NBER WORKING PAPER SERIES

NATURAL BARRIERS AND POLICY BARRIERS

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Working Paper 28171
http://www.nber.org/papers/w28171

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2020

This research is financed by the authors' university research budgets. We thank Bob Staiger, David Weinstein, and seminar participants at Columbia University, Fudan University, and World Bank for very helpful comments. Part of the work was done when Yang Jiao was a Postdoctoral Fellow at Dartmouth College, whose hospitality is greatly appreciated. All errors are our own responsibilities. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 28171
December 2020
JEL No. F1,O24

ABSTRACT

This paper investigates whether "natural" trade barriers of a country due to geography and other factors outside the country's control stimulate more or less policy barriers such as tariffs. Our theory predicts that the politician's relative weight on private benefits over social welfare in a "protection-for-sale" setup depends on these "natural" features. The key mechanism is that a society's willingness to invest in improving institutions that constrain rent-seeking behavior is influenced by the natural barriers. Two types of empirical evidence support the theoretical predictions. First, "natural" barriers beget policy barriers - countries with more "natural" barriers tend to have higher tariffs and more NTBs. Second, liberalization begets liberalization - in response to unilateral trade reforms in China in the early 2000s, those other countries that benefit more from the Chinese liberalization also undertake more liberalization of their own.

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1 Introduction

Countries differ in their levels of "natural" trade barriers due to geography and other factors outside their control. For example, as Fiji and Argentina are physically more distant from any of the major markets in North America, Europe, and East Asia, than Portugal and Panama, the former face intrinsically higher physical costs of engaging in international trade. This paper investigates whether "natural" trade barriers of a country tend to induce more man-made trade barriers such as higher tariffs, making the country even less open, or to stimulate more effort at trade liberalization, offsetting the disadvantage associated the "natural" barriers. We aim to develop a political economy theory of policy barriers that goes beyond the standard "protection-for-sale" model (Grossman-Helpman, 1994) by linking the politician's relative weight on private benefits over social welfare to these "natural" barriers. As such, it provides a novel interpretation for why the average tariff rates vary by country, and how a country's trade regime responds to trade liberalization in other countries. The part of a country's policy barriers (e.g., tariff or tariff-equivalent of other barriers) that can eventually be traced to natural trade barriers by our mechanism will be called "natural tariffs" as a shorthand.

Global average tariffs have trended downward over the last few decades (see Panel A of Figure 1). At the same time, there is still a wide dispersion in the average level of import tariffs across countries (see Panel B of Figure 1). Using tariff data at the HS 4 digit averaged over 1995-1997 for 92 countries, we perform a simple decomposition of the total variance of the tariff rates (in percentage term) into a part due to the variations across products within a country (within-country variation for short) and a part due to the variations across the mean tariff rates of the countries (between-country variation). We find that the total tariff variation (123.5) = Within-Country Variation (61.8) + Between-Country Variation (61.7). In other words, the two parts are basically equally important. Similar patterns hold for other time periods. As the existing empirical tests of the tariff theories tend to focus on within-country variations, we aim to explore between-country variations in our empirical work.

What explains the variations? The classic optimal tariff theory (dating back to Edgeworth, 1894) points out that if a country has a market power over a traded product, it can exploit it by setting a non-zero tariff. Generally, the greater the market power, the less elastic is the foreign supply of the product, the higher the optimal tariff. For a panel of 15 countries which are not WTO members, Broda, Limao, and Weinstein (2008) show that their relative tariff rates across sectors are indeed inversely proportional to the elasticities of foreign export supplies.

An alternative explanation is political economy. The state-of-art political economy theory is Grossman and Helpman's (1994) "Protection for Sale" model.[1] Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) show that the variations across US sectors in the coverage ratios of the non-tariff barriers are consistent with the model. Mitra, Thomakos and Ulubasoglu (2002) show that the cross-sector variations in the protection rates in Turkey in 1983, 1984, 1988 and 1990 are also consistent with the protection-for-sale model. These studies all focus on within-country variation of the tariff rates.

It is noteworthy that the relative weight on social welfare in the politician's objective function in both the theoretical model of Grossman and Helpman (1994) and the empirical work of Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) is an exogenous (and constant) parameter. One interesting exception in the empirical literature is Mitra, Thomakos, and Ulubasoglu (2002), who study the experience of Turkey in four separate years (1983, 1984, 1988 and 1990). 1983 was the last year of a dictator regime in the country, whereas democracy characterizes the other three years. They find that the estimated weights on the social welfare in two of the three democratic years are higher than the corresponding one in the dictatorial year. This find is interpreted as suggesting that the politician's relative weight on social welfare versus private benefits is influenced by the broad institutional environment that restraints rent seeking behavior by politicians. Given the very small number of years in their sample, this hypothesis is not formally tested in their paper.

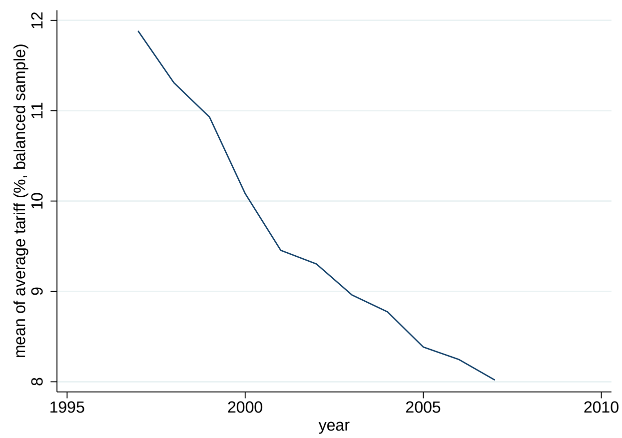
In this paper, we propose a theory that endogenizes the relative weight that the politician places on the social welfare versus his private benefits. We argue that a country's exogenous features - or certain factors outside the control of the politician such as geographic features, relative population size, and other countries' policy choices - affect the social preference for certain institutional quality which in turn affect the politician's relative weights. The underlying mechanism is this: certain natural features make it more appealing for a country to invest for better institutional quality (for example, by raising the salaries of judges and government officials to reduce the temptation of corruption or investing in electronic accounting and tax-collecting systems to make it easier to discover illicit transactions between firms and government officials) in order to respond to these exogenous natural features. A higher quality of institutions places more constraints on the politician's ability to convert private sector "donations" or bribes to private benefit. As a result, the politician in such an economy finds it optimal to pursue a lower level of policy barriers to trade. This framework provides a novel explanation for variations in the tariff rates across countries. We will show that a similar logic implies that changes in other countries' trade policies can also induce changes in domestic institutional constraint on rent seeking behavior. As a result, this theory also helps to explain some time series variations in policy barriers (or transmission of trade

[1] For earlier political-economy models, see Findlay and Wellisz (1982), Hillman (1982), and Mayer (1984).

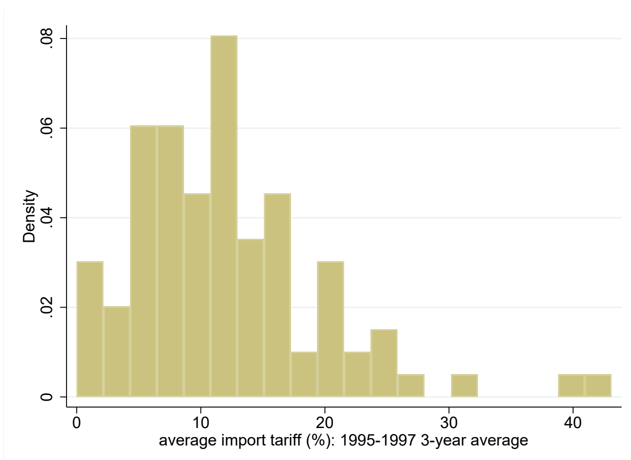
liberalization from one country to other countries).

Figure 1: Country-level Average Import Tariff

(a) Mean of Country-level Average Import Tariff in Different Years



(b) Country-level Average Import Tariff Distribution (averaged across 3-year 1995-1997)



The existing literature has confirmed that poor institutional quality appears to add transaction costs to international trade (see e.g., Jiao and Wei (2019), Beverelli et al. (2018)). A lower degree of natural barriers increases the marginal benefit of improving institutional quality for the median voter, whose willingness to pay for better institutions then rises. In this paper, we introduce this insight into the Grossman and Helpman (1994) protection-for-sales model of tariff determination. Better institutions induced by a lower degree of natural barriers place more constraints on politicians' ability to convert bribery to personal benefits. This effectively makes politicians to care more about the social welfare, leading to a more liberal trade policy in equilibrium.

We provide a set of empirical tests for the key predictions of our theory. We examine both trade policies across countries at a given time and the responses of the tariffs to some big shock to a country's external trading environment (e.g., unilateral trade liberalization by China). We find that countries with a smaller population, and certain geographical features that give them smaller natural barriers exhibit a lower average tariff. In other words, natural barriers appear to beget policy barriers.

Since our theoretical story is about unilateral tariff determination, we expect the empirical results to be stronger for countries without much international constraint on their tariff setting. Since the WTO (and its predecessor the GATT) imposes far less liberalization obligations on developing country members (under the "special and differential treatment" principle), we expect and indeed find that the empirical pattern is stronger for the sample of non-OECD countries.

Beyond the cross-sectional pattern, we examine tariff changes by small and medium-sized countries during 1997-2007 in response to a large and unilateral trade liberalization by China (which changes other countries' trading environment). China's unilateral liberalization during this period reduced its average import tariff from around 15% to 5% within a decade. While the tariff change was endogenous for China, it was exogenous for most other countries, especially for small and medium sized countries. Interestingly, this Chinese policy change represents uneven shocks to different countries due to the natural differences in proximity to China and comparative advantage in export bundles. For example, those countries that are geographically closer to China see a disproportionately greater increase in their export opportunity. Those countries whose specialization patterns happen to coincide with what China wanted to import also see a disproportionately greater increase in their export opportunity. We find that those countries experiencing a relatively greater expansion in their trading opportunity due to the Chinese reform shock indeed engage in a larger tariff reduction of their own. The effect is stronger for countries whose tariff settings are less constrained by WTO rules.

As a third type of empirical exercise, we explore implications of tariff changes across products with differential dependence on contracting institutions. An extension of our baseline model shows that, holding constant the average foreign tariff changes, a country should engage in more tariff reduction if the expansion of its trade opportunity takes place on those exportable products that are more dependent on contracting institutions. The data confirms this prediction too.

The relationship between the natural tariff and optimal tariff needs to taken into account. The theoretical argument for the "optimal tariff" was made by Edgeworth (1894). Given a country's market power over the products, the optimal tariff exploits this. Broda, Limao and Weinstein (2008) provide the first empirical support that show that countries do try to exploit their market power, especially before they become WTO members. While the optimal tariff is meant to raise social welfare, the natural tariff in our theory is the tariff in a political-economy equilibrium that is consistent with a country's public governance institutions constraining rent seeking behavior. Sometimes a country that is predicted to have a higher natural tariff may also has a higher optimal tariff. For example, a large country may simultaneously have a higher optimal tariff level (due to greater market power) and a higher natural tariff level (due to a worse institutional quality). It is an empirical challenge to distinguish the two channels. In our empirical work, we will estimate each country-sector's market power (the inverse of the elasticity of foreign export supply) and include it as a control variable. In other words, we examine, after controlling for optimal tariff, whether a country's population size has any additional predictive power for the tariff level. We will show that our argument continues to hold after controlling for optimal tariff. South Korea and India are an informative comparison. As their estimated elasticities of foreign export supply are nearly identical, they are predicted to have the same level of optimal tariff. In the data, the Indian tariff of 32% during 1995-1997 is much higher than South Korea's 7% during the same period. This pattern is consistent with our theory: As Indian's natural barriers are higher, its natural tariff rate is higher. In other words, the natural tariff hypothesis provides additional information that goes beyond the optimal tariff argument.

To place our paper in the literature, we begin with endogenous trade policy. Grossman and Helpman (1994) pioneered a theory of lobby for protection by interest groups. Using US data, Goldberg and Maggi (1999) estimate that the government places a far larger weight on social welfare than on campaign contributions. Gawande and Bandyopadhyay (2000) finds support for both the protection side and the lobbying side using non-tariff barriers data in US. Bagwell and Staiger (1999) emphasize terms of trade as a motive for the world trade system. Broda, Limao and Weinstein (2008) empirically confirm the importance of terms of trade as countries' incentives to set import tariffs. Our contribution is to connect natural features and exogenous trading opportunities to the domestic political incentives in choosing equilibrium tariffs.

Our paper is also related to the literature on effects of trade policy, which is too extensive to be comprehensively summarized here. As a relatively recent example, Pavcnik (2002) evaluates how Chilean plants' exits and productivity are affected by a trade liberalization. Amiti and Konings (2007) highlight the role of imported intermediate inputs in raising firms' productivity. Dix-Carneiro (2014) trace the labor market dynamics after a trade liberalization. McCaig and Pavcnik (2018) study the labor allocation between informal sector and formal sector in Vietnam after a shock in US import policy against Vietnam. We offer a new perspective: domestic trade policy may adjust endogenously in response to foreign policy shocks that alter the home country's exogenous trading opportunities.

Krishna and Mitra (2005) propose a theory of "reciprocated unilateralism" based on the formation of lobbying groups in a country's exporting sector in response to foreign trade liberalization. Our contribution is to add an institutional dimension as a new pathway from foreign trade policy shock to domestic policy adjustment - a large foreign trade shock first alters domestic institutions that constrain rent-seeking opportunities, which then induce a change in the domestic tariff. Separately, while they do not provide empirical tests, we show empirical evidence that a country's trade policy indeed responds to changes in foreign trade policies. In addition, the country's institutional quality also responds to changes in foreign trade barriers.

Maggi, Mrázová and Neary (2018) endogenize red-tape barriers (wasteful trade barriers) and tariff simultaneously. They argue that lower natural trade barrier will make politicians less tempted to use red-tape barriers for a given level of tariffs, reducing the need for keeping tariffs high. In their framework, politicians' objective function is exogenous while in our framework it is endogenous to deeper determinants linked to the country's natural features or trading partner's policy choices. While their contribution is on the theory side, we complement our theory with extensive empirical evidence.

The rest of the paper proceeds as follows. In Section 2, we provide the model and derive the key propositions. In Section 3, we investigate the cross-sectional patterns across countries to show they are consistent with our theory predictions. In Section 4, we conduct a long difference exercise as our main identification strategy. In Section 5, we explore product-level heterogeneity to further highlight the role of institutional quality as our key mechanism linking natural barriers and import tariff. In Section 6, we conclude.

2 The Model

2.1 Model Setup

Our model is a two-stage Stackelberg game. The second stage is characterized by a protection-for-sale game a la Grossman and Helpman (1994), in which the politician and the lobbyists exchange tariffs (protection) for lobbying contributions (bribes). In particular, the politician sets the tariff rate to maximize a weighted average of her private benefits and social welfare. In the original Grossman-Helpman (1994) model, the relative weight is set as an exogenous parameter. We will instead let the relative weight on private benefit be a function of the strength of public institutions. The idea is that the weaker the public institutions, the easier it is for the politician to convert bribes or lobbying contributions to her private benefits with impunity. This will translate into a greater relative weight on the private benefit in the politician's utility function. In the first stage, the median voter anticipates the equilibrium outcome in the second stage, and optimally decides how much resource to devote to improving public institutions. Natural barriers will turn out to affect the median voter's cost-benefit analysis in this context.

Consider an open economy (Home) with three industries. Industry 0 produces a freely tradable homogeneous good (the numeraire), industry 1 competes with imports, and industry 2 produces a good that is sold both at home and abroad. This 3-industry setup is similar to that in Krishna and Mitra (2005). Home is endowed with L workers, each supplying inelastically c units of effective labor.

Industry 0 uses only labor as an input, and each unit of effective labor produces one unit of Good 0. The wage rate is then given by c. In the import-competing industry, Industry 1, a continuum of domestic firms compete with foreign imports, and each employs a constant-returns-to-scale production function that combines labor with a specific factor T. The exportable industry, Industry 2, features a continuum of firms, with each, denoted by $i \in [0, 1]$, employing a constant-returns-to-scale technology to produce one variety of good.

All consumers have an identical preference taking the following quasi-linear form

$$u = x_0 + u(x_1) + \int_0^1 \xi(x_{2i})di.\text{[2]} \tag{1}$$

Here x_0 and x_1 are the consumption of industry-0 good and industry-1 good, respectively, and x_{2i} is the consumption of the variety provided by firm i in industry 2 in the home country.

2.2 Social Welfare

Denoting by p_1 the domestic price in industry 1 and p_{2i} the domestic price of firm i's variety in industry 2, we can write the budget constraint of a representative domestic consumer as

$$x_0 + p_1 x_1 + \int_0^1 p_{2i} x_{2i} di = w, \tag{2}$$

where w is the income of the representative consumer in Home. The consumer's utility function then gives the domestic demand functions for industry 1 and industry 2 goods, respectively:

$$u'(x_1) = p_1, \tag{3}$$

[2] Our theoretical results will not change if there is a continuum of goods in industry 1.

$$\xi'(x_{2i}) = p_{2i}. \tag{4}$$

We assume that the rest of the world's demand function for variety i in Industry 2 is similar to the domestic demand function:

$$\xi'(x_{2i}^*) = p_{2i}^*,\text{[3]} \tag{5}$$

where x_{2i}^* is the quantity and p_{2i}^* is the price. Since the solutions to the prices and quantities of Industry 2 goods will be symmetric, we will drop subscript i when there is no risk of confusion.

The indirect utility of an individual consumer at home with income w is derived as

$$w + s_1(p_1) + \int_0^1 s_2(p_{2i})di = w + s_1(p_1) + s_2(p_2), \tag{6}$$

where $s_1(p_1) = u(x_1(p_1)) - p_1 x_1(p_1)$ is the the worker's consumer surplus on industry 1 good, and $s_2(p_2) = \xi(x_2(p_2)) - p_2 x_2$ is the worker's consumer surplus on industry 2 good.

