

# Fast-track Authority: A Hold-Up Interpretation. [PRELIMINARY AND INCOMPLETE.]\*

Levent Celik<sup>†</sup>      Bilgehan Karabay<sup>‡</sup>      John McLaren<sup>§</sup>

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## Abstract

A central institution of US trade policy is Fast-Track Authority (FTA), by which Congress commits not to amend a trade agreement that is presented to it for ratification, but to subject the agreement to an up-or-down vote.

We offer a new interpretation of FTA based on a hold-up problem. If the US government negotiates a trade agreement with the government of a smaller economy, as the negotiations proceed, businesses in the partner economy, anticipating the opening of the US market to their goods, may make sunk investments to take advantage of the US market, such as quality upgrades to meet the expectations of the demanding US consumer. As a result, when the time comes for ratification of the agreement, the partner economy will be locked in to the US market in a way it was not previously. At this point, if Congress is able to amend the agreement, the partner country has less bargaining power than it did *ex ante*, and so Congress can make changes that are adverse to the partner. As a result, if the US wants to convince such a partner country to negotiate a trade deal, it must first commit not to amend the agreement *ex post*. In this situation, FTA is Pareto-improving.

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<sup>†</sup>CERGE-EI (a joint workplace of Charles University and the Economics Institute of the Academy of Sciences of the Czech Republic), Politických veznu 7, 111 21, Prague 1, Czech Republic. E-mail: levent.celik@cerge-ei.cz. URL: <http://home.cerge-ei.cz/celik>.

<sup>‡</sup>School of Economics, Finance and Marketing, RMIT University, Building 80, Level 11, 445 Swanston Street, Melbourne, VIC 3000, Australia. E-mail: bilgehan.karabay@gmail.com. URL: <http://bilgehan.karabay.googlepages.com>.

<sup>§</sup>Department of Economics, University of Virginia, P.O. Box 400182, Charlottesville, VA 22904-4182. E-mail: jmcclaren@virginia.edu. URL: <http://people.virginia.edu/~jem6x>.

# 1 Introduction

A central institution of US trade policy is the practice by which Congress from time to time commits in advance not to amend a trade agreement that is presented to it for ratification, but to subject the agreement to an up-or-down vote. This institution, which delegates a portion of Congress' authority to the executive branch, has been called *Fast-Track Authority* (FTA) in the past, and is often now referred to as *Trade-Promotion Authority*.

Fast Track has at times been intensely controversial, and the current debate over it is not an exception. A bill to enact fast-track authority has recently been introduced to the House of Representatives (H.R. 3830, named the "Bipartisan Congressional Trade Priorities Act of 2014," introduced on January 9, 2014), and has been opposed strenuously by such groups as the AFL-CIO, which has called it 'bad for democracy and bad for America' ([www.aflcio.org](http://www.aflcio.org)). The argument that FTA is incompatible with democracy is not new, as Koh (1992) discusses at length.

A natural question is why Congress would ever be interested in delegating any of its authority in this way. There have been a number of interpretations suggested, but we offer in this paper a new interpretation of FTA based on a hold-up problem. In brief, if the US government negotiates a trade agreement with the government of a smaller economy, then as the negotiations proceed, businesses in the partner economy, anticipating the opening of the US market to their goods, may make investments to prepare to take advantage of the US market – quality upgrades to meet the expectations of the demanding US consumer, changes in packaging and adjustments to US regulations, and so on. A portion of these investments are likely to be sunk and specific to the US market. As a result, when the time comes for ratification of the final agreement, the partner economy will be locked in to the US market in a way it was not previously. At this point, if Congress is able to amend the agreement, the partner country has less bargaining power than it did *ex ante*, and so Congress can make

changes that are adverse to the partner but beneficial to the US, and they will be accepted by the partner country. Given the *ex post* diminution of the partner country's bargaining power due to the sunk investments, it may well acquiesce in an agreement that makes it worse off than if it had never negotiated with the US at all. As a result, if the US wants to convince such a partner country to negotiate a trade deal, it must commit *first* not to amend the agreement *ex post* – the purpose of Fast Track Authority.

This interpretation joins a number of others that have been suggested by other authors. Lohmann and O'Halloran (1994) suggest that FTA is used to avoid a 'log-rolling' problem, in which Congress would otherwise be stuck in a bad equilibrium in which each member votes for trade protection for other members' constituent industries in return for protection for its own. Delegation to the President is seen as a way of reaching a Pareto-superior outcome of more open trade. Conconi et al (2012) suggest that FTA can be understood as strategic delegation in bargaining with the foreign government; the median member of Congress may be less protectionist than the executive branch, and thus if all of the bargaining authority is delegated to the executive branch a tougher bargain will be reached with the foreign government. Celik et al. (2013) suggest that FTA may be a way to get out of an inefficient congressional bargaining equilibrium, in which each member tries to secure the maximum possible protection rents for her own constituents and to cobble together a bare protectionist majority coalition to achieve it.

It is possible that each of these interpretations contains an important part of the story, but at the same time they all miss something: They do not explain why the partner country government would need FTA in order to be willing to negotiate with the US.

This insistence is emphasized by Hermann von Bertrab, who was the chief negotiator for the Mexican government on the North American Free Trade Agreement (NAFTA), in his memoir of the negotiation process (Bertrab (1997)). His interpretation of Fast Track is that it "grew out of a perceived need to negotiate with other countries in good faith," and that "Foreign countries would otherwise hesitate even to begin the process of negotiations." (p.1.) His account makes it clear that Congressional passage of Fast Track was viewed by

Mexican officials as an irreplaceable precondition for negotiations even to begin.

More broadly, the view that partner countries need FTA in order to have the ‘confidence’ required to negotiate a trade agreement with the US is expressed frequently by observers of the history and politics of FTA. For example, a report on the merits of FTA renewal prepared for the House Ways and Means Committee in 2002 explains: “trade promotion authority gives U.S. trading partners confidence that an agreement agreed to by the United States will not be reopened during the implementing process (Committee on Finance, United States Senate 2007, p. 34).” Similarly, from a Senate report: “A foreign country may be reluctant to conclude negotiations with the United States faced with uncertainty as to whether and when a trade agreement will come up for approval by Congress. Similarly, a country may be reluctant to make concessions, knowing that it may have to renegotiate following Congress’ initial consideration of the agreement (p.36).” In both cases, the emphasis is on convincing the foreign government to participate, using FTA as a commitment. Koh (1992, p.148) explains that “it bolstered the Executive Branch’s negotiating credibility with the United States allies, which had suffered serious damage during the Kennedy Round, by reassuring trading partners that negotiated trade agreements would undergo swift and nonintrusive legislative consideration.” As one pundit put it, “Many in Congress view fast track as a hammer to drive reluctant nations to the negotiating table because what’s agreed to between the dealmakers cannot be changed by those picky partisans in Congress (Guebert, 2014).”

None of the interpretations listed above can accommodate this concern. Lohmann and O’Halloran (1994)’s and Celik et al’s (2013) interpretations show why a foreign partner might be more eager to negotiate under FTA, but provide no reason to think that the foreign partner would be better off refusing negotiations in the absence of FTA, as long as the partner can always turn down the final agreement. Conconi et al’s (2012) interpretation, of course, is a reason the partner should be *less* eager to negotiate when FTA is in place. Only the hold-up interpretation explains why FTA may be necessary in order for the partner country to have the ‘confidence’ required to agree to negotiations in the first place.

One major innovation of the current paper is to introduce such strategic considerations

into a model in which the policy variables are not tariffs but rather rules of origin (ROO). This is realistic in the context of free trade agreements, since WTO rules require internal tariffs in a free-trade agreement to be set equal to zero, but ROO's can be set as part of the agreement in a restrictive manner that reduces or eliminates the benefits of tariff reductions. In general, a ROO is an agreed-upon rule for what products can be considered to have originated in the countries that are parties to a free-trade agreement, and therefore are eligible to be shipped from one member country to another tariff-free. ROO's take several forms, but the form we focus on for tractability is a rule that specifies a minimum content requirement; for example, within the context of NAFTA, a rule that specifies what fraction of the costs of a given product must be accounted for by North-American produced inputs or North-American labor.

The analysis of optimal (and equilibrium) ROO's is qualitatively quite different from the corresponding analysis of tariffs. It turns out that optimal ROO's quite often take the form of a corner solution, and when ROO's serve a protectionist function there are cases in which an increase in protectionism can worsen rather than improve the terms of trade of the country using it. These are starkly different from results obtained with tariffs. We allow for ROO's to be set differently for different industries, so both the level and the inter-industry pattern of ROO's are endogenous. We show conditions such that in equilibrium the *ex ante* optimal level of ROO's from the US point of view are not optimal *ex post*, after the partner country's firms have sunk their investments. *Ex post*, Congress would want to tighten those ROO's, extracting more rents from the partner country. This is the source of the hold-up problem that emerges, and is a major departure from the earlier FTA papers, all of which focus on tariffs.

*Prior work.* In formalizing this interpretation, we draw on a wide range of prior work. The idea that firms wishing to export to a given destination must make sunk investments to do so has been explored in many ways. Verhoogen (2008) shows that Mexican firms that begin to export to the US typically upgrade their quality when they do so. Hallak and Sivadasan (2013) show how the need to upgrade quality for a high-income export market

helps fit firm-level data on trade flows. Handley (2012) and Handley and Limão (2012) show that a model in which firms must make a sunk cost to export help explain the effect of uncertainty about future trade policy.

The effects of sunk costs or anticipatory investment on equilibrium policy has been studied from a number of angles. Staiger and Tabellini (1989) study time consistency of optimal policy when private resource allocation decisions are made in anticipation of policy. McLaren (1997) shows how anticipatory investment can cause a small country to suffer from a hold-up problem in liberalizing trade with a larger one, and McLaren (2002) shows how similar considerations can lead to the world dividing up into inefficient, exclusionary trade blocks rather than multilateral free trade. Maggi and Rodriguez-Clare (2007) show how similar considerations can motivate a trade agreement as a commitment device to hedge against the influence of domestic political interest groups.

In addition, we rely heavily on work by the small number of authors who have pioneered the study of ROO's, such as Krueger and Krishna (1995), who highlighted the protectionist function that ROO's can have and that is central in our model; Krishna (2006), who set out much of the basic analytical structure for ROO modelling; and Anson et al (2005), who measure the empirical effects of ROO's on trade.

In the following section we lay out the model, including consumption, production, bargaining, and how ROO's work. The following section shows how to calculate welfare. The following section shows the optimal policy and equilibrium under FTA, and the last section analyzes the equilibrium without FTA, showing how the hold-up problem emerges. The Conclusion reviews how the pieces fit together.

## 2 Model

### 2.1 Overview.

In order to have a discussion of a free-trade agreement with ROO's, we need to have at least two member countries plus at least one non-member country. Accordingly, our model includes the US, a partner country that we will call Mexico (M), and a non-member country

(N). Further, in order to allow for US policy on ROO's to pose a potential hold-up threat, it must be the case that Mexican manufacturers produce using both North-American-produced inputs, which for concreteness we assume are produced in Mexico; and non-member produced imported inputs. In order for the ROO to have a possibility of being satisfied in non-trivial cases, it must be possible for Mexican manufacturers to raise their domestic content, which implies that it is possible to substitute Mexican-produced inputs at least partially for non-member produced inputs. We allow this by specifying a Cobb-Douglas production function for Mexican manufactures that takes as arguments a composite of non-member-produced inputs, Mexican-produced inputs; and labor.

We model Mexican manufactures as produced in a monopolistically-competitive sector, which allows for the number of varieties produced to adjust to policy as an important endogenous outcome. To avoid an artificial separation between producers of industrial inputs and producers of final goods, we adopt the convenience of assuming that all manufactured goods are both final goods and inputs, just as in Krugman and Venables (1995) or Eaton and Kortum (2002). This creates a situation in which backward and forward linkages are important: An increase in demand for Mexican products can increase the range of Mexican inputs produced, lowering marginal costs for all Mexican firms. The strength of these backward and forward linkages will be an important factor in the analysis.

