International Spillovers of Quality Regulations*

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March 2024

Abstract

This paper investigates the positive international spillover effects of non-discriminatory product regulations, such as quality standards. We incorporate regulations into a multi-country general equilibrium framework with firm heterogeneity and variable markups. We model regulations as a fixed cost that any firm selling to an economy must pay, consistent with stylized facts that we present. We demonstrate that in the presence of variable markups, the fixed cost generates a positive spillover on the rest of the world as it induces entry of high-quality firms, and it improves the terms of trade of the non-imposing countries. We argue that the benefits of such regulations are not fully realized under non-cooperative policy settings, leading to a call for international cooperation in setting regulations. We estimate our model to quantify the effects of regulations on consumers' welfare, the extent of the positive externalities across countries, the relative importance of the entry of high-quality firms and of the terms of trade effect of regulations, and the value of cooperation.

Keywords: Allocative Efficiency, International Spillover, Quality Standards, Variable Markups, Trade Policy.

JEL Code: F12, F13, L11.

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*We thank Alessia Campolmi, Dave Donaldson, Devaki Ghose, Gene Grossman, Dirk Krueger, Sergey Nigai, Mathieu Parenti, Michael Waugh, Mingzhi Xu, and two anonymous referees for comments and feedback. We also thank seminar participants at Aarhus University, ETSG 2019, NØF Conference 2020, NOITS 2020, ITSG 2020, CESIfo Conference, The World Bank, Inter-American Development Bank, LACEA 2021 Meetings, WAITS 2021, Armenian Economic Association Annual Meeting 2022, 14th FIW Research Conference, Royal Economic Society Annual Conference 2022, Aix-Marseille, BATmodel international workshop 2022, EEA Annual Congress 2022, West Coast Trade Workshop 2023, European University Institute and The Vienna Institute for International Economic Studies webinar series in International Economics, and USITC Economics Seminar.

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1 Introduction

Governments grapple with a balancing act in implementing regulations for product characteristics: addressing *domestic* externalities, such as those caused by unsafe products, while also considering interdependency with trade partners. Even if regulations are aimed at domestic consumption, their implementation has ramifications across the distribution of firms selling in that market, which are both domestic and foreign. As attention in trade policy has shifted to these types of "non-tariff" barriers, the literature has recognized possible international spillovers and their consequences for trade agreements. Mostly, it has identified mechanisms where regulations *negatively* affect trade partners. For example, regulations may result in delocation effects (Grossman et al., 2021) or serve as a veiled means to revive protectionist policies (Baldwin et al., 2000). Consequently, international cooperation on regulations has been driven by the desire to address beggar-thy-neighbor externalities, akin to the motivations behind agreements on tariffs (Bagwell and Staiger, 1999; Ossa, 2011). In this paper, we demonstrate that when non-discriminatory regulations impact the allocation of production across firms with varying demand elasticities, international cooperation is motivated by *positive* international spillovers. We quantify these positive international spillovers and show that they can lead to significant under-regulation.

Take, for example, regulations concerning the minimum residue levels (MRLs) of pesticides allowed in food products. Harmonizing these regulations is not necessarily possible given that the benefits and costs associated to the standards are country-specific. Still, under World Trade Organization (WTO) rules, MRLs are *non-discriminatory* and apply to all firms selling to an economy, regardless of their origin. Compliance with stricter MRLs necessitates the payment of a fixed production cost by all active firms in the market, which only the largest ones are able to bear (Ferro et al., 2015).[1] In this paper, we derive the conditions under which these regulations affect the welfare of trading partners and quantify the incentives for international cooperation on setting domestic regulations.

We analyze a multi-country model of international trade featuring firm heterogeneity, where firms differ in their product quality. Quality acts as a demand shifter, causing higher quality firms to experience greater demand at the same price. As a result, there is a direct relationship between product quality and firm sales (Kugler and Verhoogen, 2012). Product quality is linked to a *domestic consumption* externality, as in Mei (2023), where consumers do not fully internalize the welfare effects of higher product quality. Therefore, product quality represents attributes such as safety or healthiness. Returning to our earlier example, regulations on MRLs provide a positive health externality by reducing pesticide exposure, an effect not entirely internalized by consumers. Regulations are modeled as fixed labor requirements, with more stringent regulations corresponding to higher requirements, leading to the exit of low-quality firms unable to bear the regulatory costs. Consequently, our regulations represent vertical norms that enhance the consumption externality.

[1] One instance of the fixed cost generated by regulations is the expense associated with inspections. For instance, in order to export prosciutto from Italy to the US, Italian producers must fly in US inspectors that can certify the compliance to all US regulations.

We provide empirical evidence that motivates this modeling choice as we find that quality standards in trade act primarily as a fixed cost. We combine data from the NTM-MAP database, which contains information on product standards from 71 countries with information on firm export success from the Exporter Dynamics Database (EDD) (Fernandes et al., 2016). There are fewer exporters to destinations with higher number of regulations (extensive margin), but the average value per exporter (intensive margin) is not affected. This is in contrast to the traditional measures of variable trade costs, such as distance, where both margins decline with trade costs. While the result is also documented in Fontagné et al. (2015), Asprilla et al. (2019), and Augier et al. (2023), our analysis additionally reveals that richer and more closed destinations tend to apply stricter regulations.

Within our general theoretical framework, we initially examine the most prevalent case discussed in the literature: Constant Elasticity of Substitution (CES) preferences and monopolistic competition with free entry (Melitz, 2003). In this scenario, the optimal regulation is determined by balancing the social benefit of improving the domestic consumption externality with the costs associated with reduced product variety—due to the exit of low-quality firms—and the inefficiency of increased (fixed) compliance costs. Remarkably, given non-discriminatory regulations and a domestic consumption externality, there is no justification for international cooperation. In fact, if a country raises its fixed regulatory costs, the global allocation remains unaltered. The costs associated with the regulations are entirely borne by the customers in the imposing country. As a consequence of the regulation, some foreign exporters will exit the imposing country's market, freeing up resources to cover the higher fixed costs for the remaining firms that continue to export. This does not affect foreign domestic production nor exports to other countries.

We deviate from the knife-edge case of CES preferences by assuming Indirectly Additive (IA) preferences (Bertoletti and Etro, 2017), which feature variable demand elasticities and variable markups. Compared to the CES case, there are two notable differences. First, variable markups create a distortion in the market where high-quality firms under-produce relative to an efficient allocation due to their higher market power. Consequently, regulations can enhance welfare by increasing allocative efficiency (even without considering the domestic consumption externality, such as the health effects of pesticides, mentioned earlier). Second, we demonstrate that higher standards also improve the welfare of *trade partners*. This effect is driven by two mechanisms. First, regulations impact the relative wage, which reflects changes in the terms of trade (ToT). The fixed labor requirement of the regulations necessitates workers to be employed in this "wasteful" process and this causes output to decline. As the fixed cost affects *all* domestic firms and only foreign *exporters*, the relative wage in the imposing country decreases, which in turn benefits foreign consumers. Additionally, more stringent regulations in one country promote the entry of new (high-quality) firms from both the imposing *and* foreign countries. The increase in the number of firms results from the higher profitability of surviving firms, as larger firms earn higher markups.

When setting the optimal level of restrictiveness in a non-cooperative manner, a country fails to internalize the benefits experienced by foreign countries, which arise from the reduction in the imposing country's relative wage and the entry of new firms. The presence of this positive externality on foreign economies provides a rationale for international cooperation in setting regulations, as it is mutually beneficial for governments to coordinate policies. A cooperative equilibrium ensures higher welfare with increased levels of regulation.[2] This novel result contrasts with the beggar-thy-neighbor rationales that predominantly characterize trade policy (Gros, 1987; Ossa, 2011).

Our model can explain the variations in the restrictiveness of regulations across destination countries. Our findings indicate that larger countries, those with more efficient production technologies, and more closed economies, will optimally choose to implement more restrictive standards, as they can accommodate higher levels of fixed costs. These results are in line with our novel empirical evidence. For instance, this suggests that the European Union is likely to enforce stricter standards compared to Mexico. This outcome is significant because it occurs in the absence of protectionist motives or heterogeneity in preferences, which are plausible mechanisms for the result. For instance, in the model of Parenti and Vannoorenberghe (2022), countries set heterogeneous regulations because of differences in preferences over the consumption externality.

We conduct a quantitative exercise to estimate the current restrictiveness of regulations in the EDD sample of countries and answer the following questions. What are the welfare effects of setting optimal standards for imposing countries? How significant is the international spillover identified in the theory? What is the contribution of the ToT and the entry channels? How advantageous is cooperation? To achieve this, we use data on the distribution of firm-level export sales at the country-pair level, which allows us to estimate the level of restrictiveness imposed by destinations on individual trade partners. Then, we compute the global welfare response to counterfactual changes in regulations.

In most of our quantitative findings, we exclude the domestic consumption externality addressed by the regulation. Indeed, quantifying the extent of this externality is challenging without making arbitrary assumptions that could result in either large or low welfare benefits. Consequently, the primary welfare benefit for the imposing country in our quantitative analysis is the enhancement of allocative efficiency. Unilaterally set regulations tend to benefit less open countries, such as Colombia, while offering negligible welfare gains to more open countries like Costa Rica. To evaluate the international spillover effect to each country, we calculate the welfare change when all *other* countries impose their optimal regulations but the focal country does nothing. These spillovers are just over 25% of the size of the gains from a country imposing its own optimal standards. The spillover effects also exhibit substantial heterogeneity across countries. For example, in this counterfactual, Costa Rica receives the largest gains from other countries imposing standards and

[2] The result provides a theoretical justification for the continuous efforts from the WTO of improving the Technical Barriers to Trade Agreement, which has now reached the Eighth Triennial Review (see https://www.wto.org/english/tratop_e/tbt_e/tbt_triennial_reviews_e.htm). The logic is also similar to the justification of Trade-Related Aspects of Intellectual Property Rights (TRIPs), approved in the Uruguay Round, brought forward by Grossman and Lai (2004). In a manner akin to our regulations on product standards, safeguarding intellectual property leads to positive spillover effects for foreign countries, as they can also take advantage of the resulting increase in innovation. Consequently, the presence of this positive spillover serves as a driving force for cooperation, as also concluded in our model.

this is reversed in Colombia.

To quantify the drivers of our quantitative results, we examine the welfare gains by isolating the two channels responsible for the international spillover: ToT and entry. Eliminating the ToT channel reduces the size of the spillover by one-fifth. In comparison, this gain decreases by four-fifths when we shut off entry. Therefore, in terms of magnitudes, the entry channel has more substantial effects on the international spillover although both channels play a role.

Finally, we emphasize the substantial benefits achievable through cooperation when countries jointly set standards. We examine the realistic scenario of a "deep" trade agreement involving two countries, Chile and Ecuador, and compare their optimal standards and welfare under unilateral policy decisions versus a cooperative solution that maximizes aggregate welfare. Cooperation leads to higher optimal standards, which continue to differ between the two countries. Therefore, maximizing welfare does not necessitate harmonizing standards in both countries. Cooperation also results in increased welfare for both nations.

Related Literature. We relate to Grossman et al. (2021), who explore the efficiency of trade agreements in a context where countries exhibit heterogeneous preferences for regulations and firms incur fixed costs to cater to diverse tastes. They conclude that mutual recognition is essential to prevent countries from enforcing standards solely for the purpose of inducing firm relocation. We complement their approach in offering an alternative rationale for cooperation in implementing standards, rooted in positive international spillover effects as opposed to negative ones.

Our paper also complements Parenti and Vannoorenberghe (2022) in examining incentives for countries to cooperate when setting product standards. In their study, cooperation is optimal only within subsets of countries (regulatory blocs) that tend to harmonize their regulations with those of the most efficient exporter in the bloc. Our paper diverges from their approach as our regulations exclude low-quality firms from the domestic and foreign countries. Moreover, as the ToT and entry channels impact all trading partners, countries have incentives to cooperate with all nations, not just within blocs. It is worth noting that in Parenti and Vannoorenberghe (2022), firms from different origins incur different costs to sell to a destination with varying standards, depending on the regulatory distances between the origin and the destination. In contrast, our framework requires all firms to pay the same fixed cost to sell to a destination. However, we can draw a parallel to their work, as origin countries with a lower average quality perceive the same level of non-discriminatory fixed costs as more stringent.

This paper speaks to the expanding literature on product standards and regulations, which has explored various reasons for implementing standards.[3] These reasons include addressing negative externalities, such as environmental externalities (Parenti and Vannoorenberghe, 2022; Mei, 2023), mitigating informational asymmetries (Donnenfeld et al., 1985; Disdier et al., 2023; Macedoni,

[3] Swann et al. (1996) find that standards raise exports for UK firms. Chen and Mattoo (2008) find that trade flows increase with EU/EFTA harmonization and Schmidt and Steingress (2022) confirm the rise in export flows, at the intensive and extensive margin, across a broad set of standards and across countries. Mei and Xu (2023) examine the effects of horizontal norms by considering the case of electric plugs. The effects of regulations are widely examined in agricultural economics – for a review of the empirical findings in this literature see Santeramo and Lamonaca (2019).

2022), reducing oligopolists' market power (Baldwin et al., 2000), or enhancing quality upgrading (Gaigné and Larue, 2016a,b). Standards may also be employed as a form of murky protectionism (Baldwin and Evenett, 2009), as investigated by Fischer and Serra (2000) within an international duopoly context, or as a way to force relatively more foreign firms to exit (Rebeyrol, 2023). In our paper, we represent these motives through a domestic consumption externality and demonstrate how reallocating production across firms with variable market power generates a positive international spillover independent of that domestic externality. Thus, we connect the literature on regulations to the literature on trade policy with heterogeneous firms (Demidova and Rodriguez-Clare, 2009; Felbermayr et al., 2013; Demidova, 2017; Bagwell and Lee, 2020; Costinot et al., 2020).

As regulations in our framework improve allocative efficiency, our work also contributes to the findings of Campolmi et al. (2020) (CFF) and Lashkaripour and Lugovskyy (2023) (LL), which build on Bagwell and Staiger (2001). In these papers, industrial policies, namely subsidies, are utilized to correct for domestic distortions. CFF and LL show that in an imperfect competition context, including industrial policies in trade agreements allows for global gains, but only due to a ToT externality. Policies required to reduce misallocation also deteriorate the ToT. We find that this channel is also present in our setting, starting from a different policy rationale – to act on the domestic consumption externality. However, we also identify a second type of international spillover, driven by entry. In contrast to the aforementioned studies, misallocation is *across firms* within a sector, instead of across sectors. The firm-specific nature of the distortion allows for the second channel that drives cooperation. To connect to previous work on trade policy, in Section 3.6, we explore an expanded set of domestic instruments related to subsidies and identify the sufficient instruments necessary to reduce the scope of the international spillover as a result of regulations.

2 Stylized Facts on International Regulations

Regulations and Country Characteristics. We use the NTM-MAP database provided by CEPII, which contains destination-sector incidence indicators of non-tariff measures (NTMs), and is sourced from UNCTAD Trains (see Data Appendix A). As a mapping to our interpretation of *standards* in the theory, in this empirical application we construct an incidence of *technical measures* (TMs), which measures the prevalence of sanitary and phytosanitary standards (SPS) or technical barriers to trade (TBT) (Disdier et al., 2023). These types of regulations fit most closely with the regulations in the theory because they restrict the level of quality that can survive in a market. The data is cross-sectional and is provided for 71 countries (Gourdon, 2014) – made up of mostly middle-income and lower-income countries, with the EU countries as the exception.

First, we merge the NTM-MAP database with macroeconomic measures from the Penn World Table (PWT) 9.0, to investigate descriptive relationships. From the cross-sectional data, simple correlations show that richer, larger, more closed countries tend to impose more standards (for a scatter plot, see Figure A.1 in Appendix). For example, the correlation between GDP per capita and the prevalence of measures is 0.54.[4] The relationship is very similar if we restrict standards

[4]We also find that the correlation is (unsurprisingly) very strong with other indicators such as economic size,

to include only SPS, which are more likely to reflect vertical norms. These descriptive statistics are consistent with heterogeneity in regulatory preferences, as brought forward by Grossman et al. (2021) and Parenti and Vannoorenberghe (2022), and the relationships will also be present in our model, in which we show that stricter regulations are less costly for larger and richer countries and that the optimal restrictiveness of regulations interacts with trade openness. The following regression analysis more formally shows the relationship between standards and trade restrictiveness, and how country characteristics act as moderating factors.

Regulations and Trade Margins. To motivate the model in Section 3, we complement the existing literature on domestic regulations and market access (Fontagné et al., 2015; Fernandes et al., 2019; Ferro et al., 2015; Cali et al., 2022). This literature has relied on export flows to argue that exporters from a specific origin are less likely to sell to destinations that impose relatively more regulations. Fontagné et al. (2015) show that this effect is especially strong for small exporters using firm-level data for France. A rationalization of this is that regulations impose a fixed cost on firms that restricts mainly the extensive margin of exporting. Our theory leverages this mechanism to generate reallocation from low- to high-quality firms.

Using the EDD (Fernandes et al., 2016), we reproduce the fact that product regulations act on the extensive margin of trade, and extend it to study the differential effect of TMs across different types of destinations. The EDD is a dataset from the World Bank that draws on the universe of exporter transactions obtained directly from customs agencies. We use the HS2 level data, which reports the number of exporters from an origin country to many destinations at this product classification. The EDD is merged with with bilateral time-invariant gravity measures from CEPII (Conte et al., 2022) and the NTM-MAP plus PWT data described above. We then run several specifications to study the effect that destination-specific regulations have on the number of exporters and exports per exporter. These outcomes provide information on the real *restrictiveness* of regulations, improving upon simple counts of reported standards. The baseline specification is the following:

$$\#Exporters_{ijs} = \alpha_{is} + \alpha_{ij} + TM_{js} + Access_{ijs} + \epsilon_{ijs}, \tag{1}$$

where i represents origins, j destinations, and s 2-digit HS sectors. We include a set of origin-sector (α_{is}) and origin-destination (α_{ij}) fixed effects, with the latter controlling for the usual gravity measures. Given that we exploit cross-sectional variation in technical measures, we also control for market access measures such as tariffs as well as "other" NTMs in the $Access_{ijs}$ term. These "others" are NTMs from the same database but classified *outside* of SPS or TBT. Thus, they do not necessarily discriminate based on vertically differentiated attributes and do not map to the fixed cost in our model.[5] Importantly, we find only a small correlation (equal to -0.06) between

human capital, capital intensity, and TFP.

[5]There are five different categories of NTMs in NTM-MAP: (A) SPS; (B) TBT; (C) Pre-Shipment Inspections; (D) Contingent trade-protective measures and (E) Non-automatic licensing, quotas, prohibitions and quantity-control

our *TM* prevalence measure that includes only SPS and TBT with the prevalence of these "other" measures in the data.

The first column of Table 1 reports the effect of the TM prevalence measure on the number of exporters following the specification in (1). It is clear that an origin-sector group will send fewer exporters to destinations that are more regulated. Doubling the prevalence of regulations is associated with a 1.9 percent decrease in the number of exporters.[6] In the second column, we split the TM prevalence into SPS and TBT measures and find that the negative effects are driven by SPS measures.

In the next two columns, we interact TMs with a destination (j) specific characteristic and include the full set of fixed effects. Countries are grouped into three bins for income (GDP per worker) and openness (the import share of a destination-product at the world level). The effects of TMs on the extensive margin of exporters is stronger when the destination has a higher GDP per capita and that technical standards are *less restrictive* in more open destinations.[7] Figure A.1 suggests that richer destinations tend to impose more regulations, but the literature has struggled with the fact that quantifying regulations is imperfect as not all standards are necessarily equal (nor applied equally). We confirm that rich/more closed destinations are also *more restrictive*: a given regulation is more successful in restricting market access.

The last column reports the effect of TMs on export values, and is not statistically different from zero, consistent with our interpretation that these only act on the *extensive* margin.[8] With fewer exporters, the remaining exporters do not export less to each destination as would be the case if these acted as a marginal cost. Our results *are* consistent with TMs acting as a fixed cost that restricts the survival of low-quality firms. Notice the distinction of this result with the effect of typical gravity measures such as distance, which likely reflect marginal costs, and *lower* average exports as costs increase. We acknowledge that our results identify an extensive margin response but do not guarantee that low-quality firms drive exit, as assumed in our model.[9] Unfortunately, the EDD is not suitable to measure firm-level quality. However, Macedoni and Weinberger (2022) establish that input quality proxies are strongly correlated with size in Chilean manufacturing data (as is found in Hallak and Sivadasan (2013) and consistent with Hottman et al. (2016)) and that the smallest firms were the likeliest to exit with stricter regulations. If firm size is linked to productivity (Melitz, 2003), this also implies that exit is driven by least productive firms.

measures. Note our *Technical Measures* include only SPS and TBT. Tariffs are downloaded from WITS. They are *Effectively Applied (AHS)* tariffs, computed as the simple average of bilateral tariff line tariffs within each origin-destination-HS2 sector.

[6] As reference, doubling the prevalence of regulations might, for example, take an $i-j-s$ observation from the 25th percentile to the median in terms of prevalence of regulations.

[7] Although we acknowledge the potential problems with using export information on the right hand side, note that this result is consistent with our models' prediction that lower trade costs reduce the optimal level of restrictiveness.

[8] In column (5), we replicate the first column with a reduced sample size as in the specifications with export value as the outcome, to check that the differences are not due to fewer observations available for the mean export value.

[9] Furthermore, political economy considerations come into play as big firms might lobby for regulations deterring entry by not-necessarily low-quality firms (Herghelegiu, 2018).

Table 1: Trade Margins and Regulations

	Log # of Exporters					Log Value per Exporter
	(1)	(2)	(Income)	(Openness)	(5)	(6)
TM Prevalence	-0.019***		-0.005	-0.108***	-0.025***	-0.003
	(0.004)		(0.007)	(0.005)	(0.004)	(0.011)
TM*Country Char.			-0.011***	0.049***		
			(0.004)	(0.002)		
SPS Prevalence		-0.026***				
		(0.004)				
TBT Prevalence		0.002				
		(0.004)				
Fixed Effects	i-j,i-hs2	i-j,i-hs2	i-j,i-hs2	i-j,i-hs2	i-j,i-hs2	i-j,i-hs2
Controls	Access		Access	Access	Access	Access
R^2	0.83	0.83	0.83	0.83	0.82	0.60
# Observations	35323	35323	34931	35323	30465	30465

The outcome in columns (1)-(5) is the number of exporters from i that sell in js. In all columns, we include origin-destination and origin-sector fixed effects, as well as access controls (tariffs and other non-tariff measures). In the second column we separately include the prevalence (number of products with at least one measure) of SPS and TBT measures. In columns (Income)-(Openness), we group countries into three bins, akin to "low", "middle" and "high" income/openness, and interact the country bin with the TMs prevalence measure. For the interaction terms in columns (Income)-(Openness), GDP/L is the log of real GDP (in millions of 2005 USD) over millions of engaged persons (employed) from the PWT, while Openness is the average of import share of each destination-HS2. Column (5) is the same specification as (1), but has the same sample size as the export value specifications (column (6)) for comparison. In column (6), we use the mean log export value per exporter (as reported by EDD) as the outcome. To construct the prevalence measure of TMs, we allow for SPS and TBT chapters of the NTM-MAP only, and separately control for the other NTM prevalence. Regulations are applied at the destination-sector (js) level. As in Fernandes et al. (2023), we restrict origin-destination pairs to those with sufficient transactions. We report heteroskedasticity-consistent standard errors in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

3 Model

3.1 Model Outline

We build a multi-country model of international trade to study the optimal level of regulations. The model builds on Macedoni and Weinberger (2022), who consider the effect of regulations on allocative efficiency in a closed economy framework. There are I countries indexed by i for origins and j for destinations. In each country i, L_i consumers, with per capita income y_i, derive utility from the consumption of varieties of a differentiated good. The set of goods exported from country i to country j is represented by Ω_{ij}. Each variety, indexed by ω, has an associated quality level $z(\omega)$. We assume that quality is a demand shifter: consumers exhibit a higher willingness to pay for higher quality goods. There is perfect information: consumers, firms, and the government costlessly distinguish between the quality offered in the market.

The utility from consumption is denoted by U_j^c and we will consider two cases: Constant Elasticity of Substitution (CES) preferences and Indirectly Additive (IA) preferences (Bertoletti and Etro, 2017, 2020; Bertoletti et al., 2018). The key difference between the predictions of these two types of preferences lies in the markups. In a monopolistic competition environment, markups are constant for firms with CES preferences, but increase with quality for firms with IA preferences. These variable markups result in market distortions that impact the welfare effects of regulations, which also results in international spillovers from the implementation of domestic standards.

To provide a rationale for regulations, we introduce a positive externality E_j, which increases with the quality level z of each firm. In particular, we assume that:

$$E_j = \left(\sum_i \tilde{z}_{ij} \right)^{\epsilon} \tag{2}$$

with $\epsilon > 0$, and where $\tilde{z}_{ij}$ is a geometric average of quality exported from i to j:

$$\tilde{z}_{ij} = \left[\int_{\omega \in \Omega_{ij}} z(\omega)^{\beta} \mu_{ij}(\omega) d\omega \right]^{\frac{1}{\beta}} \tag{3}$$

where $\beta > 0$ and $\mu_{ij}(\omega)$ is the pdf of the distribution of varieties conditional on being exported. In our study, we examine regulations on vertically differentiated goods, where quality can be related to product features such as safety and healthiness. As a result, higher average quality is linked to larger positive externality E_j. The utility is calculated as the sum of the utility from consumption and the externality:

$$U_j = U_j^c + E_j \tag{4}$$

The varieties are produced by a mass of single-product firms, each with a different quality level z, which is exogenously determined and cannot be changed by firms. We can replace the argument ω with z. As in the Melitz (2003) model, there is a pool of potential entrants. Upon entry, firms pay a fixed cost of entry f_E in domestic labor units and discover their quality z. Quality is drawn from an unbounded Pareto distribution whose CDF and pdf are $H_i(z) = 1 - \left(\frac{b_i}{z}\right)^{\kappa}$ and $h_i(z) = \frac{\kappa b_i^{\kappa}}{z^{\kappa+1}}$, where κ and b_i are positive constants. Only a mass J_i of firms pays the fixed cost of entry. Free entry drives expected profits equal to $w_i f_E$. All firms from i produce their goods with the same marginal cost of production c_i, in labor units. These assumptions imply that size heterogeneity is linked to the exogenous quality draws. The direct mapping of quality to size might seem stark, but it is a convenient feature that is also present in Kugler and Verhoogen (2012) and finds quantitative support in the empirical findings of Hottman et al. (2016). The market is monopolistically competitive. Because of the constant marginal costs, we can study the problem of a firm operating in each destination j independently. Given the quality draw z, a firm from country i maximizes its profits in destination j by choosing the quantity $q_{ij}(z)$ and taking the market aggregates as given.

The government of each country can set a regulation that requires all firms selling to j the payment of a fixed regulatory requirement f_j in labor units. The regulation is non-discriminatory: all firms face the same fixed regulatory requirement when selling to the same destination. The fixed cost can be thought of as a microfoundation for the selection generated by tougher regulations and it exemplifies the quality controls and certification costs a firm might go through to show that their quality level indeed is higher than a certain threshold. In reality, regulations typically combine some costs and some requirement on the quality level of a product (e.g., a minimum standard on the residue levels of pesticides allowed on agricultural products). Hence, complying to a regulation not only requires the payment of a fixed cost, but the improvement of quality until a certain level.

In our paper, quality is exogenous and so, our model predicts that high-quality firms are better able to comply (i.e., pay our fixed cost) with the regulations of all destinations, and low-quality firms are less able to do so.[10]

We choose to model the regulations as a fixed cost because their effects are consistent with our stylized facts. Fixed costs of regulation generate selection of firms based on their quality, thus, they mainly affect the extensive margin of exports. Such a prediction finds support in our empirical motivation and work cited in the previous section.[11] As the fixed cost interacts with vertically differentiated varieties, it represents a vertical norm. We will explore both the case in which the fixed cost is paid in the domestic labor units of a firm, i.e., the fixed cost equals $f_{ij} = w_i f_j$, and the case in which the fixed cost is paid in the destination labor units, i.e., $f_{ij} = w_j f_j$. The former case captures compliance tasks that are completed by the firms workers, e.g. quality controls, environmental requirements etc. The latter case captures the compliance tasks that require hiring destination country's workers, e.g. flying out inspectors.

There is an iceberg trade cost of delivering a good $\tau_{ij} \geq 1$ with $\tau_{ii} = 1$. Furthermore, each exporter pays a per unit tariff $t_{ij} \geq 1$ with $t_{ii} = 1$. Following the notation of Demidova (2017), let $p_{ij}(\omega)$ denote the price of a variety ω that is inclusive of tariff. Net of the tariff, the firm receives $\frac{p_{ij}(\omega)}{t_{ij}}$ and the government collects $(t_{ij} - 1)\frac{p_{ij}(\omega)}{t_{ij}}$. Workers earn a wage w_i. Per capita income y_i is the sum of the wage and the tariff revenue, which is distributed equally across consumers, i.e. $y_i = w_i + \frac{T_i}{L_i}$, where T_i denotes total tariff revenues.

3.2 CES Case: Constant Markups and Efficient Allocation

3.2.1 Consumers and Firms

We begin with the case of CES preferences. The utility from consumption is given by:

$$U_j^c = \left[\sum_i \int_{\omega \in \Omega_{ij}} (z(\omega) q_{ij}(\omega))^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad (5)$$

Models of heterogeneous firms and CES preferences - including the quality shifter - are widespread in the international trade literature (Melitz, 2003; Hallak and Sivadasan, 2013; Feenstra and Romalis, 2014). Therefore, we concentrate on two crucial equations in this section and provide the full derivations for the consumer and firm problems in Appendix B.

First, the price that a firm with quality z charges in a destination j is a constant markup over the marginal costs of production and delivery:

$$p_{ij}(z) = \frac{\sigma}{\sigma - 1} c_i w_i \tau_{ij} t_{ij} \quad (6)$$

[10] For an analysis of the effects of regulations with quality upgrading in a closed economy, see Gaigné and Larue (2016a).

[11] As for real-world examples, the discussion around Brexit has highlighted the extensive margin effect through the greater pain felt by small British exporters. For example, see a *Financial Times* video: https://www.ft.com/video/91b8a350-5817-4b40-a5ea-c62ec832aa9c.