The world price of Industry 1 good is denoted by p_1^*, and the domestic price of Industry 1 good is

$$p_1 = p_1^*(1+t), \tag{7}$$

where t is the home country's import tariff.

We use $\Pi(p_1)$ to denote Industry 1 firms' total profit. The per capita profit then is $\lambda_1(p_1) = \frac{\Pi(p_1)}{L}$. A higher import tariff t will raise p_1 and thus domestic firms' profit in Industry 1. Using the Envelope theorem, we obtain that the domestic per capita output in Industry 1 is

$$y(p_1) = \lambda_1'(p_1). \tag{8}$$

The total tariff revenue is

$$R(p_1) = p_1^* t(Lx_1 - Ly(p_1)), \tag{9}$$

and the per capita tariff revenue is

$$r(p_1) = \frac{R(p_1)}{L} = p_1^* t(x_1 - y(p_1)). \tag{10}$$

Finally, per capita income ι is the summation of the labor income, the profits from both Industries 1 and 2, and the tariff revenue, i.e.,

$$\iota = c + \lambda_1(p_1) + \lambda_2(p_2) + r(p_1), \tag{11}$$

[3]We can specify the foreign utility function in a similar way as the domestic one to arrive at this result.

where $\lambda_2(p_2)$ is the per capita profit in the exportable industry 2. The social welfare (before paying the cost of improving institutions) in per capita term can be written as

$$\begin{aligned} v_b &= \iota + s_1(p_1) + s_1(p_2) \\ &= \underbrace{c}_{\text{labor income}} + \underbrace{\lambda_1(p_1) + s_1(p_1) + r(p_1)}_{\text{component related to the mport-competing industry}} + \underbrace{\lambda_2(p_2) + s_2(p_2)}_{\text{component related to the exportable industry}} . \end{aligned} \tag{12}$$

As equation (12) shows, the overall social welfare can be decomposed into three parts: a labor income, a second component related to the import-competing industry, and a third component related to the exportable industry. The second component can be further decomposed into domestic Industry-1 firms' profit, the consumer surplus from consuming Industry-1 good, and the tariff revenue. The third welfare component is the sum of Industry-2 firms' profit and the consumer surplus from Industry-2 goods.

2.3 The Welfare Component Related to the Exportable Industry

We now discuss the role of institutional quality in the exportable industry. When a country has poor public governance (e.g., a high level of corruption or a judicial system that is not independent or fair), exporting firms that do not fulfill their contractual obligations may not face serious consequences in their home country. For instance, they may bribe judges or government officials to evade their contractual obligations or legal punishment for violations of the obligations. The notion that weak institutional quality is a burden on businesses has been highlighted in the existing literature, see Fisman and Svensson (1999), Wei (2000) and Tamirisa and Wei (2002) among many others.

For our theory, a key is that poorer public governance raises the cost of conducting international trade transactions. We provide a micro-foundation for this idea below. All our theoretical propositions in subsequent discussions will also hold if we assume that poorer public governance raises the cost of doing both domestic and cross-border business transactions.

Consider a domestic firm in the exportable industry, and a foreign buyer which represents a unit mass of foreign consumers. We assume that foreign consumers have the utility function $\xi^*(x) = \frac{x^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$, where x is the quantity consumed. The domestic firm has an innate productivity, normalized to 1.

The exporting firm and the buyer can jointly make relationship-specific investment ex ante to improve the exporting firm's productivity and benefit both parties. The benefit to the importer is a lower price of the good for the consumer in the importing country. Assume if the buyer pays fixed cost I_b and the exporting firm pays fixed cost I_s (s denotes "seller" and b denotes "buyer"), then that particular exporter's productivity is raised to G. On the other hand, if only the buyer pays the fixed cost I_b, then the firm's productivity is only raised to $G_b < G$. If only the exporter pays fixed cost I_s, then the firm's productivity is only raised to $G_s < G$.

Given the foreign consumers' utility function, the exporting firm's profit is

$$\frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}d(1+t^{*})c\right)^{1-\sigma}A^{\sigma-1},$$

and the foreign consumers' surplus is

$$\frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}d(1+t^{*})c\right)^{1-\sigma}A^{\sigma-1},$$

where A denotes the firm's productivity.

We will assume that joint investment is beneficial to both parties ex ante. That is, for the firm

$$\frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}d(1+t^{*})c\right)^{1-\sigma}\left(G^{\sigma-1}-1\right)-I_s>0, \tag{13}$$

and, for the buyer

$$\frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}d(1+t^{*})c\right)^{1-\sigma}\left(G^{\sigma-1}-1\right)-I_b>0. \tag{14}$$

However, if the exporting firm cannot commit to making the investment, the buyer would not make the investment.[4] In this case, neither sides would invest. In other words, we consider a scenario in which the best outcome occurs when both parties make a relationship-specific investment, but a Pareto-inferior outcome (a prisoners' dilemma) occurs when a contract on the mutual commitments cannot be enforced.

We will use q to denote the quality of public governance institutions in the home country. Denote by $\mu(q)$ the fraction of the contracts will be enforced.[5] It is natural to assume $\mu'(q)>0$, i.e., more contracts will be respected by private agents in a country with a higher

[4]This requires parameter restrictions that $\frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}d(1+t^{*})c\right)^{1-\sigma}\left(G_i^{\sigma-1}-1\right)-I_i<0, i=s,b$; and $\frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}d(1+t^{*})c\right)^{1-\sigma}\left(G^{\sigma-1}-G_b^{\sigma-1}\right)-I_s<0$.

[5]Theoretically, μ should depend on foreign institutional quality q^{*} as well. Since the small open economy takes foreign institutions as given, we omit q^{*} to save notations.

institutional quality. As a result, the total profit of the firm from selling abroad is

$$
\begin{aligned}
&\frac{1}{\sigma-1}L^*\left(\frac{\sigma}{\sigma-1}d(1+t^*)c\right)^{1-\sigma}G^{\sigma-1}\mu(q)+\frac{1}{\sigma-1}L^*\left(\frac{\sigma}{\sigma-1}d(1+t^*)c\right)^{1-\sigma}[1-\mu(q)]\\
&-L^*\mu(q)I_s=\frac{1}{\sigma-1}L^*\left(\frac{\sigma}{\sigma-1}d(1+t^*)c\right)^{1-\sigma}\left\{\mu(q)G^{\sigma-1}+[1-\mu(q)]\right\}-L^*\mu(q)I_s>0.
\end{aligned}
\tag{15}
$$

Denote $h(q) = \{\mu(q)G^{\sigma-1} + [1 - \mu(q)]\}^{\frac{1}{1-\sigma}}$. It can be easily verified that $h'(q) < 0$, which means that worse institutional quality has the same effect as raising the variable cost of doing international trade. In Tables 14 and 15 in the Appendix, we present evidence from gravity regressions that worse institutional quality reduces international trade.

With the above functional forms, we can derive the per capita profit in industry 2 as

$$
\lambda_2(p_2(q))=\frac{1}{\sigma-1}\left[\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}+\frac{L^*}{L}\left(\frac{\sigma}{\sigma-1}d(1+t^*)h(q)c\right)^{1-\sigma}-(\sigma-1)\frac{L^*}{L}\mu(q)I_s\right].
$$

An improvement in the institutional quality leads to a smaller variable trade cost and a higher firm's profit.

Note that the per capita domestic consumer surplus from industry 2 goods is

$$
\begin{aligned}
s_2(p_2(q)) &= \xi(x_2(p_2)) - p_2x_2(p_2)\\
&= \frac{1}{1-\frac{1}{\sigma}}p_2^{1-\sigma} - p_2^{1-\sigma}\\
&= \frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}.
\end{aligned}
\tag{16}
$$

Without risk of confusion, we now write firm profit $\lambda_2(p_2(q))$ and consumer surplus $s_2(p_2(q))$ as $\lambda_2(q)$ and $s_2(q)$, respectively.

Ignoring the cost of achieving a given level of institutional quality, the per capita social welfare is

$$
\begin{aligned}
v_b &= c+\lambda_1(p_1)+r(p_1)+s_1(p_1)+\lambda_2(q)+s_2(q)\\
&= c+\lambda_1(p_1)+r(p_1)+s_1(p_1)\\
&+\frac{1}{\sigma-1}\left[\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}+\frac{L^*}{L}\left(\frac{\sigma}{\sigma-1}d(1+t^*)h(q)c\right)^{1-\sigma}-(\sigma-1)\frac{L^*}{L}\mu(q)I_s\right]+\frac{1}{\sigma-1}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}.
\end{aligned}
\tag{17}
$$

If improving institutional quality is costless, better institution quality always improves the home country's social welfare. But institutional improvement may cost resources. For instance, rampant corruption in some countries is sometimes associated with under-paid judges, policemen, and civil servants.[6] Hong Kong and Singapore use very high public sector pay, sometimes pegged to the level of multinational companies' executive compensation, to deter corruption.[7] In general, countries have to spend resources to set up anti-corruption agencies and to pay government officials and civil service workers sufficiently well in order to deter corruption.[8] We use $\phi(q)$ to denote the per capita cost for achieving a given level of institutional quality, q. The post-institutional-cost per capita social welfare is

$$\begin{aligned} v &= v_b - \phi(q) \\ &= \underbrace{c}_{\text{labor income}} + \underbrace{\lambda_1(p_1) + s_1(p_1) + r(p_1)}_{\text{import-competing industry related welfare}} + \underbrace{\lambda_2(q) + s_2(q)}_{\text{exportable industry related welfare}} - \underbrace{\phi(q)}_{\text{institutional cost}}. \end{aligned} \tag{18}$$

As it will be clear in the next section, import tariff policy p_1 (or t) is also a function of institutional quality q. We will study a Stackelberg game in which institutional quality q is first chosen by the median voter and then trade policy p_1 (or t) is determined by politicians' choice.

2.4 Equilibrium Tariff in the Import-Competing Industry

We are now in a position to consider tariff determination. As stated, we consider a two-stage game. In the first stage, the median voter (in the whole economy) determines the level of institutional quality (by deciding on the amount of resources used to build institutions that constrain the politician's ability to "sell" trade protection for private benefits). In the second stage, given the level of institutional quality, the politician and the domestic firms in Industry 1 enter a "protection-for-sale" game to determine the equilibrium level of tariff. The firms form a lobby group and offer a compensation schedule as a function of tariff, $b(p_1)$, to the incumbent politician.

The objective function of the politician - the decision maker on the tariff - is given by

$$[1 - \psi(q)]b + \underline{a}v(p_1), \tag{19}$$

[6] Van Rijckeghem and Weder (2001) report that countries with a lower public sector wage tends to have a higher level of corruption.

[7] "The Singapore government believed that an efficient bureaucratic system is one in which the officers are well-paid so the temptation to resort to bribes would be reduced." - Rahman (1986), p. 151.

[8] See https://en.wikipedia.org/wiki/List_of_anti-corruption_agencies for a list (perhaps incomplete) of countries' anti-corruption agencies. The comprehensive data on the exact money spent on these agencies is not available unfortunately.

where b is the bribe that the Industry-1 firms pay to the politician, and $\underline{a}$ is a parameter that represents the weight that the politician puts on the social welfare. With institutional quality q, the politician faces an expected loss as a fraction of the bribery described by $\psi(q) \geq 0$. A better quality of institutions reduces the amount of private benefit that can be accrued to the politician to for a given dollar of bribe. This is represented by $\psi'(q) \geq 0$.

The politician's objective function can be rewritten as:

$$b + \frac{\underline{a}}{1 - \psi(q)} v(p_1).[9] \tag{20}$$

Denote $a(q) = \frac{\underline{a}}{1-\psi(q)}$. When $a \to +\infty$, the politicians are social welfare maximizers. Since $\psi'(q) \geq 0$, $a'(q) \geq 0$. In other words, better public governance effectively induces the politicians to place a greater weight on the social welfare. Recall that

$$v(p_1) = c + \lambda_1(p_1) + r(p_1) + s_1(p_1) + \lambda_2(q) + s_2(q) - \phi(q). \tag{21}$$

Note that $\lambda_2(q)$, $s_2(q)$ and $\phi(q)$ are not affected by import tariff policy p_1. We denote $\theta(p_1) = \lambda_1(p_1) + r(p_1) + s(p_1)$. Then the politician's objective function can be rewritten again as

$$b + a(q)\theta(p_1). \tag{22}$$

Using the results in Grossman and Helpman (1994), the equilibrium import tariff t after solving for a sub-game perfect Nash equilibrium is

$$\frac{t}{1+t} = \frac{I - \alpha_1}{a(q) + \alpha_1} \left(\frac{y(p_1)}{-m'(p_1)p_1} \right), \tag{23}$$

or

$$t = \frac{I - \alpha_1}{a(q) + \alpha_1} \frac{y(p_1)}{-p_1^* m'(p_1)} = \frac{I - \alpha_1}{a(q) + \alpha_1} \frac{z}{e}, \tag{24}$$

where α_1 is the fraction of the voting population that owns the specific factor of production in industry 1. I is an indicator on whether an industry is politically organized or not. We follow Broda, Limao and Weinstein (2008) and assume that the import-competing industry is organized,[10] so we set $I = 1$. In addition, the output-import ratio $z = \frac{y(p_1)}{m(p_1)/(1+t)}$, where

[9]When $\psi(q) \geq 1$ if q is larger than some threshold $\bar{q}$, politicians will simply choose b=0 and maximize social welfare, so that the weight on social welfare a(q) is $+\infty$.

[10]Broda, Limao and Weinstein (2008) consider sector-level data but assume all industries are organized when they control for the protection-for-sale effect. A primary reason is that there is no systematical data at the industry level for the degree of "organizedness" in most countries. In Goldberg and Maggi (1999), they find that in U.S. all 3-digit SIC industries have positive campaign contributions. A literal interpretation would imply that all industries are organized. They further use an "intuitive method" and set 2/3 industries as organized since there seems to be a natural break in the campaign contributions when they plot contributions'

y is the domestic Industry 1 output and $m/(1+t)$ is the import (excluding tariffs), and $e = -\frac{m'(p_1)p_1}{m(p_1)}$ is the import demand elasticity.

If $\frac{z}{e}$ were a constant, then equilibrium tariff t would clearly be a decreasing function of q. However, as $\frac{z}{e}$ is likely a function of tariff t, the relationship between t and a is more complicated. In a polar case with perfect institutional quality (q goes to infinity) and $a(q)$ going to infinity, the equilibrium tariff t collapses to 0 (the lowest possible level) and the social welfare θ is maximized.

From a calibrated numerical exercise (see Appendix A.1), we find it reasonable to expect the equilibrium tariff t to be monotonically related to weight a. Thus, in the rest of the paper, we will assume that equilibrium tariff t is decreasing in weight a. Intuitively, when the politician puts a larger weight on social welfare, the equilibrium trade policy is closer to the social optimum (i.e., with a zero tariff).

We then can prove that welfare θ is monotonically increasing in weight a (or institutional quality q).

Lemma 1 *When the domestic import demand function for industry 1 good is downward sloping, i.e.,*

$$m'(p_1) = x_1'(p_1) - y'(p_1) < 0, \tag{25}$$

then the welfare component related to industry 1 θ is decreasing in weight a (or institutional quality q),

$$\frac{d\theta}{da} > 0 \text{ and } \frac{d\theta}{dq} > 0 \tag{26}$$

Proof. The component of the social welfare related to industry 1 is

$$\theta(p_1) = \lambda_1(p_1) + r(p_1) + s_1(p_1) = \lambda_1(p_1) + (p_1 - p_1^*) * [x_1(p_1) - y(p_1)] + u(x_1(p_1)) - p_1 x_1(p_1),$$

where

$$x_1(p_1) = u^{'-1}(p_1),$$

$$y(p_1) = \lambda_1'(p_1),$$

$$u'(x_1) = p_1.$$

The first order derivative is

$$\begin{aligned}\frac{d\theta(p_1)}{dp_1} &= \lambda_1'(p_1) + \{[x_1(p_1)] - y(p_1)\} + (p_1 - p_1^*)[x_1'(p_1) - y'(p_1)] + u'(x_1(p_1))x_1'(p_1) - x_1(p_1) - p_1 x_1'(p_1) \\ &= (p_1 - p_1^*)[x_1'(p_1) - y'(p_1)] \end{aligned} \tag{27}$$

distribution.

Since $x_1'(p_1) - y'(p_1) < 0$ and $p_1 - p_1^* = p_1^*(1+t) - p_1^* = tp_1^* > 0$, we get that $\frac{d\theta(p_1)}{dp_1} < 0$. We then have

$$\frac{d\theta}{da} = \frac{d\theta}{dp_1}\frac{dp_1}{da} < 0. \tag{28}$$

As $a'(q) > 0$, we get $\frac{d\theta}{dq} > 0$. ■

In a nutshell, when institutional quality improves, the politician's choice of the import tariff becomes closer to the socially optimal level. We use function $\Theta(q)$ to denote the social welfare component related to Industry 1 as a function of the institutional quality q. As discussed, $\Theta'(q) > 0$.

2.5 Equilibrium Institutional Quality

After solving for equilibrium tariff t given institutional quality q, we go back to the first stage to determine optimal institutional quality q. For expositional convenience, we assume that the median voter owns an average level of specific factor. In other words, the median voter's welfare coincides with the social welfare. (In Appendix A.2, we study the case in which the median voter has less than the average level of the specific factor. This happens if the ownership of specific factor is concentrated. We find that all of our important conclusions go through qualitatively.)

The median voter's utility is given by

$$v(q) = c + \Theta(q) + \lambda_2(q) + s_2(q) - \phi(q). \tag{29}$$

Here c is labor income. $\Theta(q) = \lambda_1(p_1(q)) + r(p_1(q)) + s_1(p_1(q))$ includes the labor income, the per capita firm profit in Industry 1, the tariff revenue per capita, and the consumer surplus for consuming Industry-1 good. $\lambda_2(q)$ is the total profit of the firms in Industry 2, $s_2(q)$ is the consumer surplus for consuming Industry 2 goods, $\phi(q)$ is per capita cost of achieving institutional quality q. Note that $\Theta(q)$, $\lambda_2(q)$, $s_2(q)$ and $\phi(q)$ are all increasing in institutional quality q.