Some stylized simplifications in our model should be pointed out. First, we are not interested in the details of either the US or non-member economy, so these essentially both become single-product endowment economies, the US producing a numeraire consumption good, and the non-member country producing a composite input. Second, we are not interested in conflict of interest between members of Congress or between Congress and the President, since those issues have been carved out in great detail in the other FTA papers reviewed above and are not important to the hold-up problem that is our focus. Therefore, we implicitly assume that each congressional district has the same economic features, so that all members of Congress have the same preferences over policy, and so does the executive branch.

The inter-governmental bargaining structure is very simple. There are two periods. If Mexico agrees to negotiate, in period 1 the US executive branch makes a take-it-or-leave-it offer, which the government of Mexico either accepts or rejects. At the same time, each Mexican firm decides whether or not to undertake a sunk investment in quality upgrade, which is essential to export to the US market. In period 2, if FTA has been enacted, the US Congress either accepts or rejects the agreement that was struck in period 1 between the two governments, and production and consumption occur, whether there is an agreement or not. If FTA has not been enacted, then Congress may amend it; if the amendments are accepted by the Mexican government, the amended agreement goes into force, otherwise there is no agreement.

## 2.2 Consumption.

We consider a world with three countries: the United States (US); Mexico (M); and the rest of the world, a composite of countries that are not a party to the negotiations between the US and Mexico, and which we will refer to as the ‘non-member country’ (N) for short. Each individual has an identical utility function given by

$$u = \left(\frac{x_0}{\alpha}\right)^\alpha \left(\frac{Q}{1-\alpha}\right)^{1-\alpha}, \quad (1)$$

where  $x_0$  is a homogenous numeraire good and  $Q$  represents a composite good. Therefore, each individual spends a constant share of income on each good ( $\alpha$  share on numeraire and  $1 - \alpha$  share on composite good).

The composite good  $Q$  is represented by the continuous-analogue Cobb-Douglas function:

$$\ln Q = \int_{j=0}^1 \ln Q_j,$$

where  $Q_j$  represents consumption of a composite good made up of varieties of products produced by industry  $j \in [0, 1]$ . If the set of products available in industry  $j$  is  $\Omega_j \in \mathfrak{R}$ , then

aggregate consumption in industry  $j$  is

$$Q_j = \left[ \int_{i \in \Omega_j} q_j(i)^\rho \right]^{\frac{1}{\rho}}, \quad 0 < \rho < 1,$$

which is a CES function of the consumption of different varieties of  $q_j(i)$ . The range of  $i$  will be endogenously determined in equilibrium.

We can derive the demand function for a variety  $i$  in sector  $j$ ,  $q_j(i)$ , from the minimization problem given by

$$\begin{aligned} \min_{q_j(i)} \int_{i \in \Omega} p_j(i) q_j(i) di \quad \text{s.t.} \quad Q_j &= \left[ \int_{i \in \Omega} q_j(i)^\rho \right]^{\frac{1}{\rho}}. \\ q_j(i) &= \left[ \frac{p_j(i)}{P_j} \right]^{\frac{1}{\rho-1}} Q_j, \end{aligned} \quad (2)$$

where  $P_j = \left[ \int_{i \in \Omega} p_j(i)^{\frac{\rho}{\rho-1}} di \right]^{\frac{\rho-1}{\rho}}$  represents the aggregate price of composite sector  $j$  good,  $Q_j$ .

Next, we can find the demand function for a composite industry good  $j$ ,  $Q_j$ , in a similar fashion as

$$\begin{aligned} \min_{Q_j} \int_{j=0}^1 P_j Q_j dj \quad \text{s.t.} \quad \ln Q &= \int_{j=0}^1 \ln Q_j dj. \\ Q_j &= \frac{P_j Q}{P_j} \end{aligned} \quad (3)$$

where  $P = e^{\int_{j=0}^1 \ln P_j}$  represents the price of composite good  $Q$ . Finally, solving the consumer's utility maximization problem, we have

$$\max_{x_0, Q} x_0^\alpha Q^{1-\alpha} \quad \text{s.t.} \quad x_0 + PQ = Y,$$

where  $Y$  and  $P$  represents total spending and aggregate price of composite good, respectively.

Solving the above expression results

$$\begin{aligned} x_0 &= \alpha Y, \quad \text{and} \\ Q &= \frac{(1-\alpha)Y}{P}. \end{aligned} \quad (4)$$

Using  $P = e^{\int_{e^j=0}^1 \ln P_j}$ , equation (4) becomes

$$Q = \frac{(1 - \alpha)Y}{e^{\int_{e^j=0}^1 \ln P_j}}. \quad (5)$$

In addition, using equations (3), (2) and (5), we obtain

$$Q_j = \frac{(1 - \alpha)Y}{P_j}, \text{ and} \quad (6)$$

$$q_j(i) = \left[ \frac{p_j(i)}{P_j^\rho} \right]^{\frac{1}{\rho-1}} (1 - \alpha)Y. \quad (7)$$

## 2.3 Production.

The numeraire good is produced in the US with labor alone such that one unit of labor produces one unit of output.

Each Mexican differentiated-product manufacturing firm  $i$  produces output  $q_j(i)$  following the production function:

$$q_j(i) = \left( \frac{X_j(i)}{\beta} \right)^\beta \left( \frac{L_j(i)}{1 - \beta} \right)^{1-\beta}, \quad (8)$$

where  $X_j(i)$  and  $L_j(i)$  are respectively the amount of composite input and labor used by firm  $i$  in industry  $j$ . Accordingly, the unit cost function is given by

$$c_j(i) = P_I^\beta w^{(1-\beta)},$$

where  $P_I$  is the cost of composite manufactured inputs and  $w$  is the wage. The total cost of producing  $q_j(i)$  units of output is then given as

$$C_j(i) = P_I^\beta w^{(1-\beta)} (q_j(i) + F),$$

where the cost function involves a marginal cost  $P_I^\beta w^{(1-\beta)}$  and fixed overhead cost  $P_I^\beta w^{(1-\beta)} F$ .<sup>1</sup>

In order to export to the US, a Mexican firm must incur an additional fixed cost,  $P_I^\beta w^{(1-\beta)} S$ , which we interpret as a quality upgrade. Importantly, the quality upgrade cost

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<sup>1</sup>For analytical convenience, we model the fixed cost as denominated in units of output.

is sunk; a firm must incur this cost in period 1 in order to be ready to export in period 2. The fixed cost of production is not sunk, however; a firm that has not invested in the quality upgrade can shut down in period 2, thereby avoiding all cost.

## 2.4 Cost of composite input.

The price index for the composite input produced by industry  $j$  is:

$$P_j = \left( \int_{i \in \Omega} p_j(i)^{\frac{\rho}{\rho-1}} \right)^{\frac{\rho-1}{\rho}}, \quad (9)$$

where  $p_j(i)$  is the price charged by firm  $i$  in industry  $j$ .

Given the symmetry of each variety, for a purchaser of inputs from industry  $j$  in Mexico we have

$$P_j = n_j^{\frac{\rho-1}{\rho}} p_j, \quad (10)$$

and the price of the overall composite Mexico-produced input is:

$$P_M = e^{\int_0^1 \ln P_j dj} = e^{\int_0^1 \ln \left( n_j^{\frac{\rho-1}{\rho}} p_j \right) dj} = n_j^{\frac{\rho-1}{\rho}} p_j = P_j. \quad (11)$$

This will be combined with the inputs produced abroad to make up the overall composite input price.

Suppose that the composite input is produced from the Mexican-produced composite and an input from non-member countries through a Cobb-Douglas production function with a weight of  $\eta$  on the Mexican composite, so that the unit cost is:

$$P_I(P_M, P_N) = P_M^\eta P_N^{1-\eta}, \quad (12)$$

where  $P_M$  is the price of composite Mexican input and  $P_N$  is the price of the non-member country input.

## 2.5 Output per firm.

In this section, we will analyze firm's profit maximization problem. The profits of a firm that produces variety  $i$  in sector  $j$  are:

$$\begin{aligned}\pi_i &= p_j(i)q_j(i) - P_I^\beta w^{(1-\beta)} (q_j(i) + F) \\ &= q_j(i) \left[ p_j(i) - P_I^\beta w^{(1-\beta)} \right] - P_I^\beta w^{(1-\beta)} F\end{aligned}$$

Using equation (7), we can rewrite the above profit function as

$$\pi_i = P_j^{\frac{\rho}{1-\rho}} (1 - \alpha) Y \left[ p_j(i)^{\frac{\rho}{\rho-1}} - p_j(i)^{\frac{1}{\rho-1}} P_I^\beta w^{(1-\beta)} \right] - P_I^\beta w^{(1-\beta)} F$$

Maximizing this expression with respect to  $p_j(i)$  gives us

$$p_j(i) = \frac{P_I^\beta w^{(1-\beta)}}{\rho}. \quad (13)$$

As a result, optimal price dictates a constant markup of  $\frac{1}{\rho}$ . Plugging the value of  $p_j(i)$  into the profit function and using the zero-profit condition, we can calculate the amount of variety  $i$  as

$$\begin{aligned}\pi_i &= q_j(i) \frac{1-\rho}{\rho} P_I^\beta w^{(1-\beta)} - P_I^\beta w^{(1-\beta)} F = 0 \\ \Rightarrow q_j(i) &= \frac{\rho}{1-\rho} F.\end{aligned}$$

## 2.6 Equilibrium marginal costs.

Marginal costs for a Mexican manufacturer are a function of the endogenous Mexican wage and input prices as well as the variety of inputs available. Since a range of those inputs are produced by those same Mexican manufacturers, Mexican marginal cost is defined by a recursive relationship. Denote marginal cost for a typical Mexican firm in industry  $j$  by  $c$ , we have:

$$\begin{aligned}
c &= P_I^\beta (w^*)^{1-\beta} \\
&= P_M^{\beta\eta} P_N^{\beta(1-\eta)} (w^*)^{1-\beta} \\
&= \left( p_j n_j^{\frac{\rho-1}{\rho}} \right)^{\beta\eta} P_N^{\beta(1-\eta)} (w^*)^{1-\beta} \\
&= \rho p_j,
\end{aligned} \tag{14}$$

where as before  $p_j$  is the price of a typical variety. Solving for  $p_j$  and using once again the fact that the equilibrium mark-up of each variety's price over marginal cost is equal to  $1/\rho$ , we derive:

$$c = \left( \frac{n^{\frac{\rho-1}{\rho}}}{\rho} \right)^{\frac{\beta\eta}{1-\beta\eta}} \left( P_N^{\beta(1-\eta)} (w^*)^{1-\beta} \right)^{\frac{1}{1-\beta\eta}}. \tag{15}$$

Ceteris paribus, marginal costs for any Mexican firm are lower the more of them there are, since that expands the variety of inputs available. Marginal costs are also higher, the more expensive are the inputs from non-member countries and the higher is the Mexican wage. The later have an amplified effect as indicated by the exponent  $\frac{1}{1-\beta\eta}$  because any factor that raised marginal costs for any one firms by 10% holding domestic input prices constant will also raise all other firms' marginal costs, thus raising domestic input prices and therefore increasing marginal costs by more than 10%.

It should be noted that equilibrium in a model of this sort is generically inefficient. This is so despite that fact that in simple Dixit-Stiglitz models of monopolistic competition the number of firms is typically efficient in equilibrium. However, the backward and forward linkages in this model create a positive externality from entry; if a firm enters, it lowers marginal cost for all other firms, from (15), and it does not take into account the productivity benefit it confers on all other firms in making its entry decision. This is the core market failure behind the multiple equilibria in Krugman and Venables (1995), for example. Later, we will see that if the linkages are strong enough, a policy that forces Mexican manufacturers to buy more domestic inputs can raise Mexican welfare, because it helps to correct this market failure.

## 2.7 Rules of origin.

Under a free-trade agreement between the US and Mexico, if a rule of origin is imposed on an industry  $j$ , then there is a fraction, say  $\theta_j$ , such that a Mexican good is not eligible for duty-free entry into the US unless at least  $\theta_j$  of the costs of producing it are North-American in origin. This is a requirement that the firm's spending on labor and Mexican-made inputs for producing the export must be at least  $\theta_j$  times the total costs incurred in producing the export. If the ROO is satisfied, the product can then be sold in the US without tariff, but the manufacturer also has the option of ignoring the ROO and paying the tariff instead.

