

# Choked by Red Tape?

## The Political Economy of Wasteful Trade Barriers\*

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March 19, 2018

### Abstract

Red-tape barriers (RTBs) are an important source of trade costs, but have received little scholarly attention. Here we take a first step toward a theory of RTBs, and show that their implications are very different from those of more traditional trade barriers. Our model highlights that RTBs have important impacts on the extensive margin of trade, and yields rich predictions on how changes in the political-economic environment and product characteristics affect RTBs. Taking into account the endogenous response of RTBs is crucial to understanding the impact of reductions in tariffs and natural trade costs on the extensive and intensive margins of trade, as well as on welfare. Moreover, the availability of RTBs affects in important ways the tariff commitments that are specified in a trade agreement.

*Keywords:* International trade policy; Non-Tariff Measures; Political economy; Red tape barriers; Trade agreements.

*JEL Classification:* F13, D7, F55

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\*We gratefully acknowledge comments from participants in seminars at GTDW (Geneva), Hong Kong University, Indiana University, Lancaster University, Nottingham University, Princeton, Vanderbilt, the World Bank and Yale, and in conferences at ANPEC, CEPR-PRONTO, CESifo, EEA, ERWIT, ETSG and RWEITA-Villars. Monika Mrázová thanks the Fondation de Famille Sandoz for funding under the “Sandoz Family Foundation - Monique de Meuron” Programme for Academic Promotion. Peter Neary thanks the European Research Council for funding under the European Union’s Seventh Framework Programme (FP7/2007-2013), ERC grant agreement no. 295669.

# 1 Introduction

There is increasing evidence that “Red-Tape Barriers” (RTBs) – defined as policy-induced trade barriers that do not generate revenue or rents – are an important source of trade costs. Typically, RTBs take the form of procedural obstacles in the clearing of customs or in the application of non-tariff measures. According to the International Trade Center’s 2016 survey of EU exporters (ITC (2016)), the most common procedural obstacle are “time constraints,” which include delays in the clearing of customs or in the process of obtaining an import license or product certification, or short deadlines for submitting documentation. Other important procedural obstacles that often affect exporters are: administrative burdens related to regulations (such as a large number of required documents); information/transparency issues (e.g., information on the licensing/certification process is not adequately published and disseminated, or is inaccurate); and arbitrary behaviour of customs officials when handling the exporter’s application (ITC (2016), Table B6).<sup>1</sup>

Also, governments may resort to less obvious ways to increase exporters’ trade costs: one example is given by India’s decision in 2015 to allow apple imports only via the Nhava Sheva port of Mumbai, while other ports such as Chennai were more efficient options for serving large parts of the country ([spsims.wto.org/en/SpecificTradeConcerns/View/397](http://spsims.wto.org/en/SpecificTradeConcerns/View/397)).<sup>2</sup> Similar measures have been used also by developed countries. A well-known example is given by France’s decision in 1982 to allow imports of Japanese video tape recorders only through the bottleneck of Poitiers, a small inland town, which resulted in the number of customs

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<sup>1</sup>Interestingly, when EU exporters are asked about the regulations they face in the importing country, they complain more about the procedural obstacles associated with the regulations than about the regulations themselves (ITC (2016), Table B5). One representative case is illustrated by a British exporter of lamb to Ghana, whose “company has to provide a Health Certificate issued by a vet. The certificate has to be immaculate, as even a small typo could result in the goods being rejected despite there being no threat to human life. There is no possibility to amend the error, and we are given two options: either destroy the goods or return them, both of which cost roughly the same.” (ITC (2016), page 9)

<sup>2</sup>There are strong indications that this was a deliberate protectionistic measure. According to the Indian Commerce and Industry Minister, Nirmala Sitharaman, “The government has received requests from several quarters, including public representatives, for increasing import duty on apples. The present import duty rates for apples is 50% which is also the bound rate of duty agreed to in GATT/WTO. As such, there is no scope for further increase in tariff rates without further negotiation under the WTO regime” (The Economic Times, August 3, 2016).

clearances falling from 100,000 per month to 8,000 per month.<sup>3</sup>

In spite of their growing importance, RTBs have largely been ignored by the academic literature. In this paper we take a first step toward understanding the economic-political determinants of RTBs and their effects on trade. We will show that the implications of RTBs are subtle and quite different from those of more traditional trade barriers.

Before we outline the model and our main results, it is useful to discuss briefly the available empirical evidence on RTBs and their impact on trade.

There is an abundance of studies showing that RTBs are quantitatively important. For example, the 2012 WTO World Trade Report highlights that 76.5% of non-tariff measures entailed procedural obstacles, and the ITC (2016) survey points out that more than 90% of the reported product certifications were deemed problematic because of the procedural obstacles linked to the certification process. As another example, Djankov et al. (2010) estimate that 75% percent of the delays in shipping containers from origin to destination country are due to administrative hurdles, such as customs procedures, tax procedures, clearance and inspections.<sup>4</sup>

Perhaps surprisingly, RTBs are common in developed countries, although they are even more common in developing countries. This is clearly illustrated by the ITC survey (see ITC (2016), pp. 19 and 40).<sup>5</sup> Another interesting fact is that there is little difference in the impact of RTBs on small versus large firms (see ITC (2016), p.17, and Carballo et al., 2016). Furthermore, RTBs often affect variable trade costs rather than fixed trade costs.<sup>6</sup>

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<sup>3</sup>See [nytimes.com/1982/11/22/opinion/essay-the-battle-of-poitiers.html](http://nytimes.com/1982/11/22/opinion/essay-the-battle-of-poitiers.html).

<sup>4</sup>In this paper we focus on RTBs that are deliberately imposed by governments, but RTBs may also be caused by technological limitations or resource constraints. We are not aware of systematic empirical studies that try to assess the importance of these different causes of RTBs, although there are many anecdotes suggesting that RTBs are often deliberately-imposed trade barriers (see for example footnote 2).

<sup>5</sup>An interesting case mentioned in the ITC survey is that of a Germany-based wood products exporter, who reports: “Swiss Customs behave rather arbitrarily when dealing with the acceptance of the EUR.1 certificate. The processing time is always different and it is not possible to predict when the goods will reach the customer. It may take up to several weeks and as a result, the customer is displeased and suffers losses” (ITC (2016)).

<sup>6</sup>RTBs are likely to increase variable costs whenever they cause delays in customs clearing (since delaying the entry of a big shipment imposes a bigger cost than delaying a small shipment) or when they cause a shipment to be rejected at the customs with a certain probability. As an example of RTBs that affect variable costs by causing delays, “a small German company exporting musical instruments to India was not aware

Finally, RTBs are often prohibitive, and have important impacts on the extensive margin of trade. Dennis and Shepherd (2011), Nordas et al. (2006), Persson (2013), Hendy and Zaki (2013), Shepherd (2013), Beverelli et al. (2015) and Fontagné et al. (2016) examine the trade impact of various indexes of RTBs, finding that they have a significant impact on the number of imported varieties. For example, Fontagné et al. (2016) find that reducing by 10% the time and amount of documents needed to export into a market implies a 1% increase in the number of exported products for the average firm, and a 2.7% increase for large firms. This confirms both that RTBs have important extensive-margin effects and that large firms are affected at least as much as small firms.<sup>7</sup>

Existing trade agreements, including the WTO, have gone a long way toward restraining the use of trade barriers across the world. However it is difficult for a trade agreement to rein in the use of RTBs, because it is hard to specify them *ex ante*, and it is hard to monitor and verify them *ex post*.<sup>8</sup> This leads to a number of questions concerning the determinants of RTBs and their impacts on trade: How do equilibrium RTBs depend on the tariffs set by trade agreements? How are they affected by “natural” trade costs? How do they respond to lobbying pressures? How do equilibrium RTBs affect the intensive and extensive margins of trade? And how are the optimal cooperative tariffs affected by the anticipation that governments may resort to RTBs *ex post*?

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that a compulsory inspection takes place at the Indian Customs due to lack of information. According to the company, ‘the inspection officials work slowly, causing the goods to be delayed for up to 105 days without any information about the status or outcome of the inspection.’ The company estimates the total cost of this measure to be 50% of the value of the product” (ITC (2016)).

<sup>7</sup>Some of these authors suggest that the extensive-margin impacts of RTBs reflect firm-selection effects due to fixed costs, but we note that these studies use product-level data, so the underlying mechanism is not obvious. In fact, the finding in Fontagné et al. (2016) that RTBs affect large firms more than small firms is not consistent with a Melitz-type selection mechanism. A similar finding is also reported in Shepherd (2013). In the present paper we will suggest a different mechanism that could explain the extensive-margin impact of RTBs.

<sup>8</sup>Recently the WTO has made an important effort to reduce non-tariff trade costs through the “Trade Facilitation Agreement” (TFA). There are two main components to the TFA: encouraging investment in trade-related infrastructure (e.g. improving port efficiency), and reducing RTBs. Arguably, the latter objective is more challenging, especially if RTBs are used by governments as a disguised form of protectionism, and there is little evidence that the TFA has made a big difference in this respect thus far. On the other hand, deep-integration agreements like the EU can go a long way toward eliminating RTBs, especially if they remove customs borders between member countries (as the EU has done).

To make our points more transparently, we assume a standard economic structure in the spirit of Grossman and Helpman (1994), and capture domestic lobbying pressures in a reduced-form way by assuming that governments attach extra weight to domestic producers in import-competing industries. We consider two types of trade policy: import tariffs and RTBs. Given that RTBs do not generate revenue, they are more inefficient than tariffs, so a government (even if politically motivated) would never use them if tariffs were unconstrained. But if a trade agreement constrains tariffs, RTBs may emerge.

We distinguish between an ex-ante stage, when the trade agreement is written, and an ex-post stage, when governments choose RTBs given the tariffs specified in the agreement. At the ex-ante stage, the political pressure parameters are uncertain. Importantly, the trade agreement is incomplete in two dimensions. First, the agreement can specify tariffs but not RTBs, so RTBs are left to a government's discretion. Second, the tariffs specified in the agreement cannot be fully contingent on the level of political pressures in the various industries, so the agreement displays some rigidity.<sup>9</sup>

Our basic model focuses on a small country setting where the trade agreement is motivated by domestic-commitment issues, but later we consider a setting with two large countries where the agreement is motivated by terms-of-trade externalities, and show that our main insights extend to this setting.

We next preview our main results. We start by examining a government's choice of RTBs taking tariffs as exogenous.<sup>10</sup>

In general there can be two sets of products. The first set consists of products for which import demand is not too concave. For these products, given any tariff level the optimal RTB is either zero (if political pressures are weak) or prohibitive (if political pressures are strong).

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<sup>9</sup>This view of trade agreements as incomplete contracts that can display both discretion and rigidity is similar in spirit to Horn et al. (2010).

<sup>10</sup>The case of exogenous tariffs is interesting for several reasons. First, we can interpret the impact of parameter changes on RTBs as short-run effects, reflecting the fact that tariffs cannot be renegotiated frequently. Second, exogenous tariff changes can be interpreted as tariff changes caused by shocks outside our model. Third, this case can capture situations where a country has little choice on the tariff commitments, for example because it must choose whether or not to join a pre-existing trade agreement.

Thus in our model RTBs are likely to “choke” trade for a range of products, implying that the extensive margin is key for understanding the impacts of RTBs.<sup>11</sup> The second set consists of products for which import demand is sufficiently concave, in which case the optimal RTB is non-prohibitive for a range of tariff levels and political pressures.

We find that tariff reductions are likely to have perverse effects on trade, to the extent that they induce an increase in RTBs. Tariff liberalization leads to a *contraction* of trade at the extensive margin, because prohibitive RTBs are triggered for a range of products. Moreover, trade volume *decreases* for products covered by non-prohibitive RTBs, because for these products the government over-compensates for the tariff reduction with an increase in RTBs.<sup>12</sup> Tariff reductions have the intuitive trade-increasing effect only for products that are unencumbered by RTBs, which is the case if political pressures are sufficiently low.

We then examine how RTBs depend on “natural” (i.e. exogenous) trade costs, holding tariffs fixed. We find that decreasing natural trade costs *reduces* the probability that imports of a given product are choked by RTBs; and at the aggregate level, a general decrease in natural trade costs leads to an expansion of trade at the extensive margin. This seems surprising, because natural trade costs and RTBs in our model have identical economic effects, so one might expect them to be substitutes. Importantly, this counterintuitive effect of natural trade costs arises if and only if RTBs affect trade through the extensive margin; if RTBs are non-prohibitive, decreasing natural trade costs has the intuitive effect of increasing RTBs. Taken together, these results imply that the impact of natural trade costs on RTBs depends critically on whether RTBs operate at the extensive or the intensive margin.

