Conditional Policies in General Equilibrium: FTAs with ROOs Revisited.[1]

Kala Krishna

April, 2004

[1] Extremely preliminary. Please do not quote without permission.

Abstract

A large number of trade policies are "conditional" in so much as they can be invoked only if certain prerequisites are met. Hence, the benefits accruing from them can come at a cost. For example, meeting the Rules of Origin (ROOs) in a Free Trade Area (FTA) or under the generalized system of preferences (GSP) may have a cost, but on the other hand, firms are rewarded for complying with them by facing zero or lower tariffs. This paper analyzes the effects of such restrictions in a general equilibrium setting using FTAs with ROOs as an example.

Keywords: General Equilibrium, Trade Policy, Factor Price Frontier, Free Trade Areas, Rules of Origin.

JEL Classification: F13, F15, F16.

1 Introduction

Trade Policies are often conditional in practice. Only if certain conditions are met are a set of benefits obtained. In a Free Trade Area (FTA), for example, producers become eligible for zero tariffs (when exporting to a partner in the FTA) if the product is deemed to have domestic origin. Under the Generalized System of Preferences (GSP) poor developing countries obtain preferential tariffs if the product is deemed to originate in the developing country[1]. In developing countries, producers obtain preferential access to inputs if they export their products. What is the effect of such policies in a general equilibrium setting? This question has been by and large ignored. This paper looks at a particular such policy, namely, the creation of an FTA with Rules of Origin (ROOs).

Previous work on this subject has taken a partial equilibrium approach. Early work by McCulloch and Johnson (1973), Grossman (1981), Mussa (1984), and Krishna and Itoh (1988), lay the foundation for recent work on content protection and preference. See Krishna (2003) for a recent survey on FTAs with ROOs. In an FTA, members maintain their own external tariffs. As such, tariffs may differ between member countries. ROOs, therefore, assume a function additional to that under customs unions: ROOs prevent deflection. This occurs when imports enter through the country (which gets the tariff revenue) with the lowest duty on the item in question and are re-exported to other countries in the FTA. Without ROOs, an FTA could be highly liberalizing, both because at given tariffs, the lowest tariff would apply to each category of imports[2], and because the possibility of such deflection makes it in the interest of all other countries to reduce their own tariffs in order to attract imports to their ports! Only when the lowest tariff is zero is this not an issue, suggesting that in equilibrium, all

[1] Most products, other than arms and numerous agricultural goods, are covered by the GSP.

[2] Such re-exports need not be a good thing as resources are wasted in doing so.

external tariffs would be competed down to zero[3]!

ROOs can also provide an incentive for regional producers to buy intermediate goods from regional sources, even if their prices are higher than those of the identical import from outside the FTA, in order to make their product "originate" in the FTA and qualify for preferential treatment. This, in effect, protects FTA suppliers, a point first made by Krueger (1999)[4]. As a result, trade patterns and investment flows needed to sustain them can be profoundly affected by a FTA as pointed out in Krishna and Krueger (1995).

That ROOs may be protectionist does not prove that they are. However, recent work by Estevadeordal (2000) suggests that ROOs are being used to prevent trade deflection as the sectors which have large differences between tariffs between the partners are the ones where ROOs are strongest. The work of Cadot et. al. (2002) on NAFTA also suggests that ROO are negating the effects of tariff reductions due to an FTA. They show that while the severity of ROOs reduced Mexican exports, tariff preferences raised them and that the net effect was close to zero.

In addition, it is worth pointing out that ROO are often quite expensive to document. As a result, even if a product satisfies origin, an importer may prefer to pay the tariff rather than bother with the documentation needed. Some idea of how extensive this is might be gleaned from the prevalence of outward processing trade (OPT) between the EU and the Central and Eastern European countries[5]. The latter have duty free access to the EU but instead of proving origin is met, EU firms use the OPT provision instead suggesting

[3] See Richardson (1995) for more on this. It is interesting to note that this seems to have actually happened in America during the Articles of Confederation period (1777-1789). See McGillivray (2000).

[4] The Conference at which this paper was presented was in 1992.

[5] OPT encourages processing overseas by EU firms as the duty that would have been paid on the exported inputs to be processed abroad is deducted from the duty owed on the imported product.

that the cost of proving origin exceeds the duty paid using the OPT provision. For example, as documented in Breton and Manchin (2002), when Albanian exports of clothing to the EU are considered, OPT provisions were used over 90% of the time. However, Turkey, which is part of the customs union (hence it does not have any ROO to meet) used these provisions only .5% of the time[6]. Herin (1986) also shows that the cost of proving origin seems to have led over a quarter of EFTA exports to pay the MFN tariff.

The work closest to this paper is Ju and Krishna (1998) and (2003). They point out an essential non monotonicity that occurs in such settings when the link between final and intermediate goods markets is modelled. If the requirement that has to be met is easy to meet, all firms choose meet it. In this regime, one set of comparative statics results obtain. At some point however, firms will become indifferent between meeting and not meeting the restriction and at this point, a regime change occurs. Some firms meet it and some do not and the comparative statics results are reversed. Their setting may be interpreted as a specific factors model and hence valid in the short or medium run when labor is mobile between sectors while other factors are not. Despite their work, a general understanding of such situations is still lacking and the current paper develops a way of looking at the effect of ROOs in a general equilibrium setting under perfect competition.

The model is based on the dual approach utilizing the factor price frontier. Section 2 lays out the basic tools taking a physical content requirement to be the requirement for origin in a FTA. Section 3 looks at the effects of FTAs with ROOs (defined as a physical requirement) in general equilibrium in the presence and absence of capital mobility. It is shown that when ROOs are set at ex ante just binding levels, they need not be binding ex post nor must they result in

[6] It may also be that OPT trade allows a greater fraction of potential rent to be captured by the EU importer, an open question on the empirical side.

an inflow of capital. Section 4 looks at value added ROOs, highlighting the subtle differences in the analysis and showing that the basic intuition remains valid. Section 5 looks at the effects of making ROOs more restrictive and argues that the kind of non monotonicity seen in Ju and Krishna (1998) is likely to be prevalent in general equilibrium. Section 6 concludes.