Three assumptions should be clarified here, which make the analysis much simpler than it would be in their absence. First, we assume that a firm can satisfy the ROO by ensuring a high domestic content share on its exports alone; production for the Mexican market need not enter into the calculation. Second, we assume that production for the US market under a ROO does not require setting up a separate plant and incurring the fixed production cost  $F$  again. These two assumptions together might be called a 'velvet rope' assumption: A firm can separate out, within one production facility, production for export from production for domestic sale, keeping track of paperwork recording input and labor use so that it can document that the ROO is satisfied on the former without imposing it on the latter.

Third, we assume that for the purposes of the ROO an input produced by a Mexican firm with Mexican labor counts as Mexican cost for production of a good for sale in the US, even if that input itself does not satisfy the ROO. For example, Levent's Sunshine Toaster Company in Monterrey, Mexico, which wants to sell toasters in the US market, can satisfy its ROO partly by buying Mexican-produced heating coils, even if those heating coils themselves do not satisfy an ROO.

## 2.8 Comparison ROO and NROO

Now, we consider the decision by a Mexican firm that intends to export its product to the US of whether or not to satisfy its industry's ROO.

The profit of a firm  $j$  that chooses ROO option is given by

$$\pi_j^{ROO}(i) = [p_j(i) - c_j^{ROO}(i)] q_j(i) - c_j^{ROO}(i)F,$$

where  $c_j^{ROO} = (P_j^{ROO})^\beta w^{(1-\beta)}$ . Next, using equations (13), (7) and also the zero profit condition, we can rewrite the above equation as

$$\begin{aligned} \pi_j^{ROO}(i) = 0 &\iff \frac{1-\rho}{\rho} c_j^{ROO}(i) \left[ \frac{c_j^{ROO}(i)}{P_j^\rho} \right]^{\frac{1}{\rho-1}} (1-\alpha)Y = c_j^{ROO}(i)F, \text{ or} \\ &\left[ \frac{c_j^{ROO}(i)}{P_j^\rho} \right]^{\frac{\rho}{\rho-1}} (1-\rho)(1-\alpha)Y = c_j^{ROO}(i)F \end{aligned} \quad (16)$$

Similarly, we can also write the profit of a firm  $j$  under NROO option as

$$\pi_j^{NROO}(i) = [p_j(i) - c_j^{NROO}(i)] q_j(i) - c_j^{NROO}(i)F$$

where  $c_j^{NROO} = (P_j^{NROO})^\beta w^{(1-\beta)}$ . Furthermore,  $p_j(i)$  represents the FOB price for the firm. Next, using equations (13) and (7), we can rewrite the above equation as

$$\begin{aligned} \pi_j^{NROO}(i) = 0 &\iff \frac{1-\rho}{\rho} c_j^{NROO}(i) \left[ \frac{(1+\tau)c_j^{NROO}(i)}{P_j^\rho} \right]^{\frac{1}{\rho-1}} (1-\alpha)Y = c_j^{NROO}(i)F, \text{ or} \\ &\left[ \frac{c_j^{NROO}(i)}{P_j^\rho} \right]^{\frac{\rho}{\rho-1}} (1+\tau)^{\frac{1}{\rho-1}} (1-\rho)(1-\alpha)Y = c_j^{NROO}(i)F. \end{aligned} \quad (17)$$

As a result, for firm  $j$  to be indifferent between ROO option and NROO option, we must have

$$\begin{aligned} \frac{\pi_j^{ROO}(i)}{\pi_j^{NROO}(i)} &= 1 \iff \left[ \frac{c_j^{ROO}(i)}{c_j^{NROO}(i)} \right]^{\frac{\rho}{\rho-1}} \left( \frac{1}{1+\tau} \right)^{\frac{1}{\rho-1}} = \frac{c_j^{ROO}(i)}{c_j^{NROO}(i)}, \\ &\text{or} \\ \frac{c_j^{ROO}(i)}{c_j^{NROO}(i)} &= 1 + \tau. \end{aligned}$$

Therefore, for those firms that have  $c_j^{ROO}(i) > (1+\tau)c_j^{NROO}(i)$  will choose ROO option whereas the ones with  $c_j^{ROO}(i) < (1+\tau)c_j^{NROO}(i)$  will choose NROO option.

## 2.9 The Cost of an ROO.

If the Mexican firm is allowed to minimize costs taking prices as given without constraints, it will produce with a share of North American costs equal to

$$1 - \beta + \beta\eta = 1 - \beta(1 - \eta), \quad (18)$$

since  $1 - \beta$  is the share of Mexican labor in costs and  $\beta\eta$  is the share of Mexican-produced inputs in costs.

Suppose that the ROO requires firms to maintain a North American share of costs at least equal to  $\theta$  in order to export to the US without paying a tariff. Then if  $\theta \leq 1 - \beta(1 - \eta) \equiv \underline{\theta}$ , the firm satisfies the ROO even with unconstrained cost minimizing, and so if it chooses to export, it will export duty-free to the US.

Now, suppose that  $1 - \beta(1 - \eta) < \theta$ . Now, the firm cannot satisfy the ROO without incurring some additional cost to raise the North American share of its costs. Note that if the firm chooses to satisfy the ROO, it will do so in the lowest-cost manner possible. This will require that it maintain the right mix of local labor and locally-produced inputs to keep their marginal rate of substitution equal to the relative price. Given the production functions, this can be achieved by increasing the labor and local inputs per unit of output by the same proportion.

Suppose that a firm increases labor input and Mexican-produced inputs per unit of output by the factor  $X > 1$ . This implies that it reduces its rest-of-world input used by a factor  $Y = X^{-\frac{(1-\beta(1-\eta))}{\beta(1-\eta)}} < 1$ . Write the unit demand for Mexican composite input, rest-of-world input, and labor in the unconstrained cost minimization respectively as  $q_M$ ,  $q_R$ , and  $l$ . Then the North American cost share following the adjustment in inputs is:

$$\frac{P_M q_M X + w l X}{P_M q_M X + P_R q_R X^{-\frac{(1-\beta(1-\eta))}{\beta(1-\eta)}} + w l X} = \frac{1 - \beta(1 - \eta)}{1 - \beta(1 - \eta) + \beta(1 - \eta) X^{-\frac{1}{\beta(1-\eta)}}}. \quad (19)$$

Setting this equal to  $\theta$  and solving for  $X$  yields

$$X^{-\frac{1}{\beta(1-\eta)}} = \frac{(1 - \theta)(1 - \beta(1 - \eta))}{\theta\beta(1 - \eta)}. \quad (20)$$

If we write the unconstrained minimized unit cost as  $c_{UNC}$  and the minimized unit cost subject to the ROO as  $c_{ROO}$ , then substituting the expression for  $X$  into costs yields:

$$CCR(\beta, \eta, \theta) \equiv \frac{c_{ROO}}{c_{UNC}} = \left( \frac{1 - \beta(1 - \eta)}{\theta} \right)^{1 - \beta(1 - \eta)} \left( \frac{\beta(1 - \eta)}{1 - \theta} \right)^{\beta(1 - \eta)}, \quad (21)$$

where  $CCR(\beta, \eta, \theta)$  is the compliance cost ratio. This takes a value of 1 at  $\theta = 1 - \beta(1 - \eta)$  and increases as  $\theta$  increases above that value, becoming unbounded as  $\theta$  approaches unity. Further, it is straightforward to confirm that

$$\frac{\partial \log(CCR)}{\partial \beta} = (1 - \eta) \log \left( \left( \frac{\beta(1 - \eta)}{1 - \beta(1 - \eta)} \right) \left( \frac{\theta}{1 - \theta} \right) \right) > 0 \iff \theta > 1 - \beta(1 - \eta), \quad (22)$$

so the compliance cost ratio is increasing in the input intensity  $\beta$  as long as the rule of origin is a binding constraint.

If we define  $\bar{\theta}$  as the value of  $\theta$  such that  $CCR(\beta, \eta, \theta) = (1 + \tau)$ , then the following holds.

**Proposition 1** *If  $\theta_j < \underline{\theta}$ , then all exporting firms in industry  $j$  will source inputs to minimize cost; the ROO will not bind; and they will export to the US without paying tariff. If  $\underline{\theta} < \theta_j < \bar{\theta}$ , then all exporting firms in industry  $j$  will source inputs to satisfy the ROO exactly for their export operation; the ROO binds; and they will export to the US without paying tariff. If  $\theta_j > \bar{\theta}$ , then all exporting firms in industry  $j$  will source inputs to minimize cost, ignoring the ROO; and they will export to the US and pay the MFN tariff.*

This summarizes the firm's decision on whether or not to comply with a ROO: It will ignore a very low or very high ROO, but comply with an intermediate ROO, raising its costs as it does so but avoiding the tariff.

## 2.10 A key proposition on optimal ROO policy.

Some basic comparative statics regarding the effects of ROO's can now be derived.

**Proposition 2** *Suppose that the rules of origin  $\{\theta_j\}$  for  $j \in [0, 1]$  have been set so that a fraction  $R$  of the industries have  $\theta_j > \bar{\theta}$  (and thus ignore the ROO and pay the tariff); a fraction  $(1 - R)(1 - s)$  have  $\theta_j < \underline{\theta}$  (and thus for them the ROO is not binding); and a*

*fraction  $(1 - R)s$  have  $\underline{\theta} < \theta_j < \bar{\theta}$  (and thus comply with the ROO). Denote the average value of  $\theta_j$  for the complying industries by  $\theta$ . Now consider changing the ROO schedule so that  $\theta$  changes but not  $R$  or  $s$ . Then:*

$$\frac{\partial w^*}{\partial \theta} > 0, \frac{\partial n^*}{\partial \theta} > 0, \text{ and } \frac{\partial P_N Q_N}{\partial \theta} < 0. \quad (23)$$

If complying firms are made to increase their purchases of Mexican inputs and labor, that increases the demand for Mexican labor, raising the Mexican wage; raises the demand for Mexican inputs, increasing the number of inputs produced; and lowers the import of non-member inputs. Now, note that the tightening of ROO's increases  $w^*$ , which tends to raise the marginal cost of Mexican manufacturers, while it also raises  $n$ , which, recalling (15), tends to have the opposite effect. The net effect on Mexican costs is ambiguous, and depends on the following condition.

**Proposition 3**

$$\frac{\partial c}{\partial \theta} > 0 \quad (24)$$

*if and only iff*

$$\beta\eta < \frac{\rho(1 - \beta)}{(1 - \rho)}. \quad (25)$$

The stronger are backward and forward linkages, or in other words the bigger is  $\beta\eta$ , the more likely it is that the effect of the ROO on the number of Mexican firms dominates for marginal costs. This brings us to a very important conclusion on policy.

**Proposition 4** *If (25) is satisfied, it is never optimal from the point of view of US welfare for a positive mass of industries to have ROO's with  $\underline{\theta} < \theta < \bar{\theta}$ .*

The point is that if (25) is satisfied, when  $\theta$  is in the middle range, it raises the cost of producing Mexico's exports to the US, raising their prices to US consumers, but does not generate any tariff revenue. From here on, we will assume (25) unless otherwise stated, and therefore, without loss of generality, we can assume that for each  $j$ ,  $\theta_j$  is equal to either above  $\bar{\theta}$  (it makes no difference how far above) or below  $\underline{\theta}$  (it makes no difference how far

below). For brevity, henceforth we will call the former case a case with ‘no ROO,’ and the latter the case of a ‘ROO.’

It is worth underlining the inefficiency of equilibrium implied by Proposition 3. If backward and forward linkages are strong enough that (25) is not satisfied, then *Mexican firms’ costs are reduced if they are all forced to deviate from cost-minimizing behavior by an ROO that makes them buy more Mexican inputs than they would choose on their own.* The reason is that it spurs additional firm creation, which is possible without any additional resources because the additional firms raise the productivity of all Mexican firms. We will analyze at the end of the paper the case with such strong linkages.