The above results have important implications for studies aimed at evaluating the welfare

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<sup>11</sup>This feature of our model is consistent with the above-mentioned empirical finding that RTBs have important impacts on the extensive margin of trade. In the existing literature, the most popular explanation for extensive-margin effects relies on fixed trade costs and imperfect competition. Our model, on the other hand, can explain extensive-margin effects of RTBs without invoking fixed costs or imperfect competition, but rather as arising from a fundamental non-convexity in the government optimization problem, which is due to the fact that consumer surplus and producer surplus are convex in prices.

<sup>12</sup>The result that RTBs (when non-prohibitive) over-respond to tariff changes, so that tariff reductions have a perverse trade-reducing effect, contrasts with the policy-substitution effects highlighted in other papers, where typically the direct effect of the tariff reduction outweighs the indirect effect due to policy substitution toward non-tariff measures, so that trade increases as a result. See e.g. Horn et al. (2010).

gains from reducing tariffs or natural trade costs. Ignoring the possibility of RTBs will lead to *overstating* the welfare gains from tariff reductions, but may well lead to *understating* the welfare gains from reductions in natural trade costs. Tariff reductions trigger policy substitution toward RTBs, so if the endogenous RTB response is ignored, the welfare gains from tariff reductions will be overstated. In contrast, to the extent that RTBs operate at the extensive margin, reductions in natural trade costs mitigate a government's incentive to use RTBs, and hence if RTBs are ignored the welfare gains from reductions in natural trade costs will be understated.

We then examine the optimal tariff commitments. We start with the benchmark case of no political uncertainty. In this case, the optimal tariff cuts *just* prevent RTBs from arising in equilibrium. But even if RTBs remain off-equilibrium, the potential for their use affects the extent of tariff liberalization: tariffs are set above the level that would be optimal if RTBs were unavailable, in order to avoid a “protectionist backlash” in the form of RTBs.

In the presence of political uncertainty, even if tariffs are optimized, RTBs will arise in equilibrium for a range of products. Indeed, the model suggests that increasing political uncertainty tends to increase the occurrence of RTBs in equilibrium. We also find that the optimal tariff for a given product is highest for intermediate degrees of political uncertainty, at least if import demand is not too concave.

We then examine how the optimal tariffs are affected by a decrease in natural trade costs, which for brevity we refer to as “globalization”. Recall that, if import demand is not very concave, globalization reduces the government's incentive to use RTBs. Intuitively, then, globalization should reduce the need to keep tariffs high in order to mitigate such incentive. We find that this intuition is correct if political uncertainty is relatively small. If political uncertainty is large, however, the impact of globalization on the optimal tariffs may be reversed. Furthermore, if import demand is very concave, so that RTBs may be non-prohibitive, globalization always increases the optimal tariffs (a reflection of the fact that in this case globalization increases the government's incentive to use RTBs).

In the final part of the paper, we extend the model in two directions: First we consider the case of partially wasteful trade barriers, meaning that only part of the revenue/rents associated with the policy is wasted. In this case, we find that our main results continue to hold, though with some interesting qualifications. Second, we consider the case of two large countries that sign a trade agreement to address terms-of-trade externalities. We show that the key qualitative results of the small-country case carry over to this environment.

In the related literature, there are a few papers that focus on the substitutability between tariffs and non-tariff measures such as production subsidies and domestic regulations, but the implications of these policies are very different from those of RTBs. See for example Copeland (1990), Bagwell and Staiger (2001a) and Horn et al. (2010).<sup>13</sup> The paper by Beshkar and Lashkaripour (2016) is more closely related to ours. They consider a model where governments maximize welfare and show that, if tariffs are not available, RTBs can be optimal for sectors (if any) that are characterized by a trade elasticity higher than twice the world average trade elasticity. The reason RTBs can be optimal in a given sector is that they improve the terms of trade for other sectors by depressing foreign wages. In contrast, our paper presents a political-economy theory of RTBs, where RTBs can be optimal for sectors characterized by strong domestic political pressures, even if RTBs do not affect the terms of trade. As a consequence, our model can explain the use of RTBs also for small countries. Furthermore, while they focus on the interdependencies in trade policies across sectors, we focus more on the within-sector impact of changes in tariffs and natural trade costs on RTBs, as well as how the extensive and intensive margins of trade are impacted in turn, and how the availability of RTBs affects the tariffs specified in a trade agreement.<sup>14</sup>

Also related is the paper by Limão and Tovar (2011), who consider partially wasteful trade barriers. The focus of their paper however is very different from ours: they argue that

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<sup>13</sup>On the empirical side, papers that have found evidence of policy-substitution effects are Ray (1981), Ray and Marvel (1984), Bown and Tovar (2011), Limão and Tovar (2011) and Eibl and Malik (2016).

<sup>14</sup>Ossa (2011) is another model where wasteful trade barriers can increase welfare, specifically because of firm-delocation effects under monopolistic competition. However, Ossa's basic model considers wasteful trade barriers only for tractability, whereas his main focus is on tariff agreements, which he analyzes numerically.



a government may want to commit to lower tariffs to improve its bargaining position vis-à-vis domestic lobbies in the choice of non-tariff measures. Furthermore, they assume that the optimal level of the non-tariff barrier is always interior; but as we show in this paper, this assumption is unlikely to hold for RTBs, or more generally for policies with a large share of wasted revenue. Finally, Staiger (2012) focuses on trade facilitation agreements that encourage trade-cost-reducing investments. His approach is complementary to ours, in that we allow a government to freely increase trade costs above their “natural” levels, while Staiger allows a government to decrease trade costs below their “natural” levels by making costly investments.

The paper is structured as follows. Section 2 lays out the economic-political environment. Section 3 focuses on the case where RTBs affect the extensive margin of trade. Section 4 considers the richer scenario where RTBs can also affect the intensive margin. Section 5 considers partially wasteful trade barriers. Section 6 considers terms-of-trade motivated trade agreements. Section 7 concludes. Proofs not given in the text and further technical details are in the Appendix.

## **2 The Economic-Political Environment**

The setting is a small open economy that we call Home, trading with a large rest of the world, whose variables are denoted by an asterisk (\*). Markets are perfectly competitive. The economy produces and consumes a continuum of products plus an outside good (which we take to be the numéraire).

In order to make our key points in the most transparent way, we assume quasi-linear and

separable preferences.<sup>15</sup> Each individual at Home has the following utility function:

$$U = x_0 + \int_i u_i(x_i) di \quad (1)$$

Given this utility function, the demand function for each of the nonnuméraire goods depends only on the good's own price:  $x_i(p_i) = -s'_i(p_i)$ , where  $s_i(p_i) \equiv u_i(x_i(p_i)) - p_i x_i(p_i)$  is the surplus the consumer derives from good  $i$ . Integrating this over all goods  $i$  and adding individual income  $Y$  gives their indirect utility:  $Y + \int_i s_i(p_i) di$ .

On the supply side, each nonnuméraire good is produced using a specific factor and mobile labor with constant returns to scale. Aggregate supplies of all factors are fixed, equal to  $K_i$  for specific factor  $i$  and  $L$  for labor. The numéraire good uses only labor with constant returns to scale, and we assume that the labor supply is large enough that this good is always produced in equilibrium. Hence the wage is pinned down in the numéraire good sector. It is convenient to choose units of measurement such that both the wage and the aggregate supply of labor are equal to one (though it is sometimes more insightful to write  $L$  explicitly). The return to specific factor  $i$  is  $\pi_i = r_i K_i$ . Given the technology assumed,  $\pi_i$  depends only on  $p_i$ , so we denote it  $\pi_i(p_i)$ . By Hotelling's Lemma, the supply of each good is given by the derivative of the profit function:  $y_i(p_i) = \pi'_i(p_i)$ . Hence total factor income equals  $L + \int_i \pi_i(p_i) di$ .

Since we want to focus on import barriers, it is convenient to assume that (supply and demand parameters are such that) all nonnuméraire goods are imported while the numéraire good is exported. We will focus on specific tariffs  $\tau_i$ , so the revenue from a tariff is  $\tau_i m_i(p_i)$ , where  $m_i(p_i) = x_i(p_i) - y_i(p_i)$ . Tariff revenue is rebated to citizens in a non-distortionary way, but the government cannot make targeted lump-sum transfers to specific groups.

Welfare is defined as aggregate indirect utility. Letting  $\bar{Y} = L + \int_i \pi_i(p_i) di + \int_i \tau_i m_i(p_i) di$

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<sup>15</sup>Allowing for substitutability across goods complicates the analysis without adding much insight. We have explored an alternative version of our model where individuals have Melitz-Ottaviano preferences, and in such setting our qualitative results remain unchanged.

denote aggregate income, we can write welfare as  $\bar{W} = \bar{Y} + \int_i s_i(p_i)di$ , or equivalently:

$$\bar{W} = L + \int_i W_i di \quad \text{where:} \quad W_i \equiv s_i(p_i) + \pi_i(p_i) + \tau_i m_i(p_i) \quad (2)$$

In addition to the tariffs, there are two types of trade costs: red-tape barriers (RTBs), which are denoted  $\theta_i$ , and “natural” (exogenous) trade costs  $\delta_i$ . Focusing on RTBs first, for the present we assume that they generate no revenue or rents; in Section 5 we will allow them to generate some rents. The natural trade costs  $\delta_i$  are unaffected by trade policy but can be thought of as determined by factors such as technology and geography. RTBs and natural trade costs contribute to the wedge between domestic price and world price, so we can write the domestic price of good  $i$  as:

$$p_i = p_i^* + \delta_i + \tau_i + \theta_i \quad (3)$$

We now introduce the government’s objective function. To capture the idea that the government chooses trade policy subject to domestic political pressures, we assume that the government maximizes the following politically-adjusted welfare function:

$$\bar{V} = L + \int_i V_i di \quad \text{where:} \quad V_i \equiv s_i(p_i) + (1 + \gamma_i)\pi_i(p_i) + \tau_i m_i(p_i) \quad (4)$$

The weight  $\gamma_i > 0$  reflects the political influence of domestic producers of good  $i$ . This type of reduced-form government objective is similar to Hillman (1982) and Baldwin (1987), and can be “micro-founded” along the lines of Grossman and Helpman (1994).<sup>16</sup> Note that the

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<sup>16</sup>We assume that tariffs and RTBs are chosen by a unitary government, but an alternative interpretation of the same setting is that RTBs are under the control of low-level bureaucrats, e.g. customs officials, who have a different objective than the central government. Suppose that customs officials can “sell” RTBs to local producers (in the spirit of Grossman and Helpman’s “protection for sale”), and their objective is to maximize the bribes they receive. If we think of the relationship between the central government and customs officials as a principal-agent relationship, and we abstract from informational frictions, then RTBs will maximize the joint surplus of principal and agent, which in this setting boils down to a weighted average of consumer surplus, producer surplus and revenue. We also note that, since our basic model assumes that RTBs generate no revenue, it does not capture situations where customs officials can extract bribes *from exporters*, because such bribes are a form of revenue. However, if the government attaches less weight to

structure we laid out is separable across products; the reason we consider a model with many imported products, rather than a single one, is that we want to examine how the extensive and intensive margins of trade are affected by changes such as general reductions in tariffs and natural trade costs.

Before we consider trade agreements, we focus on the noncooperative scenario, that is the case in which the home government can choose tariffs and RTBs to maximize its politically-motivated objective without any constraints.

Given separability across products, we can focus on a single imported product  $i$ . Both the tariff and the RTB protect home firms, but only the tariff raises revenue. Hence, in the absence of any constraints on its use of the tariff, the government will never use the RTB. Assuming that  $V_i$  is concave in  $\tau_i$ , the optimal noncooperative tariff is defined by the following first-order condition:

$$\frac{dV_i}{d\tau_i} = \gamma_i y_i + \tau_i m'_i = 0 \tag{5}$$

This yields the optimal noncooperative tariff  $\tau_i^N = -\frac{\gamma_i y_i}{m'_i}$ . We note that  $\tau_i^N$  is prohibitive if  $\gamma_i$  is above some threshold level, which we label  $\gamma_i^H$ .

### 3 Trade Agreements

To examine trade agreements, we now distinguish between an ex-ante stage in which the Home government can sign a trade agreement, and an ex-post stage in which the government chooses trade policies subject to the constraints imposed by the trade agreement.

We assume that the political weights  $\gamma_i$  are observed ex post but uncertain ex ante. Ex ante, each  $\gamma_i$  is distributed according to some cumulative distribution function  $G_i(\gamma_i)$ , with associated density function  $g_i(\gamma_i)$ . We assume that  $g_i(\gamma_i)$  is continuous with support  $[\gamma_i^{min}, \gamma_i^{max}]$ . The political weights are assumed to be independent across products. All other such bribes than to the other components of welfare, this scenario fits in our extension of Section 5, where we consider non-tariff barriers with partial waste of revenue.

parameters of the model are assumed to be deterministic.<sup>17</sup>

As mentioned in the introduction, we view trade agreements as contracts that are incomplete in two dimensions. First, a trade agreement can specify tariffs but not RTBs, reflecting the difficulties of verifying RTBs ex-post and of describing them in detail ex-ante. This means that the agreement leaves *discretion* over RTBs. Note that, since RTBs are not covered by the agreement, they can respond flexibly to political pressures ex-post.