2 Conditional Policies in General Equilibrium

Although the tools are standard, there is a slight twist in their use that needs some explaining. The polices have a carrot and hoop element to them. The carrot, preferential treatment, is obtained only by jumping through hoops, namely meeting origin requirements. We ask, what factor prices can a firm afford to pay if it can choose to avail itself of these conditional policies? The basic insight used in this paper is that if, by availing itself of the policy, the firm can raise the factor prices it can afford to pay, it will be willing to do so. Else it will not. In other words, we look at the effects of such restrictions on the factor price frontier[7]. We then use the dual definition of the standard revenue function: namely as the value function for the problem of minimizing factor payments subject to the factor price frontier. Given the availability of resources and technology, if the opportunities created by the FTA increase the factor price that firms can pay, then the restriction matters in equilibrium.

It is easiest to illustrate with one good and two factors, capital (K) labor (L) with prices r and w respectively. Let factors be supplied inelastically and let $\frac{w}{r} = \omega$, the wage rental ratio. Consider a unit isoquant with K on the vertical axis. Combinations of K and L that lie above the unit isoquant are feasible ways of producing a unit of the good. Unit costs are minimized where the slope of the unit isoquant equals $-\frac{w}{r}$. Minimizing unit cost involves using $[a_L(\omega), a_K(\omega)]$ to

[7] In a way, such restrictions can be viewed as a combination of a tariff and technological regression.

make the good, that is, using a capital labor ratio of $\frac{a_K(\omega)}{a_L(\omega)} = k(\omega)$. Denote the minimized unit cost by $c(w, r)$.

The curve $p = c(w, r)$ defines the factor price frontier in this one good economy and is depicted in Figure 1. As is well understood, the equilibrium factor prices can be obtained as the solutions to minimizing factor payments subject to $p \leq c(w, r)$, while the revenue function is the value function for this problem[8]. Equilibrium factor prices for a one good economy at price p, and endowments $V = (L, K)$, would be given by the tangency of the line $wL + rK$ to the curve $p = c(w, r)$ which occurs at I.

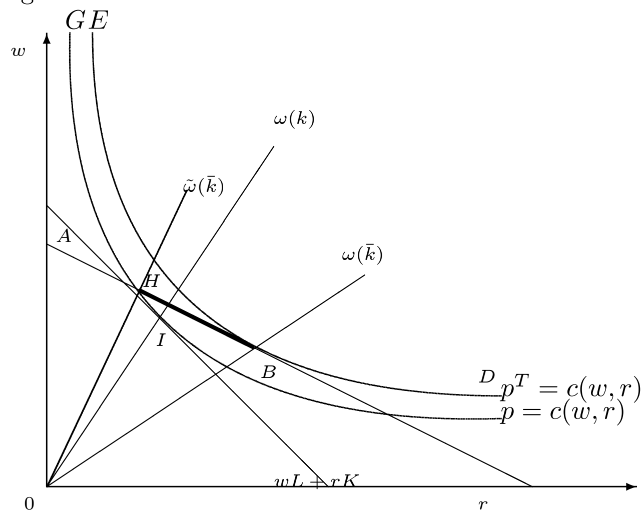
As long as the restrictions do not create non convexities, so that constant returns to scale are preserved, we can proceed in the same manner when considering conditional policy schemes. We will first derive the factor price frontier under the scheme and then minimize factor payments subject to the factor price frontier to get equilibrium factor prices.

Suppose we consider a physical content requirement as the origin rule: in particular, that $\frac{a_K}{a_L} \leq \bar{k}$. When we consider the unit isoquant as done earlier we see that in order to meet the origin rule, inputs must lie below the ray from the origin with slope $\bar{k}$ as well as above the unit isoquant. Let the wage rental ratio that induces a capital labor ratio of k be $\omega(k)$. Hence, only if the wage rental ratio exceeds $\omega(\bar{k})$ is the requirement binding. In this event, it is easy to see that cost minimization involves just meeting the origin rule. Let these distorted input choices be denoted by $\left[a_L(\bar{k}), a_K(\bar{k})\right]$. Consequently, the unit cost of production when meeting the requirement is

$$\begin{aligned} c(w, r, \bar{k}) &= wa_L(\bar{k}) + ra_K(\bar{k}) > c(w, r) \ if \ \omega > \omega(\bar{k}) \\ &= c(w, r) \qquad\qquad\qquad\qquad\quad if \ \omega \leq \omega(\bar{k}). \end{aligned}$$

[8]See Dixit and Norman (1980).

Figure 1: The Factor Price Frontier with ROOs



The factor price frontier in an FTA with ROOs is thus given by

$$p^T = c(w, r, \bar{k}).$$

This is depicted in Figure 1. The physical content requirement has to be for the firm to obtain the higher price, p^T, from selling in the in the FTA. Since obtaining a higher price allows factors to be paid more, the higher price alone results in the price equal to cost curve in the absence of any policies being proportionately blown up to the level given by $p^T = c(w, r)$. However, in order to obtain the higher price $p^T = p(1+t)$, where t is the ad-valorem default tariff, a sub-optimal technique, namely $(a_K(\bar{k}), a_L(\bar{k}))$ is used if $\omega > w(\bar{k})$. Since it would be optimal to use this technique if the restriction were just binding, unit costs when the restriction is binding would be given by the line tangent to the curve $p^T = c(w, r)$ with slope $\bar{k}$. Note that if the wage rental ratio is not too high, this line lies above the factor prices a firm can afford to pay and meet costs if it ignores the conditional policy, so that it is in its interest to take advantage of the policy. Once the wage rental ratio exceeds $\tilde{\omega}(\bar{k})$, as depicted in Figure 1, it is best to ignoring the conditional policy.[9]

Thus we can define the highest factor prices that a firm can pay if it has the option of availing itself of a conditional policy of this form to be the line $GHBD$ in Figure 1. This is the factor price frontier. The tangency of the line $wL + rK$ to this frontier gives the equilibrium factor prices. If there is only one good and the ROO is set at exactly the Pre FTA level of k, then any wage rental ratio along the straight line part of the factor price frontier would be equilibrium wage rental ratio. It is easy to see that even a slightly binding ROO could cause large factor price changes. For example if the ROO is set at $\bar{k}$, then the wage rental ratio would rise to $\tilde{\omega}(\bar{k})$. Making the restriction weaker, that is raising $\bar{k}$, will also raise the corresponding $\tilde{\omega}(\bar{k})$ but that as long as $p^T > p$, $\tilde{\omega}(\bar{k}) >> w(k)$.