This means that the relative price of any two varieties in the same destination is a function of relative marginal costs only.

Second, to highlight the role of the regulation on selection and allocation of resources, we define the quality cutoff that sets profits to zero ($\pi_{ij}(\bar{z}_{ij}) = 0$) as:

$$\bar{z}_{ij} = \left(\frac{\sigma^{\sigma}(U_j^c)^{\sigma-1}}{L_j(\sigma-1)^{\sigma-1} y_j^{\sigma}} \right)^{\frac{1}{\sigma-1}} c_i w_i \tau_{ij} (t_{ij}^{\sigma} f_{ij})^{\frac{1}{\sigma-1}} \tag{7}$$

Only firms with quality $z > \bar{z}_{ij}$ can survive in the market. Since quality is exogenous and cannot be changed – firms do not adjust their production process to comply with regulations – the only effect of higher fixed costs is a more stringent *selection*. As f_{ij} increases, the quality cutoff $\bar{z}_{ij}$ also increases, so that firms with higher quality are better able to comply (i.e., pay the fixed cost). This means that the effect of the government chosen fixed cost is that the firms with the lowest quality $z < \bar{z}_{ij}$ exit.

3.2.2 Equilibrium

Next, we present the key system of equations that define the equilibrium, to demonstrate that stricter regulations do not alter the equilibrium variables of the model. This unexpected outcome has significant implications for the role of cooperation in establishing regulations within this model.

Building on the recent developments in trade literature (Arkolakis et al., 2012), the equilibrium of a model with heterogeneous, monopolistically competitive firms can be characterized by a system of equations that depend on a parsimonious set of parameters. To do so, we express the equilibrium equations as a function of four variables: the trade shares λ_{ij}, which represent the proportion of exports from country i to country j over total sales in country j, the mass of entrants J_i, the wages w_i, and the per capita income y_i.

Let us define the trade share λ_{ij} (the gravity equation) as follows:

$$\lambda_{ij} = \frac{J_i b_i^{\kappa} (\tau_{ij} c_i w_i (t_{ij}^{\sigma} f_{ij})^{\frac{1}{\sigma-1}})^{-\kappa} f_{ij} t_{ij}}{\sum_v J_v b_v^{\kappa} (\tau_{vj} c_v w_v (t_{vj}^{\sigma} f_{vj})^{\frac{1}{\sigma-1}})^{-\kappa} f_{vj} t_{vj}} \tag{8}$$

Notice that since the fixed cost is non-discriminatory, the fixed regulatory requirement f_j does not affect equation (8) whether expressed in domestic or foreign labor units. If we assume that the fixed cost is expressed in the labor units of the destination country: $f_{ij} = w_j f_j$, then the trade share equation becomes:

$$\lambda_{ij} = \frac{J_i b_i^{\kappa} (\tau_{ij} c_i w_i)^{-\kappa} t_{ij}^{1-\frac{\kappa\sigma}{\sigma-1}}}{\sum_v J_v b_v^{\kappa} (\tau_{vj} c_v w_v)^{-\kappa} t_{vj}^{1-\frac{\kappa\sigma}{\sigma-1}}} \tag{9}$$

and is independent of the fixed cost. Because of the non-discriminatory nature of the fixed cost, an increase in fixed costs to export to country j affects all countries' revenues to j proportionately, leaving the revenue share from any source i unchanged. This result is crucial because, since λ_{ij} is unaffected by the fixed cost, the endogenous variables of the model are also independent of the fixed cost.

Three other equations characterize the equilibrium. Combining the free entry condition with the market clearing condition yields the equilibrium mass of entrants:

$$J_i = \frac{\sigma - 1}{\sigma \kappa w_i f_E} \sum_j \frac{\lambda_{ij} y_j L_j}{t_{ij}} \quad \forall i = 1, ..., I \tag{10}$$

and is also independent of the fixed cost.

The market clearing condition and the relationship between wages and income are given by:

$$\sum_j \lambda_{ij} y_j L_j = y_i L_i \quad \forall i = 1, ..., I \tag{11}$$

$$y_j = w_j + y_j \sum_i \left(\frac{t_{ij} - 1}{t_{ij}} \right) \lambda_{ij} \quad \forall j = 1, ..., I \tag{12}$$

Without loss of generality, we can normalize the wage of a country k to one and set it as the numeraire. The equilibrium is determined by the system of equations (9), (10), (11), (12), which determines the equilibrium values of λ_{ij}, J_i, w_i, and y_i. None of these equations is affected by f_j. If a country increases its fixed regulatory costs, the world allocation remains unchanged: the mass of entrants, wages, and trade shares do not change. The costs associated with the regulations are fully borne by the customers in the imposing country. As a result of the regulation, some foreign exporters will leave the imposing country, freeing up resources to cover the higher fixed costs for the remaining firms that continue to export. This has no impact on foreign domestic production or exports to other countries. However, the quantities consumed in the imposing country will change, affecting its welfare.

3.2.3 How do Regulations as Fixed Costs affect Welfare?

Despite leaving the equilibrium variables constant, the regulation will affect the country's welfare. In fact, the utility of the representative consumer equals:

$$U = U_j^{c0} f_j^{-\frac{\kappa - \sigma + 1}{\kappa}} + E_j^0 f_j^{\frac{\epsilon}{\kappa}} \tag{13}$$

where U_j^{c0} and E_j^0 are endogenous variables that depend on the equilibrium of the model. However, since the fixed cost f_j leaves unchanged the equilibrium variables of the model, it leaves U_j^{c0} and E_j^0 unchanged. Equation (13) highlights the key trade off of the regulation in this CES model: higher fixed costs cause low-quality firms to exit, leading to an increase in the positive externality due to the higher average quality. However, this also results in a decrease in the utility from consumption. This occurs because the market allocation under CES preferences and without externalities is efficient. In the absence of the externality E_j, the number of low-quality firms in the market allocation is optimal. Reducing it through the use of fixed costs reduces the overall utility.

If the setting of regulations has a positive or negative spillover on the welfare in another country, then the unilateral setting of regulations is inefficient and international cooperation can improve welfare of both countries. For this spillover to occur, the regulations in the imposing country must change the equilibrium variables in the non-imposing country. As shown in the previous section, in the model with CES preferences, the fixed regulatory requirement f_j does not alter any of the endogenous variables of any country. This means that regulations do not affect the allocation of expenditure shares across origins, represented by the gravity equation (9), nor do they affect the mass of firms, wages, and per capita income. As a result, a country's regulations leave foreign welfare unchanged. We summarize this result in the following proposition:

Proposition 1. *In the presence of CES preferences and an externality on consumption, there is no rationale for cooperative setting of a non-discriminatory fixed regulatory requirement across countries.*

As we will demonstrate in the next section, this proposition breaks down in the presence of variable markups.

It is also worth noting that this result is driven by the assumption on E_j. The externality faced by country j only depends on the consumption in country j. If there were a global externality (e.g., the welfare in j depends on the externality in i) or an externality on production (where the fixed cost in a destination affects the production and hence the externality in a non-imposing country), there would still be a rationale for cooperation even under CES preferences. Moreover, the assumption of a non-discriminatory regulatory requirement is crucial. If the regulation leads to differing increases in fixed costs across countries (such as during periods of regulatory harmonization between two countries), then countries other than the imposing one would be impacted, implying a rationale for cooperation.

3.3 Non-CES: Variable Markups and Distorted Allocation

3.3.1 Consumer Problem

We now consider a framework with preferences that allow for variable markups. We have chosen the Indirectly Additive (IA) preferences of Bertoletti and Etro (2017, 2020), which were first introduced in trade literature by Bertoletti et al. (2018). The utility from consumption equals:

$$U_j^c = \int_{\Omega_j} \left(az(\omega)\xi_j q(\omega) - \frac{(\xi_j q(\omega))^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} \right) d\omega - \xi_j \tag{14}$$

where $a > 0$ and $\gamma \geq 0$ are constants, $q(\omega)$ is the quantity consumed of variety ω, $z(\omega)$ is a variety-specific demand shifter, which we interpret as quality, and Ω_j is the set of varieties available for consumption. ξ_j is a quantity aggregator that is implicitly defined as:

$$\xi_j = \int \left(az(\omega)\xi_j q(\omega) - (\xi_j q(\omega))^{1+\frac{1}{\gamma}} \right) d\omega \tag{15}$$

The choice of IA, compared to other non-CES preferences, is made due to its ability to provide a tractable model that still effectively matches the data. The differences with other non-CES preferences are purely quantitative. In fact, as demonstrated by Dhingra and Morrow (2019), the allocative distortions that the regulations are able to offset are present in any framework with variable markups.[12]

Solving the consumer problem yields the following inverse demand function:

$$p(\omega) = y_j \left[az(\omega) - (\xi_j q(\omega))^{\frac{1}{\gamma}} \right] \tag{16}$$

where quality z shifts the intercept of the demand, while the quantity aggregator ξ_j and the parameter γ impact the slope of the demand.

3.3.2 Firm Problem

As IA preferences are less frequently used in the literature, this section provides a more in-depth description of the firm problem compared to the CES case. To simplify the analysis, let us define z^*_{ij} as the quality level that results in zero quantity demanded $q_{ij}(z^*_{ij}) = 0$. We refer to z^*_{ij} as the market quality cutoff. Based on the profit condition in the appendix:

$$z^*_{ij} = \frac{t_{ij}\tau_{ij}w_i c_i}{ay_j} \tag{17}$$

For a quality level lower than the cutoff $z < z^*_{ij}$, a firm experiences zero demand. Absent any regulatory fixed costs, z^*_{ij} would be the sole factor determining the selection of firms into production, export, or exit. A key feature of IA preferences is that the market quality cutoff is dependent only on the marginal costs of production in the origin and the per capita income in the destination.

Using the definition of z^*_{ij}, we can write the optimal pricing rule as:

$$p_{ij}(z) = \frac{ay_j z^*_{ij}}{1+\gamma} \left(\frac{z}{z^*_{ij}} + \gamma \right) \tag{18}$$

In contrast to the CES case (6), markups in this model are not constant and increase with z: firms

[12]For a quantitative analysis of market distortions in a closed economy across various non-CES preferences, and their fit to empirical sales and markup distributions, see Macedoni and Weinberger (2022). Notice that IA preferences do not nest the CES case. The preference formulation labeled "Generalized CES" or "Pollak" (Arkolakis et al., 2019; Jung et al., 2019) allows for variable demand elasticities and also nests the CES case. In our aforementioned paper, we discuss how the welfare channels of regulations change as variable markups are introduced through a parameter in those preferences. The shortcoming of using these preferences is the lack of analytical tractability in a context with fixed regulatory costs, which would greatly increases the complexity and the computational power required to solve the equilibrium of the model. Hence, we decided to adopt the IA preferences, which allow for closed-form solutions for prices and quantities.

with higher quality, which also have larger sales, have higher markups.[13] The profits $\pi_{ij}(z)$ of firm z are given by:

$$\pi_{ij}(z) = \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{ij})^{1+\gamma}}{\xi_j t_{ij}}\right)\left(\frac{z}{z^*_{ij}} - 1\right)^{1+\gamma} - f_{ij} \tag{19}$$

3.3.3 Restrictiveness of Regulations

Since profits increase with quality z, there exists a firm with quality $\bar{z}_{ij}$ such that $\pi_{ij}(\bar{z}_{ij}) = 0$. Since firms cannot adjust their quality level, the effect of the regulation is that any firm with $z < \bar{z}_{ij}$ exits the market. $\bar{z}_{ij}$ is defined as:

$$\bar{z}_{ij} = z^*_{ij} + z^*_{ij}\left[f_{ij}\left(\frac{(1+\gamma)^{1+\gamma}}{a^{1+\gamma}\gamma^{\gamma}}\right)\left(\frac{\xi_j t_{ij}}{L_j y_j (z^*_{ij})^{1+\gamma}}\right)\right]^{\frac{1}{1+\gamma}} \tag{20}$$

As in the CES case, the quality cutoff increases with the fixed regulatory cost. To simplify the analytical derivations and to facilitate the quantitative analysis, we are going to focus on a model-derived measure of the restrictiveness of the regulation $g_{ij} = \frac{\bar{z}_{ij}}{z^*_{ij}} \in [1, \infty)$. When there are no fixed costs, $g_{ij} = 1$. With larger fixed costs, our measure of restrictiveness also increases. The measure g_{ij} is related to the probability of a firm being active under the regulation, relative to the probability of being active without the regulation: $\frac{P(z \geq \bar{z}_{ij} | g_{ij} > 1)}{P(z \geq \bar{z}_{ij} | g_{ij} = 1)} = g_{ij}^{-\kappa}$. Thus, g_{ij} captures a measure of the restrictiveness of the regulation that is independent of the scale of the fixed cost. g_{ij} is implicitly defined as:

$$\left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{ij})^{1+\gamma}}{\xi_j t_{ij}}\right)(g_{ij} - 1)^{1+\gamma} = f_{ij} \tag{21}$$

Since g_{ij} is also a function of z^*_{ij}, equation (21) does not pin down the restrictiveness of the regulation. However, solving the model shows that there is a one-to-one mapping between f_{ij} and g_{ij}, meaning that for any level of fixed cost there is only one level of restrictiveness of the regulation (see Appendix C.3).

To find a simple equation that describes the relationship between the restrictiveness of the regulation for domestic firms g_{jj} and for foreign firms g_{ij}, we first take the ratio of (21) for origin j and for origin i. Then, we substitute for the market quality cutoff ratio using $\frac{z^*_{ij}}{z^*_{jj}} = \frac{t_{ij}\tau_{ij} w_i c_i}{w_j c_j}$ by (17). This yields:

$$g_{ij} = 1 + (g_{jj} - 1)\,\frac{w_j c_j}{\tau_{ij} w_i c_i}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{1+\gamma}} t_{ij}^{-\frac{\gamma}{1+\gamma}} \tag{22}$$

The degree of regulatory restrictiveness, denoted by g_{ij}, varies across different countries of origin. To build a clearer understanding, let us consider a scenario where fixed costs are denominated in

[13] Prices increase with the per capita income of the destination, but are unresponsive to market size, in line with the evidence from Simonovska (2015) and Dingel (2017). Furthermore, prices increase with quality z, a prediction supported by empirical studies such as Bastos and Silva (2010), Martin (2012), and Manova and Zhang (2017).

the labor units of the destination (i.e., $f_{ij} = w_j f_j$). Assume that the countries are symmetrical, meaning their wage and cost structures are equivalent ($w_j c_j = w_i c_i$), and no tariffs are applied ($t_{ij} = 1$). Hence, $g_{ij} = 1 + (g_{jj} - 1)\frac{1}{\tau_{ij}}$. When there are iceberg trade costs between countries i and j (i.e., $\tau_{ij} > 1$), it follows that $g_{ij} < g_{jj}$. This implies that foreign exporters to country j face less regulatory restrictiveness compared to domestic firms within j. This outcome is surprising because it emerges in a model with non-discriminatory regulations, without relying on the concept of regulation similarity as suggested by Parenti and Vannoorenberghe (2022). The rationale behind this finding is that identical fixed costs have a more lenient impact on countries with higher average product quality. To elaborate, all else being equal, elevated production and delivery costs selects for high-quality firms who can access the importing country, thereby diminishing the perceived restrictiveness of its regulations for foreign firms. Returning to our example of symmetric countries, the existence of iceberg trade costs ensures that only high-quality firms can afford to export to country j. Consequently, the fixed regulatory costs in j exert a weaker selective pressure on these exporters compared to domestic firms, where the absence of trade costs allows the survival of some low-quality firms in the market allocation.

3.3.4 Aggregation and Equilibrium

Although governments set the fixed cost, we can make the simplifying assumption that what actually is *chosen* is the level of restrictiveness of the regulation in the domestic economy g_{jj}. This assumption is particularly important for Section 4, since we are able to estimate g_{ij} and g_{jj} directly, bypassing the notoriously challenging task of estimating the fixed costs.

We next derive the gravity formulation of the model, by considering the share of sales of products from i to country j including tariffs:

$$\lambda_{ij} = \frac{(t_{ij}\tau_{ij}c_i w_i)^{-\kappa+\gamma+1} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_2(g_{ij})}{\sum_v (t_{ij}\tau_{vj}c_v w_v)^{-\kappa+\gamma+1} J_v b_v^{\kappa} g_{vj}^{-\kappa} G_2(g_{vj})} \tag{23}$$

where $G_2(g_{ih}) = \kappa g_{ih}^{\gamma}\left[\frac{g_{ih}\,{}_2F_1[\kappa-\gamma-1,-\gamma;\kappa-\gamma,g_{ih}^{-1}]}{\kappa-\gamma-1} + \frac{\gamma\,{}_2F_1[\kappa-\gamma,-\gamma;\kappa-\gamma+1,g_{ih}^{-1}]}{\kappa-\gamma}\right]$, and ${}_2F_1[a,b;c;d]$ is the hypergeometric function and is defined in Appendix C.2. In this model, bilateral trade flows are influenced by both variable trade costs, which have an elasticity of $\kappa-\gamma-1$, and by the restrictiveness of the regulations. This is a marked departure from the CES model, in which the trade shares λ_{ij} were independent of regulations as shown in equation (9).

The equilibrium mass of entrants in country i equals:

$$J_i = \frac{1}{w_i f_E}\sum_j \frac{\lambda_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} \quad \forall i = 1, ..., I \tag{24}$$

where $\tilde{G}_1(g_{ij}) = g_{ij}^{-\kappa}[G_1(g_{ij}) - (g_{ij}-1)^{1+\gamma}]$, $G_1(g_{ih}) = \kappa g_{ih}^{\gamma}\left[\frac{g_{ih}\,{}_2F_1[\kappa-\gamma-1,-\gamma;\kappa-\gamma,g_{ih}^{-1}]}{\kappa-\gamma-1} - \frac{{}_2F_1[\kappa-\gamma,-\gamma;\kappa-\gamma+1,g_{ih}^{-1}]}{\kappa-\gamma}\right]$, and $\tilde{G}_2 = g_{ij}^{-\kappa}G_2(g_{ij})$. Contrary to the CES case, the level of regulations affects the mass of firms in the market. When regulations become more restrictive, the ratio of profits to revenues increases, leading to an increase in the mass of firms that pay the fixed cost of entry, all else being constant.

The market clearing condition and the relationship between wages and per capita income are identical to the CES case ((11) and (12)). Without loss of generality, we can normalize the wage of a country k to one and set it as the numeraire. The equilibrium in the model is a vector of wages $\{w_i\}$ for $i \neq k$, per capita income $\{y_i\}$ for $i = 1, ..., I$, and mass of entrants $\{J_i\}$ for $i = 1, ..., I$, such that goods markets clear, trade is balanced, and expected profits equal the fixed cost of entry.

3.3.5 The Effects of the Regulation on Utility from Consumption

The utility of the representative consumer from the consumption of varieties is given by:

$$U_j^c = a^\kappa \left(\frac{\gamma}{1+\gamma}\right)^{1+\gamma} \frac{J_j b_j^\kappa \left(\tau_{jj} c_j w_j y_j^{-1}\right)^{-\kappa+\gamma+1}}{\lambda_{jj}} \tilde{G}_2(g_{jj}) \sum_i \frac{\lambda_{ij} G_1(g_{ij})}{G_2(g_{ij})} \tag{25}$$

Contrary to the CES case, the relationship between the regulation and the utility from consumption is more complex and cannot be expressed in a simple equation. To understand the effects of regulation on the utility of the imposing country U_j^c, numerical methods and a quantification exercise must be used. The following proposition summarizes the effects of regulation on the imposing country's utility:

Proposition 2. *While in the CES framework an increase in the restrictiveness of the regulation unambiguously reduces the utility from consumption, under IA preferences, a small regulation improves the utility from consumption.*

In a numerical exercise with two symmetric countries (home and foreign), we have found that there is a non-monotonic hump shaped relationship between the restrictiveness of the regulation g_{hh} and the utility of home consumers. This relationship is depicted in Panel (a) of Figure 1. A small level of fixed regulatory requirement can improve welfare. The result implies that there exists a rationale for regulation which is independent from the presence of an externality on consumption (E_j). In this section and the following, we only focus on the relationship between regulations and U_j^c and leave aside the externality E_j. We show in Section 3.5, that including the externality does not affect qualitatively our conclusions.

Let us now provide some intuition for the results of Proposition 2. Regulations affect the imposing country's utility through three channels. First, there is a positive composition effect: the exit of low-quality firms leads to a reallocation of production from these firms to the existing higher-quality firms and to some new higher-quality entrants, enhancing welfare. Second, there is a negative effect due to the reduction in the number of varieties available for consumption, which is welfare reducing as consumers have a love for variety. Third, the payment of the fixed cost diverts labor from production of units of output to regulatory activities, which causes a reduction in the imposing country's purchasing power: both per capita income and wages decline.

This divergence between the CES and non-CES model arises from the nature of markups, which are variable in the non-CES model but constant in the CES model. In the CES model, the constant markups mean that the relative prices of any two products equal their relative marginal production costs, making the market allocation efficient and any change in firm composition detrimental to welfare. Conversely, in the non-CES model, markups increase with the quality of the firms, leading to an allocation where high-quality goods are priced disproportionately higher than their marginal cost compared to low-quality goods. This results in an inefficient market allocation, with an over-supply of low-quality and an under-supply of high-quality products. Regulations, in this case, can correct this inefficiency by shifting resources from the excess production of low-quality firms to the insufficient production of high-quality firms. This means that in the imposing country, the positive composition effect can dominate the reduction in the number of varieties for regulations that are not too strict, which is the main force that drives Proposition 2.

Both the CES and non-CES frameworks share the first two channels: the composition effect and the loss of variety. However, the third channel, which relates to changes in wages and per capita income, is exclusive to the non-CES setting. This distinction arises because, in the CES framework, regulations do not impact the model's equilibrium variables. In contrast, under IA preferences, they do. To elucidate this difference, consider the key equilibrium variable in our model of the gravity equation, denoted as λ_{ij}.[14] In the CES framework, an increase in fixed costs does not alter λ_{ij}. Conversely, in the non-CES framework, the same increase in fixed costs exerts a variable selective pressure on exporters from different origins, contingent on their average quality. Here, a rise in fixed costs results in a higher exit rate of exporters from lower-average-quality countries compared to those from higher-average-quality countries. Consequently, expenditure shares shift with regulatory changes, impacting all other equilibrium variables, including wages. In the *imposing country*, this channel, along with the variety effect, is a cost of regulations. The subsequent section of our paper delves into the *international spillovers* of regulations and their effect on wages.

3.4 The Role of Cooperation

Proposition 1 asserts that in the CES model, there is no basis for international cooperation because regulations in one country do not impact any endogenous equilibrium variables, such as wages and the number of market entrants, leaving the welfare in other countries unaffected. However, as mentioned in the previous section, the situation differs in a non-CES framework. Here, a country's regulations can influence its own wages, triggering an effect on the relative income of other nations. Additionally, as we discuss below, regulations in the country imposing them also influence the number of firms willing to pay the fixed entry cost in other countries. Therefore, in this context, regulations do have an impact on welfare in foreign countries, creating a justification for international cooperation. This interdependence, a result of the regulations' international spillover effect, leads to the following prediction in the model with IA preferences regarding cooperation:

[14] The variable represents the expenditure share of country j on goods from country i, outlined in equation (23).

Proposition 3. *In the presence of IA preferences, when a country imposes a regulation, the utility from consumption of its trading partners improves. Therefore, allowing countries to internalize this positive externality through cooperation can achieve a higher level of welfare.*

Let us first discuss the sign of the spillover effect of regulations. To do so, we can examine how implementing a regulation in a particular country i affects the utility of consumption in another country j. Assuming that there are no tariffs and that country j imposes no regulations, we can simplify the expression for the utility of consumption in country j and write the change in utility as follows:

$$\hat{U}_j^c = \sum_i \lambda_{ij} \hat{J}_i \left(\frac{\hat{w}_j}{\hat{w}_i} \right)^{\kappa-\gamma-1} \tag{26}$$

where $\hat{x} = x_{new}/x_{old}$ is a hat-change.

Regulations in country i benefit country j in two ways. First, there is a terms of trade (ToT) effect, which is represented by the change in relative wages $\frac{\hat{w}_j}{\hat{w}_i}$. As discussed previously, one of the negative effects of the regulations in the imposing country is the reduction in the wages of workers who produce less output due to the new fixed costs. However, this negative effect on the imposing country actually improves the welfare of its trade partners. The reduction in the wage of country i is equivalent to a positive ToT shock for country j, which now faces lower import prices.

The second benefit of regulations in country i is an increase in the number of firms J_j paying the fixed cost of entry in each country. The regulation boosts average profits relative to revenues in the imposing country, stimulating new entry from all trading partners. The increased mass of varieties benefits consumers of any country, whose preferences exhibit a love for variety.[15]

Although the mass of entrants increases with regulation, as previously mentioned, there is a loss of variety in the imposing country. To explore this, consider the number of firms from i selling in the domestic economy, expressed as $N_{ii} = J_i \bar{z}_{ii}^{-\kappa}$. This variable is the product of the mass of firms that pay the fixed cost of entry, J_i, and a function of quality cutoff set by the regulation, $\bar{z}_{ii}$. When country i heightens its regulation, both J_i and $\bar{z}_{ii}$ increase. The total effect on the number of sold varieties is negative, but the increase in entrants partially offsets the increase in the quality cutoff. However, it is crucial to observe that tougher regulations in i also increase the mass of firms of its trading partners J_j. This leads to a rise in the number of domestic varieties for any country $j \neq i$, calculated as $N_{jj} = J_j \bar{z}_{jj}^{-\kappa}$, as regulations in j are unchanged. This increase in N_{jj} is beneficial for consumers in country j.

Further, the notion that increasing the mass of firms J_j improves welfare might initially appear counterintuitive. Under the conditions of Pareto distribution for quality and monopolistic competition, the market's determination of the number of firms that pay the fixed cost of entry, denoted as J_i, aligns with what a social planner would choose. This raises the question: why would increasing entry improve welfare if the existing level of entry is already optimal? The key lies in the variable markup distortions present in the market. Although the market's choice of J_i is efficient, a social planner would opt for different levels of selection and production quantities for each firm

[15] Figures C.2 and C.3 in the appendix show the relationships between regulations, entry, and purchasing power.

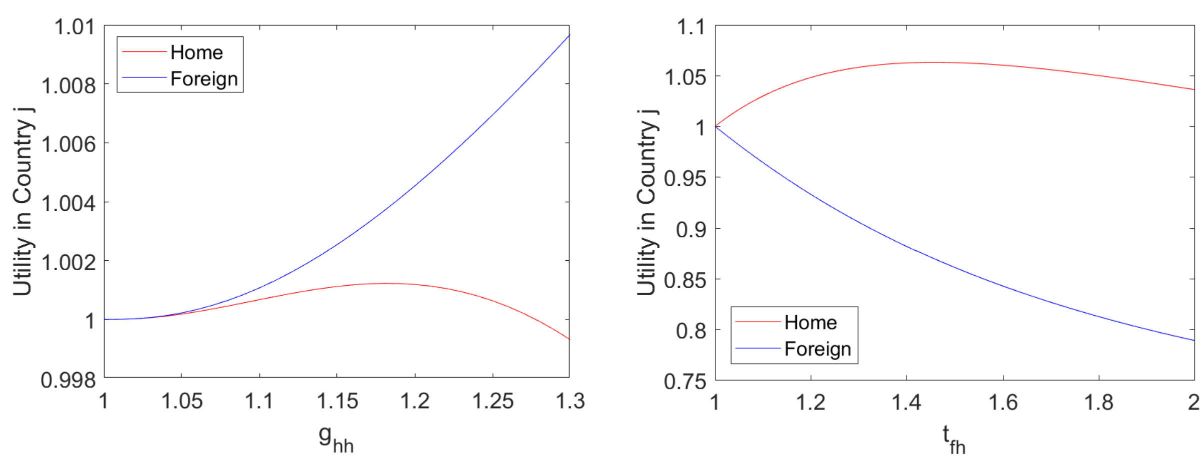
that survives in the market. The regulations influence both selection and quantities, acting as a second-best mechanism that falls short of the social planner's optimal allocation. As the market's selection and quantities remain less than optimal, an increase in the number of firms, or J_i, can enhance overall welfare.

Formula (26) illustrates that the response of welfare in country j to regulations varies depending on the trading partners. The impact of the two channels (ToT and entry) on country j depends on λ_{ij}: the larger the trade share, the greater the positive effect of a regulation in country i on the utility of country j.

In Panel (a) of Figure 1, when the home economy increases its level of restrictiveness of regulations, welfare in the foreign economy improves, despite the lack of change in their domestic level of regulatory restrictiveness. The home regulation monotonically increases the foreign utility while exhibiting a hump-shaped relationship with the home utility. The effect of regulations on foreign countries' welfare is opposite that of tariffs. In Panel (b) of Figure 1, we can observe the welfare effects at home and abroad of a higher home tariff. The tariff increases home welfare at the expenses of foreign welfare. This beggar-thy-neighbor rationale motivates cooperation in setting tariffs to prevent the prisoner's dilemma outcome of tariff wars. However, this rationale is absent in our setting with regulations: the regulation increases home *and* foreign welfare.

Figure 1: Welfare Effects of Trade Policies

(a) Home Regulation **(b)** Home Tariff



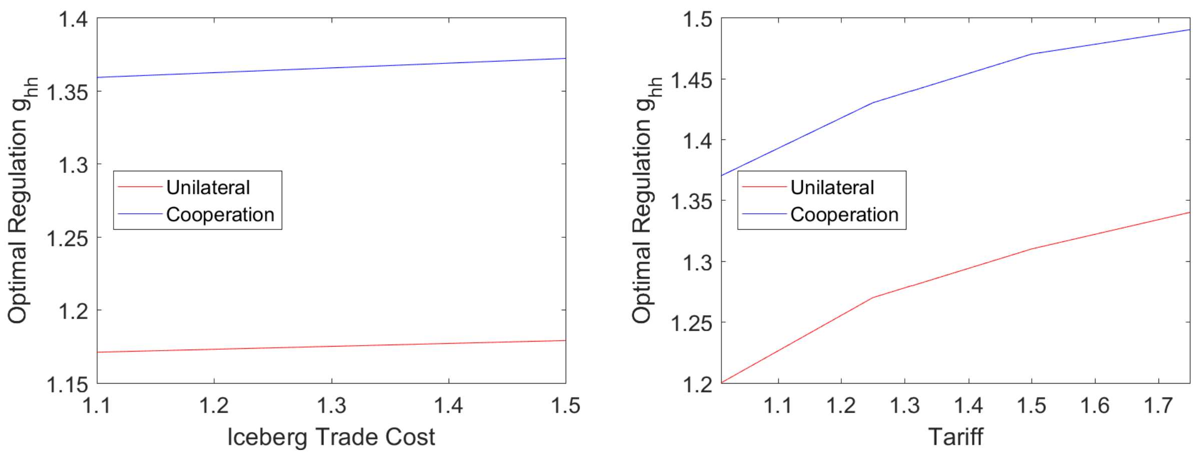
The plots show the hat change in the home utility $\hat{U}_h$ and foreign utility $\hat{U}_f$ given changes in the home regulation g_{hh} and home tariff t_{fh}. The parameters are as follows: $\kappa = 4$, $\gamma = 1.5$, $\lambda_{hh} = \lambda_{ff} = 0.65$. In the initial equilibrium, the two countries are identical and size and per capita income are normalized to one. In the initial equilibrium, there are no regulations and there is a symmetric level of tariffs $t_{hf} = t_{fh} = 1.01$. The iceberg trade costs are derived using the gravity equations and the numerical values for trade shares and tariffs.