Plugging in the expressions for profit function $\lambda_2(q)$ and consumer surplus function $s_2(q)$, respectively, we obtain the first order condition with respect to q as follows

$$\frac{\mathbf{L}^*}{\mathbf{L}}\left(\frac{\sigma}{\sigma-1}\mathbf{d}(\mathbf{1}+\mathbf{t}^*)h(q)c\right)^{1-\sigma}\left(-\frac{d\log h(q)}{dq}\right) - (\sigma-1)\frac{\mathbf{L}^*}{\mathbf{L}}I_s\frac{d\mu(q)}{dq} + \Theta'(q) = \phi'(q). \tag{30}$$

Equation (30) determines the equilibrium institutional quality. The left hand side is the marginal benefit of improving institutional quality and the right hand side is the marginal cost of improving institutional quality.

Drawing on an analogy from a firm's optimal investment problem, we assume that the marginal benefit of improving institutional quality is decreasing in q and the marginal cost is increasing q. (Mathematically speaking, we only need a weaker assumption that the slope of the marginal cost curve is greater than the marginal benefit curve in the neighborhood of the equilibrium. An upward-sloping marginal cost curve and a downward-sloping marginal benefit curve certainly satisfy the requirement.) This ensures that the optimal solution to institutional quality q is unique if it exits. If the assumption were to be reversed, the optimal solution will be a corner solution, i.e., either the worst possible institutional quality or the best possible institutional quality will prevail in all countries, which is refuted easily by what we observe in real world. To check if this assumption can be satisfied, we choose some simple functional forms for $h(q)$, $a(q)$, $\mu(q)$ and $\phi(q)$, and trace out the marginal benefit and marginal cost curves in Figure 2. The numerical exercise suggests that it is not too demanding to obtain a downward-sloping marginal benefit curve and an upward-sloping marginal cost curve. In such a diagram, the intersection point gives the equilibrium institutional quality q.

Based on equation (30), we perform several comparative statics and obtain the following propositions.

Proposition 1 ***(Market Size)*** *A smaller population increases the country's institutional quality and reduces its import tariff.*

Proof. We can re-write the first two terms on the left hand side of equation (30) as

$$\frac{L^*}{L}\left\{\left(\frac{\sigma}{\sigma-1}d(1+t^*)c\right)^{1-\sigma}(G^{\sigma-1}-1)-(\sigma-1)I_s\right\}\frac{d\mu(q)}{dq}>0.$$

Smaller $\frac{L}{L^*}$ means that in equation (30), the marginal benefit of improving institutions is larger. Therefore, the equilibrium institutional quality is better. From the section on tariff determination, we see that better institutional quality leads to a lower import tariff t. ∎

Proposition 2 ***(Geography)*** *A lower degree of natural barriers due to favorable geographic features (smaller d) increases a country's institutional quality and reduces its import tariff level.*

Proof. From the equation that determines the optimal institutional quality (30), we see that a smaller d implies a larger marginal benefit of improving institutions, so that the equilibrium institutional quality will be higher. Again, better institutional quality leads to a lower import tariff. ∎

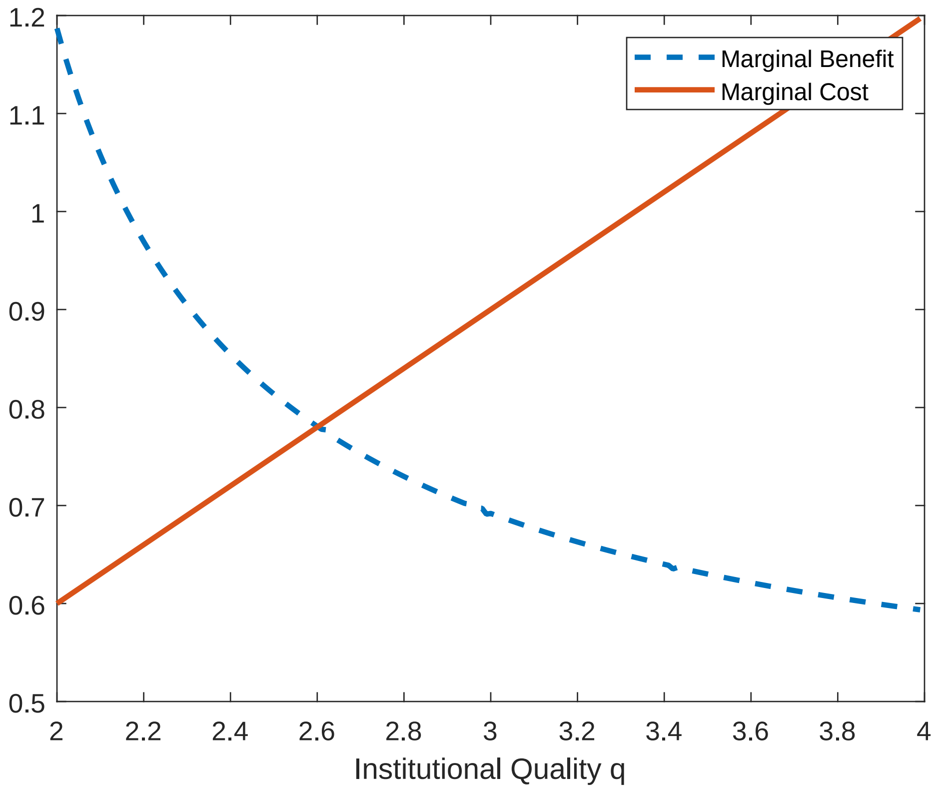
Note that geography is assumed not to affect import costs in the baseline model. This is done to simplify the exposition. In Appendix A.3, we extend the model to allow for both geography and institutional quality to affect the transport cost on the import side. While the extended model is messier, our calibrations confirm that the proposition continues to hold under reasonable assumptions.

Proposition 3 ***(Foreign Trade Policy)*** *A decline in a country's natural barriers due to foreign trade liberalization (smaller t^*) improves the country's institutional quality and lower its import tariff.*

Proof. Similar arguments as in the proof of proposition 2. ■

We will empirically test these propositions.

Figure 2: Equilibrium Institutional Quality q Determination



Notes: This figure displays the marginal benefit and marginal cost of improving institutional quality q with a numerical example, which determines the equilibrium institutional quality. We set the following functional forms and parameter values: $\mu(q) = \exp(-\frac{\pi_\mu}{q})$, $\phi(q) = \frac{\gamma}{2}q^2$, $a(q) = \frac{a}{1-\psi(q)} = \frac{a}{1-\exp(-\frac{\pi_a}{q})}$; $L = 1, L^* = 10, \gamma = 0.3, t^* = 10\%, d = 2, \sigma = 2, \pi_\mu = 1, c = 1, \pi_a = 1, I_s = 0.1, G = 1.02, \underline{a} = 1, \psi = 1 - e^{\frac{\pi_q}{q}}$. In Appendix A.1, we have a numerical relationship on welfare Θ and politicians' weight a. So with functional form $a(q)$, we are able to calculate the numerical derivative $\Theta'(q)$.

3 Empirics 1: From Natural to Policy Barriers?

3.1 Regression Specification and Data

We start with a cross-sectional regression of a country's average tariff level on some natural features of the country that our theory predicts are important, namely, population size and geography. The regression specification will take the following form:

$$\text{average tariff}_i = \alpha + \beta * \{\text{Market Size, Geography, Controls}\}_i + \epsilon_i, \tag{31}$$

where subscript i denotes country i and $\{\text{Market Size, Geography}\}_i$ include population, remoteness, coastline length/area and landlock dummy.

For tariff, we use the average value over 1995-1997. We use the average population over 1992-1994 as one regressor. We choose this period to strike a balance between an ease of comparison with Broda, Limao and Weinstein (2008) on market power and optimal tariff which focus on a similar period and a sufficient coverage of countries. (Our results are robust to other years, e.g., year 2001-2003, see Table 16 in Appendix A.7.) Our sample consists of all countries with available data and with a population size of at least 0.5 million people. Smaller countries tend to suffer from data quality problem. They also tend to have a diaspora that are big relative to people who are left behind, making population count less reliable. The resulting sample consists of 92 countries that have data on tariffs (from WITS), population, and geography.

We obtain Most Favored Nation (MFN) import tariff data from the World Integrated Trade Solution (WITS). The country coverage is poor before 1995. On the other hand, many developing countries have engaged in big trade liberalizations after 1997. For the cross-sectional patterns, our key dependent variable is the average tariff rate over 1995-1997. We linearly interpolate the data at the product level (HS4) when possible if there is missing data during 1995-1997. In a later section, we will examine change in the tariff rates from 1997 to 2007 as the dependent variable.

Throughout the paper, we focus on import tariff rates in the manufacturing sectors.[11] Trade barriers on agricultural products tend to take the form of specific tariffs or quotas rather than ad valorem tariff. Imputing ad valorem equivalents is unreliable as world commodity price fluctuations can lead to large volatility in the imputed tariffs. For this reason, Bagwell, Staiger and Yurukoglu (2018) also exclude agricultural products in their study.

The average import tariff (%) across all HS-6 digit products - henceforth known as the

[11] These are HS chapters 28-97.

average tariff - of country i is computed as

$$\text{average tariff}_i = \frac{1}{3}\sum_{t=1995}^{1997}\frac{\sum_{jt}\log(1+\frac{\text{tariff}_{ijt}}{100})*100}{N_{it}}, \tag{32}$$

where tariff_{ijt} is country i's import tariff (in percentage) of a HS good j in year t. We use $\log(1+\frac{\text{tariff}_{ijt}}{100})$ to moderate the impact of the extreme values in some product-level tariffs on the average tariff. The cross-country mean of the average tariff is 11.75 percent. There is substantial variation in the average tariff across countries, with a standard deviation of 7.75 percent.

The benchmark institutional quality data is taken from the International Country Risk Guide (ICRG). The political risk indicators report various components of institutions. We take the summation of the 3 components (in total 24 points) that are most relevant for our story: the "Investment Profile" (12 points), corruption control (6 points), and law and order (6 points). The Investment Profile is an index that is meant to measure the degree of protection against expropriation risk,[12] contract violation, repatriation and payment delays. These three measures turn out to be highly correlated with each other. As such, we will not try to identify their separate effects.

These institutional features likely affect the extent of politicians' rent seeking behavior, and the cost of doing business. To ensure sufficient country coverage, our measure of institutional quality will be the average value over 2001-2003. There is a wide variation in the measured institutional quality. For example, Democratic Republic of Congo has a score of 7.7 (out of 24), while Finland has a score of 24.

The population data is from the World Bank World Development Indicators (WDI) database and we use the average over 1992-1994 as our measure of population.[13] The remoteness of economy i is defined as follows

$$remoteness_i = \sum_{j\neq i} w_j \log(d_{ij}),$$ [14]

where $j \neq i$ denotes all other countries except i. $w_j = \frac{trade_j}{\sum\limits_k trade_k}$ is the international trade share of country j in total international trade volume of all countries, where $trade_j = \frac{import_j + \exp ort_j}{2}$ (then averaged across year 1992-1994) and d_{ij} is the great-circle distance between country i

[12]See Acemoglu, Johnson and Robinson (2001) footnote 3 for a discussion on using expropriation risk as institutional quality measure: expropriation risk is related to all the following institutional features including constraints on government expropriation, independent judiciary, property rights enforcement, and institutions providing equal access to education and ensuring civil liberties.

[13]See https://databank.worldbank.org/source/world-development-indicators.

[14]see Wei (1996) for an early exposition of this concept.

Table 1: Summary Statistics in the Cross Section

Panel A: Country Level

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
average tariff	92	11.75	7.75	0	41.94	10.78
log(population)	92	16.39	1.50	13.16	20.88	15.96
remoteness	92	8.76	0.38	7.68	9.52	8.85
coastline/area	92	0.037	0.10	0	0.90	0.01
landlock dummy	92	0.20	0.40	0	1	0
log(GDP per capita)	91	7.33	1.43	5.09	10.59	7.39
OECD dummy	92	0.08	0.28	0	1	0
institutional quality	114	14.49	3.96	2.67	24	13.83
log(export/GDP)	131	-1.23	0.60	-2.85	0.56	-1.25

Panel B: Product Level (four-digit HS)

tariff	87,364	12.12	11.11	0	109.86	9.53
log(1/inverse export elasticity)	51,294	0.92	3.48	-15.46	14.87	0.28

Notes: This table reports summary statistics of key variables we use in the cross-sectional study in Section 3.

and j computed using CIA World Factbook latitude and longitude information.

The data on each country's coastal length and area size are from the World Resource Institute[15] and the World Bank World Development Indicators, respectively. The ratio of the two will be a key regressor. There are 19 landlocked countries in our full sample of 92 countries. We will use a dummy for landlocked countries. However, in some specifications when the country coverage shrinks due to missing data for some regressors, the coefficient for the landlocked dummy cannot be precisely estimated, as many landlocked developing countries tend to be both poor and small, and have a disproportionate tendency to have missing data. Note also that, since a landlocked country has no coastline, the landlock dummy and the ratio of coastline length and area size are negatively correlated. However, the correlation, at -0.2, is not too high.

We obtain total exports and GDP in current dollars by country from the World Bank World Development Indicators (WDI). Table 1 reports the summary statistics of the key variables used in this section's regressions.

Table 2 reports the pairwise correlation matrix between different dimensions of natural

[15]See the archive https://web.archive.org/web/20120419075053/http://earthtrends.wri.org/text/coastal-marine/variable-61.html.

Table 2: Pairwise Correlation Matrix: Population and Geography

	log(population)	remoteness	coast/area	landlock dummy
log(population)	1.0000			
remoteness	-0.0477	1.0000		
coastline/area	-0.1792	0.0498	1.0000	
landlock dummy	-0.1768	-0.0754	-0.1976	1.0000

Notes: This table reports pairwise correlations of log(population), remoteness, coastline length/area and landlock dummy. The sample size is 92.

barriers. The correlations among most dimensions of natural barriers are low. For example, the correlation between log population and remoteness is -0.05, and that between coastline length/area and remoteness is 0.05.

3.2 Discussion on Identifying Assumptions

Before presenting the main results, we first discuss some of the key identifying assumptions. One important assumption is that geographic features and relative population size are pre-determined, but these can be challenged. First, both population size and geographic features can affect a country's market power, which may affect the tariff choice even without our political economy story. For this reason, we will include an estimate of market power as a control variable.

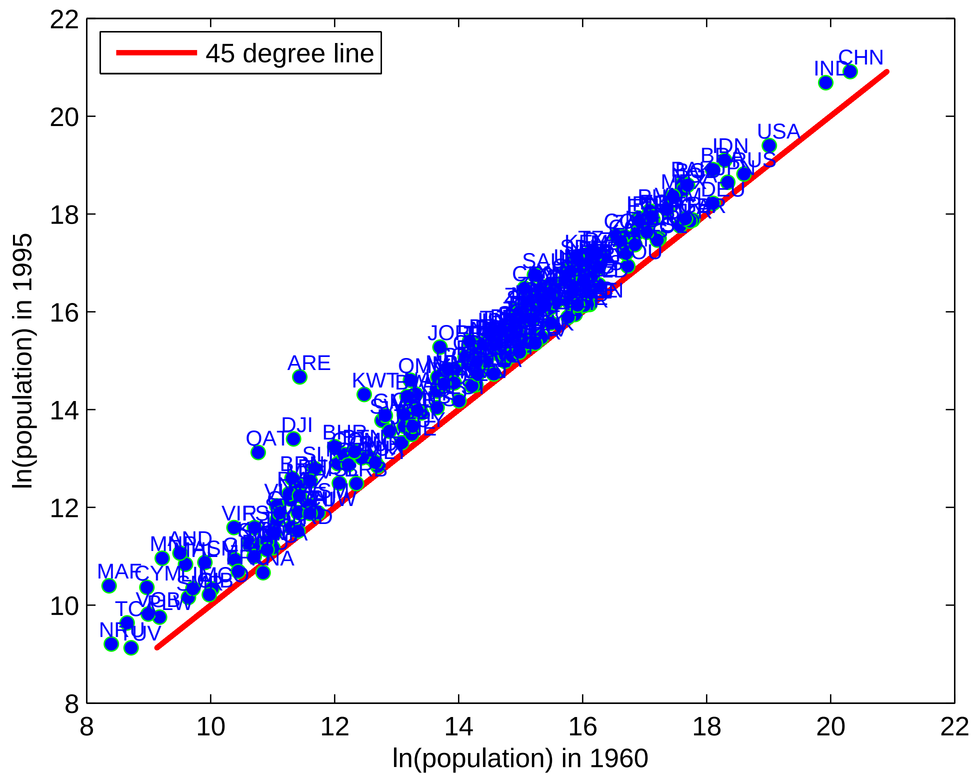
Second, the population of a country is not constant and changes literally every day with birth, death, and immigration, and can also respond to trade policies. Nevertheless, we show in Figure 3 that relative population size has been quite "sticky" in the data. The correlation between 1960 and 1995 log(population) across countries is 0.99. Since what matters for our identification is the relative population size, there is less concern on the endogenous response of population to trade policy.

Third, countries' geographic features might change via wars and other political or military events. In our analysis, we will drop all countries that have any significant border changes after 1975 as a robustness check.[16] This gives us a sample of 79 countries with relatively stable borders. We will show that this change makes little difference to our inferences. See Table 18 in the Appendix on the results with this sample.[17]

[16] Table A.5 in the Appendix provides a list of countries that have experienced significant changes in borders.

