which gives rise to market 2, shifts the demand curve for the non-GMF to D1s on market 1. The new substitute product, albeit of lower perceived quality, takes some demand away from the old product. In figure 2 we take D1s to be the demand for the non-GMF when the price of the GMF is P2s, while D2s is the demand curve for the GMF when the price of the non-GMF is P1s. In the separating equilibrium that arises with mandatory labelling, Q1s units of the non-GMF are transacted at the price of P1s, and Q2s units of the GMF are transacted at the price of P2s. Due to the perceived quality difference, P1s necessarily exceeds P2s.

We assess the impact of mandatory labelling of GMF imports on European markets by considering the two markets in sequence. Prior to the development of the GMF, its price is effectively infinite and the demand for the non-GMF is D1i. We start on the non-GMF market and raise the price from P1i to P1s while holding the price of the GMF at its initial infinite level. Since the relevant curve remains D1i, the change in consumer surplus is a loss of E+F+G Euro. The gain in producer surplus is E Euro, so that there is an overall loss of F+G Euro on market 1. This is an adverse price effect on the old high quality product. We now turn to market 2. With the price of the non-GMF already changed to P1s, the relevant demand curve for the GMF is D2s. Thus, there is a gain in new consumer surplus of H Euro on market 2. This is a beneficial new-product effect. The overall gain to Europe from allowing GMF imports with mandatory labelling is equal to H–(F+G) Euro. It should be emphasized that whenever the beneficial new-product effect outweighs the harmful price effect on the old product, European welfare rises. In figure 2, however, the adverse price effect dominates and European welfare falls notwithstanding the labelling requirement.

Figure 2 can also be used to compare an import embargo with a mandatory-labelling

policy. Since mandatory labelling creates a smaller price increase for the GMF than does an embargo, there is a smaller resultant European welfare loss on the non-GMF market. Whereas F+G Euro are lost with mandatory labelling, C+F+G Euro are lost with the embargo. The harmful price effect is smaller with mandatory labelling than with the import embargo because the price of the non-GMF generally rises less under mandatory labelling than under the import embargo. The demand curve for the non-GMF shifts to the left as a result of the presence of the low-quality GMF substitute product and mitigates the upward pressure on the domestic price. Notice that the non-GMF price could actually fall if this effect was sufficiently large. Further, on the non-GMF market there is a gain of H Euro from mandatory labelling that does not arise with the embargo. Thus, the mandatory labelling of GMF imports is unambiguously better than an import embargo by C+H Euro.

Figure 2 makes two extreme assumptions that deserve cautionary comments. First, it should be observed that the analysis in figure 2 assumes that the non-GMF market does not bear any of the costs associated with separating the supply chains under mandatory labelling. If this rather extreme assumption were to be relaxed, the non-GMF supply curve, S1, would shift upward. In such a case, the producer benefits from any given price increase would be reduced and the price increase itself would be larger. Thus, with some of the costs of mandatory labelling borne by the domestic non-GMF suppliers, it is conceivable that the increase in the non-GMF price could be larger with mandatory labelling than with the import embargo (i.e., P1s could exceed P1e). It is even possible that the welfare loss could be higher with mandatory labelling.

The second extreme assumption is that non-GMF imports remain unavailable under mandatory GMF labelling even in the presence of the higher price that prevails in Europe. More realistically, non-GMF imports are likely to remain available, albeit at a price some-what above P1i to cover the costs of certifying that the product is GMF-free. The likely availability of non-GMF imports at a price below P1e provides a strong argument for the continued dominance of mandatory licensing even when the GMF market bears some of the supply-chain separation costs associated with the labelling policy.