Second, the agreement cannot specify contingent tariffs. In our setting, the relevant contingencies are the political shocks  $\gamma_i$ , so we are assuming that tariffs cannot be made contingent on political shocks (while they can be tailored to all other product characteristics). This means that the agreement also displays some *rigidity*.<sup>18</sup> The co-existence of rigidity and discretion in the trade agreement will be key to our theory. In particular, the model will allow for RTBs to emerge in equilibrium and will yield rich predictions regarding the extensive- and intensive-margin effects of RTBs.

We will examine the implications of a trade agreement in two steps. In subsection 3.1 we will take tariff commitments as exogenous, and highlight the implications of tariff reductions for the use of RTBs, as well as the impact of some key parameter changes (in particular, a decline in natural trade costs) when tariffs are held fixed. This will serve three purposes. First, when we examine the comparative-statics effects of parameter changes on RTBs, this

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<sup>17</sup>The role that political uncertainty plays in the model is to generate a setting where tariffs cannot be fully contingent. An alternative approach would be to assume that each good  $i$  is differentiated along some dimension (e.g. quality) and the tariff on each good  $i$  must be uniform.

<sup>18</sup>Horn et al. (2010) develop a model that explains rigidity and discretion in trade agreements as arising endogenously from contracting costs. As discussed in that paper, there may exist ways to mitigate the issues of rigidity and discretion in trade agreements. For example, one way to mitigate the rigidity of tariff commitments is to use tariff caps instead of exact tariff commitments. Tariff caps allow downward flexibility in the choice of tariffs. Such flexibility can improve efficiency in some states of the world, but it cannot completely eliminate the inefficiency from rigidity. As we discuss later in the paper, our main results are qualitatively unchanged when we consider tariff caps instead of exact tariff commitments. There may also exist ways to mitigate the problem of discretion over non-tariff policies, for example introducing a “non-violation” clause such as GATT’s Article XXIII:1(b). Broadly speaking, this clause allows an exporting country to challenge any policy change applied by an importing country if it adversely impacts the volume of imports. An important limitation of such clause is that, if there are unobservable (or non-verifiable) shocks to trade volume, it can be hard to identify whether a reduction in import volume is caused by a particular policy change or by other shocks. Also, if the policy change itself is hard to observe or verify – as might be the case for subtle red-tape barriers – it is not easy for a country to challenge it by invoking such clause.

can be interpreted as a short-run scenario, since in reality tariffs are renegotiated infrequently. Second, when we examine the effect of exogenous tariff changes on RTBs, these can be interpreted as tariff changes caused by shocks that are outside our model. Third, the case of exogenous tariffs can capture situations where a country does not have much choice on the tariff commitments, for example because it must choose whether or not to join a pre-existing trade agreement.

In subsection 3.2 we will explicitly consider the formation of a trade agreement and examine the optimal tariff commitments. In the basic model we consider a domestic-commitment motivated trade agreement, focusing on a small country, but in Section 6 we will consider also the case of a terms-of-trade motivated trade agreement between two large countries. We capture domestic-commitment motives in a very stylized way, by assuming that the government's ex-ante objective is different from its ex-post objective. In particular, ex ante the government maximizes social welfare (given by (2)), but when choosing trade policies ex post it maximizes the politically-adjusted social welfare function (given by (4)).<sup>19</sup> One interpretation of this reduced-form setting is that, when the agreement is signed, the government is in "constitution-writing" mode, and would like to prevent future policy-makers from engaging in protectionism. Alternatively, this setting could capture a government that faces time-consistency issues and would like to prevent its future self from caving in to domestic political pressures. This reduced-form approach can be given micro-foundations, for example, along the lines of Maggi and Rodríguez-Clare (1998) or Mitra (2002).

### 3.1 Exogenous Tariff Commitments

In this section we examine the government's ex-post choice of RTBs given an exogenous set of tariff commitments. Before we do this, however, it is instructive to focus on the benchmark case where RTBs are the only instruments available, e.g. because a trade agreement sets the tariffs at zero. In this case, we ask, when will the government impose RTBs?

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<sup>19</sup>Our qualitative results would not change if we allowed for political pressures also at the ex-ante stage, as long as they are less strong than at the ex-post stage.

Recall that, given the separability of our structure, we can focus on a single product. The key observation here is that if  $\tau_i = 0$  then  $V_i$  is convex in  $\theta_i$ , because both consumer and producer surplus are convex in  $p_i$ :

$$(i) \frac{dV_i}{d\theta_i} = \gamma_i y_i - m_i \quad (ii) \frac{d^2V_i}{d\theta_i^2} = \gamma_i y_i' - m_i' > 0 \quad (6)$$

This implies a corner solution: the optimal  $\theta_i$  is either zero or prohibitive. Let  $V_i^{FT}$  denote the value of  $V_i$  when evaluated at free trade and  $V_i^{NT}$  (for “non traded”) its value when evaluated at prohibitive trade costs. The optimal RTB is prohibitive if and only if  $V_i^{NT} > V_i^{FT}$ . This is the case if the political weight  $\gamma_i$  exceeds a threshold level:

$$V_i^{NT} > V_i^{FT} \quad \Leftrightarrow \quad \gamma_i > \gamma_i^L \equiv \frac{s_i^{FT} - s_i^{NT}}{\pi_i^{NT} - \pi_i^{FT}} - 1 \quad (7)$$

The condition in (7) means that  $\gamma_i$  is high enough that the gain in producer surplus when moving from free trade to no trade is valued more highly than the loss in consumer surplus. It is easy to show that  $\gamma_i^L < \gamma_i^H$ . To rule out uninteresting cases, we assume that there is a non-empty intersection between the support of  $\gamma_i$  and the interval  $(\gamma_i^L, \gamma_i^H)$ .

The no-tariff scenario considered here illustrates a simple but fundamental feature of the government’s unilateral choice of wasteful trade barriers: it may be optimal to use such barriers if more efficient trade policies are not available, but then the government optimization problem is non-convex, due to the absence of revenue. This non-convexity will play a key role in what follows, and indeed will be the driver of the extensive-margin effects of RTBs in our model.

We are now ready to examine the government’s ex-post choice of RTBs given arbitrary tariff commitments. Suppose that the tariff for product  $i$  is constrained at some level  $\tau_i < \tau_i^N$ , and consider the ex-post choice of  $\theta_i$  given this tariff. A key determinant of such ex-post choice is whether  $V_i$  is concave or convex in  $\theta_i$ . Relative to the previous case of zero tariffs, an increase in the RTB now has an additional effect: increasing  $\theta_i$  lowers tariff revenue.

Because of this effect,  $V_i$  may be concave for a range of  $\tau_i$  if import demand  $m_i$  is sufficiently concave. To see this, differentiate (4) with respect to  $\theta_i$ , allowing for a positive tariff:

$$(i) \frac{dV_i}{d\theta_i} = \gamma_i y_i - m_i + \tau_i m_i' \quad (ii) \frac{d^2V_i}{d\theta_i^2} = \gamma_i y_i' - m_i' + \tau_i m_i'' \quad (8)$$

As the expressions above indicate, if import demand  $m_i$  is convex or slightly concave then  $V_i$  is convex in  $\theta_i$  for all  $\tau_i$ , but if  $m_i$  is sufficiently concave then  $V_i$  is concave in  $\theta_i$  for  $\tau_i > 0$ .

In this section we assume that for all products  $V_i$  is convex in  $\theta_i$  for all  $\tau_i$ , deferring until Section 4 the more general case in which  $V_i$  may be convex for some products and concave for others. The former case is rather special, but it is simpler and will allow us to make some key points.

If  $V_i$  is convex, the ex-post choice of  $\theta_i$  exhibits a bang-bang pattern: it is either zero or prohibitive, depending on the realized political weight and the tariff. We let  $\theta_i^R(\gamma_i, \tau_i)$  denote the ex-post choice of  $\theta_i$  as a function of  $\gamma_i$  and  $\tau_i$ . We call this the “RTB response function.” Here and throughout the analysis, in order to avoid cluttering the notation, we omit the argument  $\delta_i$  from the RTB response function and all other functions, even though this will be a key parameter of interest.

It is immediate to show that the RTB response is prohibitive if  $\gamma_i$  is above some threshold  $\gamma_i^J(\tau_i)$  and zero if  $\gamma_i$  is below  $\gamma_i^J(\tau_i)$ .<sup>20</sup> Figure 1 illustrates this result, and Remark 1 states it formally.

**Remark 1.** *Given  $\tau_i < \tau_i^N$ , there exists a threshold  $\gamma_i^J(\tau_i)$  such that  $\theta_i^R(\gamma_i, \tau_i)$  is prohibitive if  $\gamma_i > \gamma_i^J(\tau_i)$  and zero if  $\gamma_i \leq \gamma_i^J(\tau_i)$ .*

Remark 1 is intuitive, given that the optimal  $\theta_i$  must be at a corner: holding the tariff fixed, imports of product  $i$  will be choked by RTBs if the realized political weight for this product is high, while RTBs will not be used at all if the realized political weight is low.

Next we turn to the impact of tariffs on RTBs. It is intuitive and easy to show that the

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<sup>20</sup>We assume that in case of indifference the government chooses  $\theta_i = 0$ .



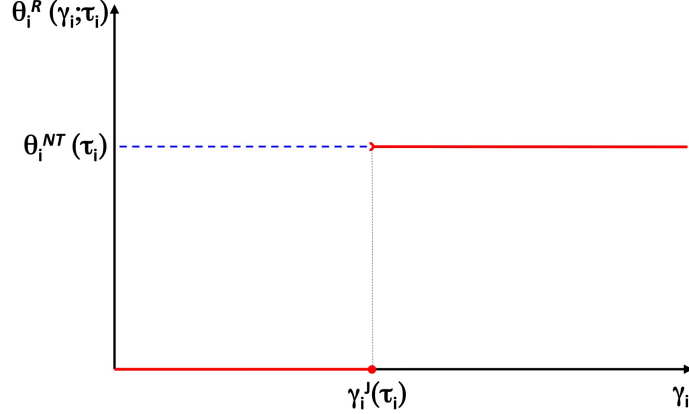


Figure 1: RTB Response as a Function of  $\gamma_i$ ; Bang-Bang Case

threshold  $\gamma_i^J(\tau_i)$  is increasing in  $\tau_i$ . As a consequence, it is clear that lowering  $\tau_i$  increases the probability that imports of product  $i$  will be choked by red tape.

Consider next the impact of a general decrease in tariffs across all products. Let  $F^{choke}$  denote the fraction of products whose imports are choked by red tape. An immediate implication of the observation just above is that, if  $\tau_i$  falls for all products,  $Pr(F^{choke} < x)$  decreases weakly for any  $x$ , therefore  $F^{choke}$  increases in the first-order stochastic sense. The following proposition summarizes the impact of tariff reductions on the optimal RTBs:

**Proposition 1.** (i) *The probability that imports of product  $i$  are choked by RTBs increases as  $\tau_i$  falls;* (ii) *If  $\tau_i$  falls for all products,  $F^{choke}$  increases in the first-order stochastic sense.*

Proposition 1 reflects a kind of “policy substitution” effect: when tariffs are lower, the government has more incentive to use red-tape barriers. The novel aspect of this substitution effect is that it occurs at the extensive margin.<sup>21</sup>

We next examine the overall effect of tariff reductions on trade when we take into account not only the direct effect of tariffs but also the induced RTB response. As a result of the tariff reductions trade increases at the intensive margin, because conditional on a product being imported (before and after the change), the tariff reduction does not trigger the use of RTBs; but trade shrinks at the extensive margin, because the fraction of products whose

<sup>21</sup>Policy-substitution effects have been highlighted in the literature for other non-tariff measures, but not at the extensive margin. See, e.g., Copeland (1990), Horn et al. (2010) and Limão and Tovar (2011).

imports are choked by RTBs increases.

**Corollary 1.** *If  $\tau_i$  decreases for all products, the joint effect of the tariff reduction and the induced RTB response is an increase in trade at the intensive margin and a contraction of trade at the extensive margin.*

Next we focus on the impact of natural trade costs on RTBs. In light of the substitutability between tariffs and RTBs, one might think that a reduction in natural trade costs should increase the government's temptation to impose RTBs. Indeed, natural trade costs and red-tape barriers enter the government's objective function only through their sum  $\delta_i + \theta_i$ , suggesting that  $\delta_i$  and  $\theta_i$  should be even more closely substitutable than  $\tau_i$  and  $\theta_i$ . However, this intuition turns out not to be correct.