[17] One may also be concerned that in the construction of the remoteness measure, there is each country's trade weight information, which can change over time too. But we find that the remoteness measures using

Figure 3: log(population) in 1995 versus 1960



Note: This figure displays the raw data of ln(population) in year 1995 against that in year 1960. The red line is the 45 degree line. The correlation between ln(population) in year 1995 and 1960 is 0.987. Our cross sectional evidence is barely changed if we drop the outlier ARE (United Arab Emirates) in the above figure.

Besides the relationship between natural barriers and tariff rates, we will undertake additional exercises. First, we will check whether institutional quality is also correlated with natural barriers as our theory suggests. Second, we will examine whether and how import tariffs of small and medium sized countries respond to changes in their natural barriers, due to unilateral trade reforms in China. This approach differences out all time-invariant determinants of import tariffs. Third, we will explore cross-product heterogeneity in other countries' unilateral trade policy change.

As a key mechanism in the natural tariff theory is that natural barriers reduce export opportunities, which in turn reduce a country's incentive in improving domestic institutional quality, we check for the plausibility of this link in the data. In Appendix Table 19, we report three sets of statistical results.

1972-1974 trade weight and 1992-1994 trade weight have a very high correlation of 0.99.

We check how a country's export volume, measured by log($export/GDP$), is linked to natural barriers. In Column (1) of Panel A, we find that countries with a larger population, a greater distance to other economies, or a lower ratio of coastline length/area tend to have a smaller log($export/GDP$). Since richer countries may export more, but being rich could also be a consequence of having better institutions, we need a "pure income" variable that is purged of the effect of natural barriers on the income. We construct this variable as the residual term from regressing log income on log population, remoteness, ratio of coastline length/area size, and a landlocked dummy. In Column (2), we add the pure income term. A positive and statistically significant coefficient confirms that richer countries on average export more. As the tariff data are available for a smaller set of countries (90 as opposed to 130), in Column (3) and (4), we restrict the sample to those countries with tariff data. The results are similar: a smaller population, a smaller distance to major markets, or a longer coastline relative to area size tends to be associated more export openness. Note that a country's distance to other countries, coastal length relative to area size, and population size during 1992-94, are all pre-determined with respect to export volume in 1995-1997.

In Panel B-1, the dependent variable is institutional quality as measured by the Political Risk Index (a greater value means better institutions). In Panel B-2, the dependent variable is control of corruption as measured by the Transparency International index. In both cases, the results show that countries with a larger population, a greater distance to other economies, a lower ratio of coastline length to area size tend to have a worse institutional quality, in both the full sample as well as in the restricted sample of the countries with tariff data.

In summary, the data confirms that natural barriers raise the costs of exports and reduce the volume of exports (not surprisingly), and appear to be associated with a lower institutional quality (which is not *ex ante* obvious but is consistent with our theory). Since the natural barriers are pre-determined (with unchanged geography at least since 1975), they cannot respond to institutional quality in the 1990s. We will interpret the data patterns as the existence of a political economy force that shape a country's institutional quality in response to the configurations of its natural barriers.

3.3 Effects on Tariffs: Initial Evidence

We now examine relative heights of import tariffs around the world. We use country-level average tariff rate during 1995-1997 as the dependent variable, and investigate whether and how they are linked to a country's natural barriers. Table 3 reports the regression results.

The most parsimonious regression is reported in column (1) of Table 3, where log($population$) and *remoteness* (besides the constant) are the only regressors. Both coefficients are positive

Table 3: Population, Geography and Average Import Tariff

	(1)	(2)	(3)	(4)	(5)
Dependent Variable: average import tariff					
log(population)	1.626**	1.480**	1.555**	1.431***	1.621***
	(0.618)	(0.615)	(0.623)	(0.530)	(0.593)
remoteness	5.149***	5.207***	5.320***	5.600***	5.069**
	(1.714)	(1.731)	(1.780)	(1.387)	(2.033)
coastline length/area		-13.488***	-12.623***	-15.009***	-14.553***
		(4.292)	(4.212)	(4.077)	(4.238)
landlock dummy			1.070		
			(1.631)		
log(population)*OECD					-1.259*
					(0.656)
remoteness*OECD					-2.098
					(1.969)
coastline length/area*OECD					13.063*
					(7.228)
OECD dummy					34.807*
					(20.449)
log per capita income*				-2.398***	-1.920***
				(0.519)	(0.642)
Observations	92	92	92	91	91
R^2	0.146	0.179	0.182	0.320	0.337

Robust standard errors in parentheses
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Notes: This table reports the relationship between natural barriers' measures and the country level average import tariff. In columns (4) and (5), Myanmar GDP per capita data is missing. log per capita income* is the residual from regressing log per capita GDP on the four natural barrier variables.

and statistically significant at the 5% level. In other words, either a larger population or a greater distance to other countries is associated with a higher import tariff. This is consistent with the theoretical prediction.

In Columns (2) and (3), we progressively add coastline length/area and a landlock dummy as additional regressors. The coefficient before the ratio of coastline length/area is negative, and that for the landlock dummy is positive. These signs are both consistent with the model prediction. The first coefficient is statistically significant at the 1% level but the landlock dummy is not. Since there are only a small number of landlocked economies in the sample, the last coefficient may not be well identified.

To understand the economic significance of the natural barriers, we use the estimates in Column (3) as an illustration. An increase in log population by one standard deviation (which is 1.5 according to Table 1) tends to lead to an increase in the tariff rate by 2.1 percentage points (=1.431x1.5). An increase in a country's remoteness by one standard deviation (which is 0.38) gives rise to an increase in the tariff rate by 2.1 percentage points (=5.6x0.38). A lower ratio of coastline/area by one standard deviation (which is 0.10) leads to an increase in the tariff rate by 1.5 percentage points (=15.0x0.1). These are all economically significant effects. It is worth remarking that many countries suffer from a combination of these disadvantageous natural barriers. Rather than making a greater effort at trade reforms to offset the disadvantage of high natural barriers, our empirical work confirms our theoretical prediction that such countries tend to erect additional man-made trade barriers, making their economies even less open to international trade.

As the history of GATT / WTO negotiations suggests, developed countries are likely to have cut their tariffs more than developing countries. This suggests that the income level may be a predictor for tariff levels too. However, the income level itself could be an outcome of a country's natural features: if natural features of a country cause it to pursue better institutions, as the empirical results in the previous subsection show, then income could also rise faster over time in countries with fewer natural barriers (see Frankel and Romer, 1999). To check if a country's income has any additional effect on tariff beyond what may come from the configurations of the natural barriers, we regress log(GDP per capita) on the natural barrier variables and denote the residual from the regression by "log(GDP per capita)$*$".[18] In Column (4), we include residual log(GDP per capita) as an additional regressor. The point estimate of the coefficient is negative and statistically significant. This is consistent with what we know about the GATT liberalization rounds - rich countries indeed have more liberal trade regimes on average more than what their natural features would suggest.

[18] The GDP per capita data of Estonia, Latvia, Lithuania and Moldova in 1992-1994 are missing in WDI and are extrapolated using their 1995 and 1996 data by assuming a constant annual growth rate.

3.4 Controlling for Market Power

According to the optimal tariff theory, market power is a predictor of tariffs too (see the evidence in Broda, Limao and Weinstein, 2008). This creates a confounding effect for us, since larger countries may also have more market power on their imports (i.e., facing a less elastic foreign supply).

To address this challenge, we will include a direct measure of market power as an additional control variable. We follow the Feenstra-Broad-Weinstein approach (see Feenstra, 1994 and Broda and Weinstein, 2006) to estimate the inverse of export elasticities ω_{ig} for each 4-digit HS product g of each importing country i. This is the same estimation procedure used in testing the validity of the optimal tariff argument by Broda, Limao, and Weinstein (2008). The details can be found in Appendix A.6.

We now run country-product level regressions. The dependent variable is import tariff of country i on HS-4 digit product g (as in Broda, Limao and Weinstein (2008)).[19] The key additional control variable is the inverse export supply elasticity ω_{ig} facing country i on product g. The regression specification is as follows:

$$\text{tariff}_{ig} = \alpha + \beta * \{\text{Market Size, Geography}\}_i + \gamma \log \omega_{ig} + \epsilon_{ig}. \tag{33}$$

According to the results reported in Table 4, a greater market power indeed leads to a higher tariff. However, this moderates the size of the point estimates of the natural barrier variables only slightly. In column (1), we only include population and geography as explanatory variables and confirm our findings in Table 3 that countries with smaller population and favorable geographic conditions (shorter distance to the rest of the world, larger coastline length/area and not landlocked) produce a lower tariff rate. The magnitudes of these estimates are in line with those in Table 3. In column (2), we add industry fixed effects following Broda, Limao and Weinstein (2008), where industry is defined as the section classifications of the HS system. It changes little of column (1) results.

In column (3), we consider the market power story by adding logarithm of inverse export supply elasticities as an additional control variable. The point estimate turns out to be positive and statistically significant. It supports the market power argument that countries set higher tariff if their trading partner's supply is inelastic. Note that the impact of market size is slightly weakened. This is due to the fact that market size is correlated with market power (see Table 13 in Appendix A.7). Overall, market size and geography continue to have similar effects on tariffs as in column (2). Finally, adding inverse export supply elasticities

[19] We use 3-year (1995-1997) average of $\log(1 + \frac{tariff}{100}) \times 100$ as the left hand side variable in order to minimize the impact of extreme values and data noises.

only increase R^2 modestly from 0.158 to 0.182. In sum, the natural tariff prediction goes beyond the optimal tariff theory.

3.5 The Design Features of the World Trade System

Our theory assumes that the tariffs are chosen voluntarily by the country in our theory. The optimal tariff theory also requires this assumption. But the tariffs in the data come from a mixture of countries, some of which may be constrained in their ability to set their own tariffs under the WTO rules.

As pointed out by Subramanian and Wei (2007) among others, the World Trade Organization (and its predecessor the GATT) imposes two-tier obligations: developed country members face binding and greater liberalization obligations. Developing country members, on the other hand, have more leeway in setting their tariffs under the principle of special and differential treatment. (During the GATT years, most of the international trade took place among developed countries. As a result, the multilateral trade negotiations focused on reciprocal tariff reductions among developed countries.) In addition, non-WTO members are not bound by obligations imposed by the WTO. These asymmetries are supported in the data (see Subramanian and Wei, 2007, for more discussions.)

In light of these institutional features, we distinguish between developed countries (defined as countries that had joined the OECD prior to 1993) and developing countries. This classification assigns Mexico, South Korea, Chile, and Colombia to the developing country group, and is common in the literature on trade and finance issues in emerging market economies. Importantly, these countries were treated as developing countries when they joined the GATT/WTO. We interact log(population) and geography with the OECD dummy. We would expect that market size and geography have a larger impact on the non-OECD countries since they are less or not constrained by WTO obligations. The estimation results are reported in column (5) of Table 3 and column (4) (and (5), (6)) of Table 4. Indeed, the signs of the estimated coefficients before the interaction terms between OECD dummy and log(population) and geographic variables are consistent with the WTO institutional features.[20] For developed countries, log(population), remoteness and coastline length/area in general play a much smaller role or little role in determining their average import tariffs.

We check the role of market power by including the interaction term between log(1/inverse export elasticity) and OECD dummy. The results are in column (5) and (6). We find that the point estimate for the interaction term is negative and statistically significant. That is,

[20] In our sample, there is only one country, Switzerland, that is both in the OECD group and landlocked. The point estimate of the interaction term between OECD and landlock dummy should be interpreted with reservation.

Table 4: Natural Barriers, Market Power and Import Tariff

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: import tariff						
log(population)	1.679***	1.686***	1.390**	1.670***	1.662***	1.422***
	(0.613)	(0.613)	(0.571)	(0.584)	(0.585)	(0.539)
remoteness	4.698***	4.676**	5.052***	3.977*	3.953*	5.400***
	(1.785)	(1.785)	(1.758)	(2.048)	(2.045)	(1.957)
coastline length/area	-12.163***	-12.142***	-12.198***	-12.300***	-12.307***	-15.340***
	(4.060)	(4.059)	(3.472)	(3.295)	(3.306)	(3.151)
landlock dummy	1.624	1.646	1.297	0.464	0.403	0.253
	(1.592)	(1.592)	(1.881)	(2.003)	(2.004)	(1.947)
log(1/export elasticity)			0.118***		0.121***	0.108*
			(0.039)		(0.045)	(0.060)
log(population)*OECD				-2.772***	-2.764***	-1.699**
				(0.614)	(0.615)	(0.669)
remoteness*OECD				-5.256**	-5.231**	-3.361
				(2.107)	(2.100)	(2.140)
coastline length/area*OECD				-22.287***	-22.258***	-0.775
				(6.608)	(6.629)	(15.037)
landlock dummy*OECD				-7.987***	-7.982***	-1.811
				(2.205)	(2.201)	(3.489)
log(1/export elasticity)*OECD					-0.120**	-0.096
					(0.056)	(0.065)
OECD dummy				85.965***	85.717***	54.798**
				(21.445)	(21.379)	(24.568)
log per capita income*						-1.994***
						(0.577)
Industry Fixed Effect	N	Y	Y	Y	Y	Y
No. of countries	92	92	87	87	87	87
Observations	87364	87364	50123	50123	50123	50123
R^2	0.091	0.158	0.182	0.240	0.241	0.275

Standard errors clustered at country level in parentheses. Industry is defined as the section classification of HS code.
${}^{*}p < 0.10$, ${}^{**}p < 0.05$, ${}^{***}p < 0.01$

Notes: This table reports the relationship between natural barriers' measures and the country-product (HS 4-digit) import tariff. log per capita income* is the residual from regressing log income per capita on the four natural barrier variables.

the market power story works more strongly for non-OECD countries. This is consistent with Broda, Limao and Weinstein (2008) who test the market power as a determinant of the tariffs. For OECD countries, we cannot reject the null of no association between market power and tariff.

3.6 Output-import Ratio and Import Demand Elasticity

Grossman-Helpman (1994) predict that the heterogeneity in both output-import ratio and import demand elasticity across countries and across sectors will matter for the tariff rates at the country-sector level. In particular, the import tariff is

$$t = \gamma(q) \frac{\text{output-import ratio}}{\text{import demand elasticity}}. \tag{34}$$

where $\gamma(q) = \frac{1-\alpha_1}{a(q)+\alpha_1}$.

We can do a first-order approximation of $\gamma(q)$ to arrive at an estimation equation:

$$t = (1-\alpha_1)(\gamma_1 * \text{natural barriers} * \frac{\text{output-import ratio}}{\text{import demand elasticity}} + \gamma_2 * \frac{\text{output-import ratio}}{\text{import demand elasticity}}) \tag{35}$$

where, if our theory is correct, $\gamma_1 > 0$.

Since both country size and geography can affect the import penetration and therefore the output to import ratio, our previous specification without these terms suffer from missing regressors.

For domestic output, we use United Nations Industrial Development Organization's (UNIDO) International Standard Industrial Classification (ISIC) 4-digit. In many occasions, the data is not presented in standard ISIC 4-digit code because different countries have different classification systems. For instance, the UNIDO data shows the output in industry 2429C in Malaysia, which is actually a combination of industry ISIC industry 2429 and industry 2430. This combined ISIC 4-digit industry code concordance is listed in the manual of the UNIDO data. We use a concordance table from WITS between the standard ISIC 4-digit code and the HS 4-digit code. Therefore, we are able to calculate the output-import ratio (excluding tariff) at the combined ISIC 4-digit level with import data from the UN comtrade database for each year when data is available. We finally use the 10-year average (1992-2001) of the output-import ratios.

The import demand elasticities are estimated along with the foreign supply elasticities based on the methodology described in Broda, Limao and Weinstein (2008) at the HS 4-digit level, see Appendix A.6 for details. We map those to the combined ISIC 4-digit level by using the simple average across the HS 4-digit codes within a combined ISIC 4-digit level industry.

As many countries are missing in the UNIDO database, we have to contend with a smaller sample of 59 countries in this exercise (compared to 92 countries in Table 12). The reduced sample also means that we lose most (10 out 19) of the landlocked economies, making it harder to identify the coefficient associated with the landlocked dummy.

Given the potentially large measurement errors in both domestic output and import demand elasticity, we winsorize $\frac{\text{output-import ratio}}{\text{import demand elasticity}}$ to a relatively large extent at the 10% level.[21] Our empirical setting follows equation (35) by substituting natural barriers with measures related to it, log(population), remoteness and coastline length/area.[22] We report the OLS estimation results in Table 5.

Column (1) presents a simple (and naive) regression (without industry fixed effects. We can see that the interaction terms between various natural barriers measures and $\frac{\text{output-import ratio}}{\text{import demand elasticity}}$ have the expected signs and two out of three are statistically significant. In Column (2), we add a measure of country-industry level market power by log(1/export elasticity), which is the simple average of all HS 4-digit measures corresponding to a given ISIC 4-digit level industry. Since the ISIC 4-digit sectors are not standardized across countries, we include 2-digit ISIC industry fixed effects. The coefficient on log of the inverse of the export supply elasticity is positive and statistically significant. This is consistent with the optimal tariff argument. The two interaction terms involving log population and remoteness are both positive and statistically significant, which are consistent with our theory. The coefficient on the interaction term involving coastline/area is negative, consistent with our theory, but statistically insignificant.

In Columns (3) and (4), we employ an instrumental variable approach in the spirit of Broda, Limao and Weinstein (2008). In particular, we use other countries' average values of $\frac{\text{output-import ratio}}{\text{import demand elasticity}}$ and log(1/export elasticity) as instruments for the corresponding variables. As the product classification at the combined ISIC 4-digit level is not standardized across countries, the instrumental variables are constructed at the ISIC 3-digit level. On balance, we find that the point estimates before natural barriers' measures*$\frac{\text{output-import ratio}}{\text{import demand elasticity}}$ become larger.

[21] Winsorizing at the 5 % level shows robustness of our results.

[22] Given that landlocked economies are disproportionately dropped and there are only a few landlocked economies left in the sample, we don't have enough power to identify the role of the landlock dummy in this exercise. So we instead focus on the related and finer geographical feature coastline length/area.