When countries impose a standard they do not internalize the positive spillover on foreign economies, and thus the restrictiveness of the standard falls below the social optimum. Figure 2 compares the optimal level of regulation imposed in two scenarios. In the first scenario, only the home economy imposes the standard (Unilateral). In the second scenario, a common standard is optimally chosen to maximize welfare in both economies. The figure shows that the optimal standard under cooperation is higher than the optimal standard chosen by countries unilaterally.

The results of this section justify a deep trade agreement such that countries should increase the restrictiveness of regulations cooperatively.[16] Notice that the optimal level of regulation under cooperation declines with the level of iceberg trade costs and tariffs (Figure 2). This means that countries in deep trade agreements who are able to reduce their iceberg trade costs and tariffs, if these are still in place, can also reduce the restrictiveness of the regulations. Still, even for very low trade costs, the optimal g_{jj} is above one.[17]

Figure 2: Optimal Regulation under Cooperation

(a) Varying Trade Costs **(b)** Varying Tariffs



The plots show the optimal regulation g_{hh} in the case of cooperation (i.e., $g_{hh} = g_{ff}$) and in the case in which the home economy is the only one to impose the standard (Unilateral). Countries are symmetric, $\kappa = 4$, and $\gamma = 1.5$. In the initial equilibrium the two countries are identical and size and per capita income are normalized to one. Trade costs and tariffs are symmetric. When varying the iceberg trade costs, tariffs are set to one; when varying the tariffs, the iceberg trade costs equal 1.5.

Fixed Costs in Origin Labor Units or Destination Labor Units. In our model, regulatory fixed costs can be denominated in either labor units of the origin country or those of the destination country. The choice between these two does not influence the qualitative outcomes of our model, as demonstrated in Appendix C.6. This appendix illustrates that the model's predictions for welfare and other equilibrium variables remain consistent, regardless of which country's labor is employed for covering these fixed costs. Furthermore, Appendix C.7 shows that the optimal level of regulatory restrictiveness reacts similarly to changes in trade costs and other characteristics of countries, irrespective of the labor units used for fixed costs.

The difference between the two assumptions is quantitative. When fixed costs are denominated in the labor units of the origin country, workers in countries that do not impose these costs con-

[16] In the presence of asymmetric countries, the optimal level of regulation would depend both on the positive externality and on the fact that the optimal regulation across heterogeneous countries varies, as discussed below.

[17] Appendix C.6 examines specifically how welfare improvements due to cooperation increase or decrease with the level of tariffs (Figure C.4). Relatedly, we have examined the Nash Equilibrium resulting when both economies impose a standard. Figure C.5 shows the best response function for the home economy, which is generally flat and slightly increasing. As a result, the optimal restrictiveness of the regulation of the home economy is largely independent of the regulation imposed by the foreign economy.

tribute to the fixed costs associated with exporting to countries that do impose them. In contrast, if fixed costs are denominated in the labor units of the destination country, the fixed costs of foreign exporters are borne by workers in the imposing country. Consequently, in the latter scenario, wages in the imposing country are more adversely affected by regulations, leading to a more pronounced decline in consumer's utility in the imposing country as regulatory restrictiveness increases.

Shallow Agreements and Regulations. An important question in the literature is: are shallow trade agreements sufficient to ensure global efficiency despite domestic distortions? Shallow agreements primarily focus on reducing import tariffs and are characterized by their commitment to maintaining a predetermined level of foreign market access. The critical issue is whether these agreements can prevent countries from deviating in a way that enhances their own welfare, such as improving their ToT, without contravening the agreement. According to the seminal work of Bagwell and Staiger (2001), shallow agreements are indeed adequate for achieving global efficiency. In their perfect competition model, any deviation aimed at benefiting a country's own welfare would inevitably restrict foreign market access, thereby breaching the agreement's terms.

By contrast, in our framework, shallow agreements are not enough. In fact, suppose that countries collaboratively establish regulations to optimize joint welfare, resulting in higher levels of restrictiveness than if set unilaterally, due to the internalization of positive spillovers on trade partners. In the absence of mechanisms to enforce adherence to this cooperative equilibrium, a country might find it advantageous to lower its regulations to enhance wages and ToT. Notably, reducing regulations from the cooperatively agreed high levels would at the same time *improve* wages in the imposing country, and also align with the principles of shallow agreements since it actually *increases* foreign market access by decreasing the fixed cost of exporting. This divergence from the findings of Bagwell and Staiger (2001) is also echoed in the works of Campolmi et al. (2020) and Lashkaripour and Lugovskyy (2023), who explored domestic industrial policies under monopolistic competition. Our analysis identifies this mechanism from a distinct policy perspective, focusing on addressing a domestic consumption externality.

Heterogeneous Optimal Regulations. The optimal restrictiveness of the regulation - chosen unilaterally or in cooperation - also depends on the characteristics of the imposing countries. We provide a summary of how the optimal regulation varies with trade barriers, country size, and technology, with figures shown in Appendix C.7.

Figure C.6 shows a positive relationship between optimal restrictiveness of standards, iceberg trade costs, and tariffs associated with exporting from and to the home economy. As foreign export costs or domestic export costs decline, the optimal standard decreases. A reduction in τ_{fh} or t_{fh} reallocates consumption and production from low-quality domestic varieties to (relatively) high-quality foreign varieties. Similarly, a reduction in τ_{hf} and t_{hf} reallocates production from low-quality non-exporter to high-quality exporters. In both cases, the trade cost-induced reallocation reduces the same distortions that enable regulations to be welfare-improving. For a similar reason, there is a positive relationship between restrictiveness of regulations and optimal tariff (see Figure

C.8). Reductions in the restrictiveness of the regulation reallocate production towards low-quality firms and lower import tariffs partially offset such a reallocation.

Larger economies have larger values of optimal g_{hh} (Figure C.7). To understand this, consider two economies identical in every aspect except size. Imposing a regulation in each country has similar qualitative effects, but the quantitative effects differ. The larger economy experiences a lower reduction in wages as workers shift toward compliance activities. Furthermore, the larger economy experiences a faster growth in the mass of entrants. As a result, welfare in the larger economy increases more with the regulations relative to the smaller economy.

A similar effect occurs when considering economies that are more technologically efficient and have higher per capita income. As the home economy's unit costs c_h decline, the optimal level of regulation rises. This theoretical result finds support in our empirical analysis, where we document a positive relationship between the restrictiveness of technical measures (in the way they affect the extensive margin) and the per capita income of a country.

Washington Apples Effect and Specific Trade Costs. An important empirical finding in the trade literature is the phenomenon known as the "Washington apples" effect (Alchian and Allen, 1964; Hummels and Skiba, 2004; Feenstra and Romalis, 2014), whereby high-quality goods are exported to more distant countries than low-quality goods. This phenomenon is often rationalized by the presence of specific trade costs, which are additive costs paid per unit of output and, therefore, differ from the multiplicative iceberg trade costs.[18] Since our baseline model features only multiplicative trade costs (iceberg trade costs and tariffs), it would be problematic to not capture this phenomenon, which is integral to studies with vertical differentiation. Yet, our model incorporates the "Washington apples" effect, because of the relationship between quality and firm size. Only the high-quality firms are able to export, because their profitability is high enough to cover for the extra costs of exporting. Note that this effect holds both in the CES and non-CES framework.[19] However, we verified that the results of our paper are robust to the inclusion of specific trade costs (see Appendix D).

3.5 The Role of the Consumption Externality

The primary motivation for governments to implement regulations is to mitigate various forms of externalities. In our model, we address this through the inclusion of a consumption externality, denoted as E_j, which is defined in equation (2) and incorporated into the utility function as shown in equation (4). However, in the non-CES framework, regulations can enhance welfare by not only addressing the consumption externality but also by optimizing the distribution of production across firms. To illustrate the potential spillover effects of regulations in the simplest terms, we previously omitted the consumption externality in our discussion. This section, however, aims to investigate

[18]In standard models, higher specific trade costs reduce the relative price of high-quality goods relative to low-quality goods, while multiplicative trade costs leave the relative prices unchanged.

[19]The difference between the two frameworks, in this regard, is that high-quality goods are also high-priced goods when there are variable markups, whereas the prices across firms are identical in the CES model.

whether the inclusion of the consumption externality alters any of our prior findings.

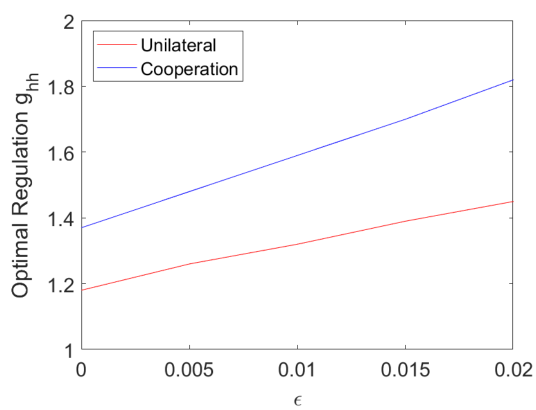
Solving for the positive consumption externality E_j yields:

$$E_j = \left[\frac{\kappa}{\kappa - \beta}\right]^{\frac{\epsilon}{\beta}} \frac{1}{a} \left(\sum_i g_{ij} t_{ij} \tau_{ij} w_i c_i y_j^{-1}\right)^{\epsilon} \tag{27}$$

Hence, all else constant, increases in g_{ij} improve the externality. An improvement in the externality also occurs with increases in other costs from i, which create tougher selection and, thus, higher average quality ($t_{ij}\tau_{ij}w_i$). Finally, a rise in y_j tends to reduce the positive externality due to the more lenient selection that a rise in per capita income generates.

To evaluate the role of the externality on international cooperation, we consider our two symmetric-country framework and evaluate the optimal restrictiveness of regulations imposed by the home country in the case of unilateral regulation setting and of cooperation as a function of ϵ. The results are in Figure 3. For the case where $\epsilon = 0$, the externality is independent of the level of quality, hence the optimal regulation only depends on its effect on U_j^c. Higher levels of ϵ result in more restrictive regulations, as they address both the allocative inefficiency of the market and the positive externality.

Figure 3: Optimal Restrictiveness of Regulation Accounting for Domestic Consumption Externality



The plot shows the optimal g for the home economy under unilateral regulation setting and cooperation with a symmetric foreign country. The values of the parameters are $\kappa = 1$, $\gamma = 1.5$, $\beta = 1$, $\tau_{fh} = \tau_{hf} = 1.5$, $L = c = 1$, $t_{fh} = t_{hf} = 1$.

Our paper's key finding – that cooperation under IA preferences leads to more restrictive regulations – is confirmed here. Furthermore, we observe that there is a positive correlation between the extent of the externality and the optimal level of regulation under cooperation: as the externality parameter ϵ increases, the difference between cooperative and unilateral regulatory approaches becomes more pronounced. This quantitative difference is attributed to the two positive spillovers: the ToT and the entry effect. A higher valuation of the externality, indicated by an increased ϵ, compels governments to tighten regulations. This is because any improvement in average product quality has a more significant impact on consumer utility in such cases. However, when acting unilaterally, governments fail to fully account for the beneficial impacts on other countries, which also increase with tighter regulations. The enhancement in regulatory restrictiveness is less pronounced in unilateral actions compared to what is achieved through cooperative efforts.

3.6 What about an Expanded Set of Policy Instruments?

Is it possible for a more comprehensive set of instruments, used alongside regulations, to enable the government in our framework to decrease domestic misallocation and subsequently modify the rationale for cooperation? In other words, can a strategic domestic policy schedule lessen the need for international coordination to the extent that the only international spillover to address is the ToT effect? We assess the robustness of the role of coordinating regulatory standards by examining two extensions of our model in Appendices E and F.

First, we incorporate production subsidies that influence domestic production for domestic consumption and export. Our analysis reveals that this type of subsidy does not improve welfare, and therefore has no impact on the scope for cooperation over standards. This result is not surprising, given that misallocation is driven by firm heterogeneity. A subsidy that is applied equally to all firms is not effective in addressing such misallocation and even exacerbates it by reducing the selection pressure on firms. Thus, we also find that higher levels of subsidy are associated with higher levels of restrictiveness of regulation. In other studies, subsidies can potentially improve welfare by mitigating misallocation *across sectors* (Campolmi et al., 2014, 2020; Lashkaripour and Lugovskyy, 2023). However, this outcome is unattainable in our single-sector model.

The previous result implies the need for granular instruments. To fix ideas, we take a heavy-handed approach where governments enforce a constant markup for all firms, thus identifying the impact of regulations in the *absence* of market distortions across firms.[20] Without the possibility of improving market distortions, regulations' sole advantage lies in enhancing the domestic consumption externality. Moreover, with constant markups, the only positive spillover present is the ToT effect, as regulations drive *down* entry so it is no longer the case that countries under-regulate due to this channel. The divergence in how regulations influence entry, compared to our baseline model, can be attributed to the role of constant markups. In a scenario where markups remain constant, the proportion of profits to revenues remains unaffected by regulatory changes. This contrasts with our baseline model, where stricter regulations lead to an increase in entry as they boost average profits relative to revenues, since surviving firms have higher markups. However, in the context of constant markups, this dynamic is altered; regulations do not lead to an increase in this profit-to-revenue ratio. Consequently, under these conditions, there is no added incentive for firms to incur the fixed costs associated with entering the market, as the potential for increased profits, is not present. Hence, as low-quality firms exit with regulations, the mass of firms that pay the fixed cost of entry declines.

[20]While this policy may be impractical, it is not entirely unfamiliar to the economic literature, as demonstrated for example, in Hottman et al. (2016). Practically, governments achieve the same allocation by implementing firm-specific taxes and subsidies that depend on the firm's quality level and the market's level of competition. Our goal is to get at the underlying question: what does it take to make the ToT motive the only international spillover, thus reducing the scope of international coordination and connecting to results in the previous trade literature.

To summarize, with constant markups, cooperation is driven only by the ToT, so the scope of cooperation is reduced although not eliminated. Having identified the necessary condition to generate an environment where the ToT motive is the only international spillover, we emphasize that the policy requires knowledge of firms' quality or markups, which are generally not observed by policy makers.[21]

4 Quantitative Analysis

The goal of this section is to leverage the gravity formulation of the model in order to estimate parameters and provide a counterfactual exercise which results in the (world) welfare consequences of either one or several countries concurrently changing their regulation policy. In Appendix C.4, we show that the gravity framework outlined in the previous section allows for a counterfactual exercise that computes the general equilibrium welfare consequences of policy changes, given a parsimonious set of variables and parameters. Given the changes in g_{jj} for $j = 1, ..., I$ and in t_{ij} for $i, j = 1, ..., I$, as well as the initial levels of w_i, y_i, λ_{ij}, t_{ij}, and g_{ij}, we can characterize the changes in trade shares, wages, per capita income, and mass of entrants through equations (69)-(73).

4.1 Estimation of the Model

Data and Estimation of Baseline Parameters. The model fits into a gravity framework (e.g (Arkolakis et al., 2019)), thus the counterfactual analysis first requires estimation of the standard parameters. Gravity data from CEPII's Geography and TRADHIST databases[22], as well as manufacturing data from the World Development Indicators (WDI), allow us to produce employment (proxy for country size, L) and gross output (GO) in manufacturing. Current tariff levels (t_{ij}) are taken directly from data (see Section 2), with the full matrix of tariffs from WITS in the year 2011. Then, trade shares are computed directly from the data on international trade flows, with the computational steps detailed in Appendix G.1. Given λ_{ij}, wages and per capita income are easily backed out through (11) and (12) using employment and tariff data. Tables H.1 and H.2 in the Appendix report the trade shares matrix and estimated wages and income for the sample of countries in the counterfactual.

To estimate κ and γ, we use a census of Chilean firms in 2012 provided by the Chilean statistics database (INE) and follow Macedoni and Weinberger (2022) to estimate these parameters with a cross-section of sales data.[23] With 2012 cross-sectional data of the firm sales distribution, our

[21] Apart from the impracticality of implementing firm-specific taxes and subsidies, the first-best allocation cannot be achieved even in these cases. In our market allocation, the mass of entrants is determined by the ratio between profits and revenues. Firm-specific subsidies can alter this ratio, as subsidized firms have higher profits, which in turn impacts the number of entrants and deviates from the optimal level attained in the market allocation. Consequently, in our framework, to eliminate the entry effect, governments must also impose an entry tax (or subsidy) that changes according to the regulation level.

[22] See Conte et al. (2022) and Fouquin and Hugot (2016).

[23] Details are provided in the cited paper, but we summarize the exercise in Appendix G.4. Chile is the one country for which we have the full census for domestic sales. With those, we match moments from the *domestic* sales distribution (similar to the export moments above). As done in the model, we assume that these parameters are

calibration results in $\kappa = 3.96$ and $\gamma = 1.88$. The rest of the procedure produces iceberg trade costs and restrictiveness measures from the structure of the model.

Estimation of Country-Pair Restrictiveness. Next, we outline the algorithm that estimates the country-pair restrictiveness of regulations g_{ij}, for a sample of trading partners without requiring data on explicit barriers imposed. The EDD provides several statistics from the distribution of sales for firms in origin i and destination j which we use to estimate g_{ij} for each country pair. As is argued above, the regulations not only eliminate low-quality firms but reallocate resources to higher-quality firms. Therefore, relative sales of firms selling in j across percentiles of the sales distribution are a function of g_{ij}. The EDD, with information on the distribution of exporters from an origin to multiple destinations, allows us to match moments informative of the imposition of restrictions on destination sales.

For each country pair in our sample $i - j$ we simulate draws of quality conditional on firms exporting to the destination, and compute revenues relative to the average revenue in the destination by firms from the same origin. We compute 6 moments and match them to the data using g_{ij} (taking as given γ and κ). The moments are: the 25th, 50th, and 75th percentiles of sales normalized by average sales, along with the export share of top 1%, 5%, and 25% of exporters. In all cases, the distribution is based on a specific $i - j$ country pair. A simulated method of moments (SMM) algorithm returns a vector of g_{ij} for each $i \neq j$.[24]

To verify that the estimated g_{ij} reflect fixed costs, in Appendix G.4, we repeat the exercise from specification (1), by regressing the log number of exporters from i to j on the estimated restrictiveness g_{ij} from the SMM procedure. Consistent with g_{ij} capturing a fixed cost, Table G.2 shows that the number of exporters to j decreases with the estimated restrictiveness in that destination. Moreover, higher restrictiveness is associated with a larger average export value.

Estimation of Domestic Restrictiveness. Although using the EDD allows us to estimate the restrictiveness of regulations in j on firms from i, it does not allow us to estimate the level of domestic restrictiveness of regulations in j on firms from j, since it does not provide data on the domestic sales distribution of firms. To estimate the *domestic* level of restrictiveness, g_{jj}, we exploit the structure of our model and, specifically the relationship between g_{ij} and g_{jj} as expressed in equation (22). The full estimation method is detailed in Appendix G.5 and the matrix of estimated restrictiveness measures is reported in Table H.3. Our proposed method allows for the domestic level of restrictiveness to be estimated relative to a normalization (see (22)). We choose Chile (the country we use to estimate κ and γ) as the reference country because of the availability of data on the distribution of firm's domestic sales, with which we can directly estimate the domestic restrictiveness of Chile's regulations. We then express all marginal costs and wages relative to Chile's to estimate g_{jj} for the rest of the countries. Note that because Chile is our numeraire

uniform across countries.

[24] For details on the SMM procedure, see Appendix G.2. All 6 moments are not necessarily available for each pair. For each pair, we estimate g_{ij} with the available moments, as long as at least one is reported.

country, countries in our sample must be destinations for Chile.

Before we proceed to our counterfactual exercises, a brief discussion is necessary on the sample of countries we use in the counterfactual analysis. To compute the hat-algebra described in Section C.4 requires an N by N matrix. However, the EDD data has a limited number of origins countries[25], and furthermore we eliminate all origins that do not sell to Chile. We introduce a "rest of the world" (ROW) trade partner in order to capture the value of trade not captured in our sample. After these restrictions, we are left with 16 origins and destinations and the ROW, which will make up our hypothetical world in estimating the global welfare effects of a change in regulations.

4.2 Counterfactual Analysis

We are now armed with the necessary parameters and initial values to solve the new equilibrium of the model, through the system of equations represented in (69)-(73), and the welfare effects of a given change in regulations. The counterfactual analysis is broken down to quantify four main theoretical results: i) what is the rise in domestic utility from consumption (abstracting from the consumption externality), when countries impose their optimal regulatory restrictiveness (Proposition 2)? ii) how large are the positive spillovers from imposing countries to their trade partners (Proposition 3)? iii) what is the relative importance of the entry vis-a-vis the ToT channel in total spillovers? and iv) what is the value of cooperation (second part of Proposition 3)? We answer question (i) in Section 4.2.1, question (ii) in Section 4.2.2, question (iii) in Section 4.2.3, and question (iv) in Section 4.2.4.

4.2.1 Welfare Effects of Regulations

We first compute the optimal non-cooperative standards in each country implied by our model, taking as given the current policy by other countries. For example, Chile maximizes its welfare by setting its optimal domestic restrictiveness ($g_{chile,chile}$), which then affects the restrictiveness perceived by its trading partners ($g_{i,chile}$) through (22), but it does not incorporate changes in policy abroad.[26]

We then compute the welfare gains as a result of moving to optimal standards starting from a laissez-faire policy (i.e. starting from $g_{jj} = 1$). Welfare changes are computed using the estimated parameters described above and hat algebra: we measure the welfare impact of moving from the starting point to the optimal standard relative to moving from the starting point to $g_{jj} = 1$, thus identifying the welfare change from $g_{jj} = 1$ to the optimal restrictiveness. These welfare gains are shown in the x-axis of the left panel of Figure 4. The results buttress the result of Proposition 2.

[25] There are a selected number of countries for which the EDD data collects information about exporters' (*origins*). Since most destinations (richer countries) are not origins in this data set, our sample decreases significantly relative to the empirical section. This is a consequence of working with EDD data, but we are not aware of any other dataset that contains the type of extensive margin information we require.

[26] As discussed above, when we consider the Nash equilibrium, the best response of the home economy is largely independent of the regulation imposed by the foreign economy (Figure C.5), which is why we allow countries to set their optimal standards independently.

Relative to laissez-faire policy, every country has positive optimal standards and imposing those standards raises welfare. There is heterogeneity across countries, with the average welfare gain at 0.04%, and the average optimal restrictiveness being $g_{jj} = 1.30$ (see Table H.5). The fact that welfare gains are possible for modest levels of optimal restrictiveness is consistent with Figure 1, where home welfare first increases with restrictiveness, before decreasing when the loss of variety and reduction in purchasing power outweigh the positive composition effect. In fact, in Table H.6 we report average welfare gains when we shut off the wage effect and when we shut off entry (which is part of the composition effect). Countries imposing regulations see larger welfare gains in the former and negative welfare changes in the latter.

Although the magnitudes of the welfare gains are not large numbers, an important caveat is that they are lower bounds due to the way we characterize standards as fixed costs that are paid in wages. Regulations that affect the selection of firms without the imposition of a fixed cost paid by *all* firms generate much larger gains as shown by Macedoni and Weinberger (2022). However, we will highlight the large benefits available to countries in *jointly* raising standards. Furthermore, in this quantification exercise, we abstract from the gains of improving the consumption externality, which could be potentially large.

4.2.2 Evidence for the International Spillover

Next, we quantify the size of the international spillover by computing the welfare gains for a country when all its trading partners impose their optimal regulations, but the country itself does not change its policy. For example, we compute the welfare gains in Chile when all countries $i \neq Chile$ impose their optimal g_{ii}, but Chile leaves its level of regulation unchanged to its current level. We do not change j's policy to identify purely the international spillover part and not confuse it with the own country's regulations. Once again, the move to the optimal g_{ii} is from $g_{ii} = 1$. On the left panel of Figure 4, we show these changes in welfare on the y-axis. Along with the cooperative case below, these results map to our Proposition 3.

Every country gains when its *partners* impose larger standards, reflecting the fact that if other countries raise their standards, there are positive spillovers. In this case, the average welfare gains are slightly above 25% of the size of the gains from j imposing its own optimal standards. Exemplified by being above the 45 degree line, some countries (mostly small and open) have larger welfare gains from spillovers than imposing their own optimal standards. Notice this is different than a cooperative equilibrium where countries choose regulations by jointly maximizing welfare. We explore that case in the final subsection.

Before moving on to the quantification of the entry and ToT channels, we discuss some results on the heterogeneity across countries and compare the welfare effects of optimal standards with those of optimal tariffs.

Heterogeneity Across Countries. In our theory, optimal standards increase with income and size, but decrease with openness, and these relationships hold when we examine the optimal regulations behind the welfare changes in the x-axis of Figure 4, left panel. Colombia, with the highest domestic share, has among the highest optimal standards. Costa Rica, which is extremely open, has the lowest optimal standard and thus lowest possible welfare gains away from laissez-faire. The role of size and income is seen for example in comparing Spain and Mexico, which have similar openness, but optimal standards are slightly larger in Spain.

Open economies such as Costa Rica, Chile, and Bolivia, due to their integration with the rest of the world, gain the most from other countries imposing stricter standards relative to imposing their own standards. Relatively closed economies such as Colombia and Peru, or rich/large economies such as Denmark and Spain, have a higher optimal restrictiveness and therefore gain more from simply imposing stricter standards even if other countries do not.

Welfare Effects of Standards Relative to Tariffs. Figure H.1 extends the previous results to tariffs. First, we show that there are clear incentives for countries to impose positive tariffs unilaterally, and in fact welfare gains can be quite large.[27] However, there is an important difference relative to the regulations, which is that the higher tariffs have large negative effects on trade partners. In the case where all countries impose optimal tariffs, everyone is worse off.

Panel (B) of Figure H.1 compares the gains from moving to the optimal regulatory restrictiveness to the case of removing current tariffs, relative to the initial allocation. For the majority of countries, changing standards results in larger welfare gains than all tariffs being removed. Very open countries such as Costa Rica gain more from tariff reductions (and do not gain as much from standards), while more closed economies such as Colombia, Peru, and Uruguay gain relatively more from standards policy. In a world where current tariffs are already quite low, these results rationalize the recent push of trade agreements towards product standard regulation.

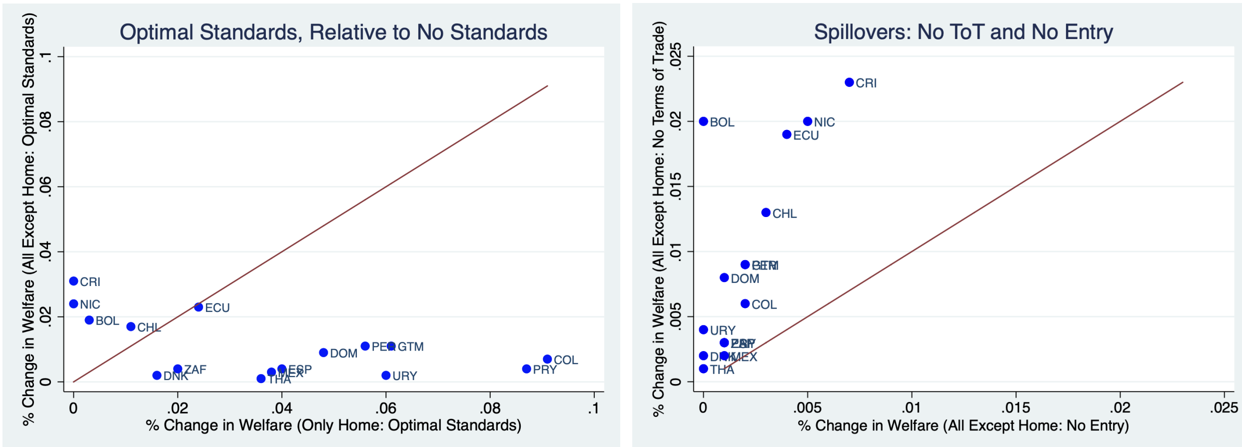
4.2.3 Quantification of Specific Channels

In the right panel of Figure 4, we quantify the contribution of each of the two spillover channels, the ToT and entry channels, on the overall spillover effects of regulations (question (iii) above). To determine each channels' relative strength, discussed theoretically in Section 3.4, we separately turn off each channel and assess the impact on the welfare calculation. Recall that our welfare calculations depend on the hat changes in the mass of entrants $\hat{J}_i$, wages $\hat{w}_i$ and per capita income $\hat{y}_i$ (see the simplified welfare equation (26)). To quantify the impact of each channel, we set the corresponding hat change to one, and re-calculate the change in welfare.

We compute the welfare gains of j when "All Except j" impose their optimal standard but j stays at no regulations. In the x-axis, we report the welfare gain when the entry channel is shut down, meaning we set $\hat{J}_j = 1$ when computing the welfare change. In the y-axis, we report the welfare gain when the ToT channel is shut down (relative wages are fixed) but entry is allowed to change as in the baseline case (setting $\hat{w}_i = \hat{y}_i = 1$, $\forall i$). For all countries, we find that the welfare gains are higher when shutting down only the ToT channel (all points above the 45 degree line).

[27] The optimal tariff on average is 36%. The welfare magnitudes of these counterfactuals compare to Ossa (2014).