## 2.11 National incomes as function of trade policy.

First, we analyze equilibrium under a free trade agreement. Let  $R$  denote the number of industries hit with an ROO. Each firm in each of these industries will choose to pay the tariff  $\tau$  when exporting to the US. Let national income in the US, which in this model amounts to GDP plus any tariff revenue, be denoted by  $Y$ , and let national income in Mexico be denoted  $Y^*$ .

Of course, an industry not subject to an ROO generates no tariff revenue. For an industry  $j$  with an ROO, US consumer spending on the industry is

$$(1 - \alpha)Y, \tag{26}$$

but only

$$\frac{(1 - \alpha)Y}{1 + \tau} \tag{27}$$

of that spending reaches the Mexican producers. Consequently, the tariff revenue generated by each ROO industry is equal to

$$\frac{\tau(1 - \alpha)Y}{1 + \tau}, \tag{28}$$

and so total tariff revenue is given by multiplying this value by  $R$ . Consequently, national income can be written as:

$$Y = L + R \frac{\tau(1 - \alpha)Y}{1 + \tau}, \tag{29}$$

where  $L$  is US GDP (the wage, equal to unity, times the labor supply) plus tariff revenue. Simplifying, this yields:

$$Y = \left( \frac{(1 + \tau)}{1 + (1 - R(1 - \alpha))\tau} \right) L. \quad (30)$$

Note that this is always greater than the GDP,  $L$ , unless the tariff is equal to zero or  $R = 0$ , so that no Mexican industry pays the tariff. (The case in which there is no trade agreement in force can be represented conveniently by setting  $R = 1$ , so that all Mexican imports to the US are subject to tariff.)

Mexican income can be derived in a similar way. First we note that:

$$Y^* = w^*L^* + \Pi^* + TR^*, \quad (31)$$

where  $w^*$  is the Mexican wage,  $L^*$  is the supply of labor in Mexico,  $\Pi^*$  is aggregate profits in Mexico, and  $TR^*$  is tariff revenue in Mexico. In equilibrium,  $\Pi^* = 0$ , but to analyze the case without FTA we will need to be able to compute income off of the equilibrium path, so that the trade policy expected by entrepreneurs is different from what is finally implemented, and in that case we can have non-zero profits. By an argument parallel to that used to derive (30), we can write:

$$Y^* = \left( \frac{(1 + d\tau^*)}{1 + (1 - \alpha)d\tau^*} \right) (w^*L^* + \Pi^*), \quad (32)$$

where  $\tau^*$  is the Mexican tariff and  $d$  is a dummy variable for MFN that takes a value of 1 if there is no free trade agreement in force, so that all US imports are subject to the tariff  $\tau^*$ , and 0 if a free trade agreement is in force, so that US imports enter the country duty-free. Once again, note that because of tariff revenue, Mexican income strictly exceeds Mexican GDP,  $w^*L^*$ , unless the Mexican tariff has a value of zero or there is a free trade agreement in force. Since the two endogenous variables in (32) are  $w^*$  and  $d$ , it will be convenient to write this as  $Y^*(w, d)$ .

## 2.12 Equilibrium wage in Mexico.

We consider market-clearing conditions for the US numeraire good. Recall that under our assumptions this is produced only in the US, but it is consumed everywhere. Its supply is

of course equal to the US labor supply,  $L$ , which, since it is the numeraire good, is both the quantity produced and the value sold. Domestic US consumer spending on the numeraire good is  $\alpha Y$ . Mexican consumer spending on the numeraire good is  $\alpha Y^*$ , of which  $\frac{\alpha Y^*}{(1+d\tau^*)}$  is the value received by US producers.

To arrive at the demand from non-member countries we need a slightly roundabout argument. Suppose that in the aggregate a quantity  $Q_N$  of input is imported to Mexico from non-member countries at the constant world price of  $P_N$ . Then Mexico will have a trade deficit with non-member countries amounting to  $P_N Q_N$ . Since each country's trade must be balanced overall in equilibrium, Mexico must run a trade surplus with the US exactly equal to this amount, and since US trade must also be balanced overall, the US runs an equal-sized trade surplus with non-member countries. Therefore, US sales of its numeraire good to non-member countries must be equal in equilibrium to  $P_N Q_N$ .

Therefore, market clearing for the numeraire good can be written as:

$$L = \alpha Y + \frac{\alpha Y^*}{(1+d\tau^*)} + P_N Q_N. \quad (33)$$

Since cost minimization by Mexican firms implies that labor's share of total production costs is equal to  $(1-\beta)$  and non-member inputs' share is equal to  $\beta(1-\eta)$ , and in the aggregate labor's share of costs must be equal to  $w^* L^*$ , the condition can be rewritten as:

$$L = \alpha Y + \frac{\alpha Y^*}{(1+d\tau^*)} + \frac{\beta(1-\eta)}{(1-\beta)} w^* L^*. \quad (34)$$

Using (30) and (32), this can be rewritten:

$$(1-\alpha) \left( \frac{1+(1-R)\tau}{1+(1-R(1-\alpha))\tau} \right) L = \left( \frac{\alpha}{(1+(1-\alpha)d\tau^*)} + \frac{\beta(1-\eta)}{(1-\beta)} \right) w^* L^*,$$

or

$$w^* = \left( \frac{(1-\alpha)(1-\beta)(1+(1-\alpha)d\tau^*)}{\alpha(1-\beta) + \beta(1-\eta)(1+(1-\alpha)d\tau^*)} \right) Z(R) \frac{L}{L^*}, \quad (35)$$

where

$$Z(R) \equiv \left( \frac{1+(1-R)\tau}{1+(1-R(1-\alpha))\tau} \right). \quad (36)$$

This condition implicitly determines the value of the Mexican wage in terms of the numeraire,  $w^*$ , in equilibrium. Note that it is decreasing in  $\alpha$  and  $L^*/L$ , since these parameters respectively shift relative demand toward US-made goods, away from Mexican-produced goods, and increase the relative supply of Mexican labor. For our discussion, there are two relevant policy variables,  $R$  and  $d$  (since we are taking the existing tariff rates as given, but governments in the course of negotiation can choose the coverage of ROO's and whether or not to walk away from the free-trade agreement). Therefore, we can use (35) to define the equilibrium Mexican wage as a function of these two variables,  $w^*(R, d)$ . It is easy to verify that this function is decreasing in  $R$  and increasing in  $d$ . An increase in  $R$  causes a wider range of Mexican industries to be subject to US tariffs, which switches US consumer demand away from Mexican-produced goods. Switching  $d$  from 0 to 1 amounts to tearing up the free-trade agreement, which causes the Mexican tariff to be in force on all imports from the US. This pushes down the relative price of the numeraire good relative to Mexican products, raising the Mexican wage  $w^*$  relative to the US wage, and providing Mexico with a terms-of-trade benefit.

**Proposition 5** *The Mexican wage in terms of the numeraire,  $w^*$ , is decreasing in the number  $R$  of industries hit by rules of origin and is also decreased if Mexico eliminates its tariff (switching  $d$  from 1 to 0).*

### 2.13 Equilibrium number of firms.

Consider first the number of firms in each Mexican industry that choose to export to the US. For an industry  $j$  that is not subject to an ROO, US consumer spending on the industry's products together is equal to  $(1 - \alpha)Y$ . Each firm produces  $\frac{\rho}{1-\rho}S$  units of marketted output. In order for the total industry export revenues to be equal to the value of consumer spending on the products, we must have

$$\tilde{n}_j p_j \left( \frac{\rho}{1-\rho} \right) S = (1 - \alpha)Y, \quad (37)$$

where  $\tilde{n}_j$  denotes the number of  $j$ -industry firms that choose to export. This yields the equilibrium number of exporters for a typical non-ROO industry:

$$\tilde{n}^{NR} = (1 - \alpha)(1 - \rho) \frac{Y}{Sc}, \quad (38)$$

For an industry subject to an ROO, the analysis is the same except that only  $1/(1 + \tau)$  of the consumer spending is received by firms, so their equilibrium number is reduced accordingly:

$$\tilde{n}^R = \frac{\tilde{n}^{NR}}{(1 + \tau)}. \quad (39)$$

The total number of exporters  $\tilde{n}$  is defined as

$$\tilde{n} = R\tilde{n}^R + (1 - R)\tilde{n}^{NR}.$$

It is straightforward to derive that if Mexican firms correctly anticipate the ROO policy that will be followed, then a more restrictive ROO policy will result in fewer exporters:

**Proposition 6** *The total number of exporting firms in Mexico,  $\tilde{n}$ , is decreasing in  $R$  in equilibrium.*

Turning now to the equilibrium number of domestic Mexican firms, we need to add up the total domestic Mexican demand for a typical industry  $j$ . This consists of Mexican final consumer demand; demand by Mexican firms for inputs to produce output for domestic sale; and demand by Mexican firms for inputs to produce output for export. Domestic consumer demand is equal to  $(1 - \alpha)Y^*$ , and the demand for inputs to produce that much output amounts to  $\beta\eta(1 - \alpha)Y^*$ . Regarding input demand due to exports, total revenues from exports, and therefore total costs for export production, amount to  $(1 - \alpha)Y$  for a non-ROO industry and  $\frac{(1 - \alpha)}{(1 + \tau)}Y$  for an ROO industry. Given that there are  $(1 - R)$  of the former and  $R$  of the latter industries and that in each industry a fraction  $\beta\eta$  of the cost amounts to domestic input demand, the condition matching up industry  $j$ 's revenues with the total demand for its products becomes:

$$np \left( \frac{\rho}{1 - \rho} \right) F = (1 - \alpha) \left[ Y^* + \frac{\beta\eta}{1 - \beta\eta} Y^* + \left( \frac{1 + (1 - R)\tau}{1 + \tau} \right) \frac{\beta\eta}{1 - \beta\eta} Y \right],$$

so

$$n = \frac{(1-\alpha)(1-\rho)}{(1-\beta\eta)F} \left[ Y^*(w^*, d) + \left( \frac{1+(1-R)\tau}{1+\tau} \right) \beta\eta Y \right] \frac{1}{c(n, w^*)}.$$

Using (30), (32), and (35), this can be rewritten as:

$$n = \left( \frac{(1-\alpha)(1-\rho)}{(1-\beta\eta)F} \right) \left[ \frac{(1-\alpha)}{\left( \frac{\alpha}{(1+(1-\alpha)d\tau^*)} + \frac{\beta(1-\eta)}{(1-\beta)} \right)} \frac{1+d\tau^*}{1+(1-\alpha)d\tau^*} + \beta\eta \right] \frac{Z(R)L}{c(n, w^*)}. \quad (40)$$

From (15), the right-hand side of (40) is increasing in  $n$ , taking a limit of 0 as  $n \rightarrow 0$ .

Further, the elasticity of the right-hand side with respect to  $n$  is equal to:

$$\left( \frac{1-\rho}{\rho} \right) \left( \frac{\beta\eta}{1-\beta\eta} \right) \quad (41)$$

We make the following assumption:

$$\eta < \frac{\rho}{\beta}, \quad (42)$$

which is necessary for stability of the equilibrium.