Table 5: Considering $\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$

	(1)	(2)	(3)	(4)
Dependent variable: import tariff				
	OLS		IV	
log(population)* $\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$	0.561***	0.524***	0.951***	0.854**
	(0.134)	(0.135)	(0.324)	(0.368)
remoteness* $\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$	1.936***	1.817***	3.990***	3.918***
	(0.520)	(0.509)	(0.980)	(0.990)
coastline length/area* $\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$	-4.070	-3.549	-10.252	-9.792
	(3.565)	(3.467)	(12.078)	(12.230)
$\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$	-25.452***	-23.771***	-49.624***	-46.908***
	(5.282)	(5.346)	(12.165)	(12.851)
log(1/export elasticity)		0.203*		0.495
		(0.106)		(0.326)
log per capita income*	-2.772***	-2.860***	-2.722***	-3.010***
	(0.850)	(0.866)	(0.747)	(0.675)
Industry FE	N	Y	N	Y
No. of countries	59	59	59	59
Observations	4322	4322	4322	4322
R^2	0.234	0.290	0.168	0.149

Standard errors clustered at country level in parentheses. Industry is defined at the ISIC 2-digit industry level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Notes: This table reports the relationship between natural barriers' measures and the country-industry (ISIC 4-digit) import tariff by taking into account the heterogeneity in $\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$ across country-industry pairs. In Columns (3) and (4), the point estimates are obtained by an instrumental variable approach, where $\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$ and log(1/export elasticity) are instrumented by other countries' average values.

3.7 Non-Tariff Barriers

Man-made trade barriers go beyond tariffs, and include quotas on imports and subsidies to domestic producers especially in agriculture. Our theory in principle applies to these non-tariff barriers as well. Kee, Nicita and Olarreaga (2009) provide an estimate of the ad-valorem equivalent for non-tariff barriers at country-product level.

We construct total trade barriers by summing tariffs and the ad-valorem equivalents to the non-tariff barriers. Using the total trade barriers as the dependent variable, Table 6 reports the new estimation results. All our qualitative results including the signs of the key coefficients and the significance levels are similar as before. Quantitatively, the point estimates related to natural barriers' measures in the table are in general larger in absolute value than their counterparts when we do not consider the non-tariff barriers. These results hold after we control for the market power ("the optimal tariff") effect and the role of the GATT/WTO.

Table 6: Sum of Tariff and the Ad-valorem Equivalent of Non-Tariff Barriers

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: Tariff plus the Ad-valorem Equivalent of Non-Tariff Barriers						
log(population)	2.388**	2.258**	2.007**	2.062**	2.059**	1.366
	(0.933)	(0.901)	(0.969)	(1.009)	(1.014)	(0.891)
remoteness	6.885*	6.736*	6.874**	5.203	5.186	11.962***
	(3.886)	(3.785)	(3.157)	(4.277)	(4.239)	(4.298)
coastline length/area	-22.007***	-22.849***	-22.125***	-21.798***	-21.788***	-22.920***
	(6.759)	(6.924)	(7.047)	(7.306)	(7.325)	(6.541)
landlock dummy	-1.374	0.165	0.372	0.319	0.272	3.831
	(3.954)	(3.415)	(3.888)	(4.105)	(4.092)	(3.780)
log(1/export elasticity)			0.142		0.115	0.106
			(0.189)		(0.204)	(0.152)
log(population)*OECD				-2.305	-2.319	0.418
				(1.461)	(1.481)	(1.391)
remoteness*OECD				-3.799	-3.849	-2.965
				(5.129)	(5.104)	(4.986)
coastline length/area*OECD				6.135	6.056	55.827
				(28.627)	(28.383)	(37.767)
landlock dummy*OECD				-16.121**	-16.287**	-5.123
				(7.055)	(7.075)	(7.587)
log(1/export elasticity)*OECD					-0.042	-0.082
					(0.315)	(0.314)
OECD dummy				64.156	64.954	18.250
				(60.447)	(60.858)	(60.669)
log per capita income*						-4.525***
						(0.880)
Industry FE	N	Y	Y	Y	Y	Y
No. of countries	69	69	69	69	69	69
Observations	16470	16470	11715	11715	11715	11715
R^2	0.037	0.068	0.091	0.101	0.101	0.131

Standard errors clustered at country level in parentheses. Industry is defined as the section classification of HS code.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Notes: This table reports the relationship between natural barriers and a more comprehensive measure of policy induced trade barriers (the sum of tariff and the ad-valorem equivalent of non-tariff barriers). The number of observations in the table is much smaller than Table 4 partly because some countries in our sample are not included in Kee, Nicita and Olarreaga (2009) due to data availability and partly because some products in a country don't have a corresponding non-tariff barriers estimates. log per capita income * is the residual from regressing log per capita GDP on the natural barrier variables.

4 Empirics 2: Does Liberalization Beget Liberalization? The Case of the China Reform Shock

The previous section reports cross-sectional results. While they are consistent with the natural tariff theory, they do not control for time-invariant country fixed effects. We now study tariff changes over 1997-2007 from an exercise that differencing out country fixed effects by exploiting big and external trade policy shocks.

In particular, the key dependent variable is the tariff change made by small and medium-sized economies during 1997-2007. During this period, one of the biggest shocks to these countries' trading environment is unilateral trade liberalization by China. Figure 4 presents the dynamics of big economies' MFN import tariff (weighted average) provided by UNCTAD. While there are variations in all big economies' import tariff, the magnitude of China's tariff cuts clearly stands out.

Importantly, the same set of tariff reductions in China (or G7 countries) generates differential impact on different small and medium sized economies' natural barriers, depending on whethe those products experiencing greater tariff cuts by China are important for a given country's export bundle. It also depends on whether a given country is physically close to China or not.

By employing the variations across small/medium-sized economies in the initial product shares in their exports to China (and other big economies), we can construct exogenous changes in the export opportunity for them during this period. We first describe the main variables and their summary statistics.

4.1 Data Description

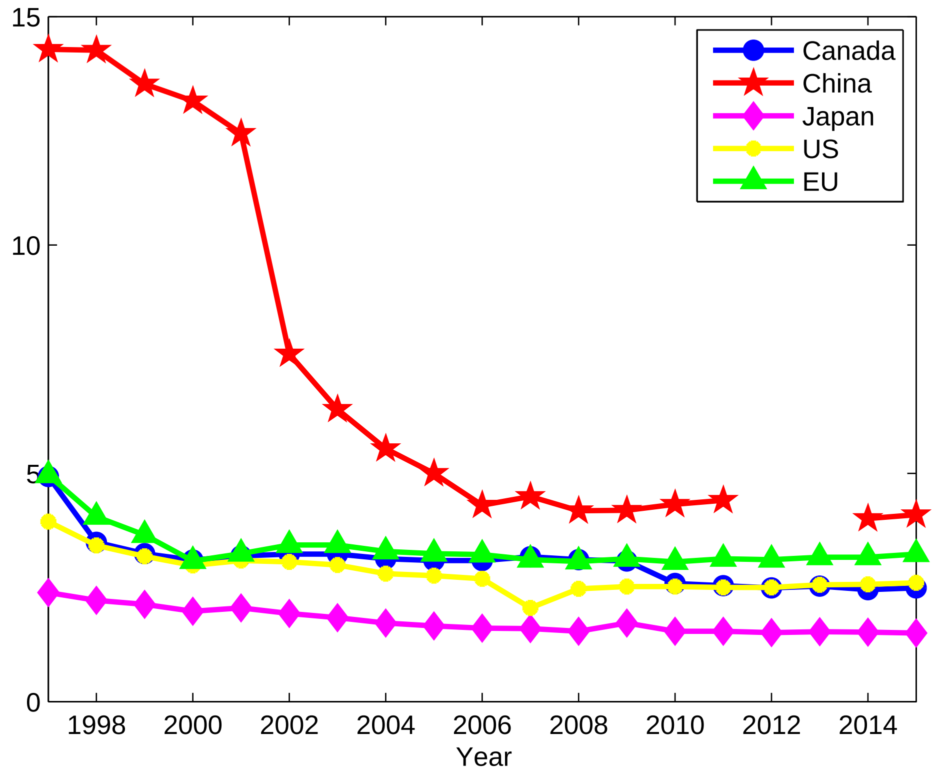
We define the composite natural barriers of an economy in the sample as the weighted average of the tariffs that it faces when exporting to the big economies. Formally, *composite natural barriers* of country i at year t is constructed as:

$$composite\ natural\ barriers_{it} = \frac{\sum_{j,k} export_{ijk} \log(1 + tariff_{jkt}/100) * 100}{\sum_{j,k} export_{ijk}} \tag{36}$$

where j denotes one of the large economies and k is HS4 product. Variable $export_{ijk}$ utilizes initial years' data.[23] In addition, each country's import MFN tariff data is averaged across all HS4 products and is always linearly interpolated for missing data. As noted earlier, the

[23]Our benchmark is 1996. If the 1996 data is not available, we use year 1997 data. If the 1997 data is not available, we use the 1998 data.

Figure 4: MFN Import Tariff Rates (%) of Big Economies 1997-2015



Source: UNCTAD

Table 7: Summary Statistics on Key Variables in the Long Difference

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Δ average import tariff (%)	79	-4.15	5.36	-22.40	5.80	-2.19
Δ composite natural barriers	79	-0.97	0.82	0.93	-2.47	-1.15
1997 average import tariff	79	12.45	6.58	0	33.59	12.02
OECD & late WTO member dummy	79	0.17	0.38	0	1	0
Δ log(GDP per capita)	79	0.19	0.12	-0.08	0.53	0.18
Δ log(export to G7 and China)	104	0.57	1.13	-2.81	3.60	0.55
Δ institutional quality	82	-0.22	2.68	-7.16	5.66	0

Note: This table reports the summary statistics of main variables used in the long difference exercise in Section 4.

changes in the composite natural barriers across small/medium-sized economies during 1997-2007 are overwhelmingly driven by Chinese trade liberalization during this period, interacting with the relative importance of the Chinese market for these economies.

We drop Hong Kong and Macao as their special status implies possible integration with China beyond China's tariff regime. We winsorize the change in the composite natural barriers at the 5% level to reduce the impact of potential outliers. Table 7 reports the summary statistics of the key variables used in our long difference exercise. We have 79 economies with available data on both change in import tariff and change in the composite natural barriers as constructed in equation (36). For these economies, the median change in the natural barriers is negative. This is not surprising given the trade liberalization by large economies, especially by China. The largest drop in the big economies' tariff faced by a small country is around 2.5% in the 10-year window. At the same time, the median change in the average import tariff is 2.19%. In other words, many of the small/medium economies also have reduced their own import barriers. Our theory suggests that the tariff reductions by small/medium-sized countries are to a significant extent a response to the tariff reductions by the large economies, especially the unilateral trade liberalization by China.

4.2 Empirical Evidence on the Long Difference

We pursue the following long-difference regression over the 1997-2007 period:

$$\Delta\ average\ import\ tariff_i = \beta_0 + \beta_1 \Delta\text{composite natural barriers}_i + \gamma X' + \epsilon_i,$$

where i denotes a small and medium sized economy and Δ means the change over the 10-year period. X_i is a set of control variables including initial tariff, change in log per capita income, the export share of unorganized industries and the China export growth shock in the spirit of Autor, Dorn and Hanson (2013). We will explain its construction later.

In Column (1) of Table 8, we look at whether the change in a composite measure of natural barriers for a country has an impact on the change in its average import tariff. We find that the estimated coefficient is positive and statistically significant. That is, a greater reduction in a country's natural barriers due to its exposure to the China reform shock gives rise to a greater reduction the country's own tariffs. In Column (2), we add the initial import tariff in 1997 as a control variable. The point estimate on change in the natural barriers is still positive and statistically significant. As the point estimate in Column (2) is 1.12, we find that a reduction in the big economies' tariff rates by one percentage point will lead to a small/medium economy to cut its own import tariff by 1.12 percentage points. This effect is economically large, since the median change in the import tariffs in the sample is around 2.2 percent. Note that in this long difference setting, time-invariant country fixed effects are already differenced out.

4.3 The Global Trading Architecture

We can enrich our estimation by taking into the design features of the global trading system. As noted in Subramanian and Wei (2007), one improvement of the WTO over GATT is that developing country members that join the WTO after 1995 have to fulfill more liberalization obligations. The natural tariff force in our theory, on the other hand, would work better for pre-existing developing country GATT members that are not subject to fewer constraints in their tariff setting power. If our theory is right, we should see the natural barriers to play systematically a bigger role for the less constrained countries than for the more constrained countries. Empirically, whether we observe a difference between these two sets of countries becomes another check of our theory.

For this purpose, we classify all countries into two groups. The first is those developing countries that were members of the GATT before the WTO was founded in 1995, plus all non-WTO members in our sample (up to 2007). These countries have more discretion over their tariff setting. The second group consists of all other countries, including both OECD countries and other developing countries that joined the WTO after 1995. We will label the second group by "OECD/late WTO members" and create a dummy for them.

In Column (3) of Table 8, we include as two additional regressors the dummy for OECD/late WTO members and its interaction with the change in natural barriers. The coefficient on the interaction term is negative and statistically significant. Based on the estimated coefficients, while a reduction in Chinese and other large countries' tariff rates by one percentage point would trigger an unconstrained small/medium country to also cut down their own tariff by about 1.6 percentage point, the constrained countries (OECD/late WTO members) do not respond at all (the sum of 1.593 and -1.687 is not statistically different from zero). The difference between the two groups of countries provides further confirmation that policy barriers respond to changes in natural barriers when the policy barriers are not constrained by the international trading system.

4.4 Organized Export Industries and the Chinese Export Shock

Krishna and Mitra (2005) theorize that foreign trade liberalization induces home country to undertake trade liberalization, because previously unorganized export industries in home country may now find it worthwhile to organize themselves and become a counterweight to lobbying effort from the import competing sectors. This will result in lower import tariffs.

Since there is no systematic cross-country information on which industries are organized in which countries, we take the following shortcut. We assume that the technical nature of an industry such as the presence of local increasing returns to scale plays a role in how easy or hard for the industry to be organized, and this technical feature for a given industry is the same across countries. Under this assumption, industries that are organized in the United States (e.g., steel and automobiles) are also likely to be organized in other countries.

We take the information on whether an industry in the United States is organized or not from Goldberg and Maggi (1999) and calculate, for each small and medium-sized country, the fraction of export sales to G7 and China that comes from organized industries. We interact this fraction with the change in natural barriers and include it as a control in Columns (4) and (5). The point estimate before the organized fraction * change in natural barriers is statistically insignificant in both regressions. In fact, the sign seems inconsistent with Krishna and Mitra (2005)'s prediction.

A large literature starting from Autor, Dorn and Hanson (2013) has examined the consequences of the Chinese export growth shock (often abbreviated as the China shock). For a small or medium-sized country i, the China export growth shock is constructed as $\sum_j s_{ij,0} China\_export\_growth_j$, where $s_{ij,0}$ is the share of country i's import in HS 4-digit product j in the initial year,[24] and $China\_export\_growth_j$ is China's export growth to the world of product j from 1997 to 2007. (We use product-level Chinese export growth to the world rather than Chinese export growth to country i itself in order to minimize possible endogeneity associated with country i's own import growth patterns which may be affected by its own tariff policy.)

[24] The initial year is usually 1996. If the weight $s_{ij,0}$ is unavailable using 1996 data, we use the information in 1997 or 1998.

In Column (5), we include the China export growth shock and change in income as additional controls. It turns out that neither is statistically significant. We interpret it as evidence that the Chinese liberalization shock (which causes a reduction in natural barriers for small/medium sized countries) and the Chinese export growth shock (which is the shock emphasized by Autor, Dorn, and Hanson, 2013) are distinct shocks. A typical small/medium sized country adjusts its tariff rates in response to the Chinese trade liberalization, but not to the Chinese export growth shock.

Table 8: Change in Composite Natural Barriers and Change in Import Tariff

	(1)	(2)	(3)	(4)	(5)
Dependent variable: change in average import tariff					
			× OECD/Late WTO member		
Δ composite natural barriers	1.124*	1.116***	1.593***	1.866***	2.051***
	(0.580)	(0.392)	(0.424)	(0.590)	(0.618)
average import tariff 1997		-0.615***	-0.692***	-0.698***	-0.703***
		(0.065)	(0.068)	(0.068)	(0.071)
Δ composite natural barriers× OECD/Late WTO members			-1.687***	-1.643***	-1.648***
			(0.596)	(0.576)	(0.574)
OECD/Late WTO members			-4.205***	-4.339***	-4.291***
			(0.993)	(1.016)	(0.991)
Δ composite natural barriers×organized fraction				4.299	5.552
				(5.618)	(5.381)
organized fraction				3.517	6.734
				(8.307)	(8.182)
Δ log(GDP per capita)*					-2.860
					(3.055)
China export growth shock					-0.943
					(1.141)
Observations	79	79	79	79	76
R^2	0.030	0.601	0.641	0.643	0.652

Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the long difference results of the effects of change in natural barriers on change in average import tariff. Δ log(GDP per capita)* is the residual component after projecting the variable change in log(GDP per capita) on the change in natural barriers.

4.5 Does Institutional Quality Respond to Chinese Liberalization?

As the key mechanism of our story is political economy and endogenous adjustment in the institutional constraint on rent seeking, we now examine the public institutions in a typical small/medium-sized economy are adjusted in response to the Chinese trade liberalization in a way that is consistent with our theory. We perform two exercises.

In the first exercise, we check if the Chinese trade liberalization does result in an improvement in the external trading opportunities for other countries. The dependent variable is the change in log(exports to China and G7) from the average value during 1996-1998 to the average value during 2005-2007. In Column (1) of Panel A in Table 9, we find that the coefficient on change in natural barriers is negative and statistically significant. This means that, across small/medium-sized countries, those experiencing a greater reduction in their natural barriers do see a greater relative increase in their exports to China (and other major markets). In Column (2) where we have added the initial exports to the major markets and the increase in log per capita income as regressors, there is no change in the main results. That is, those countries that experience a greater effective reduction in their export barriers in China (and the G7 market) indeed exhibit a faster growth in their exports to these markets. These results should not be surprising, but it is a confirmation that our measure of a change in natural barriers contains economically useful and intuitive information.