Figure 4: % Change in Welfare with Optimal Standards: Own Effects, Spillovers, and Channels



This figure displays the % change in welfare for countries in several scenarios. We compare always to the case where the policy is laissez-faire (i.e. welfare gain of optimal standards starting from no standards). Welfare changes are computed using the estimated parameters described in Section 4.1 and hat algebra: we measure the welfare impact of moving from the starting point to the optimal standard relative to moving from the starting point to $g_{jj} = 1$, thus identifying the welfare change from $g_{jj} = 1$ to the optimal restrictiveness. The left figure computes the welfare gain of each country j when: i) j sets optimal regulation unilaterally (x-axis); and ii) all trade partners *except for* j set their optimal standards (y-axis). In the right panel, we decompose the welfare gain from spillovers, assuming all trade partners except j change their standards. First, we compute the % change in welfare when the terms of trade channel is shut down (y-axis) and then when the entry channel is shut down (x-axis). In all cases, after altering policy through $\hat{g}_{jj}$, we then compute $\hat{J}_j$, $\hat{w}_j$, $\hat{y}_j$ and $\hat{g}_{ij} (i \neq j)$ as a response, which produces the equivalent variation in income according to (77). When we shut down a channel, we assume the "hat-change" in that channel is equal to 1.

On average, shutting down only the relative wages/incomes leaves about 80% of the spillover intact. We can interpret this result to mean that 80%, or four-fifths, of the spillover is driven by the entry channel. As discussed in the model, as the payment of the fixed cost diverts labor to regulatory activities and reduces purchasing power of the imposing country, import prices decline for trade partners. Disabling this channel reduces spillovers. Shutting down only entry leaves intact 20% of the spillover, meaning that changes in ToT only drive 20%, or one-fifth, of the spillover.[28] Stricter regulations boost average profits relative to revenues, which in the baseline model boost foreign entry and thus welfare in trade partners. This analysis highlights the important magnitude of the entry channel as a share of total the total spillover. There are some countries, such as Bolivia and Uruguay, where the spillover is almost completely explained by entry effects. This channel has not been part of the policy discussion in regards to regulatory policy or industrial policy more generally (Lashkaripour and Lugovskyy, 2023), but we show it is quantitatively important when firm misallocation is prevalent. Overall, our decomposition strengthens our discussion in Section 3.4 by providing evidence on the operation of *both* channels in their role for cooperation.

[28]The sum of the welfare gains of each axis produces the total spillover effect reported in the left panel, y-axis, of Figure 4. Table H.5 reports results by country, while Table H.6 shows the decomposition across the 16 countries. Notice for example Chile's gain from spillovers is 0.017%, which can be decomposed into a 0.0135% gain left when we shut down changes in the ToT (80% of the total spillover) and a 0.0035% gain left when we shut down changes in entry (20%).

4.2.4 Benefits from Cooperation

To quantify the value of cooperation (question (iv) above), we conduct a two-country exercise with a deep trade agreement, where countries cooperatively choose the level of restrictiveness. We will show that relative to the unilateral case, when countries *jointly* set standards, they can both gain through higher restrictiveness in parallel to the theoretical results displayed in Figure 2 and the claim in the second part of Proposition 3.

For exposition purposes, we focus on Chile and Ecuador, so that each partner has a significant presence in the other country. In this two-country case, we first recalculate the optimal domestic standard for each country taking the current level of its partner country standard as given – or the non-cooperative case.[29] Then, cooperation allows them to sign a binding agreement where each country sets a domestic standard such that *joint welfare* is maximized. Total welfare depends on the weights given to the welfare change in each country, which we vary from the extreme case where Ecuador receives 80% of the weight to the case where Chile receives 80% of the weight. Recall that in Section 3, we explore two mechanisms that shape the optimal standard under cooperation. First, we show that under symmetry across countries, the cooperative standard is larger than the non-cooperative one. Second, we show that a country's optimal standard depends on the country's technology and size. Hence, when two asymmetric countries cooperatively choose their standards, the first mechanism tends to raise their restrictiveness, while the second tends to make the standards more in line with each country's preferences. By changing the weight on each country in maximizing joint welfare, we illustrate such a trade off with a practical exercise.

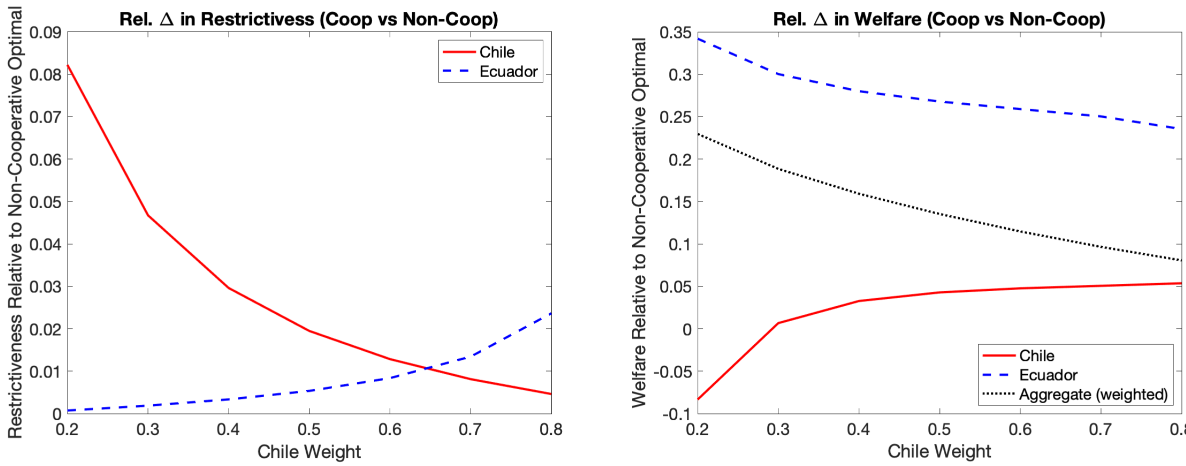
The gains from cooperation are displayed in Figure 5. The x-axis is always the range of weights given to Chile's welfare in the agreement (with Ecuador's weight equal to one minus Chile's). The left (right) panel plots the agreed upon domestic restrictiveness (welfare gains) in each country *relative to the non-cooperative case.* Thus, a positive number reflects a higher restrictiveness level or welfare gain relative to each country setting their unilaterally optimal standards.

It is clear that by cooperating, they both choose to set higher standards (left panel) and the welfare of both countries increases significantly as long as each country gets a large enough weight (red solid and blue dashed lines in the right panel). Intuitively, each country gains when its partners' standards increase, but a unilateral increase in standards reduces the ToT (or the lost purchasing power through lower wages) and welfare. When Chile's weight is very small, the agreement is such that Ecuador marginally raises its standard but Chile does so much more significantly. In this case, although the weighted average welfare change is maximized, Chile's welfare is less than the non-cooperative case while Ecuador's increases significantly. As Chile's weight increases, its own standard decreases while Ecuador's increases, which also raises Chile's welfare. For example, in the case where the weights are equal, both countries set a standard around 1-2% larger than the non-cooperative case.[30] Welfare increases in both countries: by 5% in Chile, 25% in Ecuador, and the average welfare gain is 15% (black dotted line). Ecuador always gains more from the cooperation

[29] We also re-scale trade shares assuming these countries only trade with each other.

[30] Note that it is not the case that at equal weights countries necessarily raise standards by same amount.

Figure 5: The Role for Cooperation: Optimal Restrictiveness, g_{jj}^{opt}, (left) and Welfare Gains (right), relative to Non-Cooperation in 2-country Case (for varying weights on Chile).



The figures display the relative restrictiveness of regulations and welfare gains when countries cooperate in a deep trade agreement, relative to each country (at the same time) setting their own optimal rate. We assume a two-country world where Chile and Ecuador enter into a trade agreement that sets the level of domestic restrictiveness in each country. We calculate the non-cooperative optimal restrictiveness for each country in this two-country scenario. Then, we compare that to the case where they maximize joint welfare, while varying the weights for each country. In all figures, the x-axis is the range of weights given to Chile's welfare in the agreement (with Ecuador's weight equal to one minus Chile's). The left (right) panel plots the agreed upon domestic restrictiveness (welfare gains) in each country relative to the non-cooperative case. "Relative" refers to the relative change (e.g. $\frac{(\Delta W^{Coop} - \Delta W^{Non-Coop})}{\Delta W^{Non-Coop}}$). The right panel (welfare gains) also reports "aggregate" welfare gains, which is the weighted average of welfare gains for each country when moving to the optimal standards (black dotted line). For example, when the weights are 0.5 for each country, cooperation (relative to unilateral policy) leads to 25% higher welfare gains in Ecuador, 5% higher welfare in Chile, and 15% higher welfare on aggregate.

because of the relative trade shares – Chile's firms have more presence in Ecuador.

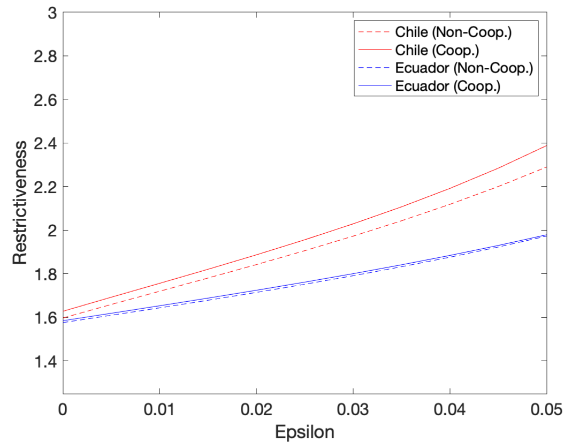
4.2.5 Extension: Including the Consumption Externality E_j

Thus far the quantitative exercise has ignored the consumption externality E_j, as we established that this will not overturn qualitatively our results. The challenge in estimating effects on E_j is that we do not have any baseline estimates on ϵ, which governs the relationship between average quality and the level of the externality and likely varies by types of regulations. We therefore examine changes in welfare for varying levels of ϵ. In Figure 6, we compare the optimal restrictiveness in the unilateral case and the cooperative case (with weights of 0.5 for each country) for the two-country agreement described in the previous subsection, now at different levels of ϵ. This allows us a natural comparison to the numerical exercise in Figure 3. For both countries, the optimal restrictiveness is larger in the case with cooperation. Furthermore, as ϵ increases, the gain from cooperation rises.

5 Conclusions

Governments set standards on the product characteristics that can be sold domestically, applicable to both foreign and domestic firms, to correct for various types of domestic consumption externalities. We model these standards as fixed labor requirements, leading to the exit of low-quality firms, and provide empirical evidence for the extensive margin effect in export data. The

Figure 6: Optimal Restrictiveness of Regulation



This figure plots the optimal restrictiveness (g_{jj}) for Chile and Ecuador in the two-country case where each first sets a unilateral optimal policy and then we allow for cooperation. In the cooperative case, we use a weight of 0.5 for each country. We also allow for regulations to act on the externality, E_j, defined in (2). For both Chile and Ecuador, the dotted line represents the unilateral optimal restrictiveness which is always lower than the cooperative one.

theoretical framework studies the effects of implementing these regulations with a focus on the interdependency created across trade partners. Our first result is that there is no role for international coordination in a framework where preferences are CES. However, deviating from that knife-edge case, regulations now affect the economy through multiple new channels. We show that there is a positive optimal standard for all countries even allowing for the loss of variety and wastefulness of the fixed cost, but our main result is that higher standards improve the welfare of trade partners as well. This is because outside of CES, regulations affect trade shares and thus create spillovers on trade partners. For this reason, the paper justifies trade agreements on standards on the basis of a positive externality and extends the role of cooperation to efficiency considerations. We identify and provide a decomposition of the international spillover into two channels: a terms of trade channel and an entry channel. A two-country deep trade agreement exercise highlights the way cooperation, in lieu of harmonization, can lead to jointly optimal standards with higher welfare achieved through higher levels of regulations.

Our framework allows us to compare the optimal degree of restrictiveness of standards that countries of different characteristics impose. We find that richer countries and those with a higher level of average quality optimally choose more restrictive standards. This result is consistent with our evidence that larger, richer, and less open economies tend to impose a larger number and more restrictive technical standards.

Throughout, we examine standards linked to vertical norms, aimed to induce a positive externality in domestic consumption. There are various potentially fruitful extensions. First, regulations might also relate to horizontal product norms (Schmidt and Steingress, 2022; Mei and Xu, 2023). Second, endogenous quality would introduce new margins of adjustment (Disdier et al., 2023). Finally, potentially most impactful, there are important externalities governments aim to reduce that are *global* in nature, such as pollution. We are not aware of current papers that examine regulations on these fronts in a setting where market power distortions create their own spillovers.

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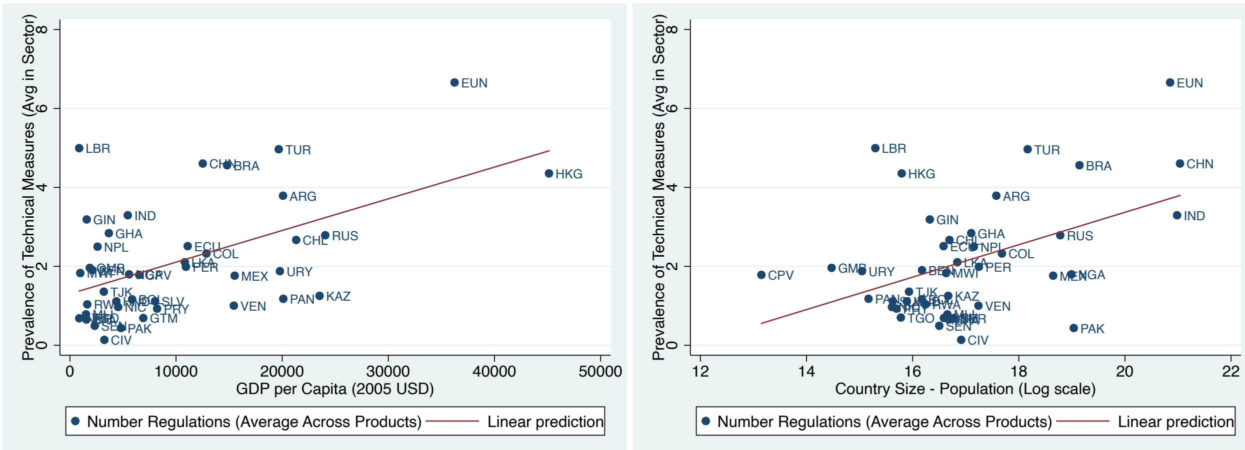
Appendix

A Data Appendix

Figure A.1: Regulations and Country Characteristics



The figure is a scatter plot of GDP per capita (left) and population (right) against the prevalence of TMs (SPS+TBT). The TM data is provided at the country-HS2 product level by CEPII. The prevalence measure we use captures the average number of standards which apply to a HS6 product. We take a weighted average of the HS2 products, weighting by the number of product lines in each sector. Source of the national production and population data is the Penn World Table 9.0. GDP is output-side real GDP, using PPP chain-weighted prices. "EUN" is an aggregate of all EU28 countries. For the country size plot, we plot on a log scale of population due to the huge differences between EU, China, and India with the rest of the countries.

Figure A.1 displays scatter plots of the TM prevalence measure, with country income and size, for 43 countries. For this figure, but not for the regression analysis, we aggregate EU28 countries into "EUN" since they all have the same level of standards. Richer countries tend to impose more standards (left panel). The correlation between GDP per capita and the prevalence of measures is 0.54. In the relationship with country size, measured as population, we also observe almost the same relationship, with a correlation coefficient of 0.52. The relationship is very similar with GDP, or if we restrict standards to include only SPS, which are more likely to reflect vertical norms.

NTM-MAP Database. The database is available at http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=28 and is described in Gourdon (2014). It computes several incidence indicators: a frequency index, coverage ratio, and prevalence score of non-tariff measures (NTMs). These are computed for 71 countries (destinations) at the HS2 and HS-Section level of product aggregation. The source of the data is UNCTAD Trains.

The NTM-MAP produces these incidence measures for different types of NTMs: (A) SPS; (B) TBT; (C) Pre-Shipment Inspections; (D) Contingent trade-protective measures and (E) Non-automatic licensing, quotas, prohibitions and quantity-control measures. For our "product standard" regulations, which we call *Technical Measures* in the empirical application, we aggregate the prevalence measures of SPS and TBT measures. In the "other NTMs" control, we sum up the prevalence measures for the rest of the NTMs included. Data is only reported for *one year* for each country (making it a cross-section across destination-products). However, the "reported year" varies from 2009-2015 across countries (although for most countries the data is either from 2012 or 2014).

Exporter Dynamics Database (EDD). The EDD is a dataset from the World Bank that draws on the universe of exporter transactions obtained directly from customs agencies. We use the HS2 level data, which reports the number of exporters from an origin country to many destinations at this product classification level. It also includes several measures of the intensive margin, in terms of the mean, median, etc. of export values across exporters. The EDD is provided in the following link: https://microdata.worldbank.org/index.php/catalog/2545/get-microdata. Specifically, we use the file *CYH2D_all_1000usd*, which provides measures at the exporting country-year-HS 2-digit product-destination country level for all HS2 codes.

There are 45 origins in the EDD data and 70 destinations. We can match the vast majority of destinations to our TM data, but if we wanted a measure of the barriers imposed by the origin we would only be able to do this for less than half the countries. In this case, we split the EU into separate countries to take advantage of variation in trade flows to separate European destinations.

Since the TM data includes regulations mostly from 2010 to 2014, we use these same years for EDD data and take the means across years to generate a cross-section of trade margins. For certain countries, data is only available for previous years, in which case we use the latest available year. If no data is available before 2010 we drop that country. Finally, we only keep country-pairs where there are at least 200 total exporters from the origin selling to that destination (across all products). This database is also used in the estimation procedure described in Section 4.

Other Datasets.

- PTW Data, version 9.0, available at https://www.rug.nl/ggdc/productivity/pwt/pwt-releases/pwt9.0?lang=en. From this dataset we use the following variables: population and real GDP at constant prices (both total and per capita). We take the means across 2010-2014 to generate a cross-section of country-characteristics.

- Gravity Data: This comes from the GeoDist database available at CEPII: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=6. We use the commonly used measures of distance as well as indicators for country-pairs based on whether they share a border, share a language, or share a common colonial history.

- Trade Flows: Trade flows used to construct trade shares are from the BACI database in CEPII: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37. Our openness measure is based on the import share of a destination-HS2 product relative to the global imports of that HS2 product.

- Tariff Data: imported from the WITS database. We download the data at the reporter-partner-HS2 level for the tariff-year 2011 (middle of our EDD sample). For each reporter-partner observation, our HS2 data reflects the simple average of *Effectively Applied Tariffs* (AHS) across all tariff lines.

B Model Derivations: CES

B.1 Firms and Cutoff

Solving the consumer problem yields the following inverse demand function:

$$p_{ij}(\omega) = y_j (U_j^c)^{\frac{1-\sigma}{\sigma}} z(\omega)^{\frac{\sigma-1}{\sigma}} q_{ij}(\omega)^{-\frac{1}{\sigma}} \tag{28}$$

The profits of a firm with quality z from i to j are given by:

$$\pi_{ij}(z) = L_j \left[\frac{y_j}{t_{ij}(U_j^c)^{\frac{\sigma-1}{\sigma}}} z^{\frac{\sigma-1}{\sigma}} q(z)^{\frac{\sigma-1}{\sigma}} - c_i w_i \tau_{ij} q_{ij}(z) \right] - f_{ij} \tag{29}$$

Solving the firm's problem yields the standard CES pricing equation with constant markups:

$$p_{ij}(z) = \frac{\sigma}{\sigma-1} c_i w_i \tau_{ij} t_{ij} \tag{30}$$

Substituting (30) into (28) yields the optimal quantity supplied by the firm, which equals:

$$q(z) = z^{\sigma-1} \left[\frac{\sigma-1}{\sigma} \frac{y_j}{c_i w_i \tau_{ij} t_{ij} (U_j^c)^{\frac{\sigma-1}{\sigma}}} \right]^{\sigma} \tag{31}$$

Substituting $q(z)$ in the profit function yields:

$$\pi_{ij}(z) = L_j \left[\frac{y_j}{t_{ij}(U_j^c)^{\frac{\sigma-1}{\sigma}}} z^{\frac{\sigma-1+(\sigma-1)^2}{\sigma}} \left[\frac{\sigma-1}{\sigma} \frac{y_j}{c_i w_i \tau_{ij} t_{ij} (U_j^c)^{\frac{\sigma-1}{\sigma}}} \right]^{\sigma-1} - c_i w_i \tau_{ij} z^{\sigma-1} \left[\frac{\sigma-1}{\sigma} \frac{y_j}{c_i w_i \tau_{ij} t_{ij} (U_j^c)^{\frac{\sigma-1}{\sigma}}} \right]^{\sigma} \right] - f_{ij} \tag{32}$$

$$= L_j \left[\frac{\sigma-1}{\sigma} \frac{y_j}{c_i w_i \tau_{ij} t_{ij} (U_j^c)^{\frac{\sigma-1}{\sigma}}} \right]^{\sigma} \left[\left(\frac{\sigma}{\sigma-1} \right) c_i w_i \tau_{ij} z^{\sigma-1} - c_i w_i \tau_{ij} z^{\sigma-1} \right] - f_{ij} = \tag{33}$$

$$= \frac{L_j (\sigma-1)^{\sigma-1} y_j^{\sigma}}{\sigma^{\sigma} t_{ij}^{\sigma} (U_j^c)^{\sigma-1}} (c_i w_i \tau_{ij})^{-(\sigma-1)} z^{\sigma-1} - f_{ij} \tag{34}$$

Finally, we repeat from the main text the equation that characterizes the quality cutoff that sets profits to zero ($\pi_{ij}(\bar{z}_{ij}) = 0$):

$$\bar{z}_{ij} = \left(\frac{\sigma^{\sigma} (U_j^c)^{\sigma-1}}{L_j (\sigma-1)^{\sigma-1} y_j^{\sigma}} \right)^{\frac{1}{\sigma-1}} c_i w_i \tau_{ij} (t_{ij}^{\sigma} f_{ij})^{\frac{1}{\sigma-1}} \tag{7}$$

The cutoff from i to j relative to the destination's domestic cutoff can be written as:

$$\bar{z}_{ij} = \bar{z}_{jj} \frac{c_i w_i \tau_{ij} (t_{ij}^{\sigma} f_{ij})^{\frac{1}{\sigma-1}}}{c_j w_j \tau_{jj} (t_{jj}^{\sigma} f_{jj})^{\frac{1}{\sigma-1}}} \tag{35}$$

Substituting (7) into the profit function (29) yields:

$$\pi_{ij}(z) = f_{ij} \left[\left(\frac{z}{\bar{z}_{ij}} \right)^{\sigma-1} - 1 \right] \tag{36}$$

Substituting (7) into the optimal quantity (31) yields:

$$q_{ij}(z) = \left(\frac{z}{\bar{z}_{ij}} \right)^{\sigma-1} \frac{y_j^{\sigma} (\sigma-1)^{\sigma}}{\sigma^{\sigma} (c_i w_i \tau_{ij})^{\sigma} t_{ij}^{\sigma} (U_j^c)^{\sigma-1}} \left(\frac{\sigma^{\sigma} (U_j^c)^{\sigma-1}}{L_j (\sigma-1)^{\sigma-1} y_j^{\sigma}} \right) \left(c_i w_i \tau_{ij} (t_{ij}^{\sigma} f_{ij})^{\frac{1}{\sigma-1}} \right)^{\sigma-1} =$$

$$= \frac{f_{ij}(\sigma-1)}{L_j c_i w_i \tau_{ij}} \left(\frac{z}{\bar{z}_{ij}} \right)^{\sigma-1} \tag{37}$$

Using the pricing equation (30), firm revenues equal:

$$r_{ij}(z) = \frac{L_j p_{ij}(z) q_{ij}(z)}{t_{ij}} = \sigma f_{ij} \left(\frac{z}{\bar{z}_{ij}} \right)^{\sigma-1} \tag{38}$$

B.2 Aggregation and Equilibrium

Average revenues equal:

$$\bar{r}_{ij} = \frac{\sigma \kappa f_{ij}}{\kappa - \sigma + 1} \tag{39}$$

Aggregate revenues (net of tariff) equal:

$$R_{ij} = J_i b_i^{\kappa} (\bar{z}_{ij})^{-\kappa} \frac{\sigma \kappa f_{ij}}{\kappa - \sigma + 1} = \tag{40}$$

$$= \frac{\sigma \kappa (\bar{z}_{jj})^{-\kappa} (c_j w_j \tau_{jj})^{\kappa} (t_{jj} f_{jj})^{\frac{\kappa}{\sigma-1}}}{\kappa - \sigma + 1} J_i b_i^{\kappa} (c_i w_i \tau_{ij})^{-\kappa} (t_{ij}^{\sigma} f_{ij})^{-\frac{\kappa}{\sigma-1}} f_{ij} \tag{41}$$

and we restrict the parameter space so that $\kappa > \sigma - 1$.

The gravity equation is given by:

$$\lambda_{ij} = \frac{t_{ij} R_{ij}}{\sum_v t_{vj} R_{vj}} = \frac{J_i b_i^{\kappa} (\tau_{ij} c_i w_i (t_{ij}^{\sigma} f_{ij})^{\frac{1}{\sigma-1}})^{-\kappa} f_{ij} t_{ij}}{\sum_v J_v b_v^{\kappa} (\tau_{vj} c_v w_v (t_{vj}^{\sigma} f_{vj})^{\frac{1}{\sigma-1}})^{-\kappa} f_{vj} t_{vj}}$$

To show that our results are independent on whether the fixed cost is paid in origin or destination labor units, let $f_{ij} = w_i^{\alpha} w_j^{1-\alpha} f_j$, where $\alpha = \{0, 1\}$. Regardless of the level of α, as shown in the main text, the gravity equation is independent of the regulatory cost f_j:

$$\lambda_{ij} = \frac{t_{ij}R_{ij}}{\sum_v t_{vj}R_{vj}} = \frac{J_i b_i^\kappa (\tau_{ij} c_i w_i (t_{ij}^\sigma w_i^\alpha w_j^{1-\alpha})^{\frac{1}{\sigma-1}})^{-\kappa} w_i^\alpha w_j^{1-\alpha} t_{ij}}{\sum_v J_v b_v^\kappa (\tau_{vj} c_v w_v (t_{vj}^\sigma w_i^\alpha w_j^{1-\alpha})^{\frac{1}{\sigma-1}})^{-\kappa} w_i^\alpha w_j^{1-\alpha} t_{vj}} \quad \forall i,j = 1,...,I \tag{42}$$

Average profits equal:

$$\bar{\pi}_{ij} = \frac{(\sigma-1)f_{ij}}{\kappa-\sigma+1} = \bar{r}_{ij}\frac{\sigma-1}{\sigma\kappa} \tag{43}$$

Hence, expected profits equal:

$$E[\pi_{ij}] = \sum_j b_i^\kappa (\bar{z}_{ij})^{-\kappa} \bar{\pi}_{ij} = \frac{\sigma-1}{\sigma\kappa}\sum_j b_i^\kappa (\bar{z}_{ij})^{-\kappa} \bar{r}_{ij} =$$

$$= \frac{\sigma-1}{\sigma\kappa}\sum_j b_i^\kappa (\bar{z}_{ij})^{-\kappa} \bar{r}_{ij} = \frac{\sigma-1}{\sigma\kappa}\sum_j b_i^\kappa (\bar{z}_{ij})^{-\kappa} \frac{R_{ij}}{J_i b_i^\kappa (\bar{z}_{ij})^{-\kappa}} = \tag{44}$$

$$= \frac{\sigma-1}{\sigma\kappa}\sum_j \frac{t_{ij}R_{ij}\sum_v t_{vj}R_{vj}}{J_i t_{ij}\sum_v t_{vj}R_{vj}} = \tag{45}$$

$$= \frac{\sigma-1}{\sigma\kappa}\sum_j \frac{\lambda_{ij} y_j L_j}{J_i t_{ij}} \tag{46}$$

where we used the fact that $\sum_v t_{vj}R_{vj} = y_j L_j$ by the market clearing condition.

Setting expected profits equal to the fixed cost of entry ($w_i f_E$) yields the equilibrium mass of entrants that we showed in the main text (10).

Per capita income is given by:

$$y_j = w_j + \frac{1}{L_j}\sum_i (t_{ij}-1)R_{ij}$$

$$y_j = w_j + y_j \sum_i (t_{ij}-1)\frac{\lambda_{ij}}{t_{ij}}$$

which is the expression shown in the main text.

B.3 Welfare and Externality

Consider the cutoff definition for $\bar{z}_{jj}$:

$$\bar{z}_{jj} = \left(\frac{\sigma^\sigma (U_j^c)^{\sigma-1}}{L_j(\sigma-1)^{\sigma-1} y_j^\sigma}\right)^{\frac{1}{\sigma-1}} c_j w_j \tau_{jj} (t_{jj}^\sigma f_{jj})^{\frac{1}{\sigma-1}} = (U_j^c)\left(\frac{\sigma^\sigma}{L_j(\sigma-1)^{\sigma-1} y_j^\sigma}\right)^{\frac{1}{\sigma-1}} c_j w_j \tau_{jj} (t_{jj}^\sigma w_j f_j)^{\frac{1}{\sigma-1}} \tag{47}$$

Hence, the utility equals:

$$U_j^c = \bar{z}_{jj}\frac{(\sigma-1)(L_j y_j^\sigma)^{\frac{1}{\sigma-1}}}{\sigma^{\frac{\sigma}{\sigma-1}} c_j w_j \tau_{jj} (t_{jj}^\sigma w_j f_j)^{\frac{1}{\sigma-1}}} \tag{48}$$

From the aggregate revenue definition:

$$\begin{aligned}
R_{jj} &= J_j b_j^\kappa (\bar{z}_{jj})^{-\kappa} \frac{\sigma\kappa w_j f_j}{\kappa-\sigma+1} \\
(\bar{z}_{jj})^\kappa &= \frac{\sigma\kappa w_j f_j J_j b_j^\kappa}{(\kappa-\sigma+1)R_{jj}} \\
(\bar{z}_{jj})^\kappa &= \frac{\sigma\kappa w_j f_j J_j b_j^\kappa t_{jj}}{(\kappa-\sigma+1)\lambda_{jj} y_j L_j}
\end{aligned}$$

where we used the fact that $t_{jj}R_{jj} = \lambda_{jj} y_j L_j$. Hence,

$$\bar{z}_{jj} = \left(\frac{\sigma\kappa w_j J_j b_j^\kappa t_{jj}}{y_j L_j(\kappa-\sigma+1)}\right)^{\frac{1}{\kappa}} f_j^{\frac{1}{\kappa}} \lambda_{jj}^{-\frac{1}{\kappa}} \tag{49}$$

Substituting this into the utility function yields:

$$\begin{aligned}
U_j^c &= \left(\frac{\sigma\kappa w_j J_j b_j^\kappa t_{jj}}{y_j L_j(\kappa-\sigma+1)}\right)^{\frac{1}{\kappa}} \frac{(\sigma-1)(L_j y_j^\sigma)^{\frac{1}{\sigma-1}}}{\sigma^{\frac{\sigma}{\sigma-1}} c_j w_j \tau_{jj}(t_{jj}^\sigma w_j f_j)^{\frac{1}{\sigma-1}}} f_j^{\frac{1}{\kappa}} \lambda_{jj}^{-\frac{1}{\kappa}} = \\
&= \left(\frac{\sigma\kappa w_j J_j b_j^\kappa t_{jj}}{y_j L_j(\kappa-\sigma+1)}\right)^{\frac{1}{\kappa}} \frac{(\sigma-1)(L_j y_j^\sigma)^{\frac{1}{\sigma-1}}}{\sigma^{\frac{\sigma}{\sigma-1}} c_j w_j \tau_{jj}(t_{jj}^\sigma w_j)^{\frac{1}{\sigma-1}}} f_j^{-\frac{\kappa-\sigma+1}{\kappa}} \lambda_{jj}^{-\frac{1}{\kappa}} =
\end{aligned}$$

Hence, an increase in f_j reduces the utility due to the loss in product variety (since all other variables in the utility function are constant).