We can now identify the main comparative statics results with respect to a change in the ROO policy. It will be useful to focus on elasticities, and we use denote by  $\xi_x^y$  the elasticity of variable  $y$  with respect to the variable  $x$ . Nothing in the big parenthesis or the big square brackets of (40) depends on  $R$  either directly or indirectly, so in computing the elasticity  $\xi_{n,R}^{FTA}$  of  $n$  with respect to  $R$  under FTA, we need only to focus on the fraction at the end of the expression. Given (15), this amounts to:

$$\xi_{n,R}^{FTA} = \xi_{Z,R} - \left( \frac{\rho-1}{\rho} \right) \left( \frac{\beta\eta}{1-\beta\eta} \right) \xi_{n,R}^{FTA} - \left( \frac{1-\beta}{1-\beta\eta} \right) \xi_{w^*,R}^{FTA}, \quad (43)$$

which from (35) is the same as:

$$\xi_{n,R}^{FTA} = \xi_{Z,R} - \left( \frac{\rho-1}{\rho} \right) \left( \frac{\beta\eta}{1-\beta\eta} \right) \xi_{n,R}^{FTA} - \left( \frac{1-\beta}{1-\beta\eta} \right) \xi_{Z,R}. \quad (44)$$

Solving this, we have the elasticity of the number of firms in Mexico with respect to the extent of the rules of origin:

$$\xi_{n,R}^{FTA} = \frac{\beta\rho(1-\eta)}{\rho-\beta\eta} \xi_{Z,R} < 0. \quad (45)$$

Therefore, if  $R$  is increased, the number of firms in Mexico goes down. This will tend to raise marginal costs for Mexican firms (recall (15) again), while at the same time, from (35), the increase in  $R$  lowers the Mexican wage  $w^*$ , which tends to *lower* Mexican marginal costs. The net effect on marginal costs in Mexico is ambiguous, and given by:

$$\xi_{c,R}^{FTA} = \left( \frac{\rho - 1}{\rho} \right) \left( \frac{\beta\eta}{1 - \beta\eta} \right) \xi_{n,R}^{FTA} + \left( \frac{1 - \beta}{1 - \beta\eta} \right) \xi_{w^*,R}^{FTA}, \quad (46)$$

which, given (45) and (35), yields:

$$\xi_{c,R}^{FTA} = \left( \frac{\rho(1 - \beta(1 - \eta)) - \beta\eta}{\rho - \beta\eta} \right) \xi_{Z,R}. \quad (47)$$

Since  $\xi_{Z,R} < 0$ , this means that an increase in  $R$  lowers  $c$ , and therefore the price of each good produced in Mexico, as long as the expression in parentheses is positive. This will be true if  $\eta$  is small enough; specifically,

$$\xi_{c,R}^{FTA} < 0 \iff \eta < \left( \frac{\rho}{1 - \rho} \right) \left( \frac{1 - \beta}{\beta} \right). \quad (48)$$

A sufficient condition for this is that  $\rho > \beta$ . In general, a rise in  $R$  helps the US terms of trade unless  $\eta$  is big.

To understand this, first off,  $\eta$  can be interpreted as the strength of ‘backward linkages.’ If  $\eta > 0$ , then a rise in demand for Mexican products increases the number of inputs produced in Mexico, lowering the cost of production in Mexico. When the US tightens its protectionism against Mexico (by increasing  $R$ ), it lowers the demand for Mexican products. This has a direct effect on Mexican production costs, by lowering the demand for Mexican workers, and thus lowering the Mexican wage, which is beneficial to the US because it improves the US terms of trade. However, it also has an indirect effect, through the backward linkages; the reduction in the number of inputs produced in Mexico *raises* marginal costs in Mexico, which is harmful to the US because it worsens the US terms of trade. The net effect of an increase in  $R$  on the US terms of trade therefore depends on the strength of backward linkages, as indexed by  $\eta$ .

Wages in Mexico are determined by (35), and given the effect of  $R$  on  $w^*$  from (35), the effect of  $R$  on  $n$  can be computed from (40) (taking account of the effect of  $R$  on  $w^*$ ).

Consider two cases. (i) If  $\eta$  is close to zero, then under FTA an increase in  $R$  lowers  $w^*$ , lowering marginal costs in Mexico, and so lowering the cost of each export sold to Mexico. That's an improvement in the US terms of trade. Now, that has to be traded off against the distortion of the tariffs and the reduction in  $\tilde{n}$ , but there will generally be some optimal level of  $R$ . (ii) As  $\eta$  gets close to  $\rho/\beta$ , the derivative of  $w^*$  with respect to  $R$  takes some finite non-zero limit, but the derivative of  $n$  with respect to  $R$  from (40) goes to minus infinity, so an increase in  $R$  raises marginal cost in Mexico (i.e.,  $c(n, w^*)$  rises with  $R$ ). In this case, the backward linkages are strong enough that protectionism against Mexico raises marginal costs in Mexico, hurting the US terms of trade. In this case, the US cannot benefit from an increase in  $R$ , and the optimal value for  $R$  under FTA for the US is  $R = 0$ .

### 3 Welfare.

Welfare in Mexico can be computed from the indirect utility function, derived from (1):

$$U^M = \frac{Y^*}{(1 + d\tau^*)^\alpha \left( n^{\frac{\rho-1}{\rho}} p \right)^{1-\alpha}}. \quad (49)$$

**Proposition 7** *Under assumptions (42) and (48), a fully anticipated increase in  $R$  will lower the Mexican wage, the number of varieties produced in each Mexican industry, and Mexican welfare.*

**Proof.** Proposition 5 shows that an increase in  $R$  will lower the Mexican wage in terms of the numeraire, and under the stated assumptions it will also lower  $n$ . Using (32), (49) can be written as:

$$\left( \frac{(1 + d\tau^*)L^*}{1 + (1 - \alpha)d\tau^*} \right) \frac{w^*}{(1 + d\tau^*)^\alpha \left( n^{\frac{\rho-1}{\rho}} c(n, w^*)/\rho \right)^{1-\alpha}} \quad (50)$$

The first factor in this expression does not depend on  $n$  or  $w^*$ . Since, from (15), the function  $c(n, w^*)$  is decreasing in  $n$  and increasing in  $w^*$  with an elasticity less than one, the second factor is increasing in both  $n$  and  $w^*$ . ■

The corresponding expression for US welfare requires computation of the consumer price index in the US. Suppose that  $\bar{R}$  industries expect a ROO *ex ante*, and *ex post*, a total of  $R = \bar{R} + \epsilon$  industries are subject to a ROO. The  $\epsilon$  term is, if positive, the number of industries that are surprised by a ROO *ex post*, and if negative, the number of industries that expected a ROO but were pleasantly surprised to be exempted from the ROO *ex post*. Under an FTA,  $\epsilon = 0$  by assumption, but without an FTA we must have  $\epsilon = 0$  in equilibrium. Each variety in an industry  $j$  without a rule of origin sells for a price of  $p$  in the US, while each variety sold under a rule of origin will sell for a price  $(1 + \tau)p$ . Assume that  $\epsilon \geq 0$  for concreteness; the case of  $\epsilon < 0$  is analogous and produces the same equation. We can divide the industries into three groups. The first group consists of  $(1 - \bar{R} - \epsilon)$  industries that were expecting to be exempt from ROO and were not surprised. The price index for each of those industries' composite goods in the US is  $P_j = (\tilde{n}^{NR})^{\frac{\rho-1}{\rho}} p$ . The second group consists of  $\epsilon$  industries that were not expecting an ROO but had one imposed on them anyway. The price index for each of those composite goods is  $P_j = (\tilde{n}^{NR})^{\frac{\rho-1}{\rho}} (1 + \tau)p$ . The third group consists of  $\bar{R}$  industries that expected and received an ROO. The price index for the composite good for each of those industries is  $P_j = (\tilde{n}^R)^{\frac{\rho-1}{\rho}} (1 + \tau)p$ . Consequently, recalling that  $\tilde{n}^R = \tilde{n}^{NR}/(1 + \tau)$ , the log of the price in the US of composite imported goods from Mexico is  $\ln(P) = \int_0^1 \ln(P_j) dj = (1 - \bar{R} - \epsilon) \ln\left((\tilde{n}^{NR})^{\frac{\rho-1}{\rho}} p\right) + \epsilon \ln\left((\tilde{n}^{NR})^{\frac{\rho-1}{\rho}} (1 + \tau)p\right) + \bar{R} \ln\left((\tilde{n}^R)^{\frac{\rho-1}{\rho}} (1 + \tau)p\right)$ , so:

$$P = (1 + \tau)^{\frac{\bar{R} + \epsilon}{\rho}} (\tilde{n}^{NR})^{\frac{\rho-1}{\rho}} p. \quad (51)$$

Holding constant the value of  $\tilde{n}$  and  $p$ , the elasticity of this price index with respect to  $R$  can be written:

$$\xi_{P, \bar{R}} = \frac{\log(1 + \tau)R}{\rho}, \text{ and } \xi_{P, \epsilon} = \log(1 + \tau)R. \quad (52)$$

Essentially, holding constant for the moment the value of  $p$ , expanding ROO's *ex ante* increases the US consumer price index by more than an *ex post* expansion of ROO's because imposing an ROO on an industry *ex ante* discourages firms from investing in export capacity, reducing the diversity of products available to US consumers. The derivative of the CPI with respect to  $\bar{R}$  is greater than the derivative with respect to  $\epsilon$  by a factor of  $\frac{1}{\rho}$ , so

(again, holding  $p$  constant) the elasticity of the CPI with respect to  $R$  under an FTA (in other words, varying  $\bar{R}$  but holding  $\epsilon$  constant) is greater than the elasticity *ex post* without FTA (in other words, varying  $\epsilon$  but holding  $\bar{R}$  fixed). Formally:

$$\partial \xi_{P,R}^{NF} / \partial R = \rho \partial \xi_{P,R}^F / \partial R. \quad (53)$$

This is a reason that expanding ROO's can be more attractive *ex post* than *ex ante*, and can lead to a hold-up problem.

Consequently, US welfare is given by:

$$U^{US} = \frac{Y}{\left( (1 + \tau)^{\frac{\bar{R}}{\rho} + \epsilon} (\tilde{n}^{NR})^{\frac{\rho-1}{\rho}} p \right)^{1-\alpha}}. \quad (54)$$

## 4 Equilibrium with Fast Track Authority.

To compute US welfare under a given value of  $R$  under FTA, combine (54) with (38) and the condition that  $c = \rho p$  to obtain:

$$U^{US} = \left[ (1 + \tau)^{\frac{\bar{R}}{\rho}} \left( \frac{(1 - \alpha)(1 - \rho)}{S\rho} \right)^{\frac{\rho-1}{\rho}} \right]^{-(1-\alpha)} Y^{\frac{1-\alpha(1-\rho)}{\rho}} p^{-\frac{(1-\alpha)}{\rho}} \quad (55)$$

US negotiators choose  $R$  to maximize US welfare, taking into account the effect of  $R$  on all endogenous variables ( $n$ ,  $\tilde{n}^R$ ,  $\tilde{n}^{NR}$ ,  $w$ , and  $p$ ), subject to the constraint that Mexican welfare with the agreement is not less than Mexican welfare without it. This amounts to:

$$\max_R \{U^{US}(R, 0)\} \ni U^{MEX}(R, 0) \geq U^{MEX}(1, 1), \quad (56)$$

where  $U^{US}(R, d)$  and  $U^{MEX}(R, d)$  denote respectively US and Mexican utility, taking full account of the equilibrium effect of  $R$  and  $d$  on all endogenous variables. As before,  $d$  is a dummy variable that records a value of 1 if no free-trade agreement is in force, so that the tariffs apply to all trade between the US and Mexico; and  $d$  records a value of 0 if a free-trade agreement is in force, so that the tariff applies only to ROO sectors exporting to the US from Mexico.

Denote the equilibrium value of  $R$  under Fast Track by  $R^{FT}$ . There are two cases, the case in which the constraint on Mexican welfare does not bind, which we may call the ‘interior solution,’ and the case in which it does bind, which we may call the ‘corner solution.’