In the second exercise, the dependent variable is the change in institutional quality from 1997 to 2007 (or more precisely, the institutional quality scores averaged over 2005-2007 minus those averaged over 1997-1999). In Column (1) of Panel B in Table 9 , the coefficient on the change in natural barriers is negative and significant at the 10%. This suggests that the Chinese trade liberalization (which results in a reduction in natural barriers for a typical small/medium-sized economy) tends to lead to an improvement in institutions in other countries. In Column (2) where we have included initial institutional quality and change in log per capita income as additional regressors, the effect of a change in natural barriers on home-country institution remains the same. In other words, those countries that benefit more from the Chinese trade liberalization also have done more to improve their institutional quality.

Table 9: Foreign Liberalization, Export Growth, and Institutional Improvement

	(1)	(2)
Panel A Dependent variable: Increase in log(exports to China & G7) from 1997-2007		
Δ Composite natural barriers	-0.227*	-0.213*
	(0.132)	(0.126)
Initial log(export to G7 and China/GDP)	-0.182**	-0.179*
	(0.075)	(0.093)
Δ log(GDP per capita)*		1.437**
		(0.624)
Observations	104	101
R^2	0.104	0.127

Panel B Dependent variable: Improvement in institutional quality from 1997 to 2007		
Δ composite natural barriers	-0.582*	-0.581*
	(0.330)	(0.337)
Initial institutional quality	0.002	0.014
	(0.107)	(0.107)
Δ log(GDP per capita)*		1.461
		(1.259)
Observations	82	82
R^2	0.029	0.037

Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Panel A shows the relationship between change in natural barriers and export growth. Panel B shows the relationship between change in natural barriers and improvement in institutional quality. Δ log(GDP per capita)* is the residual component after projecting the change in log(GDP per capita) on the change in natural barriers. To construct the initial log(export to G7 and China/GDP), we average both the export values to G7 and China and GDP across 1996-1998. The initial institutional quality is the 1997-2001 averaged value.

5 Product Heterogeneity and Tariff Changes

While the Chinese trade liberalization involves a reduction in tariff rates over a large number of products, not all products are equally important in inducing institutional reforms in other countries. Nunn (2007) recognizes that certain products are more dependent on the quality of contracting institutions than others. A given deterioration of contracting institutions does more harm to international trading in products whose inputs are more specialized and more relationship-specific. We now explore implications of this insight and ask whether a small or medium-sized country would respond to a greater extent if its natural barriers fall more on those products that are more intensive in contracting institutions.

We will split a given small/medium-sized economy's export bundle into a sub-bundle consisting of products that are intensive in contracting institutions and another sub-bundle consisting of all other products. We will compute separate changes in natural barriers for these two sub-bundles. Because the two sub-bundles can have different product shares across countries, the same Chinese trade liberalization would translate into different values for the sub-bundles for different countries.

Our model in Section 2 can be extended to account for differential institutional sensitivities by different products. Suppose a fraction $\kappa \in [0,1]$ of the goods in industry 2 are contract intensive. The remaining $1-\kappa$ fraction is not contract-intensive. We use subscripts c and nc to denote contract-intensive and non-contract-intensive goods, respectively.

The per capita profit from industry 2 can be rewritten as

$$\lambda_2(q) = \frac{1}{L}\left(L\kappa\frac{p_2^{c\,1-\sigma}}{\sigma-1} + L(1-\kappa)\frac{p_2^{nc\,1-\sigma}}{\sigma-1} + \kappa L^*\frac{p_2^{*c\,1-\sigma}}{\sigma-1} + (1-\kappa)L^*\frac{p_2^{*nc\,1-\sigma}}{\sigma-1}\right) = \frac{1}{\sigma-1}\times$$
$$\left[\kappa\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma} + (1-\kappa)\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma} + \kappa\frac{L^*}{L}\left(\frac{\sigma}{\sigma-1}d(1+t^{*c})h^c(q)c\right)^{1-\sigma} + (1-\kappa)\frac{L^*}{L}\left(\frac{\sigma}{\sigma-1}d(1+t^{*,nc})c\right)^{1-\sigma}\right], \tag{37}$$

Here t^{*c} is the foreign import tariff on the contract intensive goods and $t^{*,nc}$ is the foreign import tariff on the non-contract intensive goods. For the non-contract intensive goods, we normalize $h^{nc}(q)$=1.

The per capita profit from industry 2 comes from four parts: (1) the domestic sale of the contract-intensive goods, (2) the domestic sale of the non-contract-intensive goods, (3) the foreign sale of the contract-intensive goods, and (4) the foreign sale of the non-contract-intensive goods. The key comparative statics from the extended model can be summarized by the following proposition.

Proposition 4 *(Foreign Trade Policy and Product Heterogeneity) A reduction in the foreign import barriers on contract-intensive goods inspires an improvement in the home country's* *institutional quality and an reduction in its own import tariff. By contrast, a reduction in the foreign import barriers on non-contract-intensive goods does not generate any change in the home country's tariff.*

Proof. As before, the median voter chooses institutional quality q in order to maximize the following objective function:

$$\max_q c + \lambda_2(q) + s_2(q) + \Theta(q) - \phi(q). \tag{38}$$

The consumer surplus $s_2(q)$ can be decomposed into two parts:

$$s_2(q) = \kappa \frac{1}{\sigma - 1} \left(\frac{\sigma}{\sigma - 1} c \right)^{1-\sigma} + (1-\kappa) \frac{1}{\sigma - 1} \left(\frac{\sigma}{\sigma - 1} c \right)^{1-\sigma} \tag{39}$$

The first order condition with respect to institutional quality q is given by

$$\kappa \frac{\mathbf{L}^*}{\mathbf{L}} \left(\frac{\sigma}{\sigma - 1} \mathbf{d}(\mathbf{1} + \mathbf{t}^{*c}) h^c(q) c \right)^{1-\sigma} \left(-\frac{\partial \log h^c(q)}{\partial q}\right) + \Theta'(q) = \phi'(q)$$

It is clear that the optimal q depends on $(1+t^{*c})$ but not on $(1+t^{*nc})$. A reduction in $(1+t^{*c})$ leads to a higher q. Furthermore, a higher q leads to a reduction in home country tariff. ■

If these implications are borne out in the data, it will further bolster the interpretation that the pathway from Chinese trade liberalization to tariff cuts in other countries goes through institutional reforms in the latter countries. To test these implications, we assign all HS4 products into a contract-intensive basket and a non-contract-intensive basket.

Following Nunn (2007), we measure the degree of relationship specificity for each NAICS 6-digit product based on the fraction of the inputs that are differentiated (i.e., those inputs that are not traded on an exchange). Using a concordance table available on BEA website, we derive the degree of relationship specificity for each HS 4-digit product. The contract-intensive basket consists of all HS 4-digit products whose relationship specificity values are greater than the median value. The non-contract-intensive basket consists of all other HS 4-digit products.

The correlation between whether a sector is intensive in contracting institution and whether it is organized (in the US data) is low at -0.11. Given this, it appears unlikely that the empirical support for our story is confounded by the mechanism in Krishna and Mitra (2005).

For each small/medium sized country, we compute the share of contract-intensive products in its export bundle to China and the G7 countries during 1996-1998, and denote the share by Ψ_i. For each country, we also compute separate natural barriers for the contract-intensive goods and non-contract-intensive goods, respectively. The first one, denoted by "ci-composite natural barriers", is calculated as Ψ_i multiplied by the weighted average tariff on the goods in the contract-intensive basket. The second one, "nci-composite natural barriers," is calculated as $1-\Psi_i$ multiplied by the weighted average tariff on the goods in the non-contract intensive basket.

We run variations of the following regression:

$$\Delta\ average\ \ tariff_i = \beta_0 + \beta_1 \Delta\text{ci-composite natural barriers}_i + \beta_2 \Delta\text{nci-composite natural barriers}_i + \epsilon_i.$$

Table 10 reports the results. In Column 1, we find that the two types of natural barriers indeed have different impact on domestic tariff. A reduction in the natural barriers on the contract-intensive goods significantly reduces domestic import tariff. However, a similar reduction in the natural barriers on the non-contract-intensive goods does not produce a statistically significant effect on domestic tariffs. This dichotomy is consistent with the prediction of the extended model.

In Column 2, we add an initial import tariff in 1997 as a control variable. The new regressor has a negative and statistically significant coefficient. This means that, during 1997-2007, countries with a higher initial tariff tend to undertake more trade liberalization on average. At the same time, the dichotomy in the effects on domestic tariffs from reduced barriers on contract-intensive goods versus those on non-contract-intensive goods is still there as before.

In Column 3, we separate countries whose trade policies are more constrained by WTO rules (OECD countries plus new members of WTO) versus those that are less constrained (old developing members and non-WTO-members). We find that the effect of lower foreign barriers in contract-intensive goods on domestic tariffs is driven by countries less constrained by the WTO rules. In Column 4, we add Chinese export growth shock (a la Autor, Dorn, and Hanson, 2013) and change in income. They turn out to be not statistically significant.

In Table 11, we examine whether reductions in barriers on contract-intensive goods versus non-contract-intensive goods would produce different effects on the home country's institutional quality over 1997-2007. The results are also consistent with our model predictions. In particular, lower foreign barriers on contract-intensive goods tend to lead to an improvement in domestic institutions. In comparison, similar reductions in foreign barriers on non-contract-intensive goods produce no response in home country institutional quality.

To summarize, the regression results confirm that both institutional quality and domestic tariff rates respond to foreign trade liberalization. Moreover, foreign liberalization on contract-intensive goods produces a greater response.

Table 10: Product Heterogeneity, Change in Natural Barriers and Change in Import Tariff

	(1)	(2)	(3)	(4)
Dependent variable: change in average import tariff				
			× OECD/Late WTO member	
Δ ci-natural barriers	2.260**	2.424***	2.857***	2.994***
	(1.017)	(0.611)	(0.673)	(0.662)
Δ nci-natural barriers	-0.064	-0.092	0.206	0.082
	(0.839)	(0.601)	(0.663)	(0.627)
average import tariff 1997		-0.620***	-0.682***	-0.680***
		(0.061)	(0.063)	(0.065)
Δ ci-composite natural barriers× OECD/Late WTO member			-4.169***	-3.889***
			(1.076)	(1.063)
Δ nci-composite natural barriers× OECD/Late WTO member			0.309	0.577
			(0.845)	(0.856)
OECD/Late WTO member			-5.453***	-5.399***
			(1.170)	(1.213)
Δ log(GDP per capita)*				-4.662
				(3.089)
China export growth shock				-1.020
				(1.111)
Observations	79	79	79	76
R^2	0.052	0.631	0.672	0.691

Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the long difference results of the effects of changes in the natural barriers for contract intensive goods and non-contract intensive goods on change in average import tariff. Variable "Δ log(GDP per capita)*" is the residual component after projecting the variable change in log(GDP per capita) on the changes in natural barriers.

Table 11: Product Heterogeneity, Change in Natural Barriers and Change in Institutional Quality

	(1)	(2)	(3)
Dependent variable: Improvement in institutional quality from 1997 to 2007			
Δ ci-composite natural barriers	-1.455***	-1.444***	-1.444***
	(0.482)	(0.504)	(0.506)
Δ nci-composite natural barriers	0.027	0.015	0.011
	(0.503)	(0.511)	(0.504)
Δ log(GDP per capita)*		1.466	1.486
		(1.319)	(1.318)
Initial institutional quality			0.008
			(0.106)
Observations	82	82	82
R^2	0.068	0.077	0.077

Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the long difference results of the effects of changes in the natural barriers for contract intensive goods and non-contract intensive goods on change in institutional quality. Variable "Δ log(GDP per capita)*" is the residual component after projecting the variable change in log(GDP per capita) on the changes in natural barriers.

6 Conclusion

The natural tariff theory that we propose here is a new political economy mechanism of trade policy determination. Because the natural barriers of a country (market size, geography and big trading partners' trade policy) affect a society's incentive in improving institutional quality, they alter the constraints on politicians' rent seeking behavior. In other words, these natural barriers affect how much "protection for sale" can take place.

We conduct a set of empirical tests on the key predictions of the theory. First, we document that natural barriers beget policy barriers - countries that are naturally less open, either with a larger domestic market or less convenient geographically to do international trade, display higher tariffs and non-tariff barriers. Second, we document that liberalization begets liberalization - the unilateral China trade reform shock in the early 2000s induces other countries to undertake their own liberalization. Importantly, the same China tariff change implies differential changes in the trading opportunities for different countries depending on their relative proximity to China or their relative comparative advantage in meeting the Chinese import demand. We find that, as our theory predicts, those countries that see a bigger improvement in their external trading opportunity also choose to do more to improve their institutions and lower their own tariff barriers.

Moreover, product-level heterogeneity matters too. A reduction in foreign barriers in contract-intensive goods produces greater responses in domestic institutions and tariffs. This provides a new perspective on the global gains from an individual country's trade liberalization. A large country's unilateral trade liberalization can promote improvement of their trade partners' institutions, inducing them to liberalize their trade policies too. This positive feedback channel implies that the welfare gains of one country's liberalization may spill over to other countries beyond the usual price channel. A useful future research item is to quantify this spillover effect.

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A Appendices

A.1 A Calibrated Exercise on Import Tariff $t(a)$

We provide a calibrated exercise which gives a monotonic relationship between politicians' weight a and import tariff t (thus the welfare component related to the import competing industry).

We set consumer utility as constant relative risk aversion (CRRA) form:

$$u(x_1) = \frac{x_1^{1-\gamma}}{1-\gamma}. \tag{40}$$

Domestic production function in industry 1 is in Cobb-Douglas form:

$$F(T, H) = AT^{\beta}H^{1-\beta}, \tag{41}$$

where T is the specific factor in industry 1 and H is the amount of labor hired. $1-\beta$ is the labor share.

With the above utility function and production function, we can derive the per capita output

$$y(p_1) = A\frac{T}{H}[\frac{(1-\beta)p_1 A}{c}]^{\frac{1-\beta}{\beta}}, \tag{42}$$

and consumption in industry 1 is given by

$$x_1(p_1) = p_1^{-\frac{1}{\gamma}}. \tag{43}$$

Recall that equilibrium tariff t satisfies that

$$\begin{aligned} \frac{t}{1+t} &= \frac{1-\alpha_1}{a(q)+\alpha_1}\frac{y(p_1)}{-m'(p_1)p_1} \\ &= \frac{1-\alpha_1}{a(q)+\alpha_1}\frac{y(p_1)}{-[x_1'(p_1)-y'(p_1)]p_1} \\ &= \frac{1-\alpha_1}{a(q)+\alpha_1}\frac{y(p_1)}{\frac{1}{\gamma}x_1(p_1)+\frac{1-\beta}{\beta}y(p_1)}, \end{aligned} \tag{44}$$

and the social welfare component related to industry 1 θ is given by

$$\begin{aligned}\theta(p_1) =& [\frac{(1-\alpha)p_1 A}{c}]^{\frac{1}{\beta}}\frac{\beta}{1-\beta}c\frac{T}{H} + p_1^* t[p_1^{-\frac{1}{\gamma}} - A\frac{T}{H}[\frac{(1-\beta)p_1 A}{c}]^{\frac{1-\beta}{\beta}}] + \frac{\gamma}{1-\gamma}p_1^{-\frac{1-\gamma}{\gamma}} - \frac{1}{1-\gamma}\\ =& y\beta p_1 + p_1^* t(x_1 - y) + \frac{\gamma}{1-\gamma}x_1 p_1\\ =& \beta p_1 y + \frac{t}{1+t}p_1 x_1 - \frac{t}{1+t}p_1 y + \frac{\gamma}{1-\gamma}p_1 x_1,\end{aligned} \tag{45}$$

where we have dropped the constant term, which is not relevant for the comparative statics.

A.1.1 Calibration

We pick up a developing country Malaysia to calibrate our model. Malaysia is a small open economy and joins GATT in 1957. Therefore, WTO places relatively few constraints on its tariff setting. This feature is consistent with the home country of interest in our model in the sense that home country can set its trade policy without external constraint.

We calibrate the parameters. γ takes standard value 2. From Penn World Table, Malaysia's labor share in 1996 is around $1-\beta = 0.3$. In the data, Malaysia's import/GDP around 1996 is 90%, so we set $x_1/y = 1.9$. Based on Malaysia Labor Force Survey, the fraction of entrepreneurs in its population is around 9% from 1982 to 2013. So we set $\alpha_1 = 0.09$. The average tariff rate in Malaysia in 1996 is 21%. It implies that the weight on the social welfare is $a = 3.5$. This is our baseline calibration with equilibrium variables denoted by $(a_{ss}, t_{ss}, p_{1,ss}, y_{ss}, x_{1,ss})$. We are interested in how tariff and welfare changes when a deviates from a_{ss} .