With many goods, the factor prices that each sector can afford to pay can be derived in this manner. The factor price frontier is then the set of factor prices that lie above all of them. Factor prices which minimize factor payments subject to this set are the factor prices in equilibrium. Goods (techniques) which have cost exceeding price are not made (used), and output levels are determined so that factor markets clear. The value function for this problem yields the revenue or national income function.

2.1 FTAs With ROOs

Suppose that there are two goods and two countries A and B which form an FTA. Assume that there is no specialization prior to the FTA and that both countries import good 1. Denote the world price by p^* and label the countries so that country A has a lower tariff and hence a lower domestic price of good 1 prior to the FTA. If one of the countries exports the good after the FTA, it

[9] Note that making the restriction stricter, that is lowering $\bar{k}$, will also lower the corresponding $\tilde{\omega}(\bar{k})$.

must be A which does so as its domestic price is lower than that in B. There are no export subsidies and Good 2 is assumed to be freely traded and is taken as the numeraire[10].

Superscripts A and B refer to the countries while the superscripts 0 and 1 refer to pre and post FTA levels respectively. Let $e(P, u)$ and $r(P, V)$ denote the standard expenditure and revenue functions where P denotes the vector of prices. Subscripts on $e(P, u)$ and $r(P, V)$ denote the partial derivative with respect to the subscripted variable. As usual, by the envelope theorem, $e_P(.) = c^h(.)$, the vector of Hicksian compensated demands. Similarly, $r_P(.) = x(.)$, the supply of goods, while $r_V(.) = w(.)$, the vector of factor prices.

In the equilibrium before the FTA the endogenous variables are u^{A0}, u^{B0} while p_1^{A0} and p_1^{B0} are given by the tariffs set by each country and the fixed world price. Setting expenditure equal to income gives the equilibrium levels of utility in A and B to be defined by

$$\begin{aligned} e(p_1^{A0}, 1, u^{A0}) &= r(p_1^{A0}, 1, V^A) + t^A \left[e_1(p_1^{A0}, 1, u^{A0}) - r_1(p_1^{A0}, 1, V^A) \right] \quad (1) \\ e(p_1^{B0}, 1, u^{B0}) &= r(p_1^{B0}, 1, V^B) + t^B \left[e_1(p_1^{B0}, 1, u^{B0}) - r_1(p_1^{B0}, 1, V^B) \right]. \quad (2) \end{aligned}$$

After the FTA the endogenous variables are u^{A1}, u^{B1}, p_1^{B1}. p_1^{A0} and p_1^{B0} are given by the tariffs prior to the FTA and the fixed world price. Instead of the standard revenue function we now need to use the constrained revenue function where factor payments are minimized over the factor price frontier in the presence of the FTA and the given ROO. Call this function $R(p, 1, V)$. It has the usual properties of a revenue function. For any given p_1^{B1}, we can get

[10] Alternatively, A can be thought of as the developing country who obtains lower tariffs when exporting to B if it meets origin requirements. For the most part the example will be the FTA one but the analogy to the GSP exaple is obvious.

u^{A1}, u^{B1} from

$$
\begin{aligned}
e(p_1^{A0}, 1, u^{A1}) &= R(p_1^{B1}, 1, V^A) + t^A \left[e_{p_1}(p_1^{A0}, 1, u^{A1}) + \min \left[s_1(p_1^{B1}), 0 \right] \right] & (3) \\
e(p_1^{B1}, 1, u^{B1}) &= R(p_1^{B1}, 1, V^B) + t^B \max \left[s_1(p_1^{B1}), 0 \right] & (4)
\end{aligned}
$$

where

$$
s_1(p_1^{B1}) = e_{p_1}(p_1^{B1}, 1, u^{B1}) - R_{p_1}(p_1^{B1}, 1, V^B) - r_{p_1}(p_1^{B1}, 1, V^A).
$$

s_1 is the excess of B's demand over FTA supply at p_1^{B1}. If s_1 is positive then $p_1^{B1} = p_1^{B0}$ and A imports all its consumption at its pre FTA price. If s_1 is negative then p_1^{B1} is given by p_1^{A0}, and A imports only $e_1(p_1^{A01}, 1, u^{A1}) + s_1(p_1^{B1})$. If s_1 is zero then A imports all its consumption and p_1^{B1} comes from

$$
e_1(p_1^{B1}, 1, u^{B1}) = r_1(p_1^{B1}, 1, V^B) + R_1(p_1^{B1}, 1, V^A) \tag{5}
$$

and (3), (5), and (4) can be used to solve for the endogenous variables.

3 Physical ROOs

We proceed by examining the effects of ROOs defined in physical terms requiring a maximum use of capital relative to labor. We look at the effects of the FTA both with and without capital mobility assuming that the ROO is set at the pre FTA or GSP level. Two cases are considered: when good 1 is relatively capital intensive and when it is relatively labor intensive.

3.1 Restricting the Capital Intensive Good

Assume good 1 is relatively capital intensive. Then the FTA allows A to obtain a higher price for good 1 by exporting to B on preferential terms if it meets the ROO.