The key point is that, for each product, the threshold political weight  $\gamma_i^J$  increases as  $\delta_i$  decreases. To see why, consider a configuration of parameters such that the government is indifferent between  $\theta_i = 0$  and a prohibitive value of  $\theta_i$ . Since  $V_i$  is convex in  $\theta_i$  and takes the same value at the two extremes of  $\theta_i$ , it follows that  $V_i$  is U-shaped in  $\theta_i$ , and thus a small increase in  $\theta_i$  from zero reduces  $V_i$ . But an increase in  $\delta_i$  has the same effect as an increase in  $\theta_i$ , and has no impact on the no-trade payoff level,  $V_i^{NT}$ . Hence a rise in  $\delta_i$  favors the prohibitive level of the RTB over the zero level. Figure 2 visualizes this point.

An alternative perspective to understand this result is to consider the cross derivative of  $V_i$  with respect to  $\theta_i$  and  $\delta_i$ . Clearly, this cross derivative is equal to the second derivative of  $V_i$  with respect to  $\theta_i$ , which in this setting is positive. Thus, when the objective function is convex in  $\theta_i$ , so that the optimum is at a corner,  $\theta_i$  is complementary to  $\delta_i$ .

Consider next the impact of a general fall in natural trade costs. Applying a similar aggregation logic as the one we used above for tariffs, it is easy to argue that, if  $\delta_i$  falls for all products,  $F^{choke}$  must decrease in the first-order stochastic sense, and therefore trade expands at the extensive margin. We can thus state:

**Proposition 2.** *Holding tariffs constant: (i) The probability that imports of product  $i$  are*

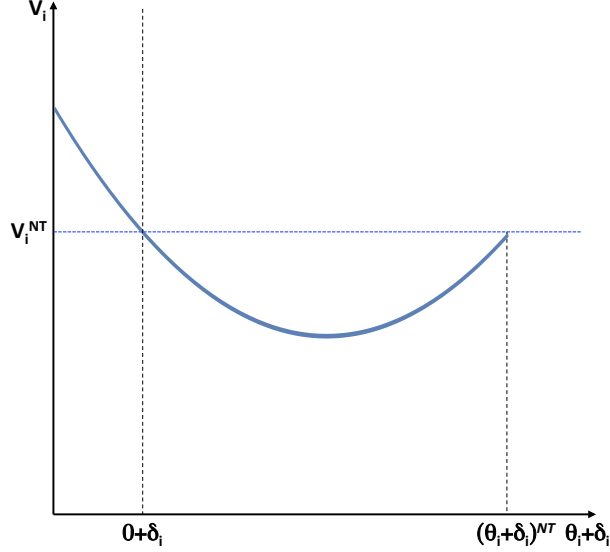


Figure 2: RTBs and Natural Trade Costs

choked by red tape is increasing in  $\delta_i$ . (ii) If  $\delta_i$  falls for all products,  $F^{choke}$  decreases in the first-order stochastic sense.

Proposition 2(i) suggests a cross-sectional prediction of the model: products characterized by lower natural trade costs are less likely to be hit by RTBs. Proposition 2(ii) suggests a “time-series” prediction of the model: globalization should lead to fewer RTBs, and through this channel, to an expansion of trade at the extensive margin.<sup>22</sup>

Before proceeding we note an important implication of the results presented above. If one evaluates the welfare gains from a reduction in tariffs or natural trade costs ignoring the possibility of RTBs, one will *overstate* the welfare gains from tariff reductions, but *understate* the welfare gains from reductions in natural trade costs. Tariff reductions trigger policy substitution toward RTBs, so it is obvious that if the endogenous RTB response is ignored, the welfare gains from tariff reductions will be overstated. But the sign of this “bias” is reversed when evaluating the welfare effects of a fall in natural trade costs, because in this case reductions in natural trade costs reduce a government’s incentive to use RTBs.

<sup>22</sup>The impact of a general reduction in natural trade costs on trade (when taking into account the induced RTB response) is that trade increases both at the extensive and the intensive margin: trade volume increases for products that are RTB-free before and after the change, and the fraction of products whose imports are choked by RTBs decreases.

## 3.2 Optimal Tariff Commitments

In this section we examine the optimal choice of tariff commitments. The agreement is chosen ex ante to maximize the Home country's welfare, taking into account that ex post the government will be subject to political pressures. Recall that the agreement can only specify tariffs, and that the tariffs cannot be contingent on the political shocks ( $\gamma_i$ ).

It is instructive to start with the benchmark case in which there is no political uncertainty, in the sense that the distribution of each  $\gamma_i$  is degenerate at some value  $\gamma_i^0$ . In this case each tariff can be tailored to the political weight of a product (as well as to the other product characteristics), so there is effectively no rigidity in the tariffs. For this reason we call the optimal tariffs in this scenario the “bespoke” tariffs, and denote them by  $\tau_i^B(\gamma_i^0)$ .

Given the separability of our structure, we can optimize the tariff commitment product by product. Focusing on product  $i$ , the optimization problem can be written as follows:

$$\tau_i^B(\gamma_i^0) \equiv \arg \max_{\tau_i} W_i(\tau_i, \theta_i^R(\gamma_i^0, \tau_i)), \quad \text{where} \quad \theta_i^R(\gamma_i^0, \tau_i) \equiv \arg \max_{\theta_i} V_i(\tau_i, \theta_i, \gamma_i^0) \quad (9)$$

Recall from Proposition 1 that  $\theta_i^R(\gamma_i^0, \tau_i)$  is prohibitive if and only if  $\gamma_i > \gamma_i^J(\tau_i)$ , where  $\gamma_i^J(\tau_i)$  is increasing in  $\tau_i$ . It follows immediately that  $\theta_i^R$  is prohibitive if and only if  $\tau_i < \tau_i^J(\gamma_i^0)$ , where  $\tau_i^J(\cdot)$  is the inverse of  $\gamma_i^J(\cdot)$ . We now argue that the bespoke tariff  $\tau_i^B(\gamma_i^0)$  is the lowest tariff that does not trigger RTBs, hence it coincides with  $\tau_i^J(\gamma_i^0)$ .<sup>23</sup>

Figure 3 illustrates the bespoke tariff for product  $i$ . For all tariffs below  $\tau_i^J(\gamma_i^0)$  a prohibitive RTB is triggered, thus yielding the no-trade level of welfare  $W_i^{NT}$ ; if the tariff is raised slightly above  $\tau_i^J(\gamma_i^0)$  the RTB response jumps down to zero, so the welfare level jumps up, and then falls as the tariff increases further. It follows that the bespoke tariff is  $\tau_i^J(\gamma_i^0)$ .

Next we ask how the bespoke tariff varies with the natural trade cost  $\delta_i$ . Recall from the discussion after Proposition 2 that reducing  $\delta_i$  reduces the incentive to impose RTBs. There we showed that, given the tariff, the threshold political weight  $\gamma_i^J$  is decreasing in  $\delta_i$ . With

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<sup>23</sup>Recall the assumption that, in case of indifference, the government chooses  $\theta_i = 0$ . If instead it chooses  $\theta_i = 0$  with probability less than one, then the optimal tariff will be “just” above  $\tau_i^J(\gamma_i^0)$ .

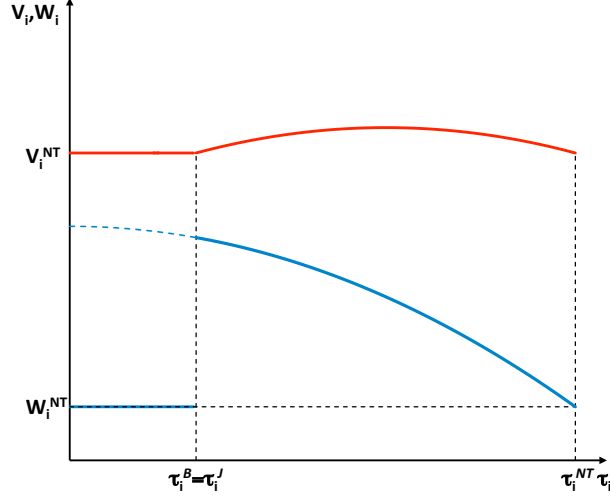


Figure 3: The Bespoke Tariff

the same logic it is easy to show that the threshold tariff  $\tau_i^J(\gamma_i^0)$  – and hence the bespoke tariff  $\tau_i^B(\gamma_i^0)$  – goes down as  $\delta_i$  decreases. Summarizing our results for the bespoke tariff:

**Remark 2.** *If the distribution of  $\gamma_i$  is degenerate at  $\gamma_i^0$  (so there is no rigidity in the tariff commitment), then: (i) the optimal tariff for product  $i$  is the lowest tariff that does not trigger choking by red tape; (ii) the optimal tariff is increasing in the natural trade cost  $\delta_i$ .*

The intuition for Remark 2(i) is simple: a complete trade agreement would specify zero trade barriers in this small open economy, but given that the agreement cannot specify RTBs, the optimal (incomplete) agreement sets a tariff which is just high enough to avoid a “protectionist backlash” that would choke imports. Note that, in this benchmark case where tariffs are fully contingent, no RTBs emerge in equilibrium. However, the *potential* for use of RTBs limits the extent of tariff liberalization: if RTBs were not available the optimal agreement would lower tariffs all the way to zero, but given that RTBs are available, the optimal agreement sets strictly positive tariffs to prevent RTBs from emerging. This effect is reminiscent of the “indirect incentive-management” effect in Horn et al. (2010), where tariffs need to be kept relatively high to mitigate the incentive of governments to use production subsidies, if these are not specified in the agreement.

Remark 2(ii) states that, in this scenario, optimal tariffs are lower when natural trade

costs are lower. Intuitively, if natural trade costs are lower the government is less tempted to use RTBs for given tariffs, so there is less need to keep tariffs high for “indirect incentive-management” purposes.

Now we introduce political uncertainty, by considering a non-degenerate distribution of  $\gamma_i$  for each  $i$  (keeping the assumption that  $\tau_i$  cannot be contingent on  $\gamma_i$ ). The optimal tariff, which we denote  $\bar{\tau}_i$ , maximizes expected welfare for product  $i$ :

$$\bar{\tau}_i \equiv \arg \max_{\tau_i} \int_{\gamma_i^{\min}}^{\gamma_i^{\max}} W_i(\tau_i, \theta_i^R(\gamma_i^0, \tau_i)) dG_i(\gamma_i) \quad (10)$$

Given the RTB response function  $\theta_i^R(\gamma_i^0, \tau_i)$ , we can write expected welfare from (10) as:

$$\int_{\gamma_i^{\min}}^{\gamma_i^J(\tau_i)} W_i(\tau_i, 0) dG_i(\gamma_i) + \int_{\gamma_i^J(\tau_i)}^{\gamma_i^{\max}} W_i^{NT} dG_i(\gamma_i) = G_i(\gamma_i^J(\tau_i)) W_i(\tau_i) + [1 - G_i(\gamma_i^J(\tau_i))] W_i^{NT} \quad (11)$$

where we adopt the convention  $\int_a^b f(x) dx = 0$  if  $a > b$ . When  $\gamma_i < \gamma_i^J(\tau_i)$  the product is imported at the tariff  $\tau_i$ , but when  $\gamma_i > \gamma_i^J(\tau_i)$  imports of product  $i$  are choked by red tape, yielding the no-trade welfare level. In what follows we assume that the optimal tariff is interior, so it must satisfy the first-order condition (FOC):

$$g_i(\gamma_i^J(\tau_i)) \frac{d\gamma_i^J(\tau_i)}{d\tau_i} \Delta W_i(\tau_i) + G_i(\gamma_i^J(\tau_i)) \frac{\partial W_i(\tau_i, 0)}{\partial \tau_i} = 0 \quad (12)$$

where  $\Delta W_i(\tau_i) \equiv W_i(\tau_i, 0) - W_i^{NT}$  is the welfare loss caused by a prohibitive RTB relative to a zero RTB (for a given tariff).

The FOC above highlights the tradeoffs involved in the optimal choice of tariff. An increase in the tariff has two distinct effects on welfare. The first term is positive and is due to the fact that raising the tariff reduces the range of  $\gamma_i$  for which imports are choked by red tape, by increasing the threshold  $\gamma_i^J$  and hence generating a discrete welfare gain  $\Delta W_i$  for values of  $\gamma_i$  close to  $\gamma_i^J$ . The second term in (12), on the other hand, is negative and reflects the adverse “infra-marginal” welfare effects of increasing the tariff for the range of  $\gamma_i$  such

that red-tape barriers are not imposed.

We next consider how the optimal tariff commitments and the induced RTBs are affected by changes in political uncertainty.