Finally, let us compute the geometric average of quality from i to j (3):

$$\begin{aligned}
\tilde{z}_{ij} &= \left[\frac{\kappa}{\kappa-\beta}(\bar{z}_{ij})^\beta\right]^{\frac{1}{\beta}} = \\
&= \left[\frac{\kappa}{\kappa-\beta}\right]^{\frac{1}{\beta}} \bar{z}_{ij} = \\
&= \left[\frac{\kappa}{\kappa-\beta}\right]^{\frac{1}{\beta}} \left(\frac{\sigma\kappa w_i^\alpha w_j^{1-\alpha} J_i b_i^\kappa t_{ij}}{y_j L_j(\kappa-\sigma+1)}\right)^{\frac{1}{\kappa}} f_j^{\frac{1}{\kappa}} \lambda_{ij}^{-\frac{1}{\kappa}}
\end{aligned}$$

We can then solve for the externality as follows:

$$E = f_j^{\frac{\epsilon}{\kappa}} \left[\frac{\kappa}{\kappa-\beta}\right]^{\frac{\epsilon}{\beta}} \left(\sum_i \left(\frac{\sigma\kappa w_i^\alpha w_j^{1-\alpha} J_i b_i^\kappa t_{ij}}{y_j L_j(\kappa-\sigma+1)}\right)^{\frac{1}{\kappa}} \lambda_{ij}^{-\frac{1}{\kappa}}\right)^\epsilon \tag{50}$$

Hence, consumer's utility can be written as:

$$U_j = \left(\frac{\sigma\kappa w_j J_j b_j^\kappa t_{jj}}{y_j L_j(\kappa-\sigma+1)}\right)^{\frac{1}{\kappa}} \frac{(\sigma-1)(L_j y_j^\sigma)^{\frac{1}{\sigma-1}}}{\sigma^{\frac{\sigma}{\sigma-1}} c_j w_j \tau_{jj}(t_{jj}^\sigma w_j)^{\frac{1}{\sigma-1}}} f_j^{-\frac{\kappa-\sigma+1}{\kappa}} \lambda_{jj}^{-\frac{1}{\kappa}} + \tag{51}$$

$$+ f_j^{\frac{\epsilon}{\kappa}} \left[\frac{\kappa}{\kappa-\beta}\right]^{\frac{\epsilon}{\beta}} \left(\sum_i \left(\frac{\sigma\kappa w_i^{\alpha} w_j^{1-\alpha} J_i b_i^{\kappa} t_{ij}}{y_j L_j(\kappa-\sigma+1)}\right)^{\frac{1}{\kappa}} \lambda_{ij}^{-\frac{1}{\kappa}}\right)^{\epsilon} \tag{52}$$

We can re-write the utility to isolate the effect of the fixed cost as shown in the main text:

$$U = (U_j^c)^0 f_j^{-\frac{\kappa-\sigma+1}{\kappa}} + E_j^0 f_j^{\frac{\epsilon}{\kappa}} \tag{53}$$

C Model Derivations: Non-CES

C.1 Firm Problem

Profits of a firm in from i to j are given by:

$$\begin{aligned}\pi_{ij}(z) &= L_j \left[\frac{p_{ij}(z)}{t_{ij}} q_{ij}(z) - c_i w_i \tau_{ij} q_{ij}(z)\right] - f_{ij} = \\ &= L_j \left[\frac{y_j}{t_{ij}} \left(az q_{ij}(z) - (\xi_j)^{\frac{1}{\gamma}} (q_{ij}(z))^{1+\frac{1}{\gamma}}\right) - \tau_{ij} w_i c_i q_{ij}(z)\right] - f_{ij}\end{aligned} \tag{54}$$

Given the quality draw z, a firm from i maximizes its profits in a destination j by choosing the quantity $q_{ij}(z)$ and taking ξ_j as given. The first order condition with respect to $q_{ij}(\omega)$ equals:

$$\frac{y_j}{t_{ij}} az - \frac{y_j}{t_{ij}} \left(1 + \frac{1}{\gamma}\right) (\xi_j q_{ij}(z))^{\frac{1}{\gamma}} = \tau_{ij} w_i c_i \tag{55}$$

Setting $q_{ij}(z_{ij}^*) = 0$ yields the market quality cutoff as in the main text:

$$z_{ij}^* = \frac{t_{ij} \tau_{ij} w_i c_i}{a y_j} \tag{56}$$

Substituting the cutoff (56) into the first order condition (55) yields the optimal quantity:

$$q_{ij}(z) = \left(\frac{a\gamma}{1+\gamma}\right)^{\gamma} \frac{(z_{ij}^*)^{\gamma}}{\xi_j} \left(\frac{z}{z_{ij}^*} - 1\right)^{\gamma} \tag{57}$$

Substituting (57) into the inverse demand function (16) yields the optimal pricing rule we show in the main text:

$$p_{ij}(z) = \frac{a y_j z_{ij}^*}{1+\gamma} \left(\frac{z}{z_{ij}^*} + \gamma\right) \tag{58}$$

We report here the formula for revenues and profits we also showed in the main text:

$$r_{ij}(z) = \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right) \left(\frac{L_j y_j (z_{ij}^*)^{1+\gamma}}{\xi_j t_{ij}}\right) \left(\frac{z}{z_{ij}^*} - 1\right)^{\gamma} \left(\frac{z}{z_{ij}^*} + \gamma\right) \tag{59}$$

$$\tilde{\pi}_{ij}(z) = \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right) \left(\frac{L_j y_j (z_{ij}^*)^{1+\gamma}}{\xi_j t_{ij}}\right) \left(\frac{z}{z_{ij}^*} - 1\right)^{1+\gamma} - f_{ij} \tag{60}$$

C.2 Aggregation and Equilibrium

The mass of active firms N_{ij} from i selling to destination j equals:

$$N_{ij} = \frac{J_i b_i^\kappa}{\bar{z}_{ij}^\kappa} = \frac{J_i b_i^\kappa}{(z_{ij}^* g_{ij})^\kappa} = a^\kappa J_i b_i^\kappa (c_i w_i)^{-\kappa} w_j^\kappa (t_{ij}\tau_{ij} g_{ij})^{-\kappa} \tag{61}$$

and is declining in the restrictiveness of the regulation g_{ij}.

Aggregate revenues (net of tariffs) of firms from i to country j are given by:

$$\begin{aligned}
R_{ij} &= N_{ij} \int_{\bar{z}_{ij}}^{\infty} r_{ij}(z) \frac{\kappa \bar{z}_{ij}^\kappa}{z^{\kappa+1}} dz = \\
&= N_{ij} \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}} \right) \left(\frac{L_j y_j (z_{ij}^*)^{1+\gamma}}{\xi_j t_{ij}} \right) \int_{\bar{z}_{ij}}^{\infty} \left(\frac{z}{z_{ij}^*} - 1 \right)^\gamma \left(\frac{z}{z_{ij}^*} + \gamma \right) \frac{\kappa \bar{z}_{ij}^\kappa}{z^{\kappa+1}} dz = \\
&= N_{ij} \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}} \right) \left(\frac{L_j y_j (z_{ij}^*)^{1+\gamma}}{\xi_j t_{ij}} \right) G_2(g_{ij}) = \\
&= \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}} \right) \left(\frac{L_j y_j (z_{ij}^*)^{1+\gamma-\kappa}}{\xi_j t_{ij} g_{ij}^\kappa} \right) J_i b_i^\kappa G_2(g_{ij}) = \\
&= \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}} \right) \left(\frac{L_j y_j (z_{jj}^*)^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}} \right) (\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} t_{ij}^{-\kappa+\gamma} J_i b_i^\kappa g_{ij}^{-\kappa} G_2(g_{ij})
\end{aligned}$$

where we used the definition of quality cutoff $z_{ij}^* = z_{jj}^* \frac{t_{ij}\tau_{ij}c_i w_i}{c_j w_j}$. $G_2(g_{ij})$ is given by:

$$G_2(g_{ij}) = \kappa g_{ij}^\gamma \left[\frac{g_{ij\,2}F_1[\kappa-\gamma-1, -\gamma; \kappa-\gamma, g_{ij}^{-1}]}{\kappa-\gamma-1} + \frac{\gamma_2 F_1[\kappa-\gamma, -\gamma; \kappa-\gamma+1, g_{ij}^{-1}]}{\kappa-\gamma} \right]$$

where ${}_2F_1[a, b; c; d]$ is the hypergeometric function defined as:

$${}_2F_1[a, b; c; d] = \frac{\Gamma(c)}{\Gamma(b)\Gamma(c-b)} \int_0^1 t^{b-1}(1-t)^{c-b-1}(1-td)^{-a} dt \tag{62}$$

where $\Gamma()$ is the gamma function.

The sum of sales (including tariffs) across origins to destination j is then:

$$\sum_i t_{ij} R_{ij} = \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}} \right) \left(\frac{L_j y_j (z_{jj}^*)^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}} \right) \sum_i (t_{ij}\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} J_i b_i^\kappa g_{ij}^{-\kappa} G_2(g_{ij}) \tag{63}$$

Hence, the gravity equation is represented by the following expression for the trade share, which we reported in the main text:

$$\lambda_{ij} = \frac{t_{ij} R_{ij}}{\sum_v t_{vj} R_{vj}} = \frac{(t_{ij}\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} J_i b_i^\kappa g_{ij}^{-\kappa} G_2(g_{ij})}{\sum_v (t_{ij}\tau_{vj} c_v w_v)^{-\kappa+\gamma+1} J_v b_v^\kappa g_{vj}^{-\kappa} G_2(g_{vj})} \tag{64}$$

By market clearing, total sales in a destination equal the total income of that destination, i.e., $\sum_i t_{ij} R_{ij} = y_j L_j$. Thus, we obtain:

$$\left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{jj})^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}}\right) = L_j y_j \left[\sum_i (t_{ij}\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_2(g_{ij})\right]^{-1} \tag{65}$$

Average profits from i to j are:

$$\begin{aligned}
\bar{\pi}_{ij} &= \int_{\bar{z}_{ij}}^{\infty} \pi_{ij}(z) \frac{\kappa \bar{z}_{ij}^{\kappa}}{z^{\kappa+1}} dz - f_{ij} = \\
&= \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j w_j (z^*_{ij})^{1+\gamma}}{\xi_j}\right) \int_{\bar{z}_{ij}}^{\infty} \left(\frac{z}{z^*_{ij}} - 1\right)^{1+\gamma} \frac{\kappa \bar{z}_{ij}^{\kappa}}{z^{\kappa+1}} dz - f_{ij} = \\
&= \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j w_j (z^*_{ij})^{1+\gamma}}{\xi_j}\right) G_1(g_{ij}) - f_{ij} = \\
&= \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j w_j (z^*_{ij})^{1+\gamma}}{\xi_j t_{ij}}\right) (G_1(g_{ij}) - (g_{ij} - 1)^{1+\gamma})
\end{aligned}$$

where we used the implicit definition of g_{ij} (21) and where $G_1(g_{ij})$ is given by:

$$G_1(g_{ij}) = \kappa g_{ij}^{\gamma} \left[\frac{g_{ij}\, {}_2F_1[\kappa-\gamma-1, -\gamma; \kappa-\gamma, g_{ij}^{-1}]}{\kappa-\gamma-1} - \frac{{}_2F_1[\kappa-\gamma, -\gamma; \kappa-\gamma+1, g_{ij}^{-1}]}{\kappa-\gamma}\right]$$

Let $\tilde{G}_1(g_{ij}) = g_{ij}^{-\kappa}[G_1(g_{ij}) - (g_{ij}-1)^{1+\gamma}]$ and $\tilde{G}_2(g_{ij}) = g_{ij}^{-\kappa} G_2(g_{ij})$. Expected profits from i to j equals:

$$\begin{aligned}
E[\pi_{ij}] &= \left(\frac{b_i}{\bar{z}_{ij}}\right)^{\kappa} \bar{\pi}_{ij} = b_i^{\kappa} (z^*_{ij})^{-\kappa} g_{ij}^{-\kappa} \bar{\pi}_{ij} = \\
&= \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j w_j (z^*_{ij})^{-\kappa+1+\gamma}}{\xi_j t_{ij}}\right) b_i^{\kappa} g_{ij}^{-\kappa} (G_1(g_{ij}) - (g_{ij}-1)^{1+\gamma}) = \\
&= \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{jj})^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}}\right) (\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} t_{ij}^{-\kappa+\gamma} b_i^{\kappa} \tilde{G}_1(g_{ij}) = \\
&= \frac{L_j y_j (\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} t_{ij}^{-\kappa+\gamma} b_i^{\kappa} \tilde{G}_1(g_{ij})}{\sum_i (t_{ij}\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_2(g_{ij})}
\end{aligned}$$

where we used (65). Using our gravity equation (64), the expected profits can be written as:

$$E[\pi_{ij}] = L_j y_j \frac{\lambda_{ij}}{J_i t_{ij}} \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} \tag{66}$$

The zero expected profit condition yields the expression for the equilibrium mass of firms:

$$\sum_j E[\pi_{ij}] = w_i f_E$$

$$\sum_j L_j y_j \frac{\lambda_{ij}}{J_i t_{ij}} \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} = w_i f_E$$

$$J_i = \frac{1}{w_i f_E} \sum_j \frac{\lambda_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} \quad \forall i = 1, ..., I \tag{67}$$

which is the expression shown in the main text.

Per capita income is given by:

$$y_j = w_j + y_j \sum_i (t_{ij} - 1) \frac{\lambda_{ij}}{t_{ij}}$$

which is the expression shown in the main text for the CES case.

Let us now consider the utility function. Substituting the definition of the aggregator ξ_j into the utility function yields:

$$U_j^c = \int_{\Omega_j} \left(az(\omega)\xi_j q(\omega) - \frac{\xi_j q(\omega))^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}} \right) d\omega - \xi_j = \int_{\Omega_j} \frac{(\xi_j q(\omega))^{1+\frac{1}{\gamma}}}{1+\gamma} d\omega =$$

$$= \left(\frac{a\gamma}{1+\gamma} \right)^{1+\gamma} \sum_{i=1,h} (z_{ij}^*)^{\gamma+1} N_{ij} \int_{\bar{z}_{ij}}^{\infty} \left(\frac{z}{z_{ij}^*} - 1 \right)^{1+\gamma} \frac{\kappa \bar{z}_{ij}^{\kappa}}{z^{\kappa+1}} dz$$

Thus, the utility becomes:

$$U_j = a^{\kappa} \left(\frac{\gamma}{1+\gamma} \right)^{1+\gamma} \sum_i J_i b_i^{\kappa} \left(\frac{t_{ij}\tau_{ij}w_i c_i}{y_j} \right)^{-\kappa+\gamma+1} g_{ij}^{-\kappa} G_1(g_{ij})$$

From our gravity equation:

$$J_i b_i^{\kappa} \left(\frac{t_{ij}\tau_{ij}w_i c_i}{y_j} \right)^{-\kappa+\gamma+1} g_{ij}^{-\kappa} = \frac{\lambda_{ij}}{\lambda_{jj}} J_j b_j^{\kappa} \left(\frac{\tau_{jj} c_j w_j}{y_j} \right)^{-\kappa+\gamma} g_{jj}^{-\kappa} \frac{G_2(g_{jj})}{G_2(g_{ij})}$$

Thus, we obtain:

$$U_j^c = a^{\kappa} \left(\frac{\gamma}{1+\gamma} \right)^{1+\gamma} \frac{J_j b_j^{\kappa} (\tau_{jj} c_j w_j / y_j)^{-\kappa+\gamma+1}}{\lambda_{jj}} \tilde{G}_2(g_{jj}) \sum_i \frac{\lambda_{ij} G_1(g_{ij})}{G_2(g_{ij})}$$

C.3 Mapping of Fixed Cost to g

In this section, we show numerically that there is a monotonic relationship between the fixed cost f_j and the restrictiveness of regulations g_{jj} in the domestic economy, as well as between g_{jj} and g_{ij}.

Hence, we extend the result of Macedoni and Weinberger (2022) to the open economy framework. We do so in the two-country framework used in the previous section.

Let us re-write here the relationship between domestic restrictiveness and fixed costs (21)

$$f_{jj} = \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{jj})^{1+\gamma}}{\xi_j t_{jj}}\right)(g_{jj}-1)^{1+\gamma}$$

From our aggregate revenue definition, notice that:

$$\left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{jj})^{1+\gamma}}{\xi_j t_{jj}}\right) = \frac{R_{ij}}{N_{ij}G_2(g_{ij})}$$

Hence, our definition can be re-written as:

$$f_{jj} = \frac{R_{jj}\,(g_{jj}-1)^{1+\gamma}}{N_{jj}G_2(g_{jj})}$$

From the gravity equation definition:

$$R_{jj} = \frac{\lambda_{jj} y_j L_j}{t_{jj}}$$

Furthermore,

$$N_{jj} = J_j b_j^{\kappa} (g_{jj} z^*_{jj})^{-\kappa}$$

and

$$z^*_{jj} = \frac{t_{jj}\tau_{jj} w_j c_j}{a y_j}$$

Finally, $f_{jj} = f_j w_j$. Hence, we can write the fixed cost f_j as:

$$f_j = \frac{R_{jj}\,(g_{jj}-1)^{1+\gamma}}{w_j N_{jj} G_2(g_{jj})} \tag{68}$$

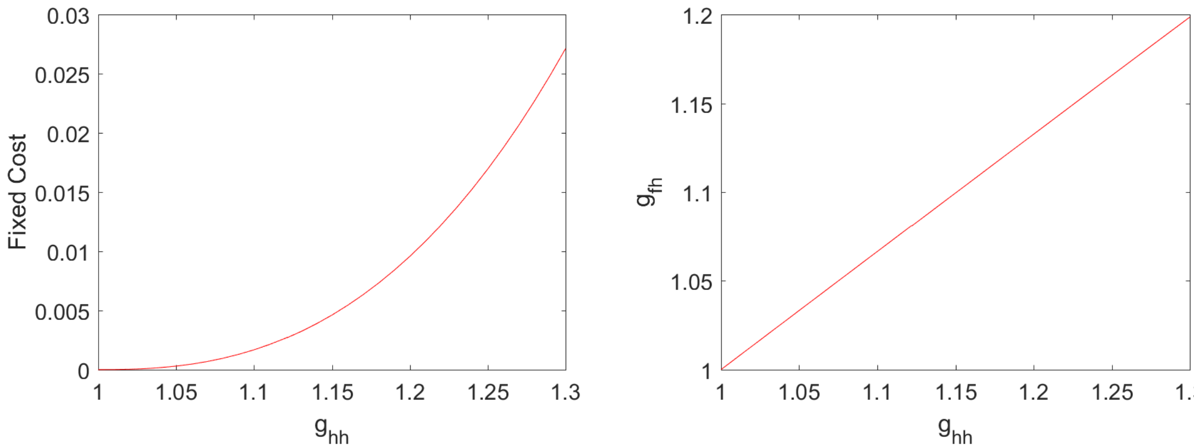
where total sales R_{ij} and mass of surviving firms N_{jj} are defined above and depend on the equilibrium variables computed in the previous section.

We use the parameters adopted in Sections 3.3.5, 3.4, and C.6. Specifically, we consider the case of two symmetric countries, where only one of them (home) is allowed to impose a regulation. The parameters are as follows: $\kappa = 4$, $\gamma = 1.5$, $\lambda_{hh} = \lambda_{ff} = 0.65$. In the initial equilibrium the two countries are identical and size and per capita income are normalized to one. In the initial equilibrium, there are no regulations and there is a symmetric level of tariffs $t_{hf} = t_{fh} = 1.01$. The iceberg trade costs are derived using the gravity equations and the numerical values for trade shares and tariffs. Figure C.1 shows that there is a one-to-one mapping of the fixed cost into the restrictiveness of regulations g_{hh} and g_{fh}.[31]

[31] We show here the results in the case in which the fixed costs are expressed in destination labor units. This assumption only affects panel (b), i.e., the relationship between g_{hh} and g_{fh}. However, the results are robust to changing this assumption.

Figure C.1: Fixed Cost and Regulatory Restrictiveness

(a) Fixed Cost f_j **(b)** Restrictiveness g_{fh}



C.4 General Effects of Regulation Changes

By use of the hat algebra as in Arkolakis et al. (2012), we can easily characterize the changes in the equilibrium values of our endogenous variables, as well as welfare, following any change in the regulatory restrictiveness of countries. Though our primary focus is on regulations, we also consider the effects of changes in tariffs t_{ij}, which allow us to examine the interaction between the two policies. Hence, the exogenous sources of shock in our model are regulations and tariffs. We abstract from endogenous policy responses so that changes in one of the two instruments do not mechanically change the other. The hat algebra technique allows us to consider these changes given a parsimonious set of parameters and we are going to use it in the quantification exercise of Section 4.

Any change in the level of domestic regulation g_{jj} is reflected to changes in the restrictiveness faced by firms from i when exporting to j (g_{ij}), as described in (22). Given exogenous changes in g_{ij} for $i, j = 1, ..., I$, and exogenous changes in t_{ij} $i, j = 1, ..., I$, for the initial levels of w_i, λ_{ij}, g_{ij}, and t_{ij} we can characterize the changes in trade shares, wages, and mass of entrants.

We denote with $\hat{x} = \frac{x_{new}}{x_{old}}$ the change in a variable, and apply the hat algebra to the equations (23), (11), (24), (12), and (22). The system of equations is as follows:

$$\hat{\lambda}_{ij} = \frac{\hat{J}_i \hat{w}_i^{-\kappa+\gamma+1} \hat{t}_{ij}^{-\kappa+\gamma+1} \hat{\tilde{G}}_2(g_{ij})}{\sum_v \lambda_{vj} \hat{J}_v \hat{w}_v^{-\kappa+\gamma+1} \hat{t}_{vj}^{-\kappa+\gamma+1} \hat{\tilde{G}}_2(g_{vj})} \qquad \forall i, j = 1, ...I \qquad (69)$$

$$\hat{y}_i = \frac{\sum_j \lambda_{ij} y_j L_j \hat{\lambda}_{ij} \hat{y}_j}{\sum_j \lambda_{ij} y_j L_j} \qquad \forall i = 1, ..., I \qquad (70)$$

$$\hat{J}_i = \frac{1}{\hat{w}_i} \frac{\sum_j \frac{\lambda_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} \frac{\hat{\lambda}_{ij}}{\hat{t}_{ij}} \hat{y}_j \widehat{\left(\frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})}\right)}}{\sum_j \frac{\lambda_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})}} \qquad \forall i = 1, ..., I \qquad (71)$$

$$\hat{y}_j = \frac{w_j}{y_j}\hat{w}_j + \sum_i \widehat{\left(\frac{t_{ij}-1}{t_{ij}}\right)}\hat{\lambda}_{ij}\hat{y}_j\left(\frac{t_{ij}-1}{t_{ij}}\right)\lambda_{ij} \qquad \forall j = 1, ..., I \tag{72}$$

$$\widehat{(g_{ij}-1)} = \widehat{(g_{jj}-1)}\hat{t}_{ij}^{\frac{-\gamma}{1+\gamma}}\hat{w}_i^{-1}\hat{w}_j \qquad \forall i, j = 1, ...I \tag{73}$$

Finally, let us consider the equilibrium value of the consumption externality E_j. First, solving $\tilde{z}_{ij}$ yields:

$$\tilde{z}_{ij} = \left[\frac{\kappa}{\kappa-\beta}\right]^{\frac{1}{\beta}}\bar{z}_{ij} = \left[\frac{\kappa}{\kappa-\beta}\right]^{\frac{1}{\beta}} g_{ij}z_{ij}^* = \left[\frac{\kappa}{\kappa-\beta}\right]^{\frac{1}{\beta}} g_{ij}\frac{t_{ij}\tau_{ij}w_ic_i}{ay_j}$$

where we used the definition of the cutoff $z_{ij}^* = \frac{t_{ij}\tau_{ij}w_ic_i}{ay_j}$. The average quality linearly increases with the government cutoff $\bar{z}_{ij}$ and, therefore with the restrictiveness of regulations g_{ij}. Substituting $\tilde{z}_{ij}$ into the externality function yields the formula we showed in the main text:

$$E_j = \left[\frac{\kappa}{\kappa-\beta}\right]^{\frac{\epsilon}{\beta}}\frac{1}{a}\left(\sum_i g_{ij}t_{ij}\tau_{ij}w_ic_iy_j^{-1}\right)^{\epsilon} \tag{74}$$

The exact hat change in the externality equals:

$$\hat{E}_j = \left(\sum_i \frac{g_{ij}t_{ij}\tau_{ij}w_ic_i}{\sum_v g_{vj}t_{vj}\tau_{vj}w_vc_v}\hat{g}_{ij}\hat{t}_{ij}\hat{w}_i\hat{y}_j^{-1}\right)^{\epsilon} \tag{75}$$

C.5 Equivalent Variation in Income

To compute the welfare changes due to the change in regulation, we consider the equivalent variation in income which leaves consumers indifferent between the new equilibrium at the new level of regulation, and the initial allocation. First, we need to compute the change in utility following a change in regulation, using (25):

$$\hat{U}_j^c = \frac{\hat{J}_j}{\hat{\lambda}_{jj}}\left(\frac{\hat{w}_j}{\hat{y}_j}\right)^{-\kappa+\gamma+1}\hat{\hat{G}}_2(g_{jj})\frac{\sum_i \frac{\lambda_{ij}G_1(g_{ij})}{G_2(g_{ij})}\frac{\hat{\lambda}_{ij}\hat{G}_1(g_{ij})}{\hat{G}_2(g_{ij})}}{\sum_i \frac{\lambda_{ij}G_1(g_{ij})}{G_2(g_{ij})}} \tag{76}$$

Then, we compute the equivalent variation in income by deriving the change in utility due to a change in income, keeping the price distribution unchanged. To do so, first, consider the indirect utility function written as:

$$V(W_j, \mathbf{p}) = \frac{1}{1+\gamma}\sum_i N_{ij}\int_0^{\bar{z}_{ij}}(\xi_j q_{ij}(z))^{1+\frac{1}{\gamma}} f(z)dz = \frac{1}{1+\gamma}\sum_i N_{ij}\int_0^{\bar{z}_{ij}}\left(az - \frac{p_{ij}(z)}{W_j}\right)^{1+\gamma} f(z)dz$$

where $W_j = y_j + EV_j$ and EV_j is the equivalent variation in income. Taking logs and differentiating with respect to W_j holding prices constant yields:

$$d\ln V_j = (1+\gamma)\frac{\sum_i N_{ij}\int_0^{\bar{z}_{ij}}\left(az - \frac{p_{ij}(z)}{W_j}\right)^{\gamma}\frac{p_{ij}(z)}{W_j}f(z)dz}{\sum_i N_{ij}\int_0^{\bar{z}_{ij}}\left(az - \frac{p_{ij}(z)}{W_j}\right)^{1+\gamma}f(z)dz}d\ln W_j$$

Substituting prices yields:

$$d\ln V_j = (1+\gamma)\frac{\sum_i N_{ij}(z^*_{ij})^{1+\gamma}\int_0^{\bar{z}_{ij}}\left(\left(1+\gamma-\frac{y_j}{W_j}\right)\frac{z}{z^*_{ij}} - \gamma\frac{y_j}{W_j}\right)^{\gamma}\frac{y_j}{W_j}\left(\frac{z}{z^*_{ij}}+\gamma\right)f(z)dz}{\sum_i N_{ij}(z^*_{ij})^{1+\gamma}\int_0^{\bar{z}_{ij}}\left(\left(1+\gamma-\frac{y_j}{W_j}\right)\frac{z}{z^*_{ij}} - \gamma\frac{y_j}{W_j}\right)^{1+\gamma}f(z)dz}d\ln W_j$$

Solving the expression generates hypergeometric functions that depend both on g_{ij} and EV_j. Integrating for $EV_j \in [0, W_j - y_j]$ yields the equivalent change in welfare. However, such an expression is quite complicated and requires numerical integration. Thus, we use the local approximation, which can be obtained by setting $y_j = W_j$. This yields:

$$\begin{aligned}
d\ln V_j &= (1+\gamma)\frac{\sum_i N_{ij}(z^*_{ij})^{1+\gamma}\int_0^{\bar{z}_{ij}}\left(\frac{z}{z^*_{ij}}-1\right)^{\gamma}\left(\frac{z}{z^*_{ij}}+\gamma\right)f(z)dz}{\sum_i N_{ij}(z^*_{ij})^{1+\gamma}\int_0^{\bar{z}_{ij}}\left(\frac{z}{z^*_{ij}}-1\right)^{1+\gamma}f(z)dz}d\ln W_j = \\
&= (1+\gamma)\frac{\sum_i J_i b_i^{\kappa}(t_{ij}\tau_{ij}c_i w_i)^{1+\gamma}g_{ij}^{-\kappa}G_2(g_{ij})}{\sum_i J_i b_i^{\kappa}(t_{ij}\tau_{ij}c_i w_i)^{1+\gamma}g_{ij}^{-\kappa}G_1(g_{ij})}d\ln W_j = \\
&= (1+\gamma)\frac{\sum_i \lambda_{ij}}{\sum_i \lambda_{ij}\frac{G_1(g_{ij})}{G_2(g_{ij})}}d\ln W_j = \\
&= (1+\gamma)\left[\sum_i \lambda_{ij}\frac{G_1(g_{ij})}{G_2(g_{ij})}\right]^{-1}d\ln W_j
\end{aligned}$$

Thus, to compute the welfare change given $\hat{U}^c_j$, we calculate:

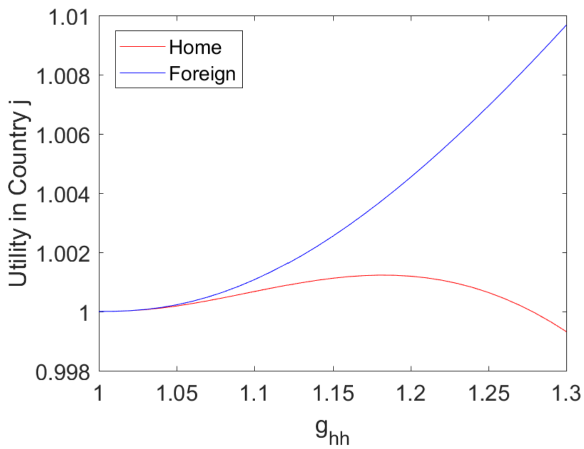
$$d\ln W_j = \frac{\sum_i \lambda_{ij}\frac{G_1(g_{ij})}{G_2(g_{ij})}}{1+\gamma}(\hat{U}^c_j - 1) \tag{77}$$

C.6 Welfare Effects of Regulations

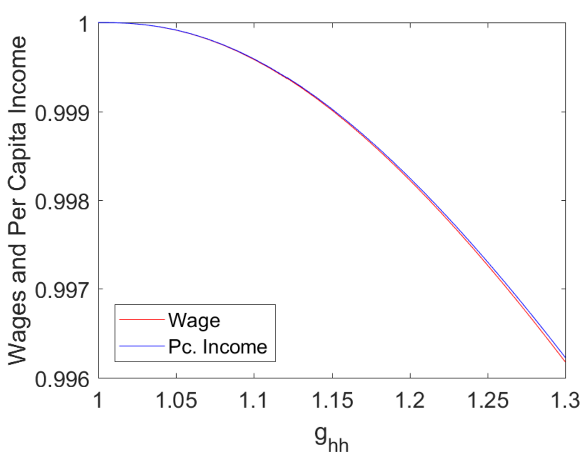
We consider the case of two symmetric countries, where only one of them (home) is allowed to impose a regulation. The parameters are as follows: $\kappa = 4$, $\gamma = 1.5$, $\lambda_{hh} = \lambda_{ff} = 0.65$. In the initial equilibrium the two countries are identical and size and per capita income are normalized to one. In the initial equilibrium, there are no regulations and there is a symmetric level of tariffs $t_{hf} = t_{fh} = 1.01$. The iceberg trade costs are derived using the gravity equations and the numerical values for trade shares and tariffs. Figure C.2 illustrates the effects of increase in restrictiveness of the standard on several outcome variables. Figure C.3 displays results for the case in which firms must pay the fixed cost of compliance in *destination* labor units. Namely, $f_{hh} = w_h f$ and $f_{fh} = w_f f = f$. This change in the assumption does not alter the results in any relevant way. Furthermore, in this case of symmetric countries, the plots look virtually identical to the case of fixed costs in source labor units. The reason for that is due to the fact that home wages change minimally in the range of regulations considered and, therefore, such a change is not enough to produce visible changes in optimal policy.