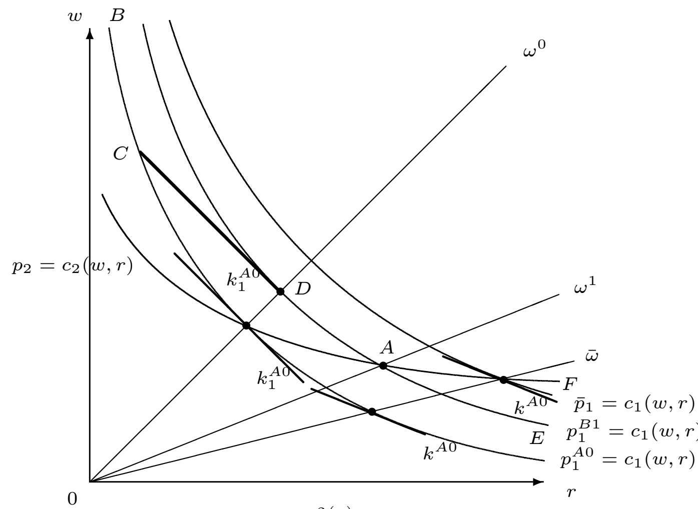
3.1.1 Price Effects of Status Quo ROOs

The factor price frontier on the assumption that the ROO is set at the status quo, namely the pre FTA capital labor ratio in sector 1, is depicted in Figure 2(a) by $BCDAF$. Before the FTA the prices facing producers in A are (p_1^{A0}, p_2), and the factor price ratio is ω^0, which occurs at the intersection of the price equal to cost curves for the two goods. The capital labor ratios in the two sectors are k_1^{A0} and k_2^{A0} and the economy wide capital labor ratio, k^{A0}, lies in between them. Being forced to use the pre FTA capital labor ratio to meet origin makes the factor price frontier depart from that associated with a higher price of good 1 alone only at wage rental ratios above ω^0. If the ROO is set at the pre FTA capital labor ratio in Sector 1 and p_1^{B1} exceeds p_1^{A0}, the factor prices that firms can just afford to pay are given by $BCDAE$ while the factor price frontier for the economy is given by $BCDAF$ in Figure 2(a). As is evident, such a ROO is not binding in equilibrium[11]. Access to higher prices for good 1 raises r and lowers w for country A thereby reducing the capital labor ratio in both sectors. If the price in B falls, the opposite happens in B. These are direct consequences of the Stolper Samuelson Theorem.

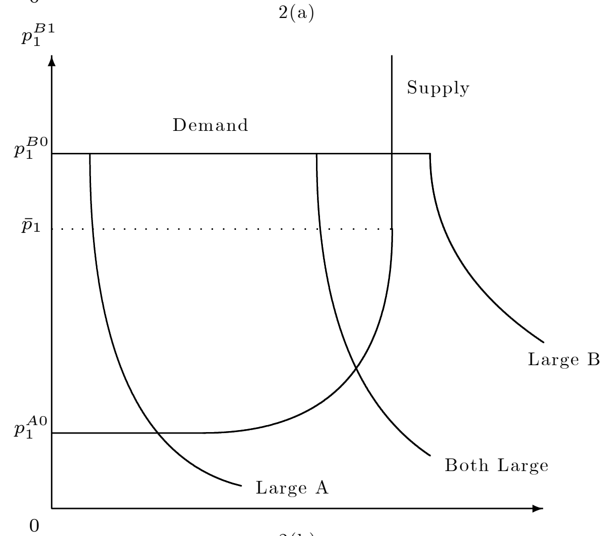
Consider the supply of good 1 from A. It is easy to see that a ROO set at k_1^{A0} results in complete specialization in good 1 once its price reaches $\bar{p}_1$ where the slope of the curve $\bar{p}_1 = c^1(w, r)$ where it intersects the curve $p_2 = c^2(w, r)$ is given by k^{A0}, the aggregate capital labor ratio in A. As shown, such a ROO is never binding for prices at or above p_1^{A0}. Thus, A's supply to B is as depicted in Figure 2(b). It is zero at prices below p_1^{A0} as firms in A can do better by selling domestically in this event. At p_1^{A0} firms are willing to supply to B and

[11] The factor price changes in A cause a ROO set to be just binding prior to the FTA be not binding after the FTA. It is easy to see that even a restrictive ROO will not be binding in equilibrium. A ROO has to be stricter than $\hat{k}$, the slope of the price cost curve in 1 at A, as depicted in Figure 2 to be restrictive in equilibrium. Of course, as the price differential in the two countries falls the corresponding $\hat{k}$ rises so that this minimally restrictive ROO is less strict.

Figure 2: Physical Content Requirement on the Capital Intensive Good



2(a)



2(b)

as price rises the normal supply response occurs. When the price reaches $\bar{p}_1$, A specializes in good 1 and supply becomes inelastic.

Similarly, B's excess demand for good 1 from A is zero at all prices above p_1^{B0} as it can obtain good 1 from the rest of the world at p_1^{B0}. It equals its total excess demand for good 1 at prices below p_1^{B0} and is horizontal at p_1^{B0} as shown. Whether the price in B after the FTA is price is p_1^{A0} or p_1^{B0} or in between depends on the size of A's supply relative to B's excess demand. If A is large and B is not then the price facing consumers and producers in A and B will be p_1^{A0}. All of B's imports of good 1 will be produced in A while A will import enough to meet its own demand.

If B is large and A is not then the price faced by consumers and producers in B will be p_1^{B0}. Consumers in A will face p_1^{A0} while producers will face p_1^{B0}. Some of B's imports of good 1 will be produced in A while all of A's consumption will be imported.

If both A and B are large, the price faced by consumers and producers in B post FTA lies in between these two extremes.[12] Consumers in A will face p_1^{A0} while producers will face p_1^{B1}.

If A is large it will supply all B's imports and A must gain from the FTA due to its appropriation of tariff revenue from B. B's prices fall but it is worse off than if it merely reduced its tariffs to get its post FTA price level as it loses tariffs to A. If B is large but A is not, B must lose as its prices are unaffected and it loses tariff revenue. In contrast A must gain as it not only gains tariff revenue but it exports good 1 to B and this price rises while its consumer prices are unchanged.

Proposition 1 *Consider a ROO on the capital intensive good which is set at*

[12] Note that A can completely specialize in serving B after the FTA only if $p_1^{B0} > \bar{p}_1$ which is how Figure $2(b)$ is drawn.

the prevailing capital labor ratio prior to the FTA between A and B. Such a ROO is not binding after the FTA. An FTA raises the welfare of A, the lower tariff country in the FTA. It can reduce the welfare of B and must do so if B is large. If B is large and A is not, the FTA reduces the wage and raises the rental rate in A leaving factor prices unchanged in B. If A is large and B is not, the FTA has no effect on factor prices in A but reduces the rental rate and raises the wage in B. If both A and B are large, the price is in between their pre FTA prices and both countries factor prices change as above.