Let  $\gamma_i^{med}$  denote the median value of  $\gamma_i$ . We now introduce a definition that will be useful to characterize the impact of changes in uncertainty on the optimal tariffs: we say that the density function  $g^a(x)$  features a *median-preserving local flattening* relative to  $g^b(x)$  if the two distributions have the same median  $x^{med}$  and  $g^a(x^{med}) < g^b(x^{med})$ . A median-preserving local flattening simply means that the density is lowered locally around the median (recall  $g_i$  is assumed continuous) while preserving the median. Note that for all common parametric distributions a median-preserving flattening is equivalent to a median-preserving spread: this is easy to check, for example, for the Pareto, normal, lognormal and uniform distributions. With this in mind, in what follows we will interpret a median-preserving flattening as an increase in uncertainty.<sup>24</sup>

Now consider the effect of a median-preserving flattening in  $g_i(\gamma_i)$  on the optimal tariff. Consider the left-hand side of (12) evaluated at  $\tau_i^J(\gamma_i^{med})$ . Recall that the first term is positive and the second term is negative. Note that  $\gamma_i^J(\tau_i^J(\gamma_i^{med})) = \gamma_i^{med}$  and  $G_i(\gamma_i^{med}) = 1/2$ ; thus, as we flatten the distribution while preserving its median, the second term evaluated at  $\tau_i^J(\gamma_i^{med})$  does not change. Next focus on the first term. If  $g_i(\gamma_i^{med})$  is close to zero, the left-hand side of (12) is negative, and hence the optimal tariff is below  $\tau_i^J(\gamma_i^{med})$ . On the other hand, if  $g_i(\gamma_i^{med})$  is high enough, the first term outweighs the second term and hence the left-hand side of (12) is positive, thus the optimal tariff is above  $\tau_i^J(\gamma_i^{med})$ . Finally recall from Remark 2 that, if the distribution of  $\gamma_i$  is degenerate at  $\gamma_i^{med}$  – that is, if  $g_i(\gamma_i^{med})$  is infinite – then the optimal tariff is equal to  $\tau_i^J(\gamma_i^{med})$ . It follows that:

**Proposition 3.** *Starting at the degenerate distribution, the optimal tariff varies in a non-monotonic way with a median-preserving local flattening of  $g_i(\gamma_i)$ : it starts at  $\tau_i^J(\gamma_i^{med})$ , then rises above it, and eventually falls below it.*

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<sup>24</sup>The reason we do not use the notion of median-preserving spread is that for our results we need local flattening of the density at the median, and this is not guaranteed in general by a median-preserving spread.

Proposition 3 highlights a surprising non-monotonicity: the optimal tariff first rises and then falls as uncertainty is increased in a median-preserving way. Thus the optimal tariff is highest for products with intermediate degrees of political uncertainty.

To gain some intuition for this result, focus on the tariff level such that there is a 50-50 chance that RTBs will be triggered (namely  $\tau_i^{med} \equiv \tau_i^J(\gamma_i^{med})$ ). If the distribution of  $\gamma_i$  is degenerate at the median, we are back to the bespoke tariff case considered above: the optimal tariff is equal to  $\tau_i^{med}$ , and RTBs are triggered with probability zero. Now consider a non-degenerate distribution of  $\gamma_i$ , but very concentrated around the same median: the infra-marginal effect of the tariff for the low range of  $\gamma_i$  where RTBs are not triggered (the second term in (12)) stays unchanged, while the impact of the tariff on the threshold  $\gamma_i^J$  above which RTBs are triggered (the first term in (12)) is positive and large, so the optimal tariff is discretely above  $\tau_i^{med}$ . Finally, consider a distribution of  $\gamma_i$  that is very flat around the median: again, the infra-marginal effect of the tariff is unchanged, but now the impact of the tariff through the threshold  $\gamma_i^J$  is small, so the optimal tariff is below  $\tau_i^{med}$ .

Next we focus on the impact of political uncertainty on the equilibrium RTBs. We argued above that if  $g_i(\gamma_i^{med})$  is sufficiently small (resp. large) then the optimal tariff is below (resp. above)  $\tau_i^J(\gamma_i^{med})$ . Next note that  $\tau_i > \tau_i^J(\gamma_i^{med})$  is equivalent to  $\gamma_i^J(\tau_i) > \gamma_i^{med}$ , which implies that product  $i$  is choked by red tape with probability lower than 1/2. We can thus state:

**Proposition 4.** *If  $g_i(\gamma_i^{med})$  is sufficiently high, the probability that imports of product  $i$  are choked by red tape is lower than 1/2. If  $g_i(\gamma_i^{med})$  is sufficiently low, the probability that imports of product  $i$  are choked by red tape is higher than 1/2.*

As we discussed above, we can interpret the case in which  $g_i(\gamma_i^{med})$  is high (resp. low) as corresponding to the case of small (resp. large) uncertainty. Recall also from Remark 2 that, if there is no uncertainty at all (i.e.  $g_i(\gamma_i^{med})$  is infinite), no RTBs arise given the optimal tariff. Thus, taken together, the results of Remark 2 and Proposition 4 suggest that RTBs should be more likely to arise for products characterized by more political uncertainty. The intuition behind this result is simple: the “ideal” level of the tariff commitment is the



one that just prevents RTBs from arising, but since tariffs cannot be contingent on political shocks, increasing political uncertainty causes “errors” and induces RTBs in equilibrium.

Next we focus on the impact of natural trade costs on the optimal tariff commitments. First note that, if political uncertainty is sufficiently small, in the sense that the distribution of  $\gamma_i$  is sufficiently concentrated, the optimal tariff is increasing in  $\delta_i$ . To see this, recall from Remark 2 that, if the distribution of  $\gamma_i$  is degenerate, the optimal tariff is increasing in  $\delta_i$ . Intuitively, this is true also if the distribution of  $\gamma_i$  is very concentrated.

This result suggests a theoretical explanation for the occurrence of gradual tariff liberalization as a result of globalization’: a reduction in natural trade costs encourages tariff liberalization because it reduces a government’s incentive to use RTBs, and hence there is less need to keep tariffs high to keep this incentive in check.

While globalization has the intuitive effect of decreasing the optimal tariffs if political uncertainty is sufficiently small, it is important to observe that this effect may be reversed if political uncertainty is large enough. A fall in  $\delta_i$  affects the first-order condition (12) through multiple channels, so it is easy to see why the overall effect can go either way. In particular, one of these effects is that reducing  $\delta_i$  increases  $\Delta W_i$ , the welfare loss from choking trade; this effect pushes in favor of a higher tariff. For example, if demand is linear, supply is fixed and the distribution of  $\gamma_i$  is either Pareto or uniform, we find that the optimal tariff is increasing in  $\delta_i$  when dispersion is sufficiently large. In the Appendix we prove:

**Proposition 5.** *If political uncertainty is sufficiently small, a fall in  $\delta_i$  reduces the optimal tariff. However, this effect may be reversed if political uncertainty is sufficiently large.*

Before concluding this section, we note that our main results would not be affected if the agreement specified tariff caps instead of exact tariff commitments (see also footnote 18). One can show that the optimal tariff cap is higher than the optimal exact tariff commitment, because the downward flexibility associated with tariff caps reduces the marginal cost of raising the tariff level, but our results are not altered in a qualitative way.<sup>25</sup>

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<sup>25</sup>The main change would be that the government can choose both  $\theta_i$  and  $\tau_i$  subject to the tariff cap. In

## 4 RTBs and the Intensive Margin

In the setting we have considered thus far, equilibrium RTBs affect only the extensive margin of trade. But in a more general setting, they can also operate at the intensive margin.

Recall from equation (8) that for product  $i$ , given a positive tariff, if import demand is sufficiently concave then  $V_i$  is concave. In this case, the RTB response  $\theta_i^R(\gamma_i, \tau_i)$  may be non-prohibitive for a range of  $\gamma_i$  and  $\tau_i$ . An example where  $\theta_i^R(\gamma_i, \tau_i)$  is non-prohibitive for a range of  $\gamma_i$  and  $\tau_i$  – it can be shown – is the case in which supply is fixed and the demand function takes the Pollak (1971) form, that is  $x_i(p_i) = \alpha_i - \beta_i p_i^{\sigma_i}$ , with  $\sigma_i > 2$ .

In this section we examine the more general setting where RTBs may or may not be prohibitive. As in the previous section, we start by focusing on the case of exogenous tariff commitments, and characterize how the RTB response depends on tariffs and natural trade costs.

### 4.1 Exogenous Tariff Commitments

Let us start by focusing on a given product  $i$ . Fix the tariff  $\tau_i$  and focus on how the optimal RTB depends on the realization of  $\gamma_i$ . Clearly  $\theta_i^R$  can be non-prohibitive only for an intermediate interval of  $\gamma_i$ , because  $\theta_i^R$  is zero if  $\gamma_i$  is close to zero and prohibitive if  $\gamma_i$  is sufficiently high. It is also intuitive that, within the non-prohibitive interval,  $\theta_i^R$  is increasing in  $\gamma_i$ . In what follows we let  $\hat{\gamma}_i(\tau_i)$  denote the threshold value of  $\gamma_i$  below which  $\theta_i^R$  is zero, and  $\tilde{\gamma}_i(\tau_i)$  the threshold value of  $\gamma_i$  above which  $\theta_i^R$  is prohibitive. To simplify exposition we assume that, if the non-prohibitive interval is non-empty (i.e.  $\tilde{\gamma}_i(\tau_i) < \hat{\gamma}_i(\tau_i)$ ), the function  $\theta_i^R(\gamma_i, \tau_i)$  is continuous.<sup>26</sup> In the Appendix we prove:

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general there will be a low interval of  $\gamma_i$  such that the tariff cap is not binding, in which case the government chooses the optimal noncooperative tariff and  $\theta_i = 0$ . Clearly this does not affect the bang-bang nature of the RTB response function, with a threshold level of  $\gamma_i$  such that  $\theta_i$  is zero below it and prohibitive above it. When it comes to the optimal tariff cap, there would be one additional term in the first-order condition (12), corresponding to the range of  $\gamma_i$  where the tariff cap is not binding, but our results would still go through.

<sup>26</sup>In general  $\theta_i^R(\gamma_i, \tau_i)$  may have jumps even if  $\tilde{\gamma}_i(\tau_i) < \hat{\gamma}_i(\tau_i)$ . In the case of fixed supply and Pollak demand, for example, it can be shown that  $\theta_i^R(\gamma_i, \tau_i)$  may have a jump (only) at the upper threshold  $\tilde{\gamma}_i(\tau_i)$ ; however, all of our results go through in this case.

**Remark 3.** Given  $\tau_i < \tau_i^N$ , there exist  $\hat{\gamma}_i(\tau_i)$  and  $\tilde{\gamma}_i(\tau_i)$  (with  $\hat{\gamma}_i(\tau_i) \leq \tilde{\gamma}_i(\tau_i)$ ) such that  $\theta_i^R(\gamma_i, \tau_i)$  is zero for  $\gamma_i < \hat{\gamma}_i(\tau_i)$ , increasing in  $\gamma_i$  for  $\gamma_i \in (\hat{\gamma}_i(\tau_i), \tilde{\gamma}_i(\tau_i))$  and prohibitive for  $\gamma_i > \tilde{\gamma}_i(\tau_i)$ .

The bang-bang case examined in the previous section corresponds to the case  $\hat{\gamma}_i(\tau_i) = \tilde{\gamma}_i(\tau_i)$ . For what follows, it is important to keep in mind that we allow for many heterogeneous products, so in general there may be products for which  $\hat{\gamma}_i(\tau_i) < \tilde{\gamma}_i(\tau_i)$  and products for which  $\hat{\gamma}_i(\tau_i) = \tilde{\gamma}_i(\tau_i)$ . Figure 4 illustrates the RTB response as a function of  $\gamma_i$ , focusing on the former case.

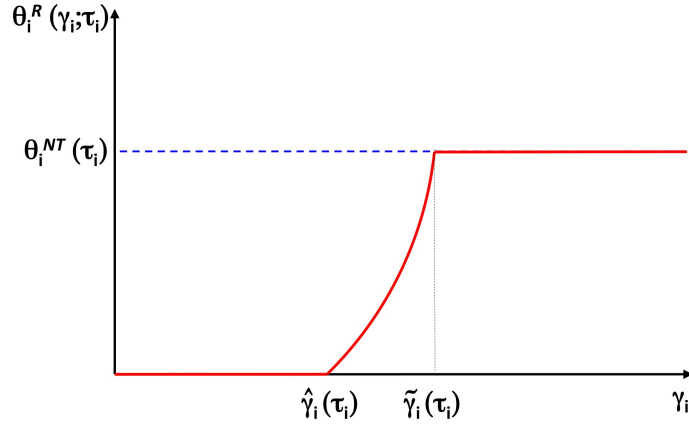


Figure 4: RTB Response as a Function of  $\gamma_i$ ; Case  $\hat{\gamma}_i(\tau_i) < \tilde{\gamma}_i(\tau_i)$

How do tariff reductions affect RTBs? It is easy to show that reducing  $\tau_i$  decreases both thresholds  $\hat{\gamma}_i(\tau_i)$  and  $\tilde{\gamma}_i(\tau_i)$ , while increasing the level of  $\theta_i^R$  in the non-prohibitive interval. As a consequence, decreasing  $\tau_i$  increases the probability that product  $i$  is affected by RTBs as well as the probability that imports of product  $i$  are choked by RTBs.