Figure C.2: Effects of Regulations (Fixed Cost in Origin Labor Units)

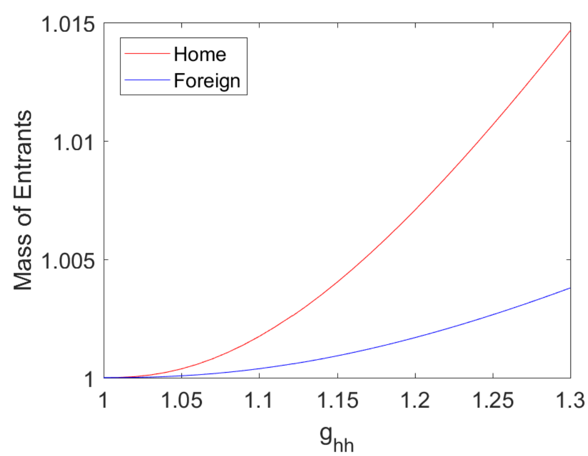
(a) Utility



(b) Wages and Pc. Income



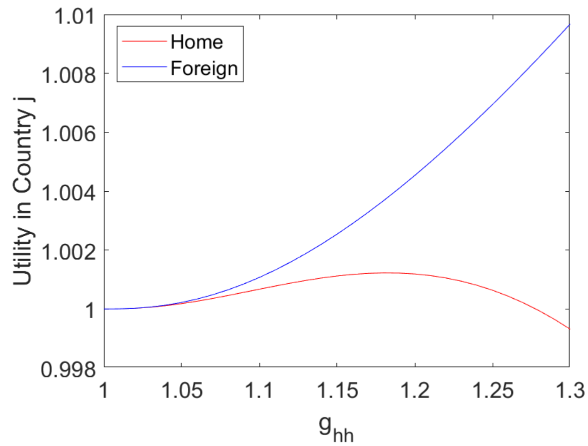
(c) Entry



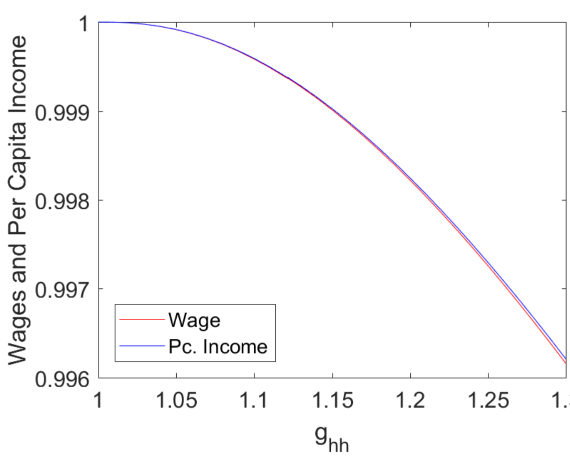
The plots show the hat change in the home and foreign utility, wages, and entry given changes in the home regulation g_{hh}. The parameters are as follows: $\kappa = 4$, $\gamma = 1.5$, $\lambda_{hh} = \lambda_{ff} = 0.65$. In the initial equilibrium, the two countries are identical and size and per capita income are normalized to one. In the initial equilibrium, there are no regulations and there is a symmetric level of tariffs $t_{hf} = t_{fh} = 1.01$. The iceberg trade costs are derived using the gravity equations and the numerical values for trade shares and tariffs. Fixed costs are in origin labor units.

Figure C.3: Effects of Regulations (Fixed Cost in Destination Labor Units)

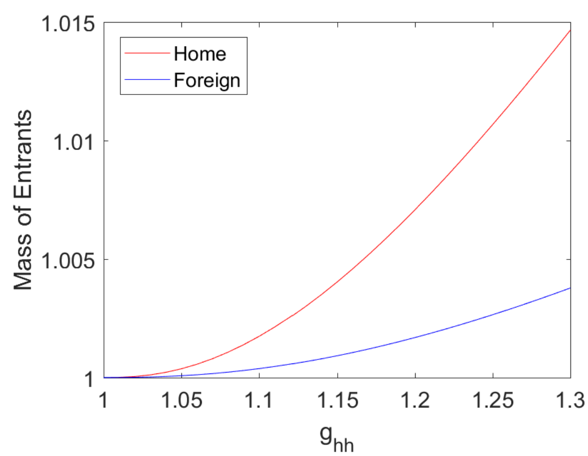
(a) Utility



(b) Wages and Pc. Income



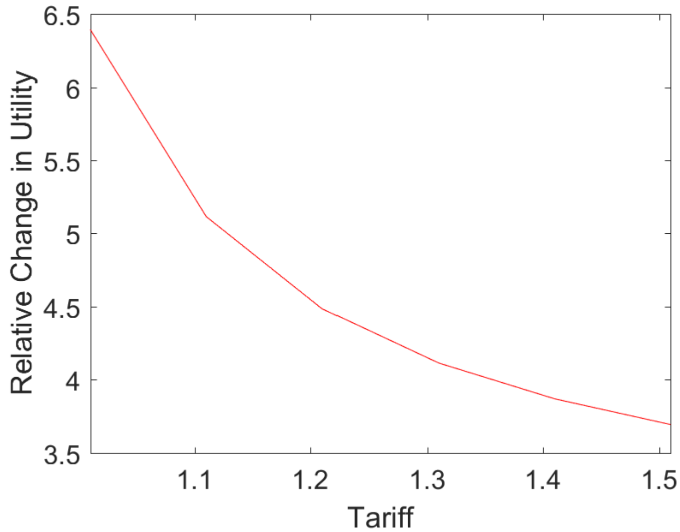
(c) Entry



The plots show the hat change in the home and foreign utility, wages, and entry given changes in the home regulation g_{hh}. The parameters are as follows: $\kappa = 4$, $\gamma = 1.5$, $\lambda_{hh} = \lambda_{ff} = 0.65$. In the initial equilibrium, the two countries are identical and size and per capita income are normalized to one. In the initial equilibrium, there are no regulations and there is a symmetric level of tariffs $t_{hf} = t_{fh} = 1.01$. The iceberg trade costs are derived using the gravity equations and the numerical values for trade shares and tariffs. Fixed costs are in destination labor units.

Jointly Setting Regulations and Tariffs. We also verify whether the welfare improvements due to cooperation increase or decrease with the level of tariffs. In particular, we evaluate the percentage in the utility of consumers $\hat{U}_j^c$ due to the imposition of the optimal level of regulations, relative to the case of no regulations. Figure C.4 shows that the welfare benefits of regulations are lower for higher levels of the iceberg trade costs. Not only is a reduction in trade costs associated with a lower optimal level of regulation, but the welfare benefits of imposing a regulation also increase. This result suggests that the positive international spillover rationale for a deep trade agreement declines with the iceberg trade costs. However, the welfare benefits from cooperation are significant at any level of iceberg trade costs, with the percentage change in utility being three to six times greater than the change in utility resulting from the unilateral imposition of regulation.

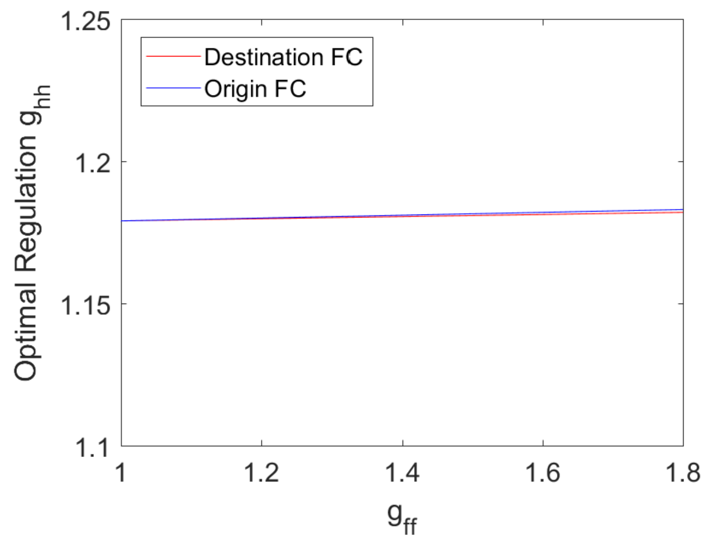
Figure C.4: Restrictiveness of Regulation and Home Welfare - Cooperation



The figure plots $\hat{U}_j^c$ for the home economy due to the imposition of the optimal regulation under cooperation relative the unilateral imposition of the regulation, at different values of tariffs.

Nash Best Response. We have examined the Nash Equilibrium resulting when both economies impose a standard. Figure C.5 shows the best response function for the home economy, which is generally flat and slightly increasing. As a result, the optimal restrictiveness of the regulation of the home economy is largely independent of the regulation imposed by the foreign economy. The reason for this is that the foreign regulation does not affect the distortions in the home economy. For the sake of the argument, assume that there are no tariffs. In that case, the market cutoff z_{hh}^* is constant. Hence, the production of high-quality firms relative to low-quality firms is independent of the level of foreign regulation. Since the home regulation improves welfare because low-quality firms under-produce, and the foreign regulation does not affect this, the incentives to set g_{hh} remain unchanged. This result supports our approach of considering the scenario in which only the home economy imposes unilaterally the regulation, which is much faster to compute than the Nash equilibrium.

Figure C.5: Best Response



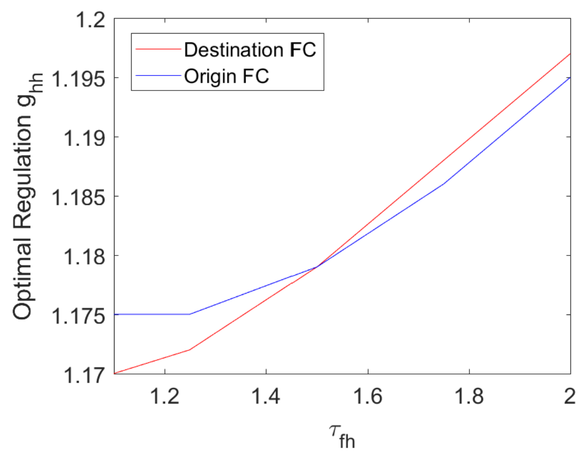
The figures plots the optimal level of regulation of the home economy (vertical axis), given a level of restrictiveness of regulation of the foreign economy (horizonthal axis).

C.7 Heterogeneous Optimal Regulations

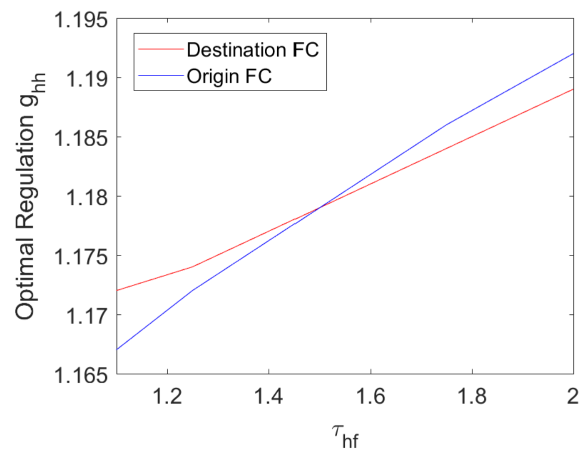
This section shows that the optimal regulations of a country depends on the level of trade costs, technology and size. Figure C.6 shows the relationship between optimal regulations and import and export trade costs and tariffs of the imposing country. Figure C.7 shows the relationship between optimal regulations and the size and unit costs of the imposing country. Figure C.8 displays the relationship between optimal tariff and level of domestic restrictiveness of regulations.

Figure C.6: Optimal Regulation, Iceberg Trade Costs, and Tariffs

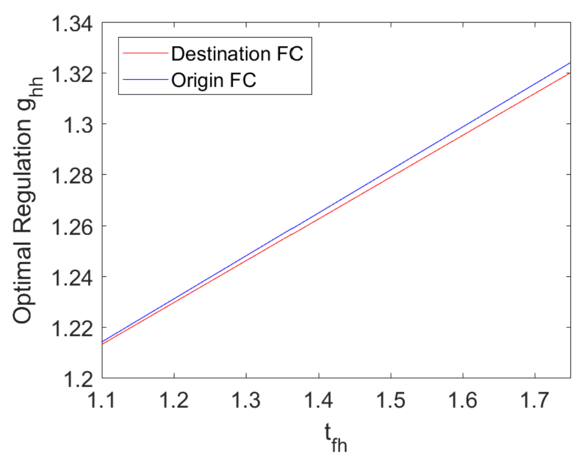
(a) Trade Cost τ_{fh}



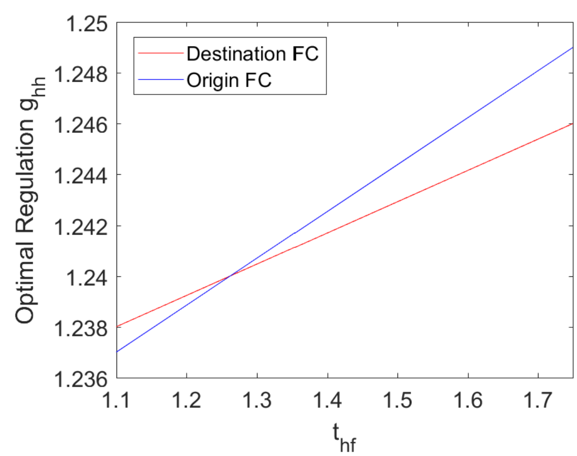
(b) Trade Cost τ_{hf}



(c) Tariff t_{fh}



(d) Tariff t_{hf}

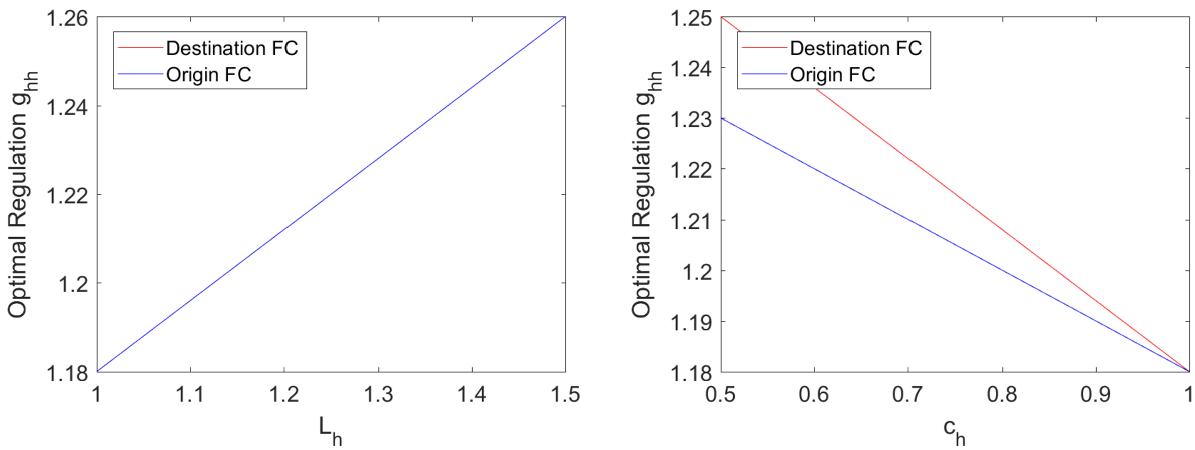


The figures plots the optimal level of regulation of the home economy (vertical axis), given import and export trade costs and tariffs.

Figure C.7: Optimal Regulation, Size, and Costs

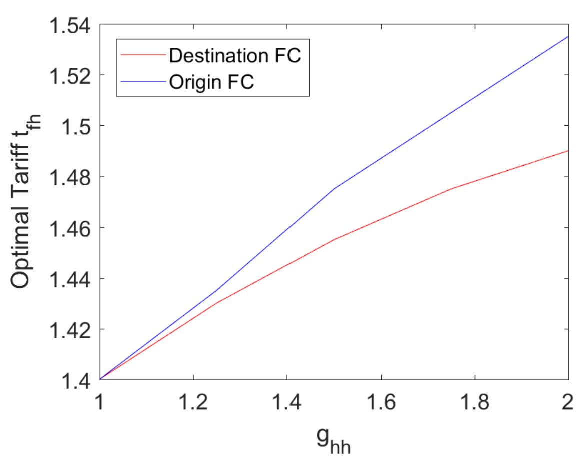
(a) Home Size

(b) Home Unit Costs



The figures plots the optimal level of regulation of the home economy (vertical axis), given home size and home unit costs.

Figure C.8: Optimal Tariff



The figures plots the optimal tariff, given a level of domestic regulations.

D Specific Trade Costs

In this section, we consider an extension to the baseline model in which exporting requires the payment of a specific trade costs T_{ij}, with $T_{ii} = 0$. We show that this model extension does not affect the key results of both the CES and non-CES model.

D.1 Model Derivations: CES

We begin with the CES framework. The profits of a firm with quality z from i to j are given by:

$$\pi_{ij}(z) = L_j \left[\frac{y_j}{t_{ij}(U_j^c)^{\frac{\sigma-1}{\sigma}}} z^{\frac{\sigma-1}{\sigma}} q_{ij}(z)^{\frac{\sigma-1}{\sigma}} - (c_i w_i \tau_{ij} + T_{ij})\, q_{ij}(z) \right] - f_{ij} \tag{78}$$

Solving the firm's problem yields the standard CES pricing equation with constant markups:

$$p_{ij}(z) = \frac{\sigma}{\sigma - 1} (c_i w_i \tau_{ij} + T_{ij})\, t_{ij} \tag{79}$$

The quality cutoff that sets profits to zero ($\pi_{ij}(\bar{z}_{ij}) = 0$) equals:

$$\bar{z}_{ij} = \left(\frac{\sigma^\sigma (U_j^c)^{\sigma-1}}{L_j(\sigma-1)^{\sigma-1} y_j^\sigma} \right)^{\frac{1}{\sigma-1}} (c_i w_i \tau_{ij} + T_{ij})\, (t_{ij}^\sigma f_{ij})^{\frac{1}{\sigma-1}} \tag{80}$$

Notice that the cutoff is increasing in T_{ij}: higher specific trade costs generate tougher quality selection. This effect is also generated by the iceberg trade cost τ_{ij}.

The cutoff from i to j relative to the destination's domestic cutoff can be written as:

$$\bar{z}_{ij} = \bar{z}_{jj} \frac{(c_i w_i \tau_{ij} + T_{ij})\, (t_{ij}^\sigma f_{ij})^{\frac{1}{\sigma-1}}}{(c_j w_j \tau_{jj} + T_{jj})\, (t_{jj}^\sigma f_{jj})^{\frac{1}{\sigma-1}}} \tag{81}$$

Substituting (80) into the profit function (78) yields:

$$\pi_{ij}(z) = f_{ij} \left[\left(\frac{z}{\bar{z}_{ij}} \right)^{\sigma-1} - 1 \right] \tag{82}$$

and is the same expression of the baseline model. Similarly, the expression for firm revenues is also identical to the baseline model:

$$r_{ij}(z) = \frac{L_j p_{ij}(z) q_{ij}(z)}{t_{ij}} = \sigma f_{ij} \left(\frac{z}{\bar{z}_{ij}} \right)^{\sigma-1} \tag{83}$$

Aggregate revenues (net of tariff) equal:

$$R_{ij} = \frac{\sigma\kappa(\bar{z}_{jj})^{-\kappa} (c_j w_j \tau_{jj} + T_{jj})^\kappa (t_{jj} f_{jj})^{\frac{\kappa}{\sigma-1}}}{\kappa - \sigma + 1} J_i b_i^\kappa (c_i w_i \tau_{ij} + T_{ij})^{-\kappa} (t_{ij}^\sigma f_{ij})^{-\frac{\kappa}{\sigma-1}} f_{ij} \tag{84}$$

and we restrict the parameter space so that $\kappa > \sigma - 1$.

The gravity equation is given by:

$$\lambda_{ij} = \frac{t_{ij}R_{ij}}{\sum_v t_{vj}R_{vj}} = \frac{J_i b_i^{\kappa}((c_i w_i \tau_{ij} + T_{ij})\,(t_{ij}^{\sigma} f_{ij})^{\frac{1}{\sigma-1}})^{-\kappa} f_{ij} t_{ij}}{\sum_v J_v b_v^{\kappa}((c_v w_v \tau_{vj} + T_{vj})\,(t_{vj}^{\sigma} f_{vj})^{\frac{1}{\sigma-1}})^{-\kappa} f_{vj} t_{vj}}$$

The presence of specific trade costs does not change the fact that the expenditure shares λ_{ij} are independent of fixed regulatory costs when those are non-discriminatory, i.e. when $f_{ij} = w_i^{\alpha} w_j^{1-\alpha} f_j$, where $\alpha = \{0, 1\}$.

Since profits are identical to the baseline model, expected profits are also identical and so is the equilibrium mass of entrants that we showed in the main text (10).

Following the same steps of the baseline model, consumer's utility can be written as:

$$U_j = \left(\frac{\sigma\kappa w_j J_j b_j^{\kappa} t_{jj}}{y_j L_j(\kappa - \sigma + 1)}\right)^{\frac{1}{\kappa}} \frac{(\sigma - 1)(L_j y_j^{\sigma})^{\frac{1}{\sigma-1}}}{\sigma^{\frac{\sigma}{\sigma-1}}\,(c_j w_j \tau_{jj} + T_{jj})\,(t_{jj}^{\sigma} w_j)^{\frac{1}{\sigma-1}}} f_j^{-\frac{\kappa-\sigma+1}{\kappa}} \lambda_{jj}^{-\frac{1}{\kappa}} + \tag{85}$$

$$+ f_j^{\frac{\epsilon}{\kappa}} \left[\frac{\kappa}{\kappa - \beta}\right]^{\frac{\epsilon}{\beta}} \left(\sum_i \left(\frac{\sigma\kappa w_i^{\alpha} w_j^{1-\alpha} J_i b_i^{\kappa} t_{ij}}{y_j L_j(\kappa - \sigma + 1)}\right)^{\frac{1}{\kappa}} \lambda_{ij}^{-\frac{1}{\kappa}}\right)^{\epsilon} = \tag{86}$$

$$= (U_j^c)^0 f_j^{-\frac{\kappa-\sigma+1}{\kappa}} + E_j^0 f_j^{\frac{\epsilon}{\kappa}} \tag{87}$$

which is identical to the baseline model since $T_{jj} = 0$.

D.2 Model Derivations: non-CES

Let us now turn to the IA case. Profits of a firm in from i to j are given by:

$$\pi_{ij}(z) = L_j\left[\frac{p_{ij}(z)}{t_{ij}} q_{ij}(z) - (c_i w_i \tau_{ij} + T_{ij})\, q_{ij}(z)\right] - f_{ij} =$$

$$= L_j\left[\frac{y_j}{t_{ij}}\left(az q_{ij}(z) - (\xi_j)^{\frac{1}{\gamma}} (q_{ij}(z))^{1+\frac{1}{\gamma}}\right) - (c_i w_i \tau_{ij} + T_{ij})\, q_{ij}(z)\right] - f_{ij} \tag{88}$$

The first order condition with respect to $q_{ij}(\omega)$ equals:

$$\frac{y_j}{t_{ij}} az - \frac{y_j}{t_{ij}}\left(1 + \frac{1}{\gamma}\right)(\xi_j q_{ij}(z))^{\frac{1}{\gamma}} = (c_i w_i \tau_{ij} + T_{ij})$$

Setting $q_{ij}(z_{ij}^*) = 0$ yields the market quality cutoff:

$$z_{ij}^* = \frac{t_{ij}\,(c_i w_i \tau_{ij} + T_{ij})}{a y_j} \tag{89}$$

Substituting z^*_{ij} into the first order condition yields the optimal quantity:

$$q_{ij}(z) = \left(\frac{a\gamma}{1+\gamma}\right)^{\gamma} \frac{(z^*_{ij})^{\gamma}}{\xi_j} \left(\frac{z}{z^*_{ij}} - 1\right)^{\gamma} \tag{90}$$

which has the same expression of the baseline model. As a result, prices, revenues, and profits also have the same expressions of the baseline model.

The presence of the specific trade cost quantitatively alters the relationship between domestic restrictiveness of regulations and import restrictiveness of regulations:

$$g_{ij} = 1 + (g_{jj} - 1) \frac{w_j c_j}{(\tau_{ij} w_i c_i + T_{ij})} \left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{1+\gamma}} t_{ij}^{-\frac{\gamma}{1+\gamma}} \tag{91}$$

Aggregate revenues (net of tariffs) of firms from i to country j are given by:

$$R_{ij} = \left(\frac{a^{1+\gamma}\gamma^{\gamma}}{(1+\gamma)^{1+\gamma}}\right) \left(\frac{L_j y_j (z^*_{jj})^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}}\right) ((c_i w_i \tau_{ij} + T_{ij}))^{-\kappa+\gamma+1} t_{ij}^{-\kappa+\gamma} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_2(g_{ij})$$

where we used the definition of quality cutoff $z^*_{ij} = z^*_{jj} \frac{t_{ij}(c_i w_i \tau_{ij} + T_{ij})}{c_j w_j}$.

The gravity equation equals:

$$\lambda_{ij} = \frac{t_{ij} R_{ij}}{\sum_v t_{vj} R_{vj}} = \frac{(t_{ij}\,(c_i w_i \tau_{ij} + T_{ij}))^{-\kappa+\gamma+1} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_2(g_{ij})}{\sum_v (t_{ij}\,(c_v w_v \tau_{vj} + T_{vj}))^{-\kappa+\gamma+1} J_v b_v^{\kappa} g_{vj}^{-\kappa} G_2(g_{vj})}$$

The gravity equation is the only equilibrium condition that is affected by the presence of specific trade costs. All other equilibrium conditions are identical to the baseline model.

Finally, the utility function equals

$$U_j^c = a^{\kappa} \left(\frac{\gamma}{1+\gamma}\right)^{1+\gamma} \frac{J_j b_j^{\kappa} \left((c_j w_j \tau_{jj} + T_{jj})/y_j\right)^{-\kappa+\gamma+1}}{\lambda_{jj}} \tilde{G}_2(g_{jj}) \sum_i \frac{\lambda_{ij} G_1(g_{ij})}{G_2(g_{ij})}$$

which is the same expression of the baseline model since $T_{jj} = 0$.