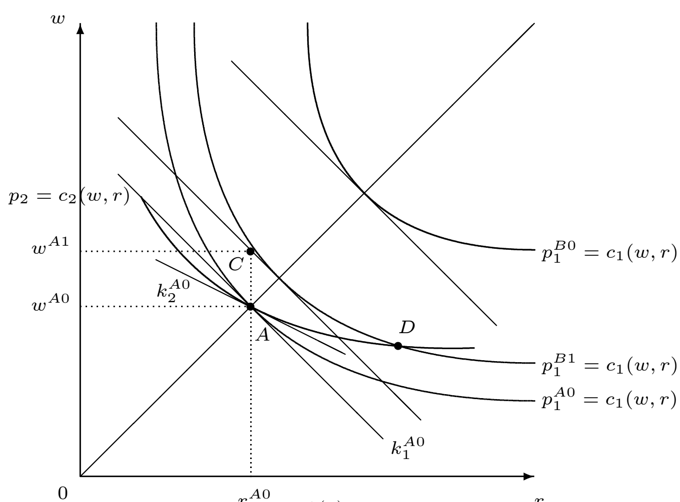
3.1.2 Allowing Capital Mobility

Allowing capital mobility into Country A has very standard effects along the lines of Mundell (1957). We assume that there is a function $G(r^A)$ which defines the rental rate in A such that there are no capital flows to A which is all we allow.[13] Also, that $G(r^{A0}) = 0$. We assume that $G(r^{A0})$ is increasing in r^A. Since r is weakly higher in A after the FTA (as p weakly rises in A) capital will flow into A. The inflow shifts the production possibility frontier of country A out further in good 1 than good 2 as good 1 is capital intensive and (via the Rybczynski Theorem) shifts out the supply curve for good 1 from country A. The process comes to an end when one of two things occurs. Either enough capital flows in to make p^{B1} fall to p^{A0} so that pre FTA equilibrium factor prices are reinstated in A. This occurs if A has enough labor to meet all of B's demand at p^{A0}. If A has a small enough labor force, then a price differential between A and B can be maintained but A will specialize in making good 1.

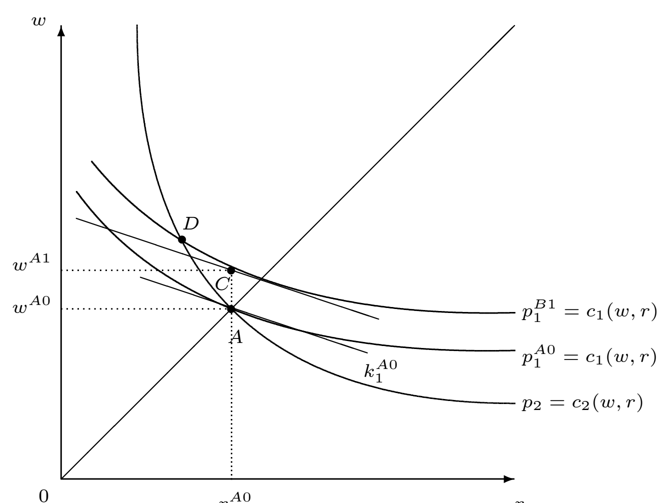
To illustrate, consider ex ante just binding ROOs so that the ROO is set at the pre FTA capital labor ratio in good 1, namely k_1^{A0}. Now suppose enough

[13] Note the rather reduced form way in which we are dealing with capital flows: changes in the price facing producers and consumers in B will also affect rental rates there and as rental rates will fall in B, we would expect capital outflows from B. We assume that there is no capital mobility in B, only in A.

Figure 3: Effects with Capital Mobility



3(a)



3(b)

capital has flowed in to make the aggregate capital labor ratio in A equal to k_1^{A0} and that A's labor force is small so that the producer and consumer price in B, which equals the producer price in A, denoted by p_1^{B1}, still exceeds p_1^{A0} as depicted in Figure 3(a). At this aggregate capital labor ratio, A is specializing in Good 1. This follows from the fact that the capital labor ratios in both sectors at D, the incomplete specialization point where price equals cost for both sectors, lie below k_1^{A0}. As depicted in Figure 3(a), the equilibrium factor prices are given by the point C which lies just above A, the pre FTA rental rate in A. Rental rates are equalized, preventing further capital inflows, but wages in A are higher than before the FTA.

Proposition 2 *Consider a ROO on the capital intensive good which is set at the prevailing capital labor ratio prior to the FTA. Capital mobility results in capital inflows to A until rental rates are equalized. In equilibrium, A specializes in exporting to B and wages are higher in A if A has a small labor force. Otherwise A does not specialize and factor prices are equalized in A and B.*

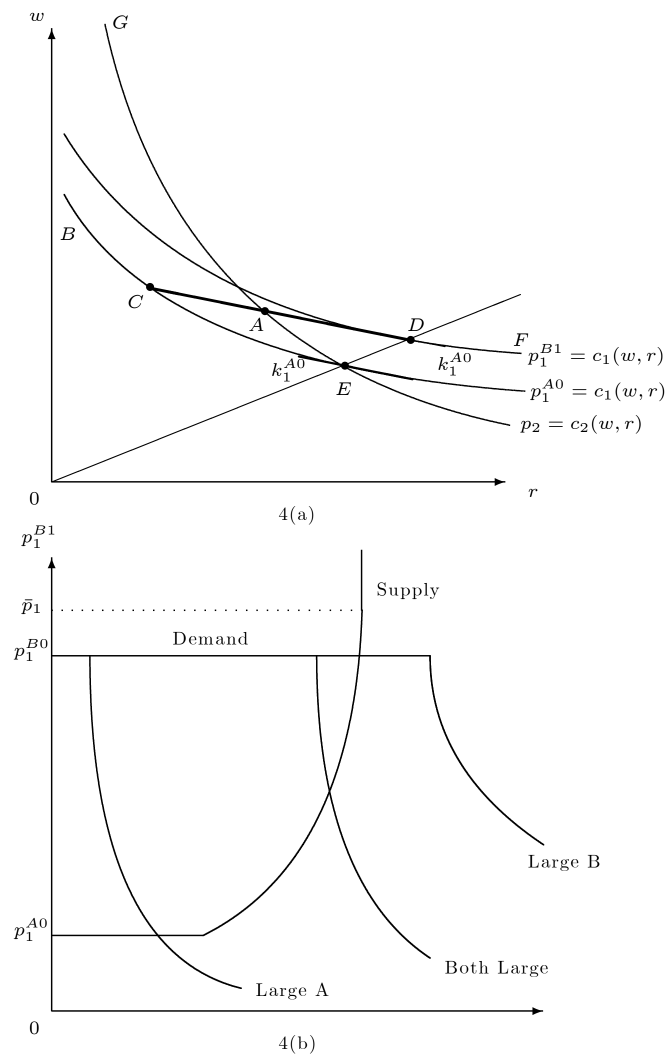
3.2 Restricting the Labor Intensive Good

What if good 1 is relatively labor intensive? Figure 4 is the analogue of Figure 2 for this case. If the ROO is set at the pre FTA capital labor ratio in Sector 1 and p_1^{B1} exceeds p_1^{A0}, the factor prices that firms can just afford to pay are given by the line $BCADF$ while the factor price frontier for the economy is given by $GADF$ in Figure 3(a). As is evident, such a ROO is strictly binding in equilibrium[14].