At the aggregate level, the above observations imply that a general reduction in tariffs increases the fraction of products choked by RTBs ( $F^{choke}$ ) and the fraction of products “covered” by RTBs (i.e. such that  $\theta_i > 0$ ), which we denote by  $F^{cov}$ . Formally, if  $\tau_i$  decreases for all products,  $F^{choke}$  and  $F^{cov}$  increase (weakly) in the first-order stochastic sense.

Another important point is the following. If the optimal level of  $\theta_i$  before the tariff change is non-prohibitive,  $\theta_i$  increases by more than the tariff reduction:  $\frac{d\theta_i^R}{d\tau_i} < -1$ . To see this,

note from (8) that  $\frac{d^2V_i}{d\theta_i d\tau_i} = \gamma_i y'_i + \tau_i m''_i < \frac{d^2V_i}{d\theta_i^2} = \gamma_i y'_i + \tau_i m''_i - m'_i < 0$ . Thus, if RTBs are non-prohibitive, the government *over-compensates* for the tariff reduction with an increase in RTBs, thus *total trade cost increases*. To gain intuition, recall that the FOC for  $\theta_i$  is  $\frac{dV_i}{d\theta_i} = \gamma_i y_i - m_i + \tau_i m'_i = 0$ . Start from a point on the RTB response function, where the FOC is satisfied, and decrease  $\tau_i$  by one unit: to restore the FOC,  $\theta_i$  must be increased by more than one unit, because  $\theta_i$  has a smaller impact than  $\tau_i$  on  $\frac{dV_i}{d\theta_i}$ , due to the lack of revenue. In the Appendix we show:

**Proposition 6.** *If  $\tau_i$  decreases for all products, both  $F^{choke}$  and  $F^{cov}$  increase (weakly) in the first-order stochastic sense. Moreover, for all products such that  $\theta_i$  is initially non-prohibitive,  $\theta_i$  increases by more than the tariff reduction ( $\frac{d\theta_i^R}{d\tau_i} < -1$ ), so total trade cost increases.*

The above result has an immediate and striking implication regarding the effects of a general tariff reduction on the extensive and intensive margins of trade:

**Corollary 2.** *If  $\tau_i$  decreases for all products, trade shrinks at the extensive margin, and it shrinks also at the intensive margin for all products such that  $\theta_i$  is non-prohibitive before and after the tariff reduction. Trade can increase at the intensive margin only for products such that  $\theta_i = 0$  before the tariff reduction.*

The result that tariff liberalization (combined with the induced RTB response) leads to a contraction of trade at the extensive margin mirrors the finding in the bang-bang scenario of the previous section. But in this richer scenario, tariff reductions can have a perverse negative effect on trade also at the intensive margin: trade volume decreases for products covered by non-prohibitive RTBs, because for these products the government over-compensates for the tariff reduction with an increase in RTBs, so that total trade cost increases.<sup>27</sup>

Next we focus on the impact of natural trade costs on RTBs. We will show that in the case  $\hat{\gamma}_i(\tau_i) < \tilde{\gamma}_i(\tau_i)$  (depicted in Figure 4) this impact is dramatically different from the case  $\hat{\gamma}_i(\tau_i) = \tilde{\gamma}_i(\tau_i)$ , where the RTB response is bang-bang.

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<sup>27</sup>If the tariff reduction triggers RTBs for a product that initially had none (that is, if  $\gamma_i$  is below  $\hat{\gamma}_i$  before the change but above  $\hat{\gamma}_i$  after the change), the RTB increase may be higher or lower than the tariff decrease.

Let us start by considering a decrease in  $\delta_i$  at the product level. The key observation is that, if  $\hat{\gamma}_i(\tau_i) < \tilde{\gamma}_i(\tau_i)$ , a decrease in  $\delta_i$  leads to a one-for-one increase in  $\theta_i^R$  in the interval  $(\hat{\gamma}_i(\tau_i), \tilde{\gamma}_i(\tau_i))$  and a decrease in the lower threshold  $\hat{\gamma}_i(\tau_i)$ , while the upper threshold  $\tilde{\gamma}_i(\tau_i)$  is not affected. That a decrease in  $\delta_i$  leads to a one-for-one increase in  $\theta_i^R$  when the latter is non-prohibitive follows from the fact that  $\delta_i$  and  $\theta_i$  enter the objective  $V_i$  through their sum: here, RTBs are used to neutralize the reduction in natural trade costs. Intuitively, this in turn implies that the lower threshold  $\hat{\gamma}_i(\tau_i)$  decreases. Finally, the upper threshold  $\tilde{\gamma}_i(\tau_i)$  is not affected, because for this level of  $\gamma_i$  there is an interior maximum for  $\theta_i$ , and the value of the objective at an interior maximum is not affected by a change in  $\delta_i$ , since this is fully offset by the change in  $\theta_i$ .

The above observations have two immediate implications. First, if the non-prohibitive interval of  $\gamma_i$  is non-empty ( $\hat{\gamma}_i(\tau_i) < \tilde{\gamma}_i(\tau_i)$ ), a decrease in  $\delta_i$  weakly increases  $\theta_i$  for all  $\gamma_i$ , but the probability of choking is not affected. Second, as  $\delta_i$  decreases, a range of non-prohibitive  $\theta_i$  can emerge, but cannot disappear; in other words, the thresholds  $\hat{\gamma}_i(\tau_i)$  and  $\tilde{\gamma}_i(\tau_i)$  may separate, but cannot merge.

Thus, for a given tariff level, there are two intervals of  $\delta_i$  (each of which may be empty): (i) for high values of  $\delta_i$  the RTB response is bang-bang, and reducing  $\delta_i$  decreases the probability that imports are choked; (ii) for low values of  $\delta_i$  the RTB response is non-prohibitive for a range of  $\gamma_i$ , and reducing  $\delta_i$  decreases this range, while the probability of choking stays unchanged. Figure 5 illustrates this result, assuming parameters are such that both intervals of  $\delta_i$  are non-empty. In the Appendix we prove:

**Proposition 7.**  *Holding  $\tau_i$  fixed, as  $\delta_i$  falls: (i) In the first phase,  $\theta_i$  is either zero or prohibitive, and the probability of choking decreases; (ii) In the second phase, the probability of choking stays unchanged, but non-prohibitive RTBs emerge for a range of  $\gamma_i$ , with this range increasing as  $\delta_i$  keeps falling. (Each phase may be empty.)*

Notice the non-monotonic effect of  $\delta_i$  on the probability that product  $i$  is covered by an RTB: as  $\delta_i$  falls, this probability initially decreases and then it increases.

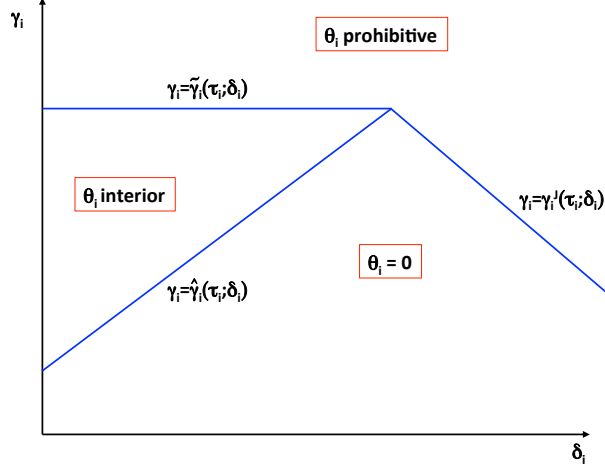


Figure 5: RTBs and Natural Trade Costs in the General Case

We now focus on the effects of a general fall in natural trade costs (globalization) at the aggregate level. We let  $E$  (for “extensive margin”) denote the set of products such that  $\hat{\gamma}_i(\tau_i) = \tilde{\gamma}_i(\tau_i)$ , so that Proposition 7(i) applies, and  $I$  (for “intensive margin”) the set of products such that  $\hat{\gamma}_i(\tau_i) < \tilde{\gamma}_i(\tau_i)$ , so that Proposition 7(ii) applies. Of course, each of these sets may be empty, depending on parameters. Also, when we talk about a change in the fraction of products choked by RTBs, we mean it in the first-order stochastic sense.

**Corollary 3.** *Holding tariffs fixed, globalization has the following effects: (i) Within product set  $E$ , trade expands at the extensive margin, as the fraction of products choked by RTBs decreases. (ii) Within product set  $I$ , the extensive margin of trade is not affected, but the fraction of products covered by RTBs increases, and for these products the level of RTBs increases. (iii) Set  $E$  shrinks (weakly) in favor of set  $I$ .*

Corollary 3 highlights an important insight: globalization reduces RTBs when these operate at the extensive margin of trade, but increases RTBs when these operate at the intensive margin. This result also suggests a couple of interesting predictions. First, conditional on observing non-prohibitive RTBs, these should be *higher* when natural trade costs are lower, both in a cross-sectional sense (RTBs should be higher for products characterized by lower natural trade costs) and in a time-series sense (RTBs should get higher as natural trade costs fall). Second, the fraction of products choked by RTBs should *decrease* over time as natural

trade costs fall. And by a similar token, products characterized by lower natural trade costs should be less likely to be choked by RTBs.<sup>28</sup>

## 4.2 Optimal Tariff Commitments

As in the previous section, we start by characterizing the optimal tariffs in the benchmark case of no political uncertainty (the “bespoke” tariffs).

It is useful to start by examining how the RTB response  $\theta_i^R(\gamma_i, \tau_i)$  varies with the tariff  $\tau_i$  for a given  $\gamma_i$ . Recalling Remark 3, it is easy to show that, for a given  $\gamma_i$ , the RTB response  $\theta_i^R$  is prohibitive for  $\tau_i < \tilde{\tau}_i(\gamma_i)$ , non-prohibitive and decreasing in  $\tau_i$  for  $\tau_i \in (\tilde{\tau}_i(\gamma_i), \hat{\tau}_i(\gamma_i))$ , and zero for  $\tau_i > \hat{\tau}_i(\gamma_i)$ , where  $\tilde{\tau}_i(\gamma_i)$  is the inverse of  $\tilde{\gamma}_i(\tau_i)$ , and  $\hat{\tau}_i(\gamma_i)$  is the inverse of  $\hat{\gamma}_i(\tau_i)$ .

Now suppose the distribution of  $\gamma_i$  is degenerate at  $\gamma_i^0$ . We can show that the bespoke tariff is the lowest tariff that does not trigger *any* red tape:  $\tau_i^B(\gamma_i^0) = \hat{\tau}_i(\gamma_i^0)$ . The reason is that  $\frac{d\theta_i^R}{d\tau_i} < -1$  in the range  $(\tilde{\tau}_i(\gamma_i), \hat{\tau}_i(\gamma_i))$ , as we noted above, so the benefit of lowering the tariff is outweighed by the cost of the induced increase in  $\theta_i^R$ .

Next consider how the bespoke tariff for product  $i$  varies with the natural trade cost  $\delta_i$ . Recall from Remark 2 that, conditional on the product being in set E, the bespoke tariff is increasing in  $\delta_i$ . Now consider a product in set I. We just argued that in this case the bespoke tariff is  $\hat{\tau}_i(\gamma_i^0)$ . Recall also from the discussion leading to Proposition 7 that  $\hat{\gamma}_i(\tau_i)$  increases with  $\delta_i$  for any given  $\tau_i$ . This implies that  $\hat{\tau}_i(\gamma_i)$  decreases with  $\delta_i$  for any given  $\gamma_i$ . Thus in this case the bespoke tariff is *decreasing* in  $\delta_i$ . The intuition is that, when RTBs operate at the intensive margin, reducing  $\delta_i$  increases the government’s incentive to use RTBs, and an increase in the tariff serves to mitigate this incentive. We can thus state:

**Remark 4.** *If the distribution of  $\gamma_i$  is degenerate at  $\gamma_i^0$ : (i) The optimal tariff for product  $i$  is the lowest  $\tau_i$  that does not trigger any RTBs. (ii) Conditional on the product being in set I, the bespoke tariff is decreasing in  $\delta_i$ . Conditional on the product being in set E, the*

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<sup>28</sup>Here we come back to a point we made in the previous section, that ignoring the endogenous choice of RTBs will lead to understating the welfare gains from reductions in natural trade costs. In the richer scenario considered here the above statement holds, loosely speaking, if the majority of products is in set E.

*bespoke tariff is increasing in  $\delta_i$ .*

As Remark 4 indicates, the result that the bespoke tariff prevents any RTBs from arising applies regardless of whether RTBs operate at the extensive margin or at the intensive margin of trade. On the other hand, natural trade costs have opposite impacts on the bespoke tariff depending on whether RTBs operate at the extensive margin or at the intensive margin.