#### 4.1 Case I: The Interior Solution.

From (54), the derivative of log US welfare with respect to  $R$  under FTA has the same sign as:

$$\xi_{US,R}^{FTA} = \xi_{Y,R}^{FTA} - (1 - \alpha)\xi_{P,R}^{FTA} - (1 - \alpha) \left( \frac{\rho - 1}{\rho} \right) \xi_{\tilde{n}^{NR},R}^{FTA} - (1 - \alpha)\xi_{p,R}^{FTA} \quad (57)$$

(Recall that  $\xi_{P,R}^{FTA}$  is defined as the elasticity of the manufactures price index for US consumers, *holding  $\tilde{n}$  and  $p$  fixed, as defined in (52).*) From (30), we have

$$\xi_{Y,R}^{FTA} = \frac{(1 - \alpha)\tau R}{1 + (1 - R(1 - \alpha))\tau}. \quad (58)$$

Using (38),  $\xi_{\tilde{n}^{NR},R}^{FTA}$  is given by

$$\xi_{\tilde{n}^{NR},R}^{FTA} = \xi_{Y,R}^{FTA} - \xi_{c,R}^{FTA}. \quad (59)$$

Combining (57) with (58), (52), (59), and (47), recalling that  $\xi_{p,R}^{FTA} = \xi_{c,R}^{FTA}$  because markups are constant, we obtain the following.

$$\xi_{US,R}^{FTA} = \frac{(1 - \alpha)R}{\rho} \left[ \frac{\tau}{1 + (1 - R(1 - \alpha))\tau} \left( 1 - \alpha(1 - \rho) + \frac{\alpha(1 + \tau)(\rho[1 - \beta(1 - \eta)] - \beta\eta)}{[1 + (1 - R)\tau][\rho - \beta\eta]} \right) - \log(1 + \tau) \right]. \quad (60)$$

The expression in the square brackets is increasing in  $R$ . Therefore, if (60) is ever equal to zero, say for some value  $R = \hat{R}$ , then for all  $R < \hat{R}$ , it is negative, and for all  $R > \hat{R}$ , it is positive. Therefore,  $\hat{R}$  is a minimum for US welfare rather than a maximum, and the only possible optimal values for  $R$  are 0 or 1. In addition, if  $R$  is bounded above by an incentive constraint, so that it cannot take a value above  $R^{max}$ , then the only possible optimal values are 0 and  $R^{max}$ . Therefore, we can disregard the interior solution and focus entirely on the corner solution.

## 4.2 Case II: The Corner Solution.

In the corner-solution case, the negotiations set the value of  $R$  so that the Mexican government will be indifferent between tearing up the agreement and ratifying it. In this case, the optimal value of  $R$ , say,  $R^*$ , will satisfy:

$$U^M(R^*, \tilde{n}^{NR}(R^*), d = 0) = U^M(R = 1, \tilde{n}^{NR}(R = 1), d = 1). \quad (61)$$

This optimal value of  $R$  will, then, fail to be credible in the absence of an FTA if:

$$U^M(R^*, \tilde{n}^{NR}(R^*), d = 0) > U^M(R = 1, \tilde{n}^{NR}(R^*), d = 1). \quad (62)$$

The left-hand side of (62) is Mexican welfare if the US promises  $R^*$ ; this promise is believed by all market participants; and the US actually implements  $R^*$ . (It is the same as the left-hand side of (61).) The right-hand side of (62) is Mexican welfare if the US promises  $R^*$ ; this promise is believed by all market participants; and Mexico in the end walks away from the agreement, tearing it up so that both countries' trade policies return to the status-quo ante ( $R = 1$  and  $d = 1$ ); but Mexico's export sector is still locked into the investment level ( $\tilde{n}(R^*)$ ) that results from an expectation of  $R^*$ . If (62) holds, then  $R^*$  is not credible *ex ante* because if it were believed *ex ante* then *ex post* Mexico would be strictly worse off tearing up the agreement rather than abiding by the agreement; therefore, Congress would have some leeway to adjust  $R$  *ex post* in a way that would be beneficial to the US and harmful to Mexico at the margin, and the Mexican government would still have an incentive to ratify. Since everyone would understand this, then (62) would imply that no-one would believe the US promise to implement  $R^*$ .

Since the left-hand sides of (61) and (62) are the same, for (62) to hold, it is sufficient that:

$$U^M(R = 1, \tilde{n}^{NR}(R = 1), d = 1) > U^M(R = 1, \tilde{n}^{NR}(R^*), d = 1). \quad (63)$$

In other words, in this case all we need to do is something really simple: Show that

Mexico's utility is lower if it walks away from the agreement once the  $\tilde{n}$ 's have been fixed, than if it walks away when the  $\tilde{n}$ 's can adjust endogenously.

If that is true, then (i) Mexico will do just as well under NAFTA with fast track as under no talks at all; (ii) Mexico will do strictly worse under NAFTA without fast track, because *ex post*, Congress can get Mexico to agree to the agreement with a higher value of  $R$  than it could with fast track. Therefore, Mexico will never agree to negotiate without fast track.

## 5 *Ex post* labor market clearing without Fast Track.

Without Fast Track Authority, each business manager in Mexico will need to conjecture what amendments the US Congress might make to the agreement, and make investments accordingly. If firm  $i$  upgrades its product quality in order to be able to export to the US, then its management must start a process of transformation of the productive process in Period 0 that will cost it  $S$  units of lost output in Period 1. This decision is irreversible; if the firm's conjecture turns out in Period 1 to be wrong, it will not be able to change it. In order to focus on the hold-up problem that results from this trade-specific sunk investment, we assume that firms can enter or exit Mexican manufacturing in Period 1, responding to new information about the actions of the US Congress.

Suppose that in Period 0, before the Congressional amendment stage, a subset of industries of mass  $\bar{R}$  were expected to be subject to an ROO. This leads to  $\tilde{n}^R$  of each of the ROO-expecting industries and  $\tilde{n}^{NR}$  of the non-ROO-expecting industries to commit to the quality upgrade, for a total of  $\tilde{n} \equiv \bar{R}\tilde{n}^R + (1 - \bar{R})\tilde{n}^{NR}$ . Suppose that in Period 1 Congress amends the agreement to impose an ROO on  $\bar{R} + \epsilon$  industries. If  $\epsilon > 0$ , the interpretation is that Congress has surprised the market by imposing an ROO on  $\epsilon$  additional industries, while if  $\epsilon < 0$ , the Congress has surprised the market by letting  $\epsilon$  industries go ROO-free that were expecting an ROO. In order for  $\bar{R}$  to be an equilibrium, it must be the case that Congress is willing to choose  $\epsilon = 0$  given the levels of  $\tilde{n}^R$  and  $\tilde{n}^{NR}$  inherited from Period 0, which Congress takes as given.

A difficulty with the analysis without fast track is that although the zero-profit condition

must be satisfied in equilibrium, it need not be satisfied off of the equilibrium path. Precisely, if  $\epsilon \neq 0$ , the firms that invested in export capability will have non-zero profit of the same sign as  $\epsilon$ . This means that the logic used to derive (35), which repeatedly involves equating expenditure on an industry's products with that industry's cost, cannot be used, at least not off the equilibrium path. To analyze labor market clearing in Mexico in this situation for an arbitrary value of  $\epsilon$ , we compute the costs for each industry as follows. Let  $C^{TOT}$  denote the cost incurred by all manufacturing firms across Mexico. The variable cost incurred for the production of products exported to the US is denoted  $C^X$ , and the variable cost of the products sold in Mexico as final consumption goods is denoted  $C^D$ . (In this model, the variable cost of a given subset of production is simply the marginal cost,  $c$ , times the number of units produced.) The variable cost of output sold in Mexico as an intermediate input (whether for production for domestic sale or for export) is denoted  $C^I$ . The cost implied by the fixed costs for all firms is  $ncF$ , and the cost implied by all of the quality upgrades for export is given by  $\tilde{n}cS$ .

These definitions imply the adding-up constraint:

$$C^{TOT} = C^D + C^X + C^I + ncF + \tilde{n}cS. \quad (64)$$

Note that regardless of the behavior of Congress, Mexican firms will make zero profits on their domestic sales. (Mexican firms that do not export will make zero profits, and Mexican firms that do export will charge the same prices and incur the same costs on their domestic sales as those that do not, and will therefore also make zero domestic profits.) This allows us to write:

$$C^D + C^I + ncF = (1 - \alpha)Y^* + \frac{C^I}{\rho}. \quad (65)$$

The left-hand side is the total cost incurred on domestic sales, including fixed costs, while the right hand side is the revenue of domestic firms on all domestic sales: the sum of Mexican final consumer demand (the first term) and Mexican spending on Mexican-made inputs (the second term). This last point follows since with price a constant mark-up of  $\frac{1}{\rho}$  over marginal

costs, total expenditure on Mexican inputs is equal to the total variable cost of producing those inputs divided by  $\rho$ , or  $\frac{C^I}{\rho}$ . Taking the  $C^I$  term to the right-hand side and substituting this into (64) yields:

$$C^{TOT} = C^D + C^X + C^I + ncF + \tilde{n}cS \quad (66)$$

$$= (1 - \alpha)Y^* + \left(\frac{1 - \rho}{\rho}\right)C^I + C^I + C^X + \tilde{n}cS \quad (67)$$

$$= (1 - \alpha)Y^* + \frac{C^I}{\rho} + C^X + \tilde{n}cS. \quad (68)$$

Now, given the Cobb-Douglas production function, total spending on domestic inputs must be equal to  $\beta\eta C^{TOT}$ . Again, given that each variety's price is a markup of  $\frac{1}{\rho}$  over marginal cost, the variable cost of production of domestic inputs must be equal to  $\rho\beta\eta C^{TOT}$ . Putting this together with (68) implies:

$$\rho\beta\eta C^{TOT} = \rho\beta\eta \left[ (1 - \alpha)Y^* + \frac{C^I}{\rho} + C^X + \tilde{n}cS \right] = C^I. \quad (69)$$

Substituting this into (68) once again and solving for  $C^{TOT}$  yields:

$$C^{TOT} = \frac{[(1 - \alpha)Y^* + C^X + \tilde{n}cS]}{(1 - \beta\eta)} \quad (70)$$

Mutlplying both sides by the Cobb-Douglas weight on labor in production yields:

$$w^*L^* = (1 - \beta) \left[ \frac{[(1 - \alpha)Y^* + C^X + \tilde{n}cS]}{(1 - \beta\eta)} \right]. \quad (71)$$

We can derive  $C^X$  from US income and preferences, recalling that for industries under an ROO, the expenditure by US consumers is equal to  $1 + \tau$  times the revenue received by Mexican firms:

$$C^X = (1 - \alpha)\rho Y \left[ \frac{\bar{R} + \epsilon}{(1 + \tau)} + (1 - \bar{R} - \epsilon) \right]. \quad (72)$$

We also need an expression for aggregate profits, for (32). These are given by revenue minus cost in the export sector. Variable costs in Mexican manufacturing are equal to  $C^X$ ; recalling

that the producer's price is equal to marginal cost divided by  $\rho$ , we conclude that revenues to the Mexican export sector equal  $\frac{C^X}{\rho}$ . Since the sunk cost for the export sector is given by  $\tilde{n}cS$ , we conclude that

$$\begin{aligned}\Pi^* &= \frac{1-\rho}{\rho}C^X - \tilde{n}cS \\ &= (1-\alpha)(1-\rho)Z(R)L - \tilde{n}cS.\end{aligned}\tag{73}$$

Substituting in the expression for  $Y^*$  from (32) and for  $C^X$  and  $\Pi^*$  just derived into (71), we have:

$$\begin{aligned}&\left(\frac{1-\beta\eta}{1-\beta} - \frac{(1-\alpha)(1+d\tau^*)}{1+(1-\alpha)d\tau^*}\right)w^*L^* \\ &= \left[1 + \frac{(1-\alpha)(1+d\tau^*)}{1+(1-\alpha)d\tau^*} \frac{1-\rho}{\rho}\right] (1-\alpha)\rho Z(R)L + \left(1 - \frac{(1-\alpha)(1+d\tau^*)}{1+(1-\alpha)d\tau^*}\right) \tilde{n}cS\end{aligned}\tag{74}$$

(Remember:

$$Z \equiv \left(\frac{1+\tau-\tau(\bar{R}+\epsilon)}{1+\tau-\tau(\bar{R}+\epsilon)(1-\alpha)}\right)\tag{75}$$

as defined before.)

Notice that the coefficients on all three terms in (74) are positive, and the coefficient on  $w^*L^*$  is strictly larger than the one on  $\tilde{n}cS$ . That implies that for a given  $R$ , increasing  $\tilde{n}$  so that  $\tilde{n}cS$  goes up by one dollar implies that  $w^*L^*$  goes up by less than a dollar – and so in that case Mexican *income*, which is the sum of wage income and profits (73), falls.