Access to higher prices for good 1 raises w and lowers r for country A thereby raising the unconstrained capital labor ratio in both sectors and making a previously just binding ROO strictly bind. If the price in B falls, the opposite

[14] The factor price changes in A cause a ROO set to be just binding prior to the FTA to be strictly binding after the FTA.

Figure 4: Physical Content Requirement on the Labor Intensive Good



happens in B.

Consider the supply of good 1 from A. If $p_1^{B1} = p_1^{A0}$, then the ROO is just binding. Firms in A are indifferent between selling in A and selling to B. This is responsible for the horizontal segment at $p_1^{B1} = p_1^{A0}$ in Figure 4(b). As p_1^{B1} rises, it is easy to verify that factor prices move from E along GE. Supply of good 1 in A rises with p_1^{B1} since $R(.)$ is convex in prices and $R_1(.)$ equals supply. The equilibrium price in B after the FTA depends on the size of A relative to B as before.

Note, however, that there is one difference. A will not specialize in good 1 at any price. Factor prices move from E towards G in Figure 4(a) as p_1^{B1} rises from p_1^{A0}. At these prices all firms in sector 1 choose to meet the ROO so that the capital labor ratio in sector 1 is fixed at k_1^{A0} while that in sector 2 rises with p_1^{B1}. The economy wide capital labor ratio lies between them so that both goods are always made. Hence, w rises and r falls in A due to the FTA, in line with Stolper Samuelson effects, unless A is large and can supply all that B demands at p_1^{A0}.

Another difference in this case comes when we consider capital mobility. Since r falls due to the FTA unless A is large relative to B, capital will flow out of A rather than into it. This outflow shifts the production possibility frontier of country A in and does so more for good 2 than good 1 as good 2 is capital intensive. Via the Rybczynski theorem, capital outflows shift the supply curve outward for good 1 from country A. Of course, the supply for good 2 is shifting in with the shift in of the PPF. The shift in the supply curve in A in turn reduces the price in B. The process comes to an end when one of two things occurs. Either enough capital flows out to make p_1^{B1} fall to p_1^{A0} so that the pre FTA equilibrium factor prices are reinstated in A. This occurs when A is very large: even after enough capital has left for the aggregate capital labor ratio in A to equal the pre FTA capital labor ratio in sector 1 in A, A is still able to supply all that B demands at p_1^{A0}. If it is not able to do so then a price differential between A and B can be maintained but A will specialize in making good 1.

This is illustrated in Figure 4(a). Suppose enough capital has flown out of A to make the aggregate capital labor ratio equal to k_1^{A0} and that $A's$ labor force is small so that the price in B, denoted by p_1^{B1}, still exceeds that in A, p_1^{A0}. At this aggregate capital labor ratio A is specializing in Good 1. This follows from the fact that the capital labor ratios in both sectors at D, the incomplete specialization point, lie weakly above k_1^{A0}, so that there must be specialization. As depicted in Figure 4(a), the equilibrium factor prices are given by a point along AD which lies vertically above E. Thus, rental rates are equalized, preventing further capital inflows, but the wages in A are higher than before the FTA. Thus, general equilibrium analysis suggests that an FTA need not always result in capital flowing into the low tariff country in order to export to the high tariff one! As shown, if sector 1 is labor intensive, capital may well flow into sector 1, but flow out of the economy as a whole.

Proposition 3 *If good i is labor intensive then a ROO set at the prevailing capital labor ratio prior to the FTA is strictly binding after the FTA. An FTA with ROOs will never result in specialization by country A in good 1 no matter how strict the ROO. In addition, the factor price effects of a FTA are reversed relative to good 1 being capital intensive. With capital mobility, capital flows out of A due to the FTA. All other results are unchanged.*

An obvious implication of this result concerns the effects of the GSP on developing countries. Developing countries, being relatively labor abundant tend to have a comparative advantage in labor intensive goods. Thus offering them lower tariffs on their exports (if origin is met) will tend to raise w and reduce r

thereby leading to capital flowing out of the developing country! Even though the labor intensive sector expands, the capital intensive one would contract even more!

4 Value Added ROOs

Value based restrictions can be dealt with as well. Suppose the restriction is that $\frac{wL}{wL+rK} \geq \theta$. This is equivalent to $k \leq \frac{\omega(1-\theta)}{\theta}$. The feasible set is now defined by combinations of K and L that lie above the unit isoquant and below the line $k = \frac{\omega(1-\theta)}{\theta}$. There are two additional complication in defining the input choice set. The first complication is that the feasible set of inputs depends on ω. However, it remains true that if the constraint is binding the cost minimizing input coefficients lies on the unit isoquant and just meet the constraint. Note that if the constraint is binding given ω, it must require a lower capital labor ratio than would have been chosen in its absence. Let these input coefficients be denoted by $[a_L(\theta,\omega), a_K(\theta,\omega)]$. Let the cost assuming that these inputs are used be denoted by $c(w,r,\theta) = wa_L(\theta,\omega) + ra_K(\theta,\omega)$. By definition, $c(w,r,\theta)$ must exceed $c(w,r)$ whenever the constraint is not exactly met so that the curve $p = c(w,r,\theta)$ must lie below the curve $p = c(w,r)$ and just touch it where the constraint is just met.