Recalling from Proposition 7 that a fall in  $\delta_i$  can induce a switch of product  $i$  from set E to set I (but not vice-versa), Remark 4 implies an interesting non-monotonicity. In the absence of uncertainty, as  $\delta_i$  falls, in general there are two phases (each of which may be empty): in the first phase the optimal tariff decreases, and in the second phase the optimal tariff increases. This in turn suggests that globalization may initially lead to tariff liberalization, but this effect may be reversed at a later stage.

We next consider the impact of natural trade costs on the optimal tariffs in the presence of political uncertainty. Recall from Proposition 5 that, conditional on a product being in set E, the optimal tariff is increasing in  $\delta_i$  if political uncertainty is sufficiently small, but the effect may get reversed if political uncertainty is large. Next consider a product in set I. Remark 4(ii) suggests that, if political uncertainty is small, the optimal tariff should be decreasing in  $\delta_i$ . In the Appendix we show that this is true not only with small uncertainty, but for *any* distribution of  $\gamma_i$ :

**Proposition 8.** *If product  $i$  is in set I (before and after the change), the optimal tariff is decreasing in  $\delta_i$ , regardless of the distribution of  $\gamma_i$ .*

This result confirms that the predictions of the model regarding the effects of natural trade costs are strikingly different depending on whether RTBs operate at the intensive margin (as here) or at the extensive margin of trade (as in Proposition 5).



## 5 Partially Wasteful Trade Barriers

Thus far we have focused on import barriers that do not generate any revenue. To what extent do our results extend to import barriers that generate some revenue? To address this question, we revisit the previous analysis by assuming that a fraction  $\phi_i > 0$  of the rents associated with the non-tariff barrier  $\theta_i$  is wasted, as in Anderson and Neary (1992) and Limão and Tovar (2011). The model analyzed in the previous sections corresponds to the special case where  $\phi_i$  equals one. We refer to this more general import barrier as a “Non Tariff Barrier” (NTB).

The government’s objective function for good  $i$  now becomes  $V_i = s_i(p_i) + (1 + \gamma_i)\pi_i(p_i) + (\tau_i + (1 - \phi_i)\theta_i)m_i$ , where  $(1 - \phi_i)\theta_i m_i$  is the revenue generated by the NTB. For any  $\phi_i > 0$ , the NTB is a less efficient instrument than a tariff, therefore in the absence of restrictions on tariffs the government will not use NTBs. But if tariffs are constrained by a trade agreement, then the government may have an incentive to use NTBs.

For simplicity, in this section we focus on the case of linear demand and fixed supply. The first step is to consider whether the government objective is convex or concave. It is immediate to derive:  $\frac{d^2 V_i}{d\theta_i^2} = (1 - 2\phi_i)m'_i$ . Clearly,  $V_i$  is concave in  $\theta_i$  if and only if  $\phi_i < 1/2$ . If  $\phi_i > 1/2$ , all our results from Section 3 continue to hold. We next examine the case  $\phi_i < 1/2$ .

If  $\phi_i < 1/2$ , so that  $V_i$  is concave in  $\theta_i$ , the characterization of the NTB response function is the same as in Section 4. In particular,  $\theta_i^R$  is zero for low values of  $\gamma_i$ , prohibitive for high values of  $\gamma_i$ , and non-prohibitive for an intermediate interval of  $\gamma_i$ , as in Remark 3. Moreover, the impact of tariff reductions is the same as described in Proposition 6. Interestingly, however, the impact of natural trade costs on the optimal NTBs is very different from Section 4. If  $\delta_i$  decreases then  $\theta_i^R$  goes down weakly for all  $\gamma_i$  and  $\tau_i$ , and both thresholds  $\hat{\gamma}_i(\tau_i)$  and  $\tilde{\gamma}_i(\tau_i)$  increase. As a consequence, globalization leads to an increase in trade both at the extensive margin (the fraction of products whose imports are choked by NTBs goes down) and at the intensive margin, and the fraction of products covered by NTBs decreases.

What underlies these results is the fact that, if  $\phi_i < 1/2$ , NTBs and natural trade costs are complementary. To see this, notice that with linear demand and fixed supply we have  $\frac{d^2 V_i}{d\delta_i d\theta_i} = -\phi_i m'_i > 0$ , and given that  $\frac{d^2 V_i}{d^2 \theta_i} < 0$  it follows that  $\frac{d\theta_i^R}{d\delta_i} > 0$ . Notice the contrast between this case and the case of non-prohibitive RTBs for  $\phi_i = 1$  (examined in Section 4), where RTBs and natural trade costs are substitutes.

A further prediction of this variant of our model is that, as  $\phi_i$  rises, the optimal NTB can switch from an interior solution to a corner solution, but not vice-versa. This suggests that we should tend to observe fewer non-prohibitive NTBs when these are more wasteful, and by a similar token, more wasteful NTBs should have a relatively bigger impact on the extensive margin than on the intensive margin of trade.

## 6 Terms-of-Trade Motivated Trade Agreements

So far we have focused on domestic commitment as the motivation for a trade agreement. However, as we show in this section, the main qualitative insights hold when trade agreements are motivated by the presence of terms-of-trade (TOT) externalities. The economic structure is analogous to that of our basic model, except that now there are two large countries, Home and Foreign. We continue to assume that markets are perfectly competitive and that the economy produces a continuum of products plus an outside good (which again we take to be the numéraire). Home is the natural importer of all non-numéraire goods.

The Home government can use both tariffs and RTBs to maximise its politically-adjusted welfare function  $\bar{V}$ . For simplicity we return to the case of totally wasteful RTBs. Focusing on a single product, the Home government's payoff is as before  $V_i = s_i + (1 + \gamma_i)\pi_i + \tau_i m_i$ . To keep the exposition as simple as possible, we assume that the Foreign government is passive and its payoff is  $V_i^* = s_i^* + (1 + \gamma_i^*)\pi_i^*$ .<sup>29</sup>

As in the small-country setting, in the absence of trade agreements, the Home government

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<sup>29</sup>For a similar partial-equilibrium setting where trade agreements are motivated by terms-of-trade externalities, see for example Bagwell and Staiger (2001b) and Horn et al. (2010).

would never use the RTB (given that it does not raise any revenue). Assuming that  $V_i$  is concave in  $\tau_i$ , the optimal noncooperative tariff is defined by the following first-order condition:

$$\frac{dV_i}{d\tau_i} = (\gamma_i y_i + \tau_i m'_i - m_i) \frac{dp_i}{d\tau_i} + m_i = 0 \quad (13)$$

This yields the optimal noncooperative tariff:  $\tau_i^N = \frac{\gamma_i y_i}{-m'_i} + \frac{1-p_i \tau_i}{p_i \tau_i} \frac{m_i}{-m'_i}$ . In this large country case, tariffs are used not only to protect domestic producers, but also to improve Home's terms of trade at the expense of Foreign. This terms-of-trade externality leads to trade policy choices which are inefficient from the perspective of the governments' joint payoff. The objective of a trade agreement in this setting is to correct this inefficiency. Thus here we abstract from domestic commitment motives. At the ex-ante stage, the governments sign a trade agreement on tariffs that maximizes the governments' joint payoff  $\bar{V} + \bar{V}^*$ .<sup>30</sup> At the ex-post stage, Home chooses its RTBs to maximize its payoff  $\bar{V}$  subject to the constraints on tariffs imposed by the trade agreement.

As in the small country case, we assume that the political weights for each product,  $\gamma_i$  and  $\gamma_i^*$ , are observed ex post but uncertain ex ante, and that the tariffs specified in the agreement cannot be contingent on these political shocks.

We will revisit the results of Section 4, which focuses on the richer scenario where RTBs can operate at both the extensive and intensive margins of trade. In the interest of space, we focus on the optimal choice of RTBs when tariff commitments are exogenously given. As before, we can focus on a single product  $i$ . Similarly to the case of a small country with commitment motives, given the tariff  $\tau_i$ , there will be two thresholds  $\hat{\gamma}_i(\tau_i)$  and  $\tilde{\gamma}_i(\tau_i)$ , with  $\hat{\gamma}_i(\tau_i) \leq \tilde{\gamma}_i(\tau_i)$ , such that for  $\gamma_i \leq \hat{\gamma}_i(\tau_i)$  the optimal RTB is zero, for  $\gamma_i \geq \tilde{\gamma}_i(\tau_i)$  the optimal RTB is prohibitive, and for  $\gamma_i \in (\hat{\gamma}_i(\tau_i), \tilde{\gamma}_i(\tau_i))$  the optimal RTB is positive but non-prohibitive. If  $V_i$  is convex in  $\theta_i$  then  $\hat{\gamma}_i(\tau_i) = \tilde{\gamma}_i(\tau_i) = \gamma_i^J(\tau_i)$ , and the optimal RTB

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<sup>30</sup>The interpretation of this assumption is that governments bargain efficiently over the Home tariffs and a transfer (from Foreign to Home), with the transfer entering payoffs linearly. So, if  $T$  is the transfer made by Foreign, Home's (resp. Foreign's) payoff inclusive of the transfer is  $\bar{V} + T$  (resp.  $\bar{V}^* - T$ ). This payoff structure, together with efficient bargaining, implies that tariffs will maximize  $\bar{V} + \bar{V}^*$ .

response function is bang-bang, as in Section 3.

It can easily be shown that the thresholds  $\hat{\gamma}_i$  and  $\tilde{\gamma}_i$  vary with the tariff  $\tau_i$  and the natural trade cost  $\delta_i$  in the same qualitative way as in Section 4. As a consequence, the results of Propositions 6 and 7 regarding the effects of tariff reductions and globalization on RTBs, as well as the results of Corollaries 2 and 3 on the overall impacts that these changes have on the extensive and intensive margins of trade, are qualitatively analogous to those in the case of a small country with commitment motives.

## 7 Conclusion

Red-tape barriers to trade are pervasive but have received little attention from scholars to date. In this paper we have taken a first step in exploring the implications of RTBs, and have shown that they are very different from those of more traditional trade barriers.

In our model, politically-motivated governments may have incentives to impose RTBs even though they yield no revenue, if a trade agreement can constrain tariffs but not RTBs. At the agreement stage, the extent of tariff liberalization is limited by the need to prevent such wasteful behavior: tariffs need to be set above the level that would be optimal with a complete agreement to avoid a “protectionist backlash” in the form of RTBs. However, RTBs may nonetheless emerge in equilibrium, if the tariff commitments are not fully contingent. The model further suggests that RTBs tend to be more frequent in equilibrium when the degree of political uncertainty is higher.

When RTBs are used, they are likely to “choke” trade for a range of products, implying that the extensive margin is key for understanding the impact of RTBs. At the same time, non-prohibitive RTBs can arise for products characterized by a sufficiently concave import demand. Whether RTBs operate at the extensive margin or at the intensive margin also matters for the effects of globalization: reductions in natural trade costs reduce a government’s incentive to resort to RTBs when these operate at the extensive margin of trade, but

increases the level of RTBs when these operate at the intensive margin.

In the presence of RTBs, tariff liberalization can have perverse effects on trade, to the extent that it induces an increase in RTBs. Tariff liberalization always leads to a contraction of trade at the extensive margin, and it also reduces trade at the intensive margin for products covered by non-prohibitive RTBs, because the government over-compensates for the tariff reduction with an increase in RTBs. Tariff reductions increase trade only for products that are unencumbered by RTBs, which is the case if political pressures are sufficiently low.

Finally our model suggests an important lesson for studies that seek to evaluate the welfare gains from reducing tariffs or natural trade costs. Ignoring RTBs will lead to *overstating* the welfare gains from tariff reductions, but may well lead to *understating* the welfare gains from reductions in natural trade costs. This is because tariff reductions trigger policy substitution toward RTBs, while reductions in natural trade costs mitigate a government's incentive to use RTBs, to the extent that RTBs operate at the extensive margin of trade.

# Appendix

Throughout the Appendix we omit the product index  $i$ , as this should not create confusion.

## Proof of Proposition 5

We start by giving a heuristic proof for the first part of Proposition 5, that the optimal tariff is increasing in  $\delta$  if the distribution of  $\gamma$  is sufficiently concentrated. Fix two levels of  $\delta$ , say  $\delta' < \delta''$ , and consider a distribution  $G$  that is close (for example in the weak-convergence sense) to the degenerate distribution at  $\gamma^0$ , which we denote  $G^0$ . We now argue that if  $G$  is sufficiently close to  $G^0$  then the optimal tariff for  $\delta = \delta'$  must be lower than the optimal tariff for  $\delta = \delta''$ . To see this, recall from Figure 3 how expected welfare depends on the tariff for a degenerate distribution such as  $G^0$ : it is constant up to the bespoke tariff, where it jumps up, and then decreases monotonically as the tariff rises above the bespoke tariff. We denote  $\tau^B(\gamma^0, \delta)$  the bespoke tariff as a function of  $\gamma^0$  and  $\delta$ . Clearly, for a given level of  $\delta$ , if  $G$  is close to  $G^0$  then the shape of the expected-welfare function is close to that of the welfare function drawn in Figure 3, so the optimal tariff is close to the bespoke tariff  $\tau^B(\gamma^0, \delta)$ . Now recall that the bespoke tariff is increasing in  $\delta$ , so  $\tau^B(\gamma^0, \delta') < \tau^B(\gamma^0, \delta'')$ . It follows immediately that, if  $G$  is sufficiently close to  $G^0$ , the optimal tariff for  $\delta = \delta'$  must be lower than the optimal tariff for  $\delta = \delta''$ .