Let us now write out the system of hat algebra equations that describes the changes in the equilibrium variables of the model given a change in regulations restrictiveness or in tariffs. Let $\hat{w}^T_{ij}$ denote the hat change in the marginal costs of production and delivery $c_i w_i \tau_{ij} + T_{ij}$:

$$\hat{w}^T_{ij} = \frac{c_i w_i \tau_{ij} \hat{w}_i + T_{ij}}{c_i w_i \tau_{ij} + T_{ij}} \tag{92}$$

which equals $\hat{w}_i$ if there are no specific trade costs. Then, the equilibrium system of hat algebra equations is given by:

$$\hat{\lambda}_{ij} = \frac{\hat{J}_i (\hat{w}_{ij}^T)^{-\kappa+\gamma+1} \hat{t}_{ij}^{-\kappa+\gamma+1} \hat{\tilde{G}}_2(g_{ij})}{\sum_v \lambda_{vj} \hat{J}_v (\hat{w}_{vj}^T)^{-\kappa+\gamma+1} \hat{t}_{vj}^{-\kappa+\gamma+1} \hat{\tilde{G}}_2(g_{vj})} \qquad \forall i, j = 1, ...I \tag{93}$$

$$\hat{y}_i = \frac{\sum_j \lambda_{ij} y_j L_j \hat{\lambda}_{ij} \hat{y}_j}{\sum_j \lambda_{ij} y_j L_j} \qquad \forall i = 1, ..., I \tag{94}$$

$$\hat{J}_i = \frac{1}{\hat{w}_i} \frac{\sum_j \frac{\lambda_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} \frac{\hat{\lambda}_{ij}}{\hat{t}_{ij}} \hat{y}_j \widehat{\left(\frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} \right)}}{\sum_j \frac{\lambda_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})}} \qquad \forall i = 1, ..., I \tag{95}$$

$$\hat{y}_j = \frac{w_j}{y_j} \hat{w}_j + \sum_i \widehat{\left(\frac{t_{ij} - 1}{t_{ij}} \right)} \hat{\lambda}_{ij} \hat{y}_j \left(\frac{t_{ij} - 1}{t_{ij}} \right) \lambda_{ij} \qquad \forall j = 1, ..., I \tag{96}$$

$$\widehat{(g_{ij} - 1)} = \widehat{(g_{jj} - 1)} \hat{t}_{ij}^{\frac{-\gamma}{1+\gamma}} (\hat{w}_{ij}^T)^{-1} \hat{w}_j \qquad \forall i, j = 1, ...I \tag{97}$$

Finally, the consumption externality equals:

$$E_j = \left[\frac{\kappa}{\kappa - \beta} \right]^{\frac{\epsilon}{\beta}} \frac{1}{a} \left(\sum_i g_{ij} t_{ij} (\tau_{ij} w_i c_i + T_{ij}) y_j^{-1} \right)^{\epsilon} \tag{98}$$

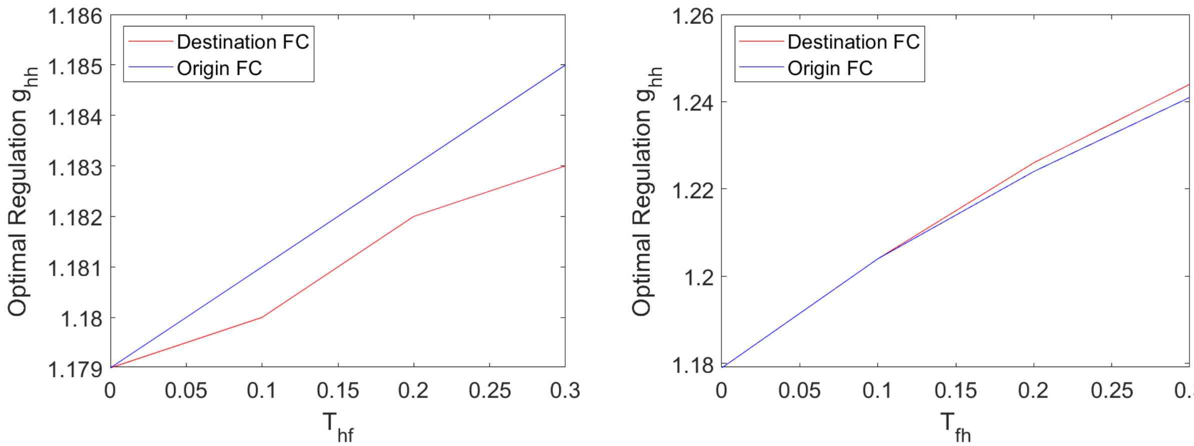
The exact hat change in the externality equals:

$$\hat{E}_j = \left(\sum_i \frac{g_{ij} t_{ij} \tau_{ij} w_i c_i}{\sum_v g_{vj} t_{vj} (\tau_{vj} w_v c_v + T_{vj})} \hat{g}_{ij} \hat{t}_{ij} \hat{w}_{ij}^T \hat{y}_j^{-1} \right)^{\epsilon} \tag{99}$$

Analytically, the presence of specific trade costs is qualitatively similar to that of iceberg trade costs. We further verify this in Figure D.1, where we show how the optimal level of restrictiveness of regulations varies with the specific trade costs in a two-country setting. Similarly to the case of iceberg trade costs and tariffs, higher specific trade costs imply a higher restrictiveness of the regulation.

Figure D.1: Optimal Regulation and Specific Trade Costs

(a) Specific Trade Cost T_{fh} **(b)** Specific Trade Cost T_{hf}



The plots show the optimal domestic regulation as a function of import and export specific trade costs.

E A Model with Subsidies

We consider a subsidy $s_{ij} \geq 1$ on production from i to j. The subsidy is modeled as the reciprocal of the tariff. The price $p_{ij}(\omega)$ is inclusive of the tariff and the subsidy. Net of the tariff and the subsidy, the firm receives $\frac{p_{ij}(\omega)s_{ij}}{t_{ij}}$ and the government collects $(t_{ij}-1)\frac{p_{ij}(\omega)s_{ij}}{t_{ij}}$ and pays $(s_{ij}-1)\frac{p_{ij}(\omega)s_{ij}}{t_{ij}}$. Profits are given by:

$$\pi_{ij}(z) = L_j\left[\frac{p_{ij}(z)s_{ij}}{t_{ij}}q_{ij}(z) - c_i w_i \tau_{ij} q_{ij}(z)\right] - f_{ij} =$$
$$= L_j\left[\frac{y_j s_{ij}}{t_{ij}}\left(az q_{ij}(z) - (\xi_j)^{\frac{1}{\gamma}}(q_{ij}(z))^{1+\frac{1}{\gamma}}\right) - \tau_{ij} w_i c_i q_{ij}(z)\right] - f_{ij} \tag{100}$$

The first order condition with respect to $q_{ij}(\omega)$ equals:

$$\frac{y_j s_{ij}}{t_{ij}}az - \frac{y_j s_{ij}}{t_{ij}}\left(1+\frac{1}{\gamma}\right)(\xi_j q_{ij}(z))^{\frac{1}{\gamma}} = \tau_{ij} w_i c_i$$

and setting $q_{ij}(z^*_{ij}) = 0$ yields the market quality cutoff as in the main text:

$$z^*_{ij} = \frac{t_{ij}\tau_{ij} w_i c_i}{a y_j s_{ij}} \tag{101}$$

Substituting the z^*_{ij} (101) into the first order condition yields the optimal quantity:

$$q_{ij}(z) = \left(\frac{a\gamma}{1+\gamma}\right)^{\gamma}\frac{(z^*_{ij})^{\gamma}}{\xi_j}\left(\frac{z}{z^*_{ij}} - 1\right)^{\gamma} \tag{102}$$

Prices (net of tariffs and subsidies) equal:

$$p_{ij}(z) = \frac{a y_j z^*_{ij}}{1+\gamma}\left(\frac{z}{z^*_{ij}} + \gamma\right) \tag{103}$$

Firm z revenues $r_{ij}(z)$ and profits $\pi_{ij}(z)$ are given by:

$$r_{ij}(z) = \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{ij})^{1+\gamma} s_{ij}}{\xi_j t_{ij}}\right)\left(\frac{z}{z^*_{ij}} - 1\right)^\gamma \left(\frac{z}{z^*_{ij}} + \gamma\right) \tag{104}$$

$$\pi_{ij}(z) = \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{ij})^{1+\gamma} s_{ij}}{\xi_j t_{ij}}\right)\left(\frac{z}{z^*_{ij}} - 1\right)^{1+\gamma} - f_{ij} \tag{105}$$

The quality cutoff equals:

$$\bar{z}_{ij} = z^*_{ij} + z^*_{ij}\left[f_{ij}\left(\frac{(1+\gamma)^{1+\gamma}}{a^{1+\gamma}\gamma^\gamma}\right)\left(\frac{\xi_j t_{ij}}{L_j y_j s_{ij} (z^*_{ij})^{1+\gamma}}\right)\right]^{\frac{1}{1+\gamma}}$$

The restrictiveness of regulations g_{ij} is implicitly defined by:

$$\left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j s_{ij} (z^*_{ij})^{1+\gamma}}{\xi_j t_{ij}}\right)(g_{ij} - 1)^{1+\gamma} = f_{ij} \tag{106}$$

Hence,

$$g_{ij} = 1 + (g_{jj} - 1)\,\frac{w_j c_j}{\tau_{ij} w_i c_i}\left(\frac{f_{ij}}{f_{jj}}\right)^{\frac{1}{1+\gamma}}\left(\frac{t_{ij}}{s_{ij}}\right)^{-\frac{\gamma}{1+\gamma}} \tag{107}$$

Aggregate revenues (net of tariffs and subsidies) of firms from i to country j are given by:

$$R_{ij} = \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{jj})^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}}\right)(\tau_{ij} c_i w_i)^{-\kappa+\gamma+1}\left(\frac{t_{ij}}{s_{ij}}\right)^{-\kappa+\gamma} J_i b_i^\kappa g_{ij}^{-\kappa} G_2(g_{ij})$$

The sum of sales (including tariffs and subsidies) across origins to destination j is then:

$$\sum_i \frac{t_{ij} R_{ij}}{s_{ij}} = \left(\frac{a^{1+\gamma}\gamma^\gamma}{(1+\gamma)^{1+\gamma}}\right)\left(\frac{L_j y_j (z^*_{jj})^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}}\right)\sum_i (t_{ij}\tau_{ij} c_i w_i / s_{ij})^{-\kappa+\gamma+1} J_i b_i^\kappa g_{ij}^{-\kappa} G_2(g_{ij}) \tag{108}$$

Hence, the gravity equation is represented by the following expression for the trade share, which we reported in the main text:

$$\lambda_{ij} = \frac{\frac{t_{ij} R_{ij}}{s_{ij}}}{\sum_v \frac{t_{vj} R_{vj}}{s_{vj}}} = \frac{(t_{ij}\tau_{ij} c_i w_i / s_{ij})^{-\kappa+\gamma+1} J_i b_i^\kappa g_{ij}^{-\kappa} G_2(g_{ij})}{\sum_v (t_{ij}\tau_{vj} c_v w_v / s_{vj})^{-\kappa+\gamma+1} J_v b_v^\kappa g_{vj}^{-\kappa} G_2(g_{vj})}$$

The zero expected profit condition yields the expression for the equilibrium mass of firms:

$$J_i = \frac{1}{w_i f_E} \sum_j \frac{\lambda_{ij} s_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} \quad \forall i = 1, ..., I \tag{109}$$

Per capita income is given by:

$$y_j = w_j + \frac{1}{L_j} \sum_i (t_{ij} - 1) R_{ij} - \frac{1}{L_j} \sum_v (s_{jv} - 1) R_{jv}$$

$$y_j = w_j + y_j \sum_i (t_{ij} - 1) \frac{\lambda_{ij} s_{ij}}{t_{ij}} - \sum_v (s_{jv} - 1) \frac{\lambda_{jv} s_{jv}}{t_{jv}} \left(\frac{y_v L_v}{L_j} \right)$$

Finally, the utility function equals:

$$U_j^c = a^\kappa \left(\frac{\gamma}{1+\gamma} \right)^{1+\gamma} \frac{J_j b_j^\kappa \left(\tau_{jj} c_j w_j / y_j s_{jj} \right)^{-\kappa+\gamma+1}}{\lambda_{jj}} \tilde{G}_2(g_{jj}) \sum_i \frac{\lambda_{ij} G_1(g_{ij})}{G_2(g_{ij})}$$

We can now update the expressions for the hat changes of our equilibrium conditions:

$$\hat{\lambda}_{ij} = \frac{\hat{J}_i \hat{w}_i^{-\kappa+\gamma+1} \left(\frac{\hat{t}_{ij}}{\hat{s}_{ij}} \right)^{-\kappa+\gamma+1} \hat{\tilde{G}}_2(g_{ij})}{\sum_v \lambda_{vj} \hat{J}_v \hat{w}_v^{-\kappa+\gamma+1} \left(\frac{\hat{t}_{vj}}{\hat{s}_{vj}} \right)^{-\kappa+\gamma+1} \hat{\tilde{G}}_2(g_{vj})} \quad \forall i, j = 1, ...I \tag{110}$$

$$\hat{y}_i = \frac{\sum_j \lambda_{ij} y_j L_j \hat{\lambda}_{ij} \hat{y}_j}{\sum_j \lambda_{ij} y_j L_j} \quad \forall i = 1, ..., I \tag{111}$$

$$\hat{J}_i = \frac{1}{\hat{w}_i} \frac{\sum_j \frac{\lambda_{ij} s_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})} \frac{\hat{\lambda}_{ij} \hat{s}_{ij}}{\hat{t}_{ij}} \hat{y}_j \left(\widehat{\frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})}} \right)}{\sum_j \frac{\lambda_{ij} s_{ij}}{t_{ij}} y_j L_j \frac{\tilde{G}_1(g_{ij})}{\tilde{G}_2(g_{ij})}} \quad \forall i = 1, ..., I \tag{112}$$

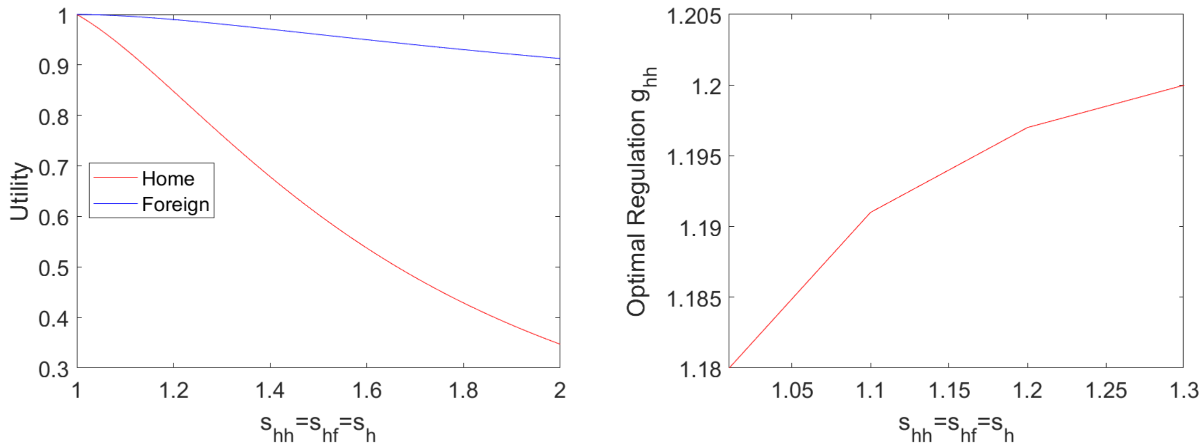
$$\hat{y}_j = \frac{w_j}{y_j} \hat{w}_j + \sum_i \left(\frac{\widehat{t_{ij} - 1}}{t_{ij}} \right) \hat{\lambda}_{ij} \hat{s}_{ij} \hat{y}_j \left(\frac{t_{ij} - 1}{t_{ij}} \right) \lambda_{ij} s_{ij} -$$

$$- \sum_v (\widehat{s_{jv} - 1}) \frac{\hat{\lambda}_{jv} \hat{s}_{jv} \hat{y}_v}{\hat{t}_{jv}} (s_{jv} - 1) \frac{\lambda_{jv} s_{jv}}{t_{jv}} \left(\frac{y_v L_v}{L_j} \right) / y_j \quad \forall j = 1, ..., I \tag{113}$$

We employ numerical methods to evaluate the welfare effects of a subsidy on production and on the optimal regulation. We consider a two-country model (home and foreign) and we set a subsidy on production: $s_{ii} = s_{ij} = s_i$. As shown in Figure E.1, a production subsidy reduces welfare. The subsidy generates a reallocation of production towards small firms that enter, since the subsidy reduces the extent of market selection. Welfare in the foreign economy decreases as well, though to a lesser extent. Higher levels of the subsidy are associated with higher optimal levels of regulations, since the regulation has the opposite effects on allocation across firms than the subsidy.

Figure E.1: Subsidies, Regulations, and Welfare

(a) Subsidy and Welfare **(b)** Subsidy and Optimal Regulation



The first plot shows the hat change in the home utility $\hat{U}_h$ and foreign utility $\hat{U}_f$ given different levels of the home production subsidy s_j. The second plot shows the optimal home regulation g_{hh} given given different levels of the home production subsidy s_j. The parameters are as follows: $\kappa = 4$, $\gamma = 1.5$, $\lambda_{hh} = \lambda_{ff} = 0.65$. In the initial equilibrium the two countries are identical and size and per capita income are normalized to one. In the initial equilibrium, there are no regulations and there is a symmetric level of tariffs $t_{hf} = t_{fh} = 1.01$. The iceberg trade costs are derived using the gravity equations and the numerical values for trade shares and tariffs.

F Non-CES Model with Constant Markups

In this section, we examine the impact of regulations and the role for cooperation when the misallocation of production among heterogeneous firms in our non-CES framework is disregarded. We show that even in this case, cooperation on regulations is optimal but the positive spillover of regulations is only driven by the ToT channel.

We assume that the government enforces a policy requiring all firms within its jurisdiction to maintain constant markups. We will demonstrate that the resulting distribution of production among firms can be achieved using a collection of firm-specific taxes and subsidies on production, which also vary based on market conditions. Both the constant markup policy and the firm-specific taxes are not feasible in practice. However, imposing a constant markup on firms is analytically simpler because it does not interfere with the relationship between income and wages. On the other hand, firm-specific taxes and subsidies may alter consumer income, and with non-CES preferences, changes in consumer income can either worsen or alleviate market distortions. In comparison to our baseline model, we eliminate tariffs, resulting in per capita income (y_j) being equivalent to the wage (w_j).

Let μ_i represent the constant markup for firms from i. The price charged by each firm is given by:

$$p_{ij} = \mu_i \tau_{ij} w_i c_i \tag{114}$$

This price is constant across firms because they all have the same marginal cost and markup. By substituting (114) in the demand function and setting the quantity to zero, we can determine the market-determined quality cutoff:

$$z_{ij}^* = \frac{\mu_i \tau_{ij} w_i c_i}{a w_j} \tag{115}$$

The ratio of z_{ij}^* to z_{jj}^* equals:

$$\frac{z_{ij}^*}{z_{jj}^*} = \frac{\mu_i \tau_{ij} w_i c_i}{\mu_j \tau_{jj} w_j c_j} \tag{116}$$

Substituting the cutoff into the demand function, we obtain the optimal quantity:

$$q_{ij}(z) = a^\gamma \frac{(z_{ij}^*)^\gamma}{\xi_j} \left(\frac{z}{z_{ij}^*} - 1 \right)^\gamma \tag{117}$$

The government can set the markup μ_i in such a way that the production quantity for each variety aligns with the amount a planner would select. The price that a firm charges can be written as:

$$p_{ij} = a w_j z_{ij}^* \tag{118}$$

Revenues and profits equal:

$$r_{ij}(z) = L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{1+\gamma}}{\xi_j} \left(\frac{z}{z_{ij}^*} - 1 \right)^\gamma \tag{119}$$

$$\pi_{ij}(z) = \left(\frac{\mu_i - 1}{\mu_i} \right) L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{1+\gamma}}{\xi_j} \left(\frac{z}{z_{ij}^*} - 1 \right)^\gamma - f_{ij} \tag{120}$$

Given the fixed regulatory cost f_{ij}, the cutoff $\bar{z}_{ij}$ is implicitly defined as:

$$\left(\frac{\mu_i - 1}{\mu_i} \right) L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{1+\gamma}}{\xi_j} \left(\frac{\bar{z}_{ij}}{z_{ij}^*} - 1 \right)^\gamma = f_{ij} \tag{121}$$

As in the main text, we define $g_{ij} = \frac{\bar{z}_{ij}}{z_{ij}^*}$. The relationship between g_{ij} and g_{jj} becomes:

$$g_{ij} = 1 + (g_{jj} - 1) \left(\frac{\mu_j w_j c_j}{\mu_i \tau_{ij} w_i c_i} \right)^{\frac{1+\gamma}{\gamma}} \left(\frac{f_{ij}}{f_{jj}} \right)^{\frac{1}{\gamma}} \left(\frac{\frac{\mu_j - 1}{\mu_j}}{\frac{\mu_i - 1}{\mu_i}} \right)^{\frac{1}{\gamma}} \tag{122}$$

Equivalent Firm-Level Taxes and Subsidies. Notice that in the absence of the constant markup policy, firm's z revenues equal:

$$r_{ij}^v(z) = \left(\frac{a^{1+\gamma} \gamma^\gamma}{(1+\gamma)^{1+\gamma}} \right) \left(\frac{L_j w_j (z_{ij}^*)^{1+\gamma}}{\mu_i^{1+\gamma} \xi_j} \right) \left(\frac{\mu_i z}{z_{ij}^*} - 1 \right)^\gamma \left(\frac{\mu_i z}{z_{ij}^*} + \gamma \right) \tag{123}$$

since z_{ij}^* is defined in (115), and without such a policy the cutoff would simply equal z_{ij}^*/μ_i. Hence, to achieve the constant markup allocation with firm-specific subsidies and taxes, each firm must pay (receive) an ad valorem tax (subsidy) equal to:

$$t_{ij}(z) = \frac{r_{ij}^{v}(z)}{r_{ij}(z)} = \left(\frac{\gamma^{\gamma}}{(\mu_i(1+\gamma))^{1+\gamma}}\right) \frac{\left(\frac{\mu_i z}{z_{ij}^*} - 1\right)^{\gamma} \left(\frac{\mu_i z}{z_{ij}^*} + \gamma\right)}{\left(\frac{z}{z_{ij}^*} - 1\right)^{\gamma}} \tag{124}$$

Therefore, to implement $t_{ij}(z)$, the government must be aware of not only the firm's quality level but also the value of the quality cutoff.

F.1 Aggregation and Equilibrium

The mass of active firms N_{ij} from i selling to destination j is analogous to the baseline model:

$$N_{ij} = \frac{J_i b_i^{\kappa}}{\bar{z}_{ij}^{\kappa}} = \frac{J_i b_i^{\kappa}}{(z_{ij}^* g_{ij})^{\kappa}} \tag{125}$$

Aggregate revenues (net of tariffs) of firms from i to country j are given by:

$$\begin{aligned}
R_{ij} &= N_{ij} \int_{\bar{z}_{ij}}^{\infty} r_{ij}(z) \frac{\kappa \bar{z}_{ij}^{\kappa}}{z^{\kappa+1}} dz = \\
&= N_{ij} L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{1+\gamma}}{\xi_j} \int_{\bar{z}_{ij}}^{\infty} \left(\frac{z}{z_{ij}^*} - 1\right)^{\gamma} \frac{\kappa \bar{z}_{ij}^{\kappa}}{z^{\kappa+1}} dz = \\
&= N_{ij} L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{1+\gamma}}{\xi_j} G_3(g_{ij}) = \\
&= L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{-\kappa+1+\gamma}}{\xi_j} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_3(g_{ij}) = \\
&= L_j w_j a^{1+\gamma} \frac{(z_{jj}^*)^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}} (\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_3(g_{ij})
\end{aligned}$$

where we used the definition of quality cutoff $z_{ij}^* = z_{jj}^* \frac{\tau_{ij} c_i w_i}{c_j w_j}$. $G_3(g_{ij})$ is given by:

$$G_3(g_{ij}) = \kappa g_{ij}^{\gamma} \left[\frac{g_{ij}\, {}_2F_1[\kappa-\gamma, -\gamma+1; \kappa-\gamma+1, g_{ij}^{-1}]}{\kappa-\gamma} - \frac{{}_2F_1[\kappa-\gamma+1, -\gamma+1; \kappa-\gamma+2, g_{ij}^{-1}]}{\kappa-\gamma+1}\right]$$

where ${}_2F_1[a, b; c; d]$ is the hypergeometric function.

The sum of sales across origins to destination j is then:

$$\sum_i R_{ij} = L_j w_j a^{1+\gamma} \frac{(z_{jj}^*)^{-\kappa+1+\gamma}}{\xi_j (c_j w_j)^{-\kappa+1+\gamma}} \sum_i (\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_3(g_{ij}) \tag{126}$$

Hence, the gravity equation equals:

$$\lambda_{ij} = \frac{(\tau_{ij} c_i w_i)^{-\kappa+\gamma+1} J_i b_i^{\kappa} g_{ij}^{-\kappa} G_3(g_{ij})}{\sum_v (\tau_{vj} c_v w_v)^{-\kappa+\gamma+1} J_v b_v^{\kappa} g_{vj}^{-\kappa} G_3(g_{vj})}$$

Average profits from i to j are:

$$\begin{aligned}\bar{\pi}_{ij} &= \left(\frac{\mu_i - 1}{\mu_i}\right) L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{1+\gamma}}{\xi_j} \int_{\bar{z}_{ij}}^{\infty} \left(\frac{z}{z_{ij}^*} - 1\right)^{\gamma} \frac{\kappa \bar{z}_{ij}^{\kappa}}{z^{\kappa+1}} dz - f_{ij} = \\ &= \left(\frac{\mu_i - 1}{\mu_i}\right) L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{1+\gamma}}{\xi_j} G_3(g_{ij}) - f_{ij} = \\ &= \left(\frac{\mu_i - 1}{\mu_i}\right) L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{1+\gamma}}{\xi_j} (G_3(g_{ij}) - (g_{ij} - 1)^{\gamma})\end{aligned}$$

Let $\tilde{G}_3(g_{ij}) = g_{ij}^{-\kappa}[G_3(g_{ij}) - (g_{ij} - 1)^{\gamma}]$ and $\tilde{G}_4(g_{ij}) = g_{ij}^{-\kappa} G_3(g_{ij})$. Expected profits from i to j equal:

$$\begin{aligned}E[\pi_{ij}] &= \left(\frac{\mu_i - 1}{\mu_i}\right) L_j w_j a^{1+\gamma} \frac{(z_{ij}^*)^{-\kappa+1+\gamma}}{\xi_j} b_i^{\kappa} \tilde{G}_3(g_{ij}) = \\ &= \left(\frac{\mu_i - 1}{\mu_i}\right) \frac{R_{ij}}{J_i} \frac{\tilde{G}_3(g_{ij})}{\tilde{G}_4(g_{ij})}\end{aligned}$$

Using our gravity equation, the expected profits can be written as:

$$E[\pi_{ij}] = L_j w_j \frac{\lambda_{ij}}{J_i} \frac{\tilde{G}_3(g_{ij})}{\tilde{G}_4(g_{ij})} \tag{127}$$

The zero expected profit condition yields the expression for the equilibrium mass of firms:

$$J_i = \frac{1}{w_i f_E} \sum_j \lambda_{ij} w_j L_j \frac{\tilde{G}_3(g_{ij})}{\tilde{G}_4(g_{ij})} \quad \forall i = 1, ..., I \tag{128}$$

Let us now consider the utility function. Substituting the definition of the aggregator ξ into the utility function yields:

$$\begin{aligned}U_j^c &= \frac{a^{1+\gamma}\gamma}{1+\gamma} \sum_{i=1,h} (z_{ij}^*)^{\gamma+1} N_{ij} \int_{\bar{z}_{ij}}^{\infty} \left(\frac{z}{z_{ij}^*} - 1\right)^{1+\gamma} \frac{\kappa \bar{z}_{ij}^{\kappa}}{z^{\kappa+1}} dz = \\ &= \frac{a^{\kappa}\gamma}{1+\gamma} \sum_i J_i b_i^{\kappa} \left(\frac{\tau_{ij} w_i c_i}{w_j}\right)^{-\kappa+\gamma+1} g_{ij}^{-\kappa} G_1(g_{ij})\end{aligned}$$

From our gravity equation:

$$J_i b_i^{\kappa} \left(\frac{\tau_{ij} w_i c_i}{w_j}\right)^{-\kappa+\gamma+1} g_{ij}^{-\kappa} = \frac{\lambda_{ij}}{\lambda_{jj}} J_j b_j^{\kappa} \left(\frac{\tau_{jj} c_j w_j}{w_j}\right)^{-\kappa+\gamma} g_{jj}^{-\kappa} \frac{G_3(g_{jj})}{G_3(g_{ij})}$$

Thus, we obtain:

$$U_j^c = \frac{a^{\kappa}\gamma}{1+\gamma} \frac{J_j b_j^{\kappa} (\tau_{jj} c_j)^{-\kappa+\gamma+1}}{\lambda_{jj}} \tilde{G}_4(g_{jj}) \sum_i \frac{\lambda_{ij} G_1(g_{ij})}{G_3(g_{ij})}$$

Applying the hat algebra to the equilibrium equations, we obtain:

$$\hat{\lambda}_{ij} = \frac{\hat{J}_i \hat{w}_i^{-\kappa+\gamma+1} \hat{\tilde{G}}_4(g_{ij})}{\sum_v \lambda_{vj} \hat{J}_v \hat{w}_v^{-\kappa+\gamma+1} \hat{\tilde{G}}_4(g_{vj})} \qquad \forall i, j = 1, ...I \qquad (129)$$

$$\hat{w}_i = \frac{\sum_j \lambda_{ij} w_j L_j \hat{\lambda}_{ij} \hat{w}_j}{\sum_j \lambda_{ij} w_j L_j} \qquad \forall i = 1, ..., I \qquad (130)$$

$$\hat{J}_i = \frac{1}{\hat{w}_i} \frac{\sum_j \lambda_{ij} w_j L_j \frac{\tilde{G}_3(g_{ij})}{\tilde{G}_4(g_{ij})} \hat{\lambda}_{ij} \hat{y}_j \widehat{\left(\frac{\tilde{G}_3(g_{ij})}{\tilde{G}_4(g_{ij})}\right)}}{\sum_j \lambda_{ij} w_j L_j \frac{\tilde{G}_3(g_{ij})}{\tilde{G}_4(g_{ij})}} \qquad \forall i = 1, ..., I \qquad (131)$$

$$(\widehat{g_{ij} - 1}) = (\widehat{g_{jj} - 1}) \hat{t}_{ij}^{\frac{-\gamma}{1+\gamma}} \hat{w}_i^{-\frac{1+\gamma}{\gamma}} \hat{w}_j^{\frac{1+\gamma}{\gamma}} \qquad \forall i, j = 1, ...I \qquad (132)$$

Finally, the change in utility following a change in regulation equals:

$$\hat{U}_j^c = \frac{\hat{J}_j}{\hat{\lambda}_{jj}} \hat{\tilde{G}}_4(g_{jj}) \frac{\sum_i \frac{\lambda_{ij} G_1(g_{ij})}{G_3(g_{ij})} \frac{\hat{\lambda}_{ij} \hat{G}_1(g_{ij})}{\hat{G}_3(g_{ij})}}{\sum_i \frac{\lambda_{ij} G_1(g_{ij})}{G_3(g_{ij})}} \qquad (133)$$

F.2 Welfare Effects of Regulations

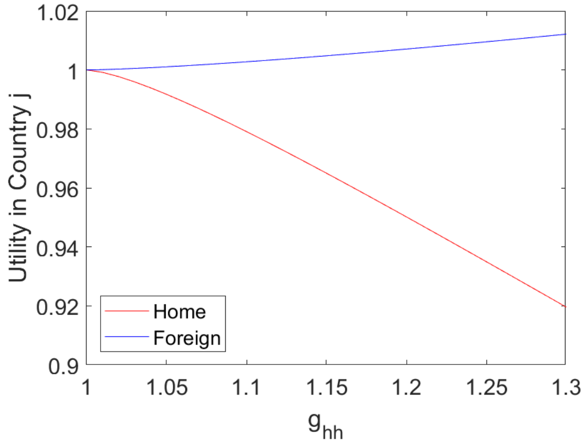
We examine a scenario involving two symmetric countries, where only the home country is permitted to enforce a regulation. The parameters are set as follows: $\kappa = 4$, $\gamma = 1.5$, $\lambda_{hh} = \lambda_{ff} = 0.65$. We also assume that $\mu_i = \mu_j$. In the initial equilibrium, both countries are identical in size and have a normalized per capita income (and wages) of one. There are no regulations in this initial equilibrium and no tariffs. The iceberg trade costs are calculated using gravity equations, taking into account trade shares and tariffs' numerical values.