One complication remains, namely where the constraint binds. This depends on the substitutability between inputs. Recall that the constraint can be written as $\frac{\omega}{k} \geq \frac{\theta}{1-\theta}$. Consider what happens when the elasticity of substitution between capital and labor exceeds unity. In this event, an increase in ω results in a greater percentage increase in k so that $\frac{\omega}{k}$ falls. Hence the constraint binds for high ω. In contrast, if the elasticity of substitution between capital and labor is less than unity, then an increase in ω results in a smaller percentage increase in k so that $\frac{\omega}{k}$ rises. Consequently, the constraint binds for low ω. If the elasticity of substitution between capital and labor equals unity then $\frac{\omega}{k}$ is a constant and equals the (constant) share of labor in costs relative to that of capital. If this share ratio is identical to $\frac{\theta}{1-\theta}$, the constraint is never binding and if it is not, it is always binding.

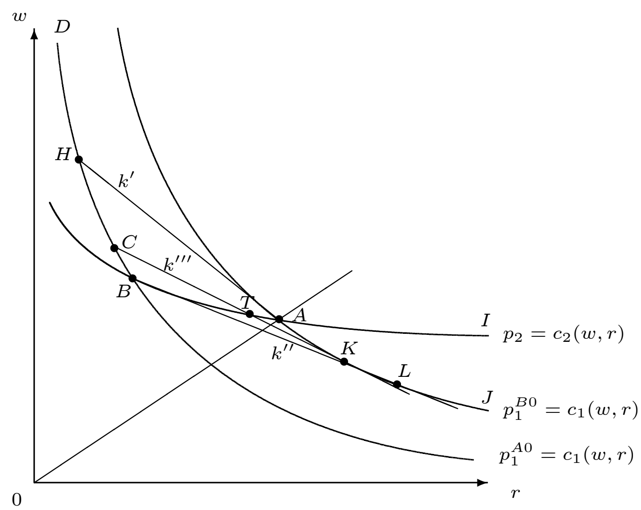
The above facts are enough for us to depict the factor price frontier analogously to that in Figure 1. The curve $p^T = c(w, r, \theta)$ lies below the curve $p^T = c(w, r)$. If the elasticity of substitution is not equal to unity, then whatever be θ, $c(w, r, \theta)$ is tangent to $c(w, r)$ at the factor price ratio where the constraint just binds.

If the elasticity of substitution exceeds unity, the constraint binds for higher ω than given by the tangency as is the case with the physical content definition of ROOs. In this case it is easy to verify that the analysis of the effects of value based ROOs in an FTA are similar to those associated with a physical definition of ROOs.

If the elasticity of substitution falls short of unity, the constraint binds for lower ω than given by the tangency. As a result, there are some small differences in the result. One worth pointing out is that when the elasticity of substitution is less than unity, a ROO at the status quo level is binding in an FTA if good 1 is capital intensive but not if good 1 is labor intensive, rather than the other way around. The effects on factor prices and the direction of factor flows follow the lines described above.

If the elasticity of substitution is equal to unity then if the constraint is set at a share different from the ratio of cost shares, it is always binding so that $c(w, r, \theta)$ is always below $c(w, r)$. If it is set at the ratio of cost shares, and is never binding so that $c(w, r, \theta)$ is always equal to $c(w, r)$.

Figure 5:



5 Making ROOs More Restrictive

The object of this section is to convince the reader that comparative statics in such models is likely to involve a fair deal of regime switching and non monotonicity as found in Ju and Krishna (1998) and (2003). To illustrate we now return to the physical ROO definition and consider the case where good 1 is capital intensive and country B is large while A is small. Also, we assume that A is not specialized in either good prior to the FTA . We ask, what is the effect of more restrictive ROOs on the equilibrium?

Our apparatus helps make this analysis quite simple. Since B is large and A is small the equilibrium price after the FTA is p_1^{B0}. k' in Figure 5 denotes the slope of the curve $p_1^{B0} = c_1(w, r)$ at its intersection with $p_2 = c_2(w, r)$ at A. Thus, ROOs less restrictive than k' are not binding in equilibrium. Let k'' be the slope of the line anchored at B and tangent to the curve $p_1^{B0} = c_1(w, r)$ at L as depicted in Figure 5. Note that at ROOs more restrictive than k'', it is optimal to ignore the possibility of meeting the ROOs and getting lower tariffs since the factor price frontier will not include this possibility. Let us assume that $k_1^{A0} > k' > k^{A0} = k''' > k'' > k_2^{A0}$ as drawn in Figure 5.

Start from a ROO at k'. At this level, or for levels less restrictive than this, the ROO is clearly not binding in equilibrium.[15] When the ROO is set at k', the price equal to cost curve in sector 1 with an FTA would be $DHAJ$. The intersection of the price equal cost curves in the two sectors would occur at A along $p_2 = c_2(w, r)$ and the factor price frontier would be $DHAI$. Given our assumptions, equilibrium factor prices would lie at A where factor payments are minimized subject to the factor price frontier. Country A would not be specialized in either good[16].

With a ROO at k' the FTA raises A's output due to a normal supply response to increasing prices. Neither consumer nor producer surplus in B is affected by an FTA and as B loses tariff revenues while A gains it, B is made worse off. A is better off as producer prices as well as tariff revenues are higher while consumer prices are unchanged.

When the ROO is between k' and k'', the two price equal to cost curves will intersect somewhere along AB in Figure 5. For example if the *ROO* were k''', they would intersect at T. The factor price frontier would be $DCTI$. If $k''' > k^{A0}$, factor payments would be minimized along AB at T, both goods would be made and all the firms in sector 1 would exactly comply with the ROO.

If $k''' < k^{A0}$, then only good 1 would be made and factor payments wuld be minimized at C! When all firms in sector 1 do the same thing, we say the regime is homogeneous. If $k''' < k^{A0}$, then though Country A would specialize

[15] In fact, it would not be binding at any possible equilibrium values of p_1^B.

[16] If $k^{A0} > k'$, then equilibrium factor prices would lie at H. Country A would specialize in good 1 but some firms would meet the *ROO* and some would not because the slope of the price equals cost line at H when the ROO is not met is steeper than k^{A0}. The mix of firms would be such as to ensure that factor markets cleared.

in making good 1,some firms would meet the ROO while others would not. This is termed the heterogeneous regime. When the ROO is stricter than $k^{''}$, equilibrium factor prices are at B and firms prefer not to invoke the FTA and the FTA is undone.