To prove the second part of the proposition, that globalization can raise the optimal commitment tariff if political uncertainty is large enough, it is sufficient to consider the special case of linear demand, fixed supply and Pareto distribution. Recall the first-order condition given by equation (12):

$$\bar{W}_\tau = G' \gamma_\tau^J \Delta W + G W_\tau = 0 \tag{14}$$

Relative to the text, this is written more compactly by omitting the arguments of all func-

tions. Now, differentiate this with respect to  $\delta$ :

$$\bar{W}_{\tau\delta} = G''\gamma_\delta^J\gamma_\tau^J\Delta W + G'\gamma_{\tau\delta}^J\Delta W + G'\gamma_\tau^J W_\delta + G'\gamma_\delta^J W_\tau + G W_{\tau\delta} \quad (15)$$

With linear demand and fixed supply, we have  $\gamma_{\tau\delta}^J = W_{\tau\delta} = 0$  and  $\gamma_\delta^J + \gamma_\tau^J = 0$ , thus:

$$\bar{W}_{\tau\delta} = G''\gamma_\delta^J\gamma_\tau^J\Delta W + G'\gamma_\tau^J(W_\delta - W_\tau) = (G''\gamma_\delta^J\Delta W - G'm)\gamma_\tau^J \quad (16)$$

where we used the fact that  $W_\delta - W_\tau = -m$ . Next we substitute from the first-order condition (14), which implies that  $\gamma_\delta^J\Delta W = -\gamma_\tau^J\Delta W = \frac{G}{G'}W_\tau$ , and use  $W_\tau = \tau m'$ , to obtain:

$$\bar{W}_{\tau\delta} = \left( \frac{GG''}{(G')^2} \frac{\tau pm'}{m} - 1 \right) mG'\gamma_\tau^J \quad (17)$$

Using the Pareto distribution,  $G = 1 - (\gamma^0)^k \gamma^{-k}$ , where the shape parameter  $k$  is an inverse measure of dispersion:  $G_k = -(1 - G) \log\left(\frac{\gamma^0}{\gamma}\right) > 0$ . Note that  $G' = k(\gamma^0)^k \gamma^{-k-1} = \frac{k}{\gamma}(1 - G)$  and  $G'' = -k(k+1)(\gamma^0)^k \gamma^{-k-2} = -\frac{k(k+1)}{\gamma^2}(1 - G)$ . Substituting into (17) gives:

$$\bar{W}_{\tau\delta} = - \left( \frac{k+1}{k} \frac{G}{1-G} \frac{\tau pm'}{m} + 1 \right) mG'\gamma_\tau^J \quad (18)$$

Clearly this is negative for  $k$  sufficiently low, in line with the second part of the proposition.

### Proof of Remark 3

The key step is to note that  $V_{\theta_\gamma} = y > 0$ . This immediately implies that  $\theta^R(\tau, \gamma)$  is weakly increasing in  $\gamma$ . Thus, for any given  $\tau < \tau^N$ , in general there are three intervals of  $\gamma$ , each of which may be empty: a low interval  $(\gamma_{min}, \hat{\gamma}(\tau))$  where  $\theta^R = 0$ , an intermediate interval  $(\hat{\gamma}(\tau), \tilde{\gamma}(\tau))$  where  $\theta^R$  is positive but non-prohibitive, and a high interval  $(\tilde{\gamma}(\tau), \gamma_{max})$  where  $\theta^R$  is prohibitive. And since  $V_{\theta_\gamma}$  is strictly positive,  $\theta^R$  is strictly increasing in the intermediate range  $(\hat{\gamma}(\tau), \tilde{\gamma}(\tau))$ .

## Proof of Proposition 6

In order to prove the aggregate results of Proposition 6, we start by showing how a tariff change affects the RTB response function at the product level. In this proof we focus on the case  $\hat{\gamma}(\tau) < \tilde{\gamma}(\tau)$ , since we already dealt with the bang-bang case ( $\hat{\gamma}(\tau) = \tilde{\gamma}(\tau)$ ) earlier.

We already established in the text that  $\frac{d\theta^R}{d\tau} < -1$  in the non-prohibitive range, so we can focus on how the tariff affects the two thresholds  $\hat{\gamma}(\tau)$  and  $\tilde{\gamma}(\tau)$ . Let us start with  $\hat{\gamma}(\tau)$ . Recalling Remark 3 and the assumption that  $\theta^R$  is continuous, the first-order condition for optimality of  $\theta$  must be satisfied at this threshold, so  $\hat{\gamma}(\tau)$  is implicitly defined by  $V_\theta(\tau, 0, \hat{\gamma}) = 0$ . Differentiating this equation in  $\hat{\gamma}$  and  $\tau$ , we obtain  $\frac{d\hat{\gamma}}{d\tau} = -\frac{V_{\theta\tau}}{V_{\theta\gamma}}$ . Note that the second-order condition  $V_{\theta\theta} < 0$  must hold, so  $V_{\theta\tau} < V_{\theta\theta} < 0$ , and furthermore  $V_{\theta\gamma} = y > 0$ , thus we can conclude that  $\frac{d\hat{\gamma}}{d\tau} > 0$ .

Next focus on the threshold  $\tilde{\gamma}(\tau)$ . This is implicitly defined by  $V_\theta(\tau, \theta^{NT}(\tau), \tilde{\gamma}) = 0$ . Differentiating this equation in  $\tilde{\gamma}$  and  $\tau$ , we obtain  $\frac{d\tilde{\gamma}}{d\tau} = \frac{V_{\theta\theta} - V_{\theta\tau}}{V_{\theta\gamma}}$ , where we used the fact that  $\frac{d\theta^{NT}}{d\tau} = -1$  (which in turn follows from the fact that  $\theta^{NT}(\tau)$  is defined by the condition that  $\theta + \tau$  equals the minimum prohibitive trade cost level). Again noting that  $V_{\theta\tau} < V_{\theta\theta} < 0$  and  $V_{\theta\gamma} > 0$ , it follows that  $\frac{d\tilde{\gamma}}{d\tau} > 0$ .

Consider next the probability that  $\theta > 0$ . Recalling that RTBs are imposed if  $\gamma > \hat{\gamma}(\tau)$ , we obtain:

$$\Pr[\theta > 0] = \int_{\hat{\gamma}(\tau)}^{\gamma^{\max}} g(\gamma) d\gamma = 1 - G(\hat{\gamma}(\tau)) \quad (19)$$

Differentiating shows that this is decreasing in  $\tau$ :

$$\frac{d\Pr[\theta > 0]}{d\tau} = -g(\hat{\gamma}(\tau)) \frac{d\hat{\gamma}}{d\tau} < 0 \quad (20)$$

where we used the fact that  $\frac{d\hat{\gamma}}{d\tau} > 0$ . A similar argument allows us to sign the effect of  $\tau$  on the probability that  $\theta$  chokes imports:

$$\Pr[\theta \geq \theta^{NT}] = \int_{\tilde{\gamma}(\tau)}^{\gamma^{\max}} g(\gamma) d\gamma = 1 - G(\tilde{\gamma}(\tau)) \quad (21)$$



Differentiating and using  $\frac{d\hat{\gamma}}{d\tau} > 0$  we conclude that this too is decreasing in  $\tau$ .

Having established that a tariff reduction decreases the probability that a product is covered by an RTB and the probability that it is choked by an RTB, it follows immediately that both  $F^{choke}$  and  $F^{cov}$  increase in the first-order stochastic sense.

## Proof of Proposition 7

Part (i) has been proved already, so we can focus on Part (ii). In this proof we suppress the argument  $\tau$  and highlight instead the argument  $\delta$ , so we write the government objective as  $V(\delta, \theta, \gamma)$  and the prohibitive level of  $\theta$  as  $\theta^{NT}(\delta)$ . All we need to prove is that a decrease in  $\delta$  leads to a reduction of the threshold  $\hat{\gamma}$  and does not affect the threshold  $\tilde{\gamma}$ .

Consider first the effect of a change in  $\delta$  on the threshold  $\hat{\gamma}$ . Recalling Remark 3 and the assumption that  $\theta^R$  is continuous,  $\theta = 0$  satisfies the first-order condition at this threshold, hence  $V_\theta(\delta, 0, \hat{\gamma}) = 0$ . Differentiating this equation with respect to  $\delta$  and  $\hat{\gamma}$ , we obtain  $\frac{d\hat{\gamma}}{d\delta} = -\frac{V_{\theta\delta}}{V_{\theta\gamma}} = -\frac{V_{\theta\theta}}{V_{\theta\gamma}}$ . Since the second-order condition  $V_{\theta\theta} < 0$  must hold and  $V_{\theta\gamma} > 0$ , it follows that  $\frac{d\hat{\gamma}}{d\delta} > 0$ .

Consider next how  $\delta$  affects the threshold  $\tilde{\gamma}$ . Again recalling Remark 3 and the assumption that  $\theta^R$  is continuous,  $\theta = \theta^{NT}(\delta)$  satisfies the first-order condition at this threshold, hence  $V_\theta(\delta, \theta^{NT}(\delta), \tilde{\gamma}) = 0$ . Differentiating this equation with respect to  $\tilde{\gamma}$  and  $\delta$ , we obtain  $\frac{d\tilde{\gamma}}{d\delta} = -\frac{V_{\theta\theta} - V_{\theta\delta}}{V_{\theta\gamma}}$ , where we used the fact that  $\frac{d\theta^{NT}}{d\delta} = -1$  (which in turn follows from the fact that  $\theta^{NT}(\delta)$  is defined by the condition that the total trade cost equals the minimum prohibitive trade cost level). But  $V_{\theta\theta} = V_{\theta\delta}$ , thus it follows that  $\frac{d\tilde{\gamma}}{d\delta} = 0$ .

## Proof of Proposition 8

We wish to show that, conditional on product  $i$  being in set I, the optimal commitment tariff is decreasing in  $\delta$ , regardless of the distribution of  $\gamma$ .

We can write expected welfare as:

$$EW = \int_{\gamma^{min}}^{\hat{\gamma}(\tau)} W(\tau, 0)g(\gamma)d\gamma + \int_{\hat{\gamma}}^{\tilde{\gamma}(\tau)} W(\tau, \theta^R(\gamma, \tau))g(\gamma)d\gamma + \int_{\tilde{\gamma}(\tau)}^{\gamma^{max}} W^{NT}g(\gamma)d\gamma \quad (22)$$

We want to evaluate the cross derivative of (22) with respect to  $\delta$  and  $\tau$ . Consider first the first derivative with respect to  $\delta$ . Recall that, when  $\theta^R$  is non-prohibitive, a change in  $\delta$  is exactly offset by a change in  $\theta^R$ , thus leaving welfare unchanged. Hence  $\delta$  does not affect the second integrand. Also the no-trade level of welfare is unaffected by  $\delta$ , so the third integrand is unaffected by  $\delta$ . Next, note that we can ignore the effect of  $\delta$  on the boundaries  $\hat{\gamma}(\tau)$  and  $\tilde{\gamma}(\tau)$ , because welfare is continuous at the lower boundary, and the upper boundary is unaffected by  $\delta$ . Thus the derivative of (22) with respect to  $\delta$  is simply:  $G(\hat{\gamma}(\tau)) \frac{\partial}{\partial \delta} W(\tau, 0)$ . The cross-derivative of expected welfare with respect to  $\delta$  and  $\tau$  is therefore:

$$\frac{\partial^2 EW}{\partial \delta \partial \tau} = G(\hat{\gamma}(\tau)) \frac{\partial^2 W(\tau, 0)}{\partial \delta \partial \tau} + g(\hat{\gamma}(\tau)) \hat{\gamma}'(\tau) \frac{\partial W(\tau, 0)}{\partial \delta} < 0 \quad (23)$$

where we have used the fact that  $\frac{\partial^2 W(\tau, 0)}{\partial \delta \partial \tau}$  has the same sign as  $m''$ , which recall is negative for products in set I, and that  $\hat{\gamma}'(\tau) > 0$  (from Proposition 6). It follows that, conditional on the product being in set I, a small decrease in  $\delta$  leads to an increase in the optimal tariff.

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