We can rewrite (74) as

$$\begin{aligned}w^*L^* &= \left(\frac{(1-\alpha)(1-\beta)[1+(1-\alpha)d\tau^*-\alpha(1-\rho)]}{\alpha(1-\beta)+\beta(1-\eta)(1+(1-\alpha)d\tau^*)}\right)Z(R)L \\ &+ \left(\frac{\alpha(1-\beta)}{\alpha(1-\beta)+\beta(1-\eta)(1+(1-\alpha)d\tau^*)}\right)\tilde{n}cS.\end{aligned}\tag{76}$$

## 5.1 Determination of $n$ .

Output of Mexican firms other than for export:

$$\frac{(1-\alpha)Y^* + \beta\eta(C^X + \tilde{n}cS)}{1-\beta\eta},\tag{77}$$

where the first term is output for Mexican consumers, the second term is output used as intermediate inputs for production of consumer goods for Mexican consumers, and the last term is output used as intermediate inputs for production for the export sector (including the fixed cost). Since the output of each domestic firm, marketed output plus the fixed cost, is equal to:

$$\frac{\rho}{(1-\rho)}F + F = \frac{F}{(1-\rho)}, \quad (78)$$

zero profits for domestic firms implies:

$$\frac{(1-\alpha)Y^* + \beta\eta(C^X + \tilde{n}cS)}{1-\beta\eta} = \frac{nc}{(1-\rho)}F. \quad (79)$$

This can be taken to be an equation that determines the value of  $n$  given the other variables. Using expressions we have for  $Y^*$  (namely, (32)) and  $C^X$  (namely, (72)), we can simplify this to:

$$\begin{aligned} & (1-\alpha)(1+d\tau^*)w^*L^* + (1-\alpha)[(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)]Z(R)L \\ - & [(1-\alpha)(1+d\tau^*) - \beta\eta(1+(1-\alpha)d\tau^*)]\tilde{n}cS \\ = & \frac{ncF}{(1-\rho)}(1-\beta\eta)(1+(1-\alpha)d\tau^*) \end{aligned} \quad (80)$$

We can put this equation together with (76) to determine  $w^*$  and  $n$  as functions of  $\tilde{n}$  (remembering that  $c$  is also a function of  $w^*$  and  $n$  through (15)).

## 5.2 Main comparative statics result for the case with no FTA.

We can now put (76) together with (80) to determine  $w^*$  and  $n$  for a given value of  $\tilde{n}$ . Combining these yields:

**Proposition 8** *There is a value  $\bar{\eta} > 0$  such that if  $\eta < \bar{\eta}$ , in period two  $w^*$  is increasing in  $\tilde{n}$  and  $n$  is decreasing in  $\tilde{n}$ . Therefore, Mexican income and welfare are decreasing in  $\tilde{n}$ .*

With weak linkages (that is, low  $\eta$ ), a rise in  $\tilde{n}$  absorbs productive resources from the Mexican economy without generating any benefit for Mexicans. It implies more product variety for US consumers, but no additional revenue for Mexicans because it does not change the amount of

US expenditure on Mexican products. Therefore, at least when  $\eta$  is not too large, it makes Mexicans less well off.

## 6 A Punchline.

We can now assemble all of these pieces into a conclusion about the desirability of FTA for cases in which  $\eta$  is not too large. Recall that FTA is needed in order to coax Mexico to the table if and only if (63) holds. From Proposition 8, all that we need is to show that

$$\tilde{n}^{NR}(R = 1) < \tilde{n}^{NR}(R^*). \quad (81)$$

But we already know this from Proposition 6, provided that  $\eta$  is not too large, since  $R^* < R$ .

**Proposition 9** *There is a value  $\bar{\eta} > 0$  such that if  $\eta < \bar{\eta}$ , Mexican welfare is worse under negotiations with the US with no FTA than with either negotiations with FTA or no negotiations. Therefore, under these conditions it is optimal for the Mexican government to refuse negotiations in the absence of FTA.*

This is the hold-up problem at work.

## 7 The Case With Strong Backward and Forward Linkages.

Now, we can address how the model works when  $\eta$  is large. The behavior of the model is qualitatively different when linkages are strong, in ways that may help understand trade policy in practice. There are two cases to identify.

### 7.1 Case I: $\beta \leq \rho$

In this case, even when  $\eta$  approaches unity, (25) and (42) will still be satisfied, and so it will still not be optimal to have any binding ROO's. Therefore, the formulation that we have used throughout, in which  $R$  is the only US policy lever, still applies.

**Proposition 10** *If  $\eta$  is close enough to 1 and  $\beta$  is close enough to  $\rho$  while  $\beta \leq \rho$  holds, then in the absence of FTA, in period 2, any increase in  $\tilde{n}$  will lower  $c$ , thereby lowering the price of each product produced in Mexico, whether for domestic use or for export. As well, in the limit,  $\frac{\partial w^*}{\partial \tilde{n}} = \frac{\partial(\frac{w}{\tilde{n}})}{\partial \tilde{n}} = 0$ .*

We can see this from the two equilibrium conditions (76) and (80). First note that in the limit, from (15), as  $\eta$  approaches 1 and  $\beta$  approaches  $\rho$ , the elasticity of  $c$  with respect to  $n$  approaches  $-1$  and the elasticity of  $c$  with respect to  $w^*$  approaches 1. Consequently, in the limit, if we increase  $\tilde{n}$  and increase  $n$  proportionally, then the right-hand side in (76) and the last two terms in (80) are unchanged, and so equality can be maintained in both equations with no change in  $w^*$ .

The reason this is so different from the weak-linkages case is as follows. A rise in  $\tilde{n}$  can be thought of having two effects. First, it removes a portion of the labor force from the domestic production sector and diverts it to the export sector, causing the wage to rise, which puts upward pressure on marginal cost in Mexico and thereby discourages the entry of new firms. This might be called the ‘labor shortage’ effect, and is captured by the right-hand side of (76). But in addition, the rise in  $\tilde{n}$  creates an increased demand for Mexican inputs to satisfy the additional fixed-cost requirement for exporting firms, and this rise in the demand for inputs increases the profitability of Mexican firms and encourages entry. Entry, in turn, by raising  $n$ , lowers marginal cost for all Mexican firms. This might be called the ‘input demand’ effect, and is captured by the last term on the left-hand side of (80). With weak linkages, the labor-shortage effect dominates, and the variety of Mexican products falls as their prices rise; this is the case of Propositions 8 and 9. With strong linkages, the input-demand effect dominates, and the opposite occurs; this is the case of Proposition 10.

It is worth pointing out that strong backward and forward linkages do not merely amplify the input-demand effect. They also attenuate the labor-shortage effect. This can be seen from the last term of (76), which represents the labor-shortage effect. With strong linkages as characterized here, the rise in  $\tilde{n}$  can be accommodated with very little diversion of labor, due to the increase in productivity due to the rise in  $n$ . In the limit, no additional labor

needs to be diverted: The additional entry of firms is sufficient to pay for the increased export-sector investment. This point amplifies our earlier observation about the inefficiency of equilibrium when linkages are present.

**Proposition 11** *If  $\eta$  is close enough to 1 and  $\beta$  is close enough to  $\rho$  while  $\beta \leq \rho$  holds, then under FTA, the optimal value of  $R$  from the point of view of the US is 0. Further, if in addition  $\rho$  is close enough to 1, then in the absence of FTA, the ex post optimal value of  $R$  from the point of view of the US is also equal to 0. Therefore, in that case there is no value to FTA either for the US or for Mexico.*

The implication of Proposition 10 for FTA is that if an agreement is anticipated between the US and Mexico, the resulting increase in  $\tilde{n}$  will *strengthen* Mexico's bargaining power. Therefore, *IF* Congress will want Fast Track, it will not be because of a hold-up problem suffered by Mexico, and Mexico would have no need to insist on Fast Track as a precondition for negotiations.

## 7.2 Case II: $\beta > \rho$

If  $\beta > \rho$ , then for sufficiently large  $\eta$ , condition (25) will fail, and it will be optimal for the US to set ROO requirements with which firms will comply. Since higher values of  $\theta$  will in this case lower the prices of Mexican goods and also increase their variety, the optimal value of  $\theta_i$  for any industry  $i$  will be the highest value such that Mexican firms will be willing to comply. This is  $\bar{\theta}$ , defined in Section 2.9 as the value of  $\theta$  such that  $CCR(\beta, \eta, \theta) = (1 + \tau)$ . Since this will be the same value *ex ante* as it is *ex post*, Congress will have no incentive to change the agreement *ex post* even if it is free to do so. Therefore, in this case with strong linkages, there is no hold-up problem.

## 8 Conclusion.

The mechanism studied here can be summarized as follows, for cases when  $\eta$  is not too large.

(i) Under full commitment (which here means under FTA), the optimal policy for the US in designing a free-trade agreement with Mexico is to set maximal ROO's on a subset  $R$  of industries, to claw back the tariff preference *de facto* that the free trade agreement creates, while setting minimal ROO's on the remaining industries. It is not optimal to distort any industry's actual input use with a ROO.

(ii) There is an optimal level of  $R$  from the point of view of US welfare, which is either  $R = 0$  or  $R = 1$ . In the empirically more interesting case where  $R = 1$  is preferred, Mexico's participation constraint will be binding, so the optimal choice of  $R$  become the value,  $R^* < 1$ , under which Mexico's welfare from the agreement is equal to its status-quo welfare.

(iii) However, it cannot achieve this optimal policy in the absence of commitment (in other words, without FTA). The reason is that if Mexican businesses anticipate  $R = R^*$ , more of them will invest in quality upgrades for the US market than would have done so under the status quo, and so their government's *ex post* bargaining power will be worse. As a result, at the last minute Congress will be able to raise  $R$  above  $R^*$  somewhat and the Mexican government will still accept the amended agreement.

(iv) Anticipating this, Mexico will refuse to enter negotiations unless FTA is in place first.

On the other hand, when  $\eta$  is large, the hold-up problem disappears. There are three reasons this can happen. (i) It can happen because the Mexican threat point *improves* ex post due to sunk export investments (which stimulate a more richly developed domestic economy through backward and forward linkages). (ii) It can happen because protectionism becomes self-defeating for the US; making Mexican business pay a tariff chokes off firm creation in Mexico, raising Mexican marginal costs and worsening the US terms of trade, the opposite of what a tariff would achieve in the absence of strong linkages. (iii) Finally, in the  $\beta > \rho$  case, the hold-up problem vanishes with strong linkages because both countries have an interest in developing the Mexican manufacturing sector through use of ROO's that stimulate Mexican firm creation and thus Mexican productivity. In general, with strong linkages, both countries benefit from promoting the entry of Mexican firms, and so their

interests are aligned.

## 9 Appendix.

### Proof of Proposition 8.

**Proof.** Let

$$G = \frac{(1-\alpha)(1-\beta)[1+(1-\alpha)d\tau^* - \alpha(1-\rho)]}{\alpha(1-\beta) + \beta(1-\eta)(1+(1-\alpha)d\tau^*)} > 0,$$

$$H = \frac{\alpha(1-\beta)}{\alpha(1-\beta) + \beta(1-\eta)(1+(1-\alpha)d\tau^*)}, \text{ where } 0 < H < 1.$$

Then, by equation (76),

$$w^*L^* = GZ(R)L + H\tilde{n}cS, \quad (82)$$

which implies

$$c = \frac{w^*L^* - GZ(R)L}{H\tilde{n}S}. \quad (83)$$

We can write (82) in the form  $f(w^*, n, \tilde{n}) = 0$  by taking all of the terms to the left-hand side.

Rewrite equation (80):

$$(1-\alpha)(1+d\tau^*)w^*L^* + (1-\alpha)[(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)]Z(R)L$$

$$= \left[ \frac{n(1-\beta\eta)(1+(1-\alpha)d\tau^*)F}{(1-\rho)} + [(1-\alpha)(1+d\tau^*) - \beta\eta(1+(1-\alpha)d\tau^*)]\tilde{n}S \right] c.$$

Substituting for  $c$  from above, this becomes

$$\left( \frac{(1-\alpha)(1+d\tau^*)w^*L^* + (1-\alpha)[(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)]Z(R)L}{w^*L^* - GZ(R)L} \right) H\tilde{n}S$$

$$- ((1-\alpha)(1+d\tau^*) - \beta\eta(1+(1-\alpha)d\tau^*))\tilde{n}S$$

$$= \frac{n(1-\beta\eta)(1+(1-\alpha)d\tau^*)F}{(1-\rho)}. \quad (84)$$

We can write (84) in the form  $g(w^*, n, \tilde{n}) = 0$  by taking all of the terms to the right-hand side. With both equations in this form, we have  $f_1, f_2, g_1, g_2 > 0$  and  $f_3, g_3 < 0$ ,

where subscripts denote partial derivatives.<sup>2</sup> Taking total derivatives of both equations with respect to  $\tilde{n}$  and solving the two-equation system for  $\frac{\partial w^*}{\partial \tilde{n}}$  and  $\frac{\partial n}{\partial \tilde{n}}$ , we obtain:

$$\frac{\partial w^*}{\partial \tilde{n}} = \frac{f_2 g_3 - g_2 f_3}{D} \quad (85)$$

$$\frac{\partial n}{\partial \tilde{n}} = \frac{g_1 f_3 - f_1 g_3}{D}, \quad (86)$$

where  $D = f_1 g_2 - g_1 f_2$  is the determinant.