It is worth noting that when the ROOs are between k' and k^{A0}, which is when both goods are made and all firms making good 1 meet the ROO, then more restrictive ROOs will raise w and reduce r as equilibrium factor prices move along BA. As a result, the capital labor ratio used in sector 2 will rise while that in sector 1 will fall due the ROO becoming more restrictive. Thus, the unit labor requirement in sector 1 will rise and the unit capital requirement will fall while the unit labor requirement in sector 2 will fall and the unit capital requirement will rise.

Recall that sector 2 is labor intensive so that with X_2 on the vertical axis and X_1 on the horizontal axis, the labor market clearing constraint is flatter than the capital market clearing one. If, in addition there is relatively little substitutability in inputs in sector 2, then the unit labor and capital requirements in sector 2 will not change much so that the lines representing factor markets clearing will not shift much where they hit the vertical axis. However, the labor market clearing line will shift in and the capital market clearing line will shift out where they hit the horizontal axis. As a result, output of good 1 will rise and of good 2 will fall when the ROO is made more strict!

However, when the constraint becomes so strict that only good 1 is made, we move to another regime. There are two kinds of firms making good 1, the ones who meet the ROO and use labor intensive techniques, and the ones who do not, and use capital intensive techniques. No one makes good 2. Equilibrium is along HB. As the ROO gets stricter, we move down HB, so w/r falls.

Firms who meet the ROO use a lower capital labor ratio because they have to and firms who choose not to meet the ROO use a higher capital labor ratio than the firms who meet the ROO. A stricter ROO will reduce the capital labor ratio of those meeting the ROO as well as reducing w/r and hence reducing the capital labor ratio of those meeting the ROO. Since both capital labor ratios are falling, the output of firms meeting the ROOs, the labor intensive ones, must fall and exports to B must fall. In other words, since both use a lower capital labor ratio, the capital constraint is loosened (the K constraint shifts out) and the labor constraint is tightened (the L constraint shifts in) so that there is more output made by firms not meeting the ROO and less by firms meeting it. Hence, there are fewer exports of good 1 to B from A! Thus, we can easily get non monotonic behavior in the supply of good 1 from A to B at a given price. Once the ROO becomes stricter than k'', it is ignored and there are no exports from A to B of good 1.

Summarizing the above, when the ROO is weak, it does not bind in equilibrium, both goods are made and all firms making good 1 choose to meet the ROO and export to B. Initially, stricter ROOs have no effect. Once the ROOs become binding at k', stricter ROOs raise w/r and in this regime, exports to B from A rise this regime prevails until the ROO hits k^{A0}. At this point, only good 1 is made and all firms meet the ROO. Further restrictiveness of the ROO results in a lower ω and more firms not meeting the ROO and exports to B falling, though only good 1 is made. Once the ROO passes k'', there is another change in regime: both goods are made and the FTA itself is undone as firms choose to ignore its existence!

6 Conclusion

This paper suggests a simple way of using well understood tools in trade to better understand "conditional policies" of various kinds. Preliminary results seem to suggest that regime switches and non monotonic behavior is endemic in such settings and need to be better understood.

References

[1] Cadot, Oliver, Jamie de Melo, Akiki Suwa Eisenmann and Bolormaa Tumurchudur (2002) "Assessing the Effect of NAFTA

[2] Dixit, Avinash and Victor Norman (1979). *The Theory of International Trade.* Cambridge University Press.'s Rules of Origin". Mimeo.

[3] Estevadeordal, Antoni (2000), "Negotiating Preferential Market Access: The Case of the North American Free Trade Agreement", Journal of World Trade , Vol. 34, pp. 141-200.

[4] Herin, Jan (1986) "Rules of Origin and Differences between Tariff Levels in EFTA and in the EC," EFTA Occasional Paper No. 13, Geneva, February 1986.

[5] Ju, Jiandong and Kala Krishna, (2002), "Regulations, Regime Switches and Non-Monotonicity when Non-Compliance is an Option: An Application to Content Protection and Preference". Forthcoming in Economics Letters. (Available at http://econ.la.psu.edu/~kkrishna/index.html)

[6] Ju, Jiandong and Kala Krishna (1998) "Firm Behavior and Market Access in a Free Trade Area With Rules of Origin: NBER Working Paper No. 6857. Cambridge, MA. Revised version at http://econ.la.psu.edu/~kkrishna/roos.pdf.

[7] Krishna, Kala (2003) "Rules of Origin in the Long Run", Mimeo.

[8] Krishna, Kala and Anne Krueger, (1995) Implementing Free Trade Areas: Rules of Origin and Hidden Protection. In Alan Deardorff, James Levinsohn, and Robert Stern (Ed.), *New Directions in Trade Theory*, pp.149-187 University of Michigan Press.

[9] McGillivray, Fiona (2000) "Bargaining Leverage for Smaller States: South-

South Customs Unions". Mimeo prepared for the Leitner Conference on Political and Economic Aspects of Regional Integration, Yale University, April 7-8, 2000.

[10] Mundell, Robert A. (1957). *American Economic Review*, XLVII(3), June, pp 321-35.

[11] Grossman, Gene (1981). “The Economics of Content Protection and Preference”. *Quarterly Journal of Economics*, Vol. 96, No. 4, pp. 583-603.

[12] Krishna, Kala and Anne O. Krueger.(1995). “Implementing Free Trade Areas: Rules of Origin and Hidden Protection,” pp. 149-187 in *New Directions in Trade Theory*, A Deardorff, J. Levinsohn and R. Stern (Ed.), University of Michigan Press, 1995.

[13] Krueger, Anne O. (1999), “Free Trade Agreements as Protectionist Devices: Rules of Origin.” In James Melvin et al (Ed) *Trade, Theory and Econometrics: Essays in Honor of John Chipman.* Routledge, London and Ney York.

[14] Krishna, Kala and M. Itoh, “Content Protection and Oligopolistic Interactions,” *Review of Economic Studies,* LV, January 1988, pp. 107-125.

[15] McCulloch, R. and H. G. Johnson, “A Note on Proportionally Distributed Quotas,” *American Economic Review,* 63, No. 4, 1973, pp. 726-32.

[16] Mussa, Michael (1984). “The Economics of Content Protection”. NBER Working Paper No. 1457.

[17] Richardson, Martin (1995) "Tariff Revenue Competition in a Free Trade Area". European Economic Review, Vol. 39, pp. 1429-1437.