For any weight a, the corresponding solution t satisfies

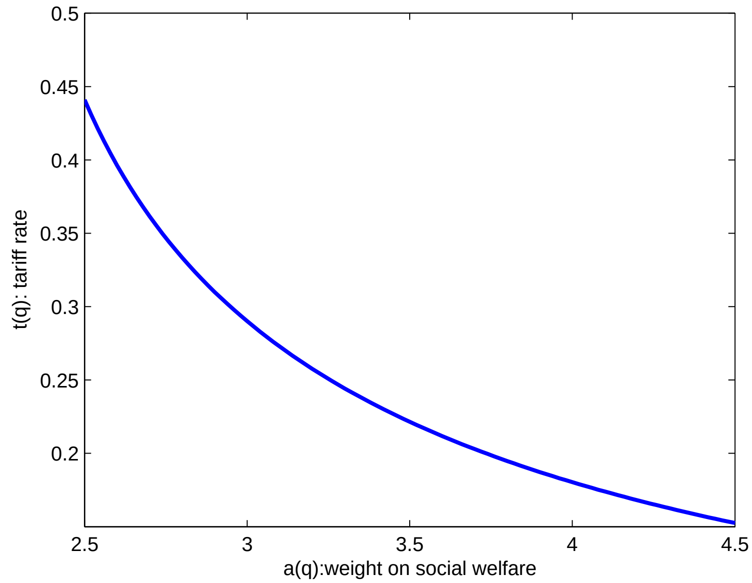
$$\begin{aligned}\frac{t}{1+t} &= \frac{1-\alpha_1}{a+\alpha_1}\frac{\frac{y(p_1)}{y_{ss}}}{\frac{x_{1,ss}}{y_{ss}}\frac{1}{\gamma}\frac{x_1(p_1)}{x_{1,ss}} + \frac{1-\beta}{\beta}\frac{y(p_1)}{y_{ss}}}\\ &= \frac{1-\alpha_1}{a+\alpha_1}\frac{[(1+t)/(1+t_{ss})]^{\frac{1-\beta}{\beta}}}{\frac{1}{\gamma}\frac{x_{1,ss}}{y_{1,ss}}[(1+t)/(1+t_{ss})]^{\frac{1}{\gamma}} + \frac{1-\beta}{\beta}[(1+t)/(1+t_{ss})]^{\frac{1-\beta}{\beta}}}\end{aligned} \tag{46}$$

and the welfare component related to industry 1, θ, is

$$\begin{aligned}\theta =& \beta p_{1,ss}y_{ss}(\frac{1+t}{1+t_{ss}})^{\frac{1}{\beta}} + \frac{t_{ss}(1+t)}{t(1+t_{ss})}p_{1,ss}x_{1,ss}(\frac{1+t}{1+t_{ss}})^{\frac{1-\gamma}{\gamma}}\\ &- \frac{t_{ss}(1+t)}{t(1+t_{ss})}p_{1,ss}y_{ss}(\frac{1+t}{1+t_{ss}})^{\frac{1}{\beta}} + \frac{\gamma}{1-\gamma}p_{1,ss}x_{1,ss}(\frac{1+t}{1+t_{ss}})^{\frac{\gamma-1}{\gamma}}.\end{aligned} \tag{47}$$

Since what matters is the relative welfare to the initial equilibrium, without loss of generality,

Figure 5: Tariff t as a Function of Politicians' Weight a on Social Welfare



Note: this figure displays the relationship between politicians' weight on social welfare and equilibrium tariff in the calibrated numerical example.

we set $p_{1,ss}y_{ss} = 1$.

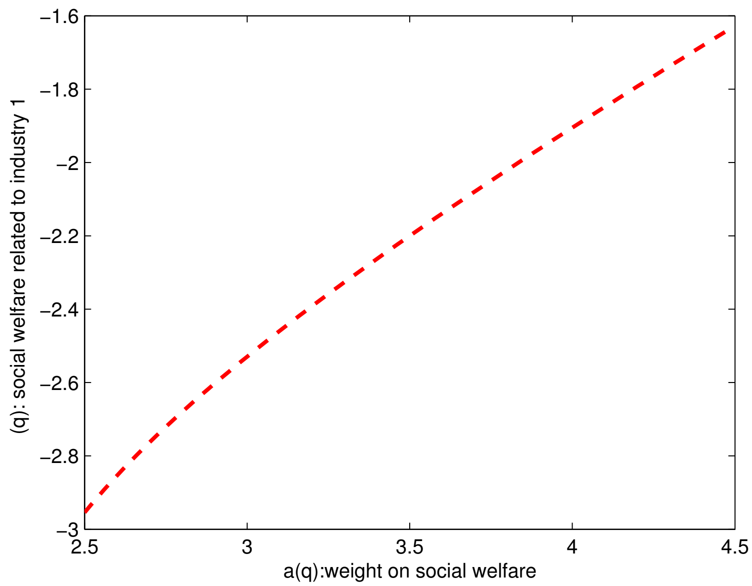
A.1.2 Numerical Results

We obtain numerical results using equations (46) and (47). Figure 5 shows the relationship between politicians' weight a on social welfare and equilibrium tariff t. It is a decreasing function: an increase in the weight a will decrease equilibrium tariff t, i.e., less protection. Figure 6 displays the relationship between politicians' weight a on social welfare and the social welfare component related to industry 1 θ. It shows that the social welfare is increasing in the weight a. This result is intuitive: the socially optimal tariff is 0, so when equilibrium tariff approaches 0, social welfare goes up.

A.2 Median Voters' Choice of Institutional Quality

Consider an extreme case when the median voter owns no specific factor in the import-competing industry. The median voters' choice of institutional quality will be based on these

Figure 6: Import-Competing Industry Related Social Welfare θ as a Function of Politicians' Weight a on Social Welfare



Note: this figure displays the relationship between politicians' weight on social welfare and import-competing industry (industry 1) related social welfare in the calibrated numerical example.

workers' preference. Her indirect utility is

$$c + r(p_1) + s_1(p_1) + \lambda_2(q) + s_2(q) - \phi(q). \tag{48}$$

Note that firms' profit in industry 1 no longer enters into their utility. Denote $\omega(p_1) = r(p_1) + s_1(p_1)$. Since

$$\omega(p_1) = (p_1 - p_1^*)[x_1(p_1) - y(p_1)] + u(x_1(p_1)) - p_1 x_1(p_1),$$

we have the first order derivative

$$\begin{aligned} \omega'(p_1) &= x_1(p_1) - y(p_1) + (p_1 - p_1^*)[x_1'(p_1) - y'(p_1)] + u'(x_1(p_1))x_1'(p_1) - x_1(p_1) - p_1 x_1'(p_1) \\ &= -y(p_1) + (p_1 - p_1^*)[x_1'(p_1) - y'(p_1)] < 0. \end{aligned} \tag{49}$$

Furthermore,

$$\frac{d\omega}{dq} = \omega'(p_1)\frac{dp_1}{da}a'(q) > 0.$$

Use $\Omega(q)$ to denote that workers' welfare related to industry 1 as a function of institutional quality q. So $\Omega'(q) > 0$.

Then for any scenario with the median voter owning less than the per capita level of the specific factor, the indirect utility $F(q)$ is a linear combination of $\Theta(q)$ and $\Omega(q)$, which is going to be increasing in institutional quality as well since both $\Theta'(q) > 0$ and $\Omega'(q) > 0$.

The equilibrium institutional quality is then given by

$$\max_q c + F(q) + \lambda_2(q) + s_2(q) - \phi(q)$$

It is easy to follow discussions on equation (30) in the main text and draw conclusions as exhibited in Proposition 1, 2 and 3.

A.3 The Role of Import Trade Cost

In our baseline model, we have deliberately ignored the role of import trade cost to facilitate the theoretical derivations. We now introduce import trade cost in industry 1. This is relevant: (1) When we consider the role of geography (parameter d in the model) since geography affects not only export trade cost but also import trade cost; (2) institutional quality can also have an impact on import transaction cost. When home country is geographically nearer to the rest of the world, one can think that the world price p_1^* is smaller as the iceberg cost to import is lower. Moreover, institutional quality's impact on import trade cost is denoted as $h_m(q) \geq 1$. Our objective is to figure out how a drop in p_1^* will have an impact on the marginal value of social welfare with respect to institutional quality q.

We now write the welfare component related to industry 1, θ, as a function of both trade policy p_1, the world price p_1^* and institutional quality: $\theta(p_1, p_1^*, q)$.

$$\begin{aligned}\theta(p_1, p_1^*, q) &= \lambda_1(p_1) + r(p_1) + s_1(p_1)\\ &= \lambda_1(p_1) + [p_1 - p_1^* h_m(q)] * [x_1(p_1) - y(p_1)] + u(x_1(p_1)) - p_1 x_1(p_1).\end{aligned} \tag{50}$$

Here

$$x_1(p_1) = u^{'-1}(p_1)$$

$$y(p_1) = \lambda_1'(p_1).$$

$$u'(x_1) = p_1.$$

Note that trade policy p_1 is a function of institutional quality q and world price p_1^*. We can write $\Phi(q, p_1^*) = \theta(p_1(q, p_1^*), p_1^*, q)$.

Notice that

$$\frac{\partial \theta}{\partial p_1} = [p_1 - p_1^* h_m(q)][x_1'(p_1) - y'(p_1)],$$

and

$$\frac{\partial \theta}{\partial p_1^*} = -h_m(q)[x_1(p_1) - y(p_1)].$$

Therefore,

$$\frac{\partial \Phi}{\partial p_1^*} = [p_1 - p_1^* h_m(q)][x_1'(p_1) - y'(p_1)]\frac{\partial p_1}{\partial p_1^*} - h_m(q)[x_1(p_1) - y(p_1)], \tag{51}$$

where

$$p_1 = p_1^*(1+t)h_m(q).$$

Then we obtain that

$$\begin{aligned}\frac{\partial^2 \Phi}{\partial p_1^* \partial q} &= \left\{[x_1'(p_1) - y'(p_1)]\frac{dp_1}{dp_1^*} + [p_1 - p_1^* h_m(q)][x_1''(p_1) - y''(p_1)]\frac{dp_1}{dp_1^*}\right\}\frac{dp_1}{dq}\\ &+ [p_1 - p_1^* h_m(q)][x_1'(p_1) - y'(p_1)]\frac{\partial^2 p_1}{\partial p_1^* \partial q} - h_m(q)[x_1'(p_1) - y'(p_1)]\frac{dp_1}{dq}\\ &- p_1^* h_m'(q)[x_1'(p_1) - y'(p_1)]\frac{dp_1}{dp_1^*} - h_m'(q)[x_1(p_1) - y(p_1)]\end{aligned} \tag{52}$$

where

$$t = \frac{1-\alpha_1}{a(q)+\alpha_1}\frac{y(p_1)}{-p_1^* h_m(q) m'(p_1)}.$$

If $\frac{\partial^2 \Phi}{\partial p_1^* \partial q} < 0$, then a drop in natural barriers (a drop in p_1^*) will increase the marginal benefit of improving institutional quality. As a result, the equilibrium institutional quality q will increase when natural barriers fall.

For $\frac{\partial^2 \Phi}{\partial p_1^* \partial q}$, the first three terms represent the channels that p_1^* and q affect welfare indirectly through p_1 in the expression of θ, since

$$\left\{[x_1'(p_1) - y'(p_1)]\frac{dp_1}{dp_1^*} + [p_1 - p_1^* h_m(q)][x_1''(p_1) - y''(p_1)]\frac{dp_1}{dp_1^*}\right\}\frac{dp_1}{dq}$$
$$+ [p_1 - p_1^* h_m(q)][x_1'(p_1) - y'(p_1)]\frac{\partial^2 p_1}{\partial p_1^* \partial q} = \partial\left\{\frac{\partial\theta}{\partial p_1}\frac{\partial p_1}{\partial q}\right\}/\partial p_1^*.$$

Intuitively, after tariff import price p_1 drops, social welfare increases. Institutional quality q increases tend to reduce p_1. What we want is that when natural barriers p_1^* drops, the sensitivity of social welfare with respect to q becomes larger. In extreme case, when p_1^* approaches infinity, foreign goods become irrelevant for domestic social welfare. The similar intuition shows up in the export side, which is why we can arrive at the three propositions in the main text.

The remaining terms of $\frac{\partial^2 \Phi}{\partial p_1^* \partial q}$ reflect the channels that p_1^* and q affect welfare directly. Some discussions are still useful even if an analytical derivation of the complete sufficient conditions is not feasible, given the complicated structure of $\frac{\partial^2 \Phi}{\partial p_1^* \partial q}$. Note that $\frac{dp_1}{dq} = p_1^*(1 + t)h_m'(q) + p_1^* \frac{\partial(1+t)}{\partial q} h_m(q)$. When q goes up, import tariff in general drops due to smaller incentive of politicians' in protecting domestic firms' sales. Therefore, if $h_m'(q)$ is very small, then the last three terms in equation (52) will be negative.

In any case, we use a calibrated exercise to show that the plausible sign of $\frac{\partial^2 \Phi}{\partial p_1^* \partial q}$ is indeed negative. We use the information in our calibration in Appendix A.1: consumption demand and domestic supply functions are given by $x_1(p_1) = p_1^{-\frac{1}{\gamma}}$ and $y(p_1) = A_1 p_1^{\frac{1-\beta}{\beta}}$. We normalize $p_1 = 1$, then $A_1 = output/consumption = y/x_1 = 1/1.9$.

We specify additional parametric assumptions. The transaction cost related to institutional quality q is set as $\log h_m(q) = \pi_m * q$, which is a linear approximation. Table 14 gives an estimate of how institutional quality affects international trade. In Column (4), a PPML exercise with institutional quality instrumented by legal origin is presented. It gives a point estimate of 0.337 for importers so that an importer's import value will increase by 33.7% if its institutional quality measure increases by 1 point or

$$\frac{\partial \log \text{import m}}{\partial q} = 0.337.$$

Since

$$\frac{\partial \log \text{import m}}{\partial q} = \frac{\partial \log \text{import m}}{\partial \log p_1}\frac{\partial \log p_1}{\partial q} = \frac{\partial \log(x_1(p_1) - y(p_1))}{\partial \log p_1}\pi_m.$$

With the functional forms of x_1, y and parameter values $\gamma = 2$, $\beta = 0.7$, we get $\pi_m = -0.220$.

Our equilibrium tariff formula is

$$t = \omega + \frac{1-\alpha_1}{a(a)+\alpha_1} * \frac{y/[m/(1+t)]}{e}.$$

In our empirical strategy, we follow Broda, Limao and Weinstein (2008) such that the market power enters into the tariff in the following way

$$t = \beta_\omega \log \omega + \frac{1-\alpha_1}{a(a)+\alpha_1} * \frac{y/[m/(1+t)]}{e}.$$

We do a first-order expansion to get $t = \beta_\omega \log \omega + (\pi_a q + c_a) * \frac{y/[m/(1+t)]}{e}$. Table 17 shows regressions that identify β_ω, π_a and c_a. However, there will be over-identification given that we also have average tariff data from the data. Realizing that there could be substantial measurement errors on import demand elasticity and institutional quality, we don't directly use the estimates on π_a, which is the coefficient before the interaction of the two variables, both with potential measurement errors. We set $c_a = 17.787$, $\beta_\omega = 0.994$ and import tariff t=0.21. The average $log(\omega)$ across industries in Malaysia is 4.50. This approach gives $\pi_a = -1.617$. It is negative and at the same order of the point estimate in column (4) of Table 17. The calibration shows $\frac{\partial^2 \Phi}{\partial p_1^* \partial q} < 0$. Therefore, a fall in natural barriers p_1^* will increase equilibrium institutional quality.

Finally, we point out that $\frac{\partial^2 \Phi}{\partial p_1^* \partial q} < 0$ (i.e., $\frac{\partial^2 \Phi}{\partial d \partial q} < 0$) offers a sufficient condition, but not a necessary condition since in equation (30), the first term (the export-related welfare component's first derivative with respect to q) already increases when natural barriers fall. What our theory needs is that the left hand side increases when natural barriers fall, i.e., $\frac{\partial^2 \Phi}{\partial d \partial q} + \frac{\partial^2 \lambda_2}{\partial d \partial q} < 0$, where $\frac{\partial^2 \lambda_2}{\partial d \partial q} < 0$ has been analytically proved.

A.4 Economies in the Cross-Sectional Exercise

Table 12: List of Economies in the Cross-Sectional Exercise

Albania	Hong Kong, China	Oman
Argentina	Honduras	Pakistan
Australia	Hungary	Panama
Burkina Faso	Indonesia	Peru
Bangladesh	India	Philippines
Belarus	Israel	Poland
Bolivia	Jamaica	Paraguay
Brazil	Japan	Romania
Bhutan	Kazakhstan	Russian Federation
Central African Rep	Kenya	Rwanda
Canada	Kyrgyzstan	Saudi Arabia
Switzerland	Korea, Rep	Sudan
Chile	Libyan Arab Jamahiriya	Singapore
China	Sri Lanka	El Salvador
Cote d'Ivoire	Lithuania	Chad
Cameroon	Latvia	Togo
Congo	Morocco	Thailand
Colombia	Moldova, Rep	Trinidad and Tobago
Costa Rica	Madagascar	Tunisia
Cuba	Mexico	Turkey
Cyprus	Mali	Tanzania
Czech Rep	Myanmar	Uganda
Dominican Rep	Mozambique	Ukraine
Algeria	Mauritius	Uruguay
Ecuador	Malawi	United States
Egypt	Malaysia	Venezuela
Estonia	Nigeria	Viet Nam
Gabon	Nicaragua	South Africa
Ghana	Norway	Zambia
Guatemala	Nepal	Zimbabwe
Guyana	New Zealand	

A.5 Economies (among Table 12 in Appendix A.4) with Changes in Borders between 1975 and 2005

Belarus: dissolution of the Soviet Union in 1991
Czechia: dissolution of Czechoslovakia in 1993
Estonia: dissolution of the Soviet Union in 1991
Indonesia: East Timor independence from Indonesia in 1999
Kazakhstan: dissolution of the Soviet Union in 1991
Kyrgyzstan: dissolution of the Soviet Union in 1991
Latvia: dissolution of the Soviet Union in 1991
Lithuania: dissolution of the Soviet Union in 1991
Moldova: dissolution of the Soviet Union in 1991
Russia: dissolution of the Soviet Union in 1991
South Africa: Namibia independence from South Africa in 1990
Ukraine: dissolution of the Soviet Union in 1991
Zimbabwe: independence in 1980

A.6 Estimating Foreign Supply Elasticities and Import Demand Elasticities

Our estimation procedures are guided by the Feenstra-Broda-Weinstein approach as in Broda, Limao and Weinstein (2008). The methodology is developed in the seminal work by Feenstra (1994) and subsequently improved by Broda and Weinstein (2006).