*The sign of the determinant.*

We now show that the determinant  $D$  is positive provided that  $\eta$  is not too big. It is positive iff  $\frac{f_1}{f_2} > \frac{g_1}{g_2}$ .

We can write:

$$\frac{f_1}{f_2} = \frac{L^* - H\tilde{n}Sc_{w^*}}{-H\tilde{n}c_n S} = \left( \frac{\rho}{1-\rho} \right) \left( \frac{1-\beta\eta}{\beta\eta} \right) \frac{n}{\tilde{n}} \left( \frac{L^* - H\tilde{n}Sc_{w^*}}{HcS} \right), \quad (87)$$

where  $c_{w^*}$  is the partial derivative of marginal cost with respect to  $w^*$ , and  $c_n$  is the partial derivative with respect to  $n$ .

To get  $\frac{g_1}{g_2}$ , we first take the derivative of  $g$  with respect to  $w^*$ , then with respect to  $\tilde{n}$ , then take the ratio of the two. Using 82, the derivative with respect to  $w^*$  is:

$$H\tilde{n}S(1-\alpha) \frac{[(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZLL^*}{[w^*L^* - GZL]^2}. \quad (88)$$

The derivative of  $g$  with respect to  $n$  is:

$$\frac{(1-\beta\eta)(1+(1-\alpha)d\tau^*)F}{(1-\rho)} \quad (89)$$

which, since it is just the right-hand side of (84) divided by  $n$ , can also be written as the left-hand side of (84) divided by  $n$ . We can use (83) to turn one of the denominator factors in (88) from  $[w^*L^* - GZL]$  to  $H\tilde{n}Sc$ . Then the ratio of (88) to (89)), can be written as:

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<sup>2</sup>Notice that the effect of  $n$  on  $f$ ,  $f_2$ , is through  $c$ .

$$\frac{g_1}{g_2} = \frac{n}{\tilde{n}} \left( \frac{[(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZLL^*}{HcS} \right) \\ \left\{ (1+d\tau^*)w^*L^* + [(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \right. \\ \left. - \left( (1+d\tau^*) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \right\}^{-1} \quad (90)$$

Putting this together with (87), we see that the condition we need is:

$$(L^* - H\tilde{n}Sc_{w^*}) \left\{ (1+d\tau^*)w^*L^* + [(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \right. \\ \left. - \left( (1+d\tau^*) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \right\} \\ > \left( \frac{1-\rho}{\rho} \right) \left( \frac{\beta\eta}{1-\beta\eta} \right) [(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZLL^*$$

Recall (82), which allows us to rewrite  $w^*L^*$  in the left hand side of this inequality.

$$(L^* - H\tilde{n}Sc_{w^*}) \left\{ (1+d\tau^*)(GZ(R)L + H\tilde{n}cS) + [(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \right. \\ \left. - \left( (1+d\tau^*) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \right\} \\ = (L^* - H\tilde{n}Sc_{w^*}) \left\{ [(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \right. \\ \left. - \left( (1+d\tau^*)(1-H) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \right\} \\ = (L^* - H\tilde{n}Sc_{w^*}) \left\{ [(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \right. \\ \left. - \left( (1+d\tau^*) \left( \frac{\beta(1-\eta)(1+(1-\alpha)d\tau^*)}{\alpha(1-\beta) + \beta(1-\eta)(1+(1-\alpha)d\tau^*)} \right) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \right\} \\ > \left( \frac{1-\rho}{\rho} \right) \left( \frac{\beta\eta}{1-\beta\eta} \right) [(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZLL^*$$

Clearly, this is satisfied if  $\eta = 0$ , so there is a strictly positive value for  $\eta$ , below which  $D > 0$ .

*The sign of the wage effect.*

From (85), we know that as long as  $D > 0$ , an increase in  $\tilde{n}$  will increase  $w^*$  iff  $0 > \frac{f_2}{f_3} > \frac{g_2}{g_3}$  (recall that  $f_3, g_3 < 0$ ).

The first part of this inequality is:

$$\frac{f_2}{f_3} = \frac{H\tilde{n}c_n S}{HcS} = \frac{\tilde{n}c_n}{c} = - \left( \frac{1-\rho}{\rho} \right) \left( \frac{\beta\eta}{1-\beta\eta} \right) \frac{\tilde{n}}{n}, \quad (91)$$

where  $c_n$  is the partial derivative of marginal cost with respect to  $n$ . The second part uses the fact that the derivative of  $g$  with respect to  $n$  is just the right-hand side of (84) divided by  $n$  and the derivative with respect to  $\tilde{n}$  is just minus one times the left-hand side divided by  $\tilde{n}$ , and the right-hand side and left-hand side are equal, to arrive at:

$$\frac{g_2}{g_3} = -\frac{\tilde{n}}{n}. \quad (92)$$

Therefore, the inequality is guaranteed by our assumption that  $\beta\eta < \rho$ .

The sign of the effect on  $n$ .

From (86), we know that as long as  $D > 0$ , an increase in  $\tilde{n}$  will decrease  $n$  iff  $0 > \frac{f_1}{f_3} > \frac{g_1}{g_3}$ .

The first part of this inequality is:

$$\frac{f_1}{f_3} = -\frac{L^* - H\tilde{n}Sc_{w^*}}{HcS}, \quad (93)$$

where  $c_{w^*}$  is the partial derivative of marginal cost with respect to  $w^*$ .

The derivative of  $g$  with respect to  $w^*$  is (88).

The derivative of  $g$  with respect to  $\tilde{n}$  is:

$$g_3 = \frac{-1}{[w^*L^* - GZL]} \left\{ H(1-\alpha)(1+d\tau^*)w^*L^* + H(1-\alpha) [(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL - ((1-\alpha)(1+d\tau^*) - \beta\eta(1+(1-\alpha)d\tau^*)) H\tilde{n}Sc \right\} S$$

We can use (83) to turn one of the denominator factors in (88) from  $[w^*L^* - GZL]$  to  $H\tilde{n}Sc$ . Then the slope of (84), minus 1 times the ratio of (88) to (94), can be written as:

$$\begin{aligned}
& - \left( \frac{[(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZLL^*}{HcS} \right) \\
& \quad \{ (1+d\tau^*)w^*L^* + [(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \\
& \quad \quad - \left( (1+d\tau^*) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \}^{-1} \quad (94)
\end{aligned}$$

Putting this together with (93), we see that the condition we need is:

$$\begin{aligned}
& (L^* - H\tilde{n}Sc_{w^*}) \{ (1+d\tau^*)w^*L^* + [(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \\
& \quad - \left( (1+d\tau^*) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \} \\
& \quad < [(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZLL^*
\end{aligned}$$

Recall (82), which allows us to rewrite  $w^*L^*$  in the left hand side of this inequality.

$$\begin{aligned}
& (L^* - H\tilde{n}Sc_{w^*}) \{ (1+d\tau^*)(GZ(R)L + H\tilde{n}cS) + [(1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \\
& \quad - \left( (1+d\tau^*) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \} \\
& = (L^* - H\tilde{n}Sc_{w^*}) \{ [(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \\
& \quad - \left( (1+d\tau^*)(1-H) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \} \\
& = (L^* - H\tilde{n}Sc_{w^*}) \{ [(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZL \\
& \quad - \left( (1+d\tau^*) \left( \frac{\beta(1-\eta)(1+(1-\alpha)d\tau^*)}{\alpha(1-\beta) + \beta(1-\eta)(1+(1-\alpha)d\tau^*)} \right) - \beta\eta \frac{(1+(1-\alpha)d\tau^*)}{(1-\alpha)} \right) \tilde{n}Sc \} \\
& \quad < [(1+d\tau^*)G + (1-\rho)(1-\alpha)(1+d\tau^*) + \rho\beta\eta(1+(1-\alpha)d\tau^*)] ZLL^*
\end{aligned}$$

A sufficient condition for this is:

$$\frac{(1-\eta)(1+d\tau^*)}{\alpha(1-\beta) + \beta(1-\eta)(1+(1-\alpha)d\tau^*)} > \frac{\eta}{(1-\alpha)}. \quad (95)$$

Clearly, this is satisfied if  $\eta = 0$ . ■

### Proof of Proposition 10.

**Proof.** Putting (91) and (92) together with (85) gives  $\frac{\partial w^*}{\partial \tilde{n}} = 0$ . Note that as  $\eta$  approaches 1 and  $\beta$  approaches  $\rho$ , from (15), marginal cost  $c$  takes a value of  $\rho^{-\left(\frac{\rho}{1-\rho}\right)} \left(\frac{w^*}{n}\right)$  in the limit. From (82), if  $w^*$  does not change when  $\tilde{n}$  rises, then  $c$  must fall in proportion with the rise in  $\tilde{n}$ , which can occur only if  $n$  rises in proportion with  $\tilde{n}$ . ■

**Proof of Proposition 11.**

**Proof.** For the first part of the proposition, note from (60) that the elasticity of US welfare with respect to  $R$  under FTA approaches  $-\infty$  in the limit under consideration for all values of  $R$ , so that trivially  $R = 0$  is optimal.

For the second part, hold  $\tilde{n}$  fixed (since we are analyzing the second period of the equilibrium). First, note that in the limit as  $\eta \rightarrow 1$  and  $\rho \rightarrow 1$ ,  $G \rightarrow \frac{(1-\alpha)}{\alpha}(1 + (1-\alpha)d\tau^*)$  and  $H \rightarrow 1$ . Further, in the limit as  $\eta$  approaches 1, the marginal cost  $c$  becomes  $\rho^{-\left(\frac{\rho}{1-\rho}\right)} \left(\frac{w^*}{n}\right)$ . From l'Hôpital's Rule, it can be confirmed that  $\rho^{-\left(\frac{\rho}{1-\rho}\right)} \rightarrow e$  as  $\rho \rightarrow 1$ , so in the limit marginal cost in Mexico can be written as  $e\frac{w^*}{n}$ . Therefore, we can write the limiting form of (82) as:

$$w^*L^* = GZ(R)L + HSe w^* \frac{\tilde{n}}{n}, \text{ or}$$

$$\left(w^* \frac{\tilde{n}}{n}\right) = \frac{\alpha w^* L^* - (1-\alpha)(1 + (1-\alpha)d\tau^*)Z(R)L}{e\alpha S}. \quad (96)$$

The limiting form of (80) can then be written as:

$$\left(w^* \frac{\tilde{n}}{n}\right) = -\frac{(1-\alpha)(1 + d\tau^*)w^*L^*}{e\alpha S} + \frac{(Fw^* - (1-\alpha)Z(R)L)(1 + (1-\alpha)d\tau^*)}{e\alpha S}. \quad (97)$$

Equations (96) and (97) both define  $\left(w^* \frac{\tilde{n}}{n}\right)$  as a function of  $w^*$ , so the two equations determine these two variables jointly. Note that an increase in  $R$  shifts both functions up *equally*, indicating that  $\left(w^* \frac{\tilde{n}}{n}\right)$  rises and  $w^*$  is unchanged. It follows that if  $R$  increases,  $n$  must fall, and so  $c$  rises. Therefore, the prices paid by US consumers for Mexican goods rises, with no change in product variety, and so US welfare falls. Consequently, the optimal value of  $R$  from the US point of view is 0. ■

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