Our import data draws from UN COMTRADE from 1992-2003 for all the 92 economies used in our cross sectional evidence at six-digit 1992 HS classifications upon availability. Our data sample is significantly larger than that in Broda, Limao and Weinstein (2008). It will enable us to extend discussions well beyond non-WTO members.

We introduce more notations. We define a good g as a four-digit HS (HS4) category. For any country i, a variety v is six-digit HS (HS6) product from a particular exporter country. Our objective is to obtain its inverse export supply elasticity $\omega_{ig} > 0$ and another parameter $\sigma_{ig} > 1$, the import demand elasticities. p_{igvt} denotes the unit price of country i's import of good g at a variety v in year t. q_{igvt} is the corresponding quantity. m_{igvt} is the corresponding import value in U.S. dollars. Import share $s_{igvt} = \frac{m_{igvt}}{\sum_{v \in I_{igt}} m_{igvt}}$. Here I_{igt} is the set of varieties that country i import of good g in year t.

The estimation methodology employs the following demand and supply systems

$$\Delta^{k_{ig}} \ln s_{igvt} = -(\sigma_{ig} - 1)\Delta^{k_{ig}} \ln p_{igvt} + \epsilon_{igvt}^{k_{ig}}; \tag{53}$$

$$\Delta^{k_{ig}} \ln p_{igvt} = \frac{\omega_{ig}}{1+\omega_{ig}}\Delta^{k_{ig}} \ln s_{igvt} + \delta_{igvt}^{k_{ig}}. \tag{54}$$

where $\Delta^{k_{ig}} = \Delta x_{igvt} - \Delta x_{igk_{ig}t}$, $\epsilon_{igvt}^{k_{ig}}$ includes demand shocks and δ_{igvt} represents shocks to the residual export supply. Broda and Weinstein (2006) extend Feenstra (1994) and reach the following empirical relationship that is ready to be estimated

$$\bar{Y}_{igv} = \chi_{ig}\left[\frac{1}{T}\sum_t(\frac{1}{q_{igvt}} + \frac{1}{q_{igv,t-1}})\right] + \theta_{ig1}\bar{X}_{1,igv} + \theta_{ig2}\bar{X}_{2,igv} + \bar{u}_{igv}. \tag{55}$$

where $Y_{igvt} = (\Delta \ln p_{igvt} - \Delta \ln p_{igk_{ig}t})^2$, $X_{1,igvt} = (\Delta \ln s_{igvt} - \Delta \ln s_{igk_{ig}t})^2$, $X_{2,igvt} = ((\Delta \ln p_{igvt} - \Delta \ln p_{igk_{ig}t})(\Delta \ln s_{igvt} - \Delta \ln s_{igk_{ig}t}))$. Here Δ denotes time different. The bars on top of these variables denote their time averages (thus subscript t is dropped). k_{ig} is a benchmark variety to be discussed later. T is the total periods of data for igv minus 1. Assumption on the error term is $E_v[\bar{u}_{igv}] = 0$.

After obtaining estimates of θ_{ig1} and θ_{ig2} (and also χ_{ig}), we can back out $\omega_{ig} > 0$ and $\sigma_{ig} > 1$ using the following equations

$$\theta_{ig1} = \frac{\omega_{ig}}{(1+\omega_{ig})(\sigma_{ig}-1)}; \tag{56}$$

$$\theta_{ig2} = \frac{\omega_{ig}(\sigma_{ig}-2)-1}{(1+\omega_{ig})(\sigma_{ig}-1)}. \tag{57}$$

Denote $\beta_{ig} = (\sigma_{ig}, \omega_{ig})'$ and $G(\beta_{ig}) = E_t[u_{igvt}(\beta_{ig})] = 0$. To estimate equation (55), at least four varieties (≥ 4) are needed for a good g of country i in order to do the following GMM estimation

$$\hat{\beta}_{ig} = arg \min_{\beta_{ig}\in B} G^*(\beta_{ig})WG^*(\beta_{ig}), \tag{58}$$

where $G^*(\beta_{ig})$ is the sample analogy of $G(\beta_{ig})$, and set B means $\{\omega_{ig} > 0, \sigma_{ig} > 1\}$. Weight matrix W is to be discussed later.

It is possible that the GMM estimation procedure returns imaginary estimates or estimates of σ_{ig} and ω_{ig}, which are not in the set B. In this case, we do a grid search procedure in set B. For computational easiness, instead of search over $(\sigma_{ig} > 1, \omega_{ig} > 0)$, we search over (σ_{ig}, ρ_{ig}), where $\rho_{ig} = \frac{\omega_{ig}(\sigma_{ig}-1)}{1+\sigma_{ig}\omega_{ig}}$ (hence $\omega_{ig} = \frac{\rho_{ig}}{(\sigma_{ig}(1-\rho_{ig})-1)}$).

For grids of σ_{ig}, we let it fall into the interval $[1.05, 131.5]$ and grids are 5 percent (0.05) apart. For grids of ρ_{ig}, we let $\rho_{ig} \in [0.01, 1]$ at intervals 0.01 apart. To ensure that $\omega_{ig} > 0$, we also restrict to grids that satisfy $\rho_{ig} < \frac{\sigma_{ig}-1}{\sigma_{ig}}$.

We choose the benchmark variety k_{ig} using the following way. Given a country i, suppose that their import data is available for some years. First, within g, pick up a set of varieties that are available for the largest number of years. Within these varieties, select the variety that has total export value to country i is the largest.

The weight matrix W is derived in the Appendix of Broda and Weinstein (2006) to take into account measurement errors in the trade data. Elements $w_{igv} = T^3 \sum_t (\frac{1}{q_{igvt}} + \frac{1}{q_{igv,t-1}})^{-1}$.

A.7 Additional Tables and Figures

Table 13: Market Power and Country Size

	(1)	(2)
Dependent variable:	log(1/export elasticity)	log(1/export elasticity)
log(population)	0.051	0.054
	(0.081)	(0.080)
remoteness	0.353*	0.323
	(0.210)	(0.217)
coastline length/area	0.020	0.021
	(0.455)	(0.462)
landlock dummy	0.549**	0.528**
	(0.248)	(0.262)
OECD dummy		-0.158
		(0.258)
Industry Fixed Effects	Y	Y
Observations	50123	50123
R^2	0.066	0.066

Standard errors clustered at country level in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Notes: this table reports the relationship between market size, geography and market power. Industry is defined as the section classification of HS code.

Table 14: Gravity Equation with Institutional Quality without Importer/Exporter Fixed Effects

	(1) OLS	(2) OLS	(3) OLS IV	(4) PPML IV
Dependent variable:	log($export_{ij}$)	log($export_{ij}$)	log($export_{ij}$)	$export_{ij}$
log(GDP_i)	1.176***	1.152***	-0.129	0.301**
	(0.010)	(0.020)	(0.310)	(0.144)
log(GDP_j)	0.957***	0.873***	0.595**	0.035
	(0.010)	(0.019)	(0.284)	(0.128)
log($distance_{ij}$)	-1.360***	-1.251***	-1.060***	-0.501***
	(0.022)	(0.023)	(0.045)	(0.050)
log($population_i$)		0.037	1.423***	0.540***
		(0.023)	(0.335)	(0.160)
log($population_j$)		0.087***	0.389	0.856***
		(0.023)	(0.306)	(0.157)
landlock $dummy_i$		-0.001	-0.460***	-0.504***
		(0.055)	(0.116)	(0.097)
landlock $dummy_j$		-0.502***	-0.628***	-0.356***
		(0.054)	(0.132)	(0.102)
coastline length/$area_i$		1.022***	0.548***	2.110***
		(0.167)	(0.197)	(0.220)
coastline length/$area_j$		0.871***	0.747***	2.237***
		(0.139)	(0.192)	(0.228)
q_i	0.019***	0.024***	0.629***	0.218***
	(0.005)	(0.007)	(0.143)	(0.064)
q_j	0.002	0.025***	0.164	0.337***
	(0.005)	(0.007)	(0.131)	(0.065)
contiguous$_{ij}$		1.177***	1.664***	0.994***
		(0.109)	(0.172)	(0.154)
common language$_{ij}$		0.703***	0.870***	0.309**
		(0.053)	(0.079)	(0.120)
hisotircal colonial $link_{ij}$		0.994***	0.474***	-0.297**
		(0.111)	(0.174)	(0.132)
Observations	12890	12686	12394	16002
R^2	0.675	0.696	0.517	

Robust standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Notes: In column (3) and (4), we use legal origin (common law dummy) to instrument institutional quality. The international trade data is taken from UNCTAD in 1997. Quality of institutions is measured the same way as in our empirical sections, which are the sum of expropriation risk (investment profile), corruption control and law and order from the Political Risk Group. $export_{ij}$ is export from country i to country j.

Table 15: Gravity Equation with Institutional Quality with Importer/Exporter Fixed Effects

	(1)	(2)	(3)	(4)
	OLS	PPML	OLS	PPML
	IV	IV	IV	IV
Dependent variable:	log($export_{ij}$)	$export_{ij}$	log($export_{ij}$)	$export_{ij}$
log(GDP$_i$)	-0.263	-0.407**		
	(0.282)	(0.194)		
log(GDP$_j$)			0.092	-0.898***
			(0.208)	(0.193)
log(distance$_{ij}$)	-1.123***	-0.520***	-1.267***	-0.407***
	(0.049)	(0.054)	(0.039)	(0.052)
log(population$_i$)	1.572***	1.327***		
	(0.306)	(0.203)		
log(population$_j$)			0.954***	1.851***
			(0.224)	(0.210)
landlock dummy$_i$	-0.539***	-1.005***		
	(0.110)	(0.136)		
landlock dummy$_j$			-0.852***	-1.065***
			(0.097)	(0.121)
coastline length/area$_i$	0.522***	1.298***		
	(0.191)	(0.227)		
coastline length/area$_j$			0.661***	0.965***
			(0.149)	(0.145)
q_i	0.690***	0.590***		
	(0.131)	(0.093)		
q_j			0.397***	0.808***
			(0.097)	(0.095)
contiguous$_{ij}$	1.595***	1.258***	1.172***	1.462***
	(0.172)	(0.137)	(0.143)	(0.129)
common language$_{ij}$	0.860***	0.558***	0.856***	0.642***
	(0.082)	(0.074)	(0.068)	(0.071)
hisotircal colonial link$_{ij}$	0.376**	-0.732***	0.825***	-0.885***
	(0.178)	(0.137)	(0.146)	(0.141)
Importer FE	Y	Y	N	N
Exporter FE	N	N	Y	Y
Observations	12847	16638	12828	16638
R^2	0.372		0.493	

Robust standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Notes: In column (3) and (4), we use legal origin (common law dummy) to instrument institutional quality. The international trade data is taken from UNCTAD in 1997. Quality of institutions is measured the same way as in our empirical sections, which are the sum of expropriation risk (investment profile), corruption control and law and order from the Political Risk Group. $export_{ij}$ is export from country i to country j.

Table 16: Natural Barriers and Import Tariff: Product Level 2001-2003

	(1)	(2)	(3)	(4)
Dependent variable: import tariff				
log(population)	0.799**	0.797**	0.968**	0.861**
	(0.396)	(0.396)	(0.434)	(0.408)
remoteness	2.893***	2.873***	3.758**	4.230***
	(1.098)	(1.097)	(1.452)	(1.153)
coastline length/area	-14.353***	-14.367***	-12.352***	-14.878***
	(3.916)	(3.917)	(3.612)	(2.593)
landlock dummy	0.158	0.170	0.976	0.472
	(0.967)	(0.967)	(1.175)	(1.192)
log(1/export elasticity)			0.090**	0.075**
			(0.035)	(0.035)
residual log(GDP per capita)				-1.760***
				(0.361)
Industry Fixed Effects	N	Y	Y	Y
Observations	127473	127473	50578	50578
R^2	0.059	0.140	0.179	0.238

Standard errors clustered at country level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: this table reports the product level (HS4) relationship between natural barriers and import tariff using 2001-2003 average import tariff data. Industry is defined as the section classification of HS code.

Table 17: Institutional Quality and Import Tariff

	(1) OLS	(2) OLS	(3) IV	(4) IV
Dependent variable: import tariff				
institution*$\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$	-0.257***	-0.224***	-0.894***	-1.063***
	(0.020)	(0.029)	(0.075)	(0.114)
$\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$	5.223***	4.803***	16.281***	17.787***
	(0.334)	(0.420)	(0.979)	(1.314)
log(1/export elasticity)	0.192***	0.231***	0.698*	0.994***
	(0.052)	(0.054)	(0.389)	(0.335)
institution*$\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$*OECD		-0.018		0.133***
		(0.012)		(0.048)
$\frac{\text{Output-Import Ratio}}{\text{Import Demand Elasticity}}$*OECD		-0.007		0.247
		(0.008)		(0.160)
log(1/export elasticity)*OECD		-0.468***		-0.620***
		(0.064)		(0.173)
residual log(GDP per capita)	-2.665***	-2.446***	-1.849***	-2.016***
	(0.124)	(0.132)	(0.319)	(0.301)
Industry FE	Y	Y	Y	Y
Observations	4202	4202	4202	4202
R^2	0.286	0.291	-0.104	-0.138

Standard errors clustered at country level in parentheses.

${}^{*}p < 0.10$, ${}^{**}p < 0.05$, ${}^{***}p < 0.01$

Notes: Column (1) and (2) are OLS regressions, and Column (3) and (4) are IV regressions, where institutional quality is instrumented by log(population), remoteness and coastline length/area. Industry is defined at the ISIC 2-digit level. Quality of institutions is measured by the sum of expropriation risk (investment profile), corruption control and law and order from the Political Risk Group.

Table 18: Natural Barriers, Market Power and Import Tariff: Dropping Countries with Border Change after 1975

	(1)	(2)	(3)	(4)
Dependent Variable: import tariff				
log(population)	1.246**	1.254**	0.862	1.163**
	(0.573)	(0.573)	(0.525)	(0.577)
remoteness	3.441**	3.416**	4.135***	2.741
	(1.561)	(1.565)	(1.375)	(2.119)
coastline length/area	-16.768***	-16.735***	-18.698***	-17.719***
	(4.037)	(4.038)	(3.175)	(3.187)
landlock dummy	0.075	0.107	0.000	
	(1.782)	(1.782)	(2.119)	
log(1/export elasticity)			0.091	0.098
			(0.071)	(0.075)
log(population)*OECD				-1.260**
				(0.614)
remoteness*OECD				-0.066
				(2.061)
coastline length/area*OECD				5.751
				(11.732)
landlock dummy*OECD				
log(1/export elasticity)*OECD				-0.080
				(0.078)
OECD dummy				17.960
				(20.678)
residual log(GDP per capita)	-2.657***	-2.648***	-2.936***	-2.320***
	(0.574)	(0.574)	(0.500)	(0.588)
Industry Fixed Effect	N	Y	Y	Y
No. of countries	78	78	74	74
Observations	76657	76657	44023	44023
R^2	0.157	0.224	0.283	0.296

Standard errors clustered at country level in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the relationship between natural barriers' measures and the country-product (HS 4-digit) import tariff, after dropping countries with border changes between 1975 and 2005.

Table 19: Population, Geography and Export/Institutional Quality

	(1)	(2)	(3)	(4)
Panel A Dependent Variable: log(export/GDP)				
	full sample		subsample with tariff data available	
log(population)	-0.174***	-0.174***	-0.207***	-0.205***
	(0.031)	(0.033)	(0.036)	(0.039)
remoteness	-0.226**	-0.240**	-0.262**	-0.266**
	(0.099)	(0.109)	(0.130)	(0.132)
coastline length/area	1.725***	1.756***	1.789***	1.828***
	(0.386)	(0.350)	(0.469)	(0.455)
landlock dummy	-0.043	-0.045	-0.154	-0.137
	(0.115)	(0.110)	(0.140)	(0.140)
residual log(GDP per capita)		0.083**		0.039
		(0.039)		(0.052)
Observations	130	128	90	90
R^2	0.310	0.339	0.383	0.388
Panel B-1 Dependent Variable: institutional quality from Political Risk Index				
	full sample		subsample with tariff data available	
log(population)	-0.549***	-0.490***	-0.590**	-0.423**
	(0.201)	(0.163)	(0.231)	(0.182)
remoteness	-4.211***	-4.121***	-3.566***	-3.737***
	(0.999)	(0.719)	(1.152)	(0.802)
coastline length/area	9.508***	10.191***	9.262**	10.745***
	(3.323)	(1.497)	(3.611)	(1.974)
landlock dummy	-0.312	-0.648	-0.845	-0.705
	(0.900)	(0.836)	(1.103)	(1.122)
residual log(GDP per capita)		1.735***		1.588***
		(0.221)		(0.275)
Observations	114	110	85	84
R^2	0.294	0.595	0.262	0.516
Panel B-2 Dependent Variable: institutional quality from Transparency International				
	full sample		subsample with tariff data available	
log(population)	-0.219**	-0.148*	-0.272**	-0.146*
	(0.110)	(0.076)	(0.126)	(0.087)
remoteness	-1.374**	-1.571***	-1.282*	-1.438***
	(0.586)	(0.329)	(0.677)	(0.366)
coastline length/area	7.151***	7.719***	6.596***	7.853***
	(2.218)	(0.999)	(2.198)	(1.171)
landlock dummy	-0.437	-0.669**	-0.705	-0.574*
	(0.424)	(0.295)	(0.431)	(0.340)
residual log(GDP per capita)		1.141***		1.092***
		(0.115)		(0.142)
Observations	111	108	83	82
R^2	0.248	0.701	0.266	0.677

Robust standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the relationship between natural barriers' measures and trade openness and institutional quality. Panel B1 uses institutional quality measure from the Political Risk Index, which is the sum of expropriation risk, corruption control and law and order, averaged between 2001-2003. Panel B2 uses institutional quality measure from the Transparency International, which is the corruption perception index, averaged between 2001-2003.