Figure F.1 illustrates the effects of an increased restrictiveness of the standard on the utility of both countries, home wages (as foreign wages are normalized to one), and entry in the two countries.

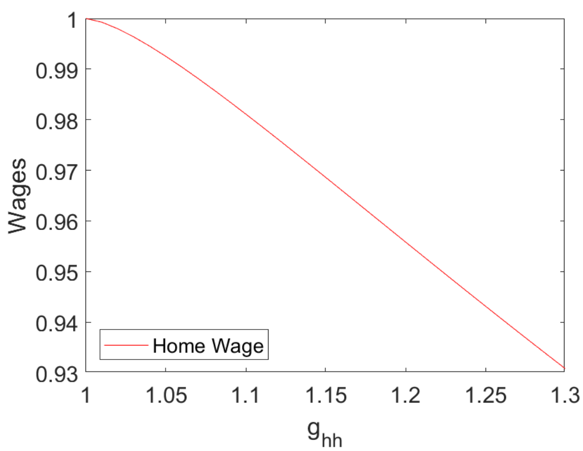
Due to the constant markups addressing the misallocation of production among heterogeneous firms, domestic welfare declines with the introduction of the regulation. The only justification for implementing this regulation is the consumption externality (which is excluded here for simplicity). However, similar to the baseline model, the domestic regulation improves welfare in the foreign country. This improvement is solely attributable to the worsening ToT for the home country. In fact, the mass of entrants in both countries decline in this scenario. This is due to the fact that keeping the markups constant prevents average profits relative to revenues from rising with the regulation, unlike in the baseline model. Although the regulation allows only the highest quality firms to survive, their profits relative to revenues do not increase, as the markups remain constant. Consequently, entry declines in both countries.

Figure F.1: Effects of Regulations (Fixed Cost in Destination Labor Units)

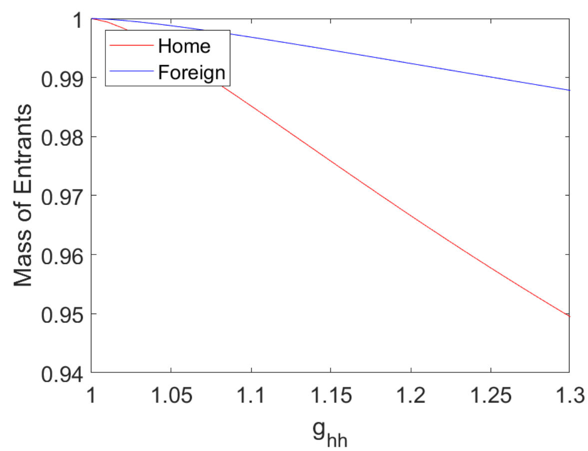
(a) Utility



(b) Wages and Pc. Income



(c) Mass of Entrants



The plots show the hat change in the home and foreign utility, wages, and entry given changes in the home regulation g_{hh}.

G Quantitative Exercise: Estimation and the Simulated Method of Moments Algorithm

G.1 Trade Shares Data

Although λ_{ij} is produced from data, producing the full matrix of trade shares requires a few computational steps because we are missing direct data on: i) a "rest of the world" (ROW) country which makes up for all of the rest of trade not captured within our sample (to make trade shares realistic); and ii) domestic trade. The process is as follows.

First, from the theory, recall that: $\lambda_{ij} = \frac{X_{ij}}{\sum_i X_{ij}}$, where X_{ij} is the value of sales from i to j. For each destination, its domestic absorption C_j, is measured as $C_j = GO_j + M_j - X_j$, where the last two components reflect total imports ($\sum_{i \neq j} X_{ij}$) and exports ($\sum_{j \neq i} X_{ji}$). Domestic trade is backed out as: $X_{jj} = GO_j - X_j$. Finally, given $\sum_{i \in s} X_{ij}$ as trade flows to destination j *within our sample,* s, exports from ROW to j are the difference between C_j and $\sum_{i \in s} X_{ij}$. Thus, trade shares sum to one, and we can use this procedure to compute trade flows into the ROW as well.

Since domestic trade shares require gross output of manufacturing, we approximate it as in Fernandes et al. (2023) by multiplying the manufacturing value added in each country (from WDI) by 4. In an alternative exercise of a previous version of the paper, we used reported gross output from CEPII's TradeProd database, but this is only available up to 2006 (and for many countries one must go further back).

Note: Although we generally do have trade flow data for almost all origin-destination pairs, the coverage is more restricted for other variables (especially the moments required to produce g_{ij}). This is why our trade share matrix (reported in the next Appendix section) has missing observations; for all our reported matrices below we only report data for the cells in which we are able to produce estimated restrictiveness. For example, although Costa Rica is an exporter to Bolivia, after cleaning the EDD data we cannot produce an estimate for g_{ij} in that case and therefore that cell is always listed as " - " in all reported tables.

Note: an alternative approach is to use the trade shares estimated by the gravity equation (i.e. back out trade shares from the theoretical model). We do not employ this approach because it leads to some improbable trade shares due to the representation of countries in our sample. For example, in our sample, Denmark would have a domestic share equal to 0.99, with slightly more realistic shares for countries like Chile, Peru and Bolivia. See Appendix H.2 for details.

G.2 Estimation of g_{ij} with EDD Data

To estimate g_{ij} for each country pair, we consider the following six moments of the exporters' sales distribution from the EDD:

- Median, First Quartile, and Third Quartile for the export value per exporter distribution, normalized by average sales
- Share of sales of the top 1%, 5%, and 25% of exporters in the export distribution

Note that to produce an estimated restrictiveness for an $i-j$ pair, we require at least one of these moments to be reported. Furthermore, we clean the data to restrict origin-destination pairs with sufficient transactions as in the empirical section. In many cases, although a pair exists in the EDD data, these moments are not available. For example, this is the case in the CRI-BOL example mentioned above. In these cases, the cell is always listed as " - " in all reported tables.

For each country pair $i-j$ in our sample, we simulate draws of quality conditional on firms exporting to the destination, and compute revenues relative to the average revenues.[32] Armed with these relative revenues for every exporter, we compute 6 moments and match them to the data (taking the values of γ and κ as given).

This algorithm returns a vector of g_{ij} for each $i \neq j$. Our identification consists of choosing the parameter set that minimizes the sum of the squared errors between empirical and theoretical moments:

$$\min_{g,\forall i, i\neq j} \sum_{q=1}^{6} \left(F_q^d - F_q^m(g_{ij}) \right)^2, \tag{134}$$

where q identifies each of the 6 moments listed above.

G.3 Estimation of κ and γ with Chilean Firm Data

The procedure below is adopted from Macedoni and Weinberger (2022). In that case, we have firm level data which allows us to produce the distribution of *domestic* sales. Chile is the one country for which we have the full census for domestic sales. The Chilean census (we use only 2012 for the present paper) can be found from the INE here: https://www.ine.cl/estadisticas/economicas/manufactura?categoria=Encuesta%20Nacional%20Industria%20Anual%20-%20ENIA. Since 2008, the INE publishes the census of manufacturing firms, but without firm indicators. We do not require a panel data.

Domestic sales are a function of g_{jj}, just as as g_{ij} is a function of the export distribution of firms in country i that sell in j. The procedure below takes a closed economy framework where g refers to g_{jj} in the model above, where $j = Chile$.

We adopt an over-identification strategy that targets 99 moments from the empirical domestic sales distribution. Given a set of potential producers in the simulation, namely those with $z > \bar{z}$, we compute firm revenues normalized by mean revenues:

$$\tilde{r}(z|z > \bar{z}) = \frac{r}{\bar{r}} = (G_2(g))^{-1} \left(\frac{z}{z^*} - 1 \right)^{\gamma} \left(\frac{z}{z^*} + \gamma \right) \tag{135}$$

where $G_2(g)$ is a function that depends on the targeted parameters and $\tilde{r}$ refers to *domestic sales.*

[32] We simulate a large enough number of draws so as to best approximate the entire continuum of firms that exist in the model. We follow the insights of Eaton et al. (2011) and relabel firm-level indicators that can be simulated from a parameter-free uniform distribution. Recall that the pdf of the quality distribution is given by $h(z) = \frac{\kappa b^{\kappa}}{z^{\kappa+1}}$. We draw 500,000 realizations of the uniform distribution on the [0; 1] domain, $U \sim [0; 1]$, we order them in increasing order, and find the maximum realization, denoted by u_{max}. Then, the firm quality indicator is $z = (u/u_{max})^{-1/\kappa} z_{ij}^*$. Notice the set of active firms in specific to an origin-pair. Given that there exists restrictions on the survival of low-quality firms, the set of producing firms is chosen from $z \in [g, \infty]$.

The theoretical relative sales are matched to their counterpart in the data in order to identify the model parameters in an approach that follows Sager and Timoshenko (2019). Let $F_q^m(g,\kappa,\gamma) = \log(\tilde{r})_q$ be the q-th quantile of the simulated log domestic sales distribution. Then, let F_q^d denote the corresponding value of the empirical CDF of the log sales distribution. Our identification consists of choosing the parameter set that minimizes the sum of the squared errors between empirical and theoretical quantiles:

$$\min_{g,\kappa,\gamma} \sum_{q=1}^{99} \left(F_q^d - F_q^m(g,\kappa,\gamma) \right)^2 . \tag{136}$$

The strategy to estimate the parameter set $(\hat{g},\hat{\kappa},\hat{\gamma})$ is based on the separate ways that each parameter is identified within the sales distribution. κ governs the shape of the quality distribution, which is proportional to the shape in the sales distribution only in special cases (Mrázová et al., 2021), which do not apply to our model. The divergence in the sales and quality distribution is due to the distribution of markups. Since firm markup levels are a function of γ (see (18)), this parameter affects the mapping from the quality to the sales distribution and is not collinear with κ.[33] Finally, the standard not only eliminates low-quality firms but reallocates resources to higher-quality firms. Therefore, relative sales across percentiles of the sales distribution are a function of g. For this reason, we use a general strategy to match sales across the firm distribution, with each parameter being identified by different parts of the distribution.

G.4 Estimated Restrictiveness and the Extensive Margin

To get a sense of the ability to estimate restrictiveness in our SMM procedure outlined above, we compare our results of the estimated restrictiveness, g_{ij}, with the TM data used in (1). First, notice that from equation (61), we can derive the ratio of the number of exporters from i across two destinations:

$$\frac{N_{ij}}{N_{ik}} = \left(\frac{w_j t_{ik} \tau_{ik} g_{ik}}{w_k \tau_{ij} t_{ij} g_{ij}} \right)^{\kappa} \tag{137}$$

We therefore repeat the exercise from (1), but with estimated g_{ij}. If the estimation described above is indeed picking up the restrictiveness as defined in the model, then we should find that the number of exporters to j decreases with restrictiveness in that destination, and that the value per exporter increases with restrictiveness (due to the selection of higher quality exporters).

We start by estimating g_{ij} for importer-exporter-product combinations since this is available in the EDD database using the procedure described in Section G.2. Relative to Section 2, we aggregate HS products to 15 "sections" in order to observe sales distributions with more exporters, and reduce the computational cost of estimating so many restrictiveness parameters. These sections are a subset of the 21 HS-Sections as classified by the UN, as listed along with their description in Table G.1 below. We combine the 21 sections into 17 aggregate sections, and have 15 left in our data with positive number of observations.

Table G.2 follows the specifications from Table 1. With product-level observations, we control

[33] As is not the case, for example, if preferences were CES and the distribution of quality is Pareto.

Table G.1: Correspondence of our Custom HS Sections to UN Classification

This Paper	HS Sec.		ISIC	HS2
1	1	Live Animals; animal products	01, 05	1 to 5
1	2	Vegetable products	15	6 to 14
1	3	Animal or vegetable fats and oils; prepared fats	15	15
2	4	Prepared foodstuffs; beverages, spririts vinegar; tobacco	15,16	16-24
3	5	Mineral products	23	25-27
4	6	Products of chemical or allied industries	24	28-38
5	7	Plastics and articles thereof; rubbers	25	39-40
6	8	Raw hids and skins; leather; handbags; articles of animal gut	18	41-43
7	9	Wood; charcoal; cork; straw; plaiting materials	20	44-46
8	10	Pulp or wood or other cellulosic material;paper or paperboard	21	47-49
9	11	Textiles and textile articles	17	50-63
10	12	Footwear, headgear, umbrellas; prepared feathers; flowers, human hair	19	64-67
11	13	Articles of stone, plaster, cement, asbestos, mica, ceramic, glass, wine	26	68-70
12	14	Natural or cultured pearls, precious stones, metals, jewelry	36	71
13	15	Base metals and articles of base metal	27	72-83
14	16	Machinery and mechanical appliances; electrical equipment	31,28	84-85
15	17	Vehicles, aircraft, transport"	34,35	86-89
16	18	Optical photographic, cinematographic, medical and musical instruments	32,33	90-92
17	19	Arms and ammunition, parts thereof	29	93
12	20	Miscellaneous manufactured products	36	94-96
	21	Works of art, collectors pieces		97-98

for exporter-HS Section fixed effects, along with either only destination or importer-destination fixed effects. Either way, we capture variation in the restrictiveness of destinations for the same importer-product exports. Column (1) includes the gravity controls, and we confirm that a rise in g_{ij} reduces the number of exporters to a destination. In this sample, the gravity variables also have the expected sign, as for example, the number of exporters is reduced with distance. In column (2), we check the *intensive margin*, or the export value per exporter. We find that a higher restrictiveness is associated with a larger amount of average exports, consistent with the selection present in the model – regulations select for higher quality exporters. For these first set of results we do not include "Access" controls as the non-tariff measures are only available for a subset of the EDD sample used above.

The last 2 columns in Table G.2 compare the model-implied estimated restrictiveness with the technical measures we use to proxy these in Section 2. These include importer-exporter interacted fixed effects, and therefore no gravity controls, in order to compare the most restrictive specifications. First, notice that in the model sample ("Model Estimation"), the coefficient on g_{ij} is still negative and large (column (3)), although smaller than column (1). In this case, we add the full set of controls. Next, we run the same regression with the TM data described in Section 2. In this sample, we still find that a higher prevalence of TMs are associated with fewer exporters to the destination.[34] In fact, destinations with more TMs have a larger estimated g_{ij}, confirming that TMs

[34]The number of observations are smaller in this case because it requires a country to be included in the NTM-MAP dataset.

are one type of standard that we pick up in our general restrictiveness estimate.[35] The counterfactual presented in the next subsection requires a substantially restricted sample, but the results in this table serve as confirmation that our estimated restrictiveness in fact captures a reduction in entry from i to j.[36]

Table G.2: Estimated Restrictiveness and Extensive Margin

	Log N Exporters	Exports per Exporter	Log N Exporters	
	(Model Estimation)	(Model Estimation)	(Model Estimation)	(NTM Data)
Estimated g (log)	-0.541***	0.290***	-0.302***	
	(0.016)	(0.021)	(0.021)	
TM Prevalence (log)				-0.055***
				(0.013)
Log Dist	-0.961***	-0.078***		
	(0.011)	(0.013)		
Border	0.473***	0.286***		
	(0.034)	(0.037)		
Common Language	0.930***	-0.356***		
	(0.026)	(0.026)		
Fixed Effects	j,i-HS	j,i-HS	i-j,i-HS	i-j,i-HS
Controls			Access	Access
R^2	0.768	0.725	0.912	0.908
# Observations	18856	18639	8233	8233

In this table, we test whether the estimated restrictiveness, g_{ij}, have the expected effect on the extensive and intensive margin of exporters. The main independent variable in the first three columns is the estimated g_{ij} from the SMM procedure with EDD data. In the first two columns we use all available estimated g_{ij}s, and control only for gravity measures. Column (1) has number of exporters as the outcome and column (2) has mean exports per exporter (both from EDD). In column (3) we repeat column (1) but with a reduced sample that include the NTM data. In this case, we control for tariffs and non-tariff measures that are not technical measures, plus origin-destination and destination-sector fixed effects. Finally, in column (4) we repeat the previous specification with TM prevalence data from Table 1. $***p < 0.01$, $**p < 0.05$, $*p < 0.1$.

G.5 Estimation of Domestic Restrictiveness

Our method to estimate the domestic level of restrictiveness requires a reference country k. Let Chile be country k, for which we have an estimate of g_{kk} from the Macedoni and Weinberger (2022) procedure described in Section G.3. In that paper, we describe an algorithm to estimate the domestic level of restrictiveness along with κ and γ, which results in $g_{kk} = 1.066$.

Given an estimation of κ, γ, and g_{kk} for $k = Chile$, we next turn to information about relative trade costs. First, the ratio of the number of exporters from i across two different destinations is derived from (61) and shown in (137). We obtain the relative iceberg trade costs $\frac{\tau_{ij}}{\tau_{ik}}$ with the following extensive margin specification:

$$\ln \frac{N_{ij}}{N_{kj}} = \ln S_i - \ln S_k - \kappa \ln \frac{\tau_{ij}}{\tau_{kj}} - \kappa \ln \frac{t_{ij}}{t_{kj}} - \kappa \ln \frac{g_{ij}}{g_{kj}} \tag{138}$$

where S_i and S_k are country i and k fixed effects (which include wages from (137) above), $\frac{g_{ij}}{g_{kj}}$ are taken from the SMM estimation for $\forall i \neq j$ described in Section 4.1, and the number of exporters is data from EDD. Trade costs take the following form: $\tau_{ij} = \beta_1 \ln dist_{ij} + \beta_2 contig_{ij} +$

[35] We do point out that a 1% rise in the prevalence of TMs seems to have a smaller effect on the number of exporters as a 1% rise in g_{ij}, which is not surprising as the estimated restrictiveness is a broader measure.

[36] We have checked however that the negative relationship exists in the evolving samples.

$\beta_3 commlang_{ij} + \beta_4 colony_{ij}$[37], and since we know κ, we then obtain predicted values of $\frac{\tau_{ij}}{\tau_{kj}}$ by estimating the parameters of the equation above.

Given relative trade costs, the domestic levels of restrictiveness can be backed out from the relationships in the model. The relationship between g_{ij} and g_{jj} is given by (22). For exposition purposes, suppose the fixed costs are expressed in destination labor units.[38] Our relationship becomes:

$$g_{ij} - 1 = (g_{jj} - 1)\frac{w_j c_j}{\tau_{ij} w_i c_i} t_{ij}^{-\frac{\gamma}{1+\gamma}} \tag{139}$$

Let $a_i = w_i c_i$, and let us normalize, without loss of generality $a_k = 1$ for Chile. This implies setting its wage to one, and assuming that all marginal costs are expressed as relative to the marginal costs of Chile. Thus, we have:

$$g_{ij} - 1 = (g_{jj} - 1)\frac{a_j}{\tau_{ij} t_{ij}^{\frac{\gamma}{1+\gamma}} a_i}$$

We can obtain each value of a_i simply by taking the following ratio:

$$\frac{g_{ij} - 1}{g_{kj} - 1} = \frac{\tau_{kj} t_{kj}^{\frac{\gamma}{1+\gamma}}}{\tau_{ij} t_{ij}^{\frac{\gamma}{1+\gamma}}} \frac{1}{a_i} \tag{140}$$

Since we have the estimated values of g_{ij} for each country pair and relative trade costs, $\frac{\tau_{kj} t_{kj}^{\frac{\gamma}{1+\gamma}}}{\tau_{ij} t_{ij}^{\frac{\gamma}{1+\gamma}}}$, we compute g_{jj} as the solution to[39]:

$$\frac{g_{ij} - 1}{g_{ik} - 1} = \frac{g_{jj} - 1}{g_{kk} - 1} \frac{\tau_{ik} t_{ik}^{\frac{\gamma}{1+\gamma}} a_j}{\tau_{ij} t_{ij}^{\frac{\gamma}{1+\gamma}}} \tag{141}$$

[37] The latter three variables are equal to one if the country pair shares a border, has a common language, or a colonial relationship, respectively. The first variable is the log distance between the pair in miles.

[38] This algorithm would support also the more general case where the fixed cost is expressed both in domestic and foreign labor units, bundled together in a Cobb-Douglas fashion: $f_{ij} = w_i^{\alpha} w_j^{1-\alpha}$.

[39] Notice that the relationship above is over-identified, so we estimate the parameters by minimizing the sum of squared errors.

H Quantitative Exercise: Extra Results

H.1 Trade Share, Wages, Income and Restrictiveness Results

The following tables report the initial values for trade shares, wages and estimated restrictiveness. Methods to compute each of these measures are detailed in the main text and the above Appendix section. We reiterate the note given in the previous Appendix section: Although we generally do have trade flow data for almost all origin-destination pairs, the coverage is more restricted for other variables (especially the moments required to produce g_{ij}). This is why all matrices have missing observations; for all our reported matrices below we only report data for the cells in which we are able to produce estimated restrictiveness. For example, although Costa Rica is an exporter to Bolivia, after cleaning the EDD data we cannot produce an estimate for g_{ij} in that case and therefore that cell is always listed as " - " in all reported tables. A " - " should be interpreted as not available, and not a 0. A "0" in the trade share matrix (seen only in the ROW destination) is due to rounding of extremely small trade shares.

Table H.1: Trade Shares Matrix for all $i-j$, taken from trade flow data

	BOL	CHL	COL	CRI	DNK	DOM	ECU	ESP	GTM	MEX	NIC	PER	PRY	ROW	THA	URY	ZAF
BOL	0.4557	0.0013	-	-	-	-	-	-	-	-	-	0.0029	-	0	-	-	-
CHL	0.0244	0.5762	0.0032	0.0138	0.0007	0.001	0.0089	0.0018	0.002	0.0013	0.0026	0.0073	0.0034	0.0001	0.0005	0.0036	0.0006
COL	0.0103	0.0121	0.8133	0.0155	-	0.0072	0.0311	0.003	0.0083	0.0008	0.0018	0.0091	0.0005	0.0001	-	0.001	-
CRI	-	0.0002	0.0002	0.1916	-	0.0039	0.0008	0.0001	0.0071	0.0029	0.0452	0.0002	-	0	-	0.0002	-
DNK	0.0006	0.0011	0.0003	0.001	0.5994	0.0012	0.0003	0.0022	0.0001	0.0004	-	0.0004	-	0.0001	0.0004	0.0023	0.0012
DOM	-	-	0.0001	0.0018	-	0.7131	-	0.0001	0.0019	0.0001	-	-	-	0	-	-	-
ECU	0.0021	0.0119	0.0035	0.0013	-	0.0008	0.6468	0.0005	0.0034	0.0001	-	0.0119	-	0	-	-	-
ESP	0.0064	0.0077	0.0026	0.009	0.0061	0.0085	0.0087	0.6915	0.0028	0.0036	0.0104	0.0047	0.002	0.0004	0.0009	0.0037	0.0051
GTM	-	0.0006	0.0002	0.0192	-	0.0018	0.0004	0.0001	0.7496	0.0005	0.0343	0.0005	-	0	-	-	-
MEX	0.0151	0.0144	0.0211	0.0551	0.0008	0.0169	0.0126	0.0066	0.0287	0.6807	0.0433	0.0098	0.0038	0.0006	0.0009	0.0074	0.003
NIC	-	-	-	0.005	-	-	-	-	0.0015	0.0001	0.4308	-	-	0	-	-	-
PER	0.0356	0.0115	0.003	0.0022	-	0.0009	0.016	0.002	0.0017	0.0004	0.0016	0.7548	0.0002	0.0001	-	0.0006	-
PRY	0.0054	-	-	-	-	-	-	-	-	-	-	-	0.7377	0	-	0.002	-
ROW	0.4375	0.3569	0.1509	0.6802	0.3906	0.2437	0.2701	0.29	0.191	0.305	0.4231	0.1943	0.2469	0.9979	0.3314	0.257	0.403
THA	0.0044	0.004	0.0011	0.0043	0.0018	0.0009	0.0044	0.0008	0.002	0.0034	0.0069	0.0026	0.0017	0.0003	0.6631	0.0008	0.0112
URY	0.0023	0.0015	0.0003	-	-	-	-	0.0001	-	0.0003	-	0.001	0.0038	0	-	0.7215	-
ZAF	-	0.0006	0.0001	-	0.0006	-	-	0.001	-	0.0005	-	0.0004	-	0.0002	0.0029	-	0.5758

This table reports trade shares, for our trade matrix. In the cases where there is no exporter information in EDD, we assume no trade between those country pairs (since we cannot estimate g_{ij} in those cases). Trade shares estimated from international trade flow data are equal to: $\lambda_{ij} = \frac{X_{ij}}{\sum_i X_{ij}}$ (where X_{ij} = reflect trade flow data from i to j). Producing the full matrix of λ_{ij} requires a few extra computational steps because we are missing direct data on: i) a "rest of the world" (ROW) country which makes up for all of the rest of trade not captured within our sample (to make trade shares realistic); and ii) domestic trade. The process is as follows. For each destination, its domestic absorption, C_j is measured as $C_j = GO_j + M_j - X_j$, where the last two components reflect total imports ($\sum_{i \neq j} X_{ij}$) and exports ($\sum_{j \neq i} X_{ji}$). Domestic trade is backed out as: $X_{jj} = GO_j - X_j$. Given $\sum_{i \in s} X_{ij}$ as trade to destination j *within our sample, s*, exports from ROW to j are the difference between C_j and the sample exports to j. Thus, trade shares sum to one.

Table H.2: Predicted Wages and Income (Market Clearing)

	Wages	Income
BOL	0.170040986	0.170693342
CHL	1	1.002164661
COL	0.65120712	0.651490168
CRI	0.855951039	0.858036764
DNK	4.293177874	4.293566511
DOM	0.295739781	0.296811631
ECU	0.453012817	0.454078352
ESP	1.824774916	1.824896922
GTM	0.27902311	0.279414182
MEX	0.959316854	0.960386899
NIC	0.141852507	0.142274511
PER	0.543505243	0.543883307
PRY	0.315180694	0.315424374
ROW	9.417142154	9.418083868
THA	0.993703775	0.994269049
URY	1.066411722	1.067347472
ZAF	0.603414377	0.604419202

This table reports the estimated wages given employment data, trade shares, and the relationship given by (11). We normalize the wages in Chile equal to one.

Table H.3: Estimated Restrictiveness Index (g_{ij}) Matrix for all $i - j$

	BOL	CHL	COL	CRI	DNK	DOM	ECU	ESP	GTM	MEX	NIC	PER	PRY	ROW	THA	URY	ZAF
BOL	1.33	1.07	-	-	-	-	-	-	-	-	-	1.15	-	1.00	-	-	-
CHL	1.03	1.07	1.01	1.07	1.09	1.16	1.03	1.04	1.09	1.02	1.34	1.01	1.11	1.00	1.49	1.06	1.12
COL	1.00	1.00	1.03	1.00	-	1.00	1.00	1.02	1.00	1.00	1.15	1.00	1.15	1.00	-	1.09	-
CRI	-	1.00	1.00	1.17	-	1.00	1.00	1.03	1.00	1.00	1.00	1.00	-	1.00	-	1.20	-
DNK	1.15	1.47	1.12	1.25	1.08	1.10	3.33	1.12	1.73	1.02	-	1.14	-	1.00	1.33	1.35	1.52
DOM	-	-	1.13	1.07	-	1.10	-	1.05	1.00	1.05	-	-	-	1.00	-	-	-
ECU	1.18	1.06	1.01	1.10	-	1.05	1.10	1.12	1.05	1.16	-	1.00	-	1.00	-	-	-
ESP	1.14	1.00	1.00	1.05	1.00	1.04	1.04	1.27	1.05	1.00	1.05	1.00	1.37	1.00	1.00	1.10	1.00
GTM	-	1.08	1.05	1.00	-	1.00	1.08	1.26	1.11	1.00	1.00	1.03	-	1.00	-	-	-
MEX	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NIC	-	-	-	1.03	-	-	-	-	1.03	1.11	1.01	-	-	1.00	-	-	-
PER	1.00	1.00	1.00	1.01	-	1.02	1.01	1.01	1.00	1.02	1.05	1.06	1.05	1.00	-	1.05	-
PRY	1.44	-	-	-	-	-	-	-	-	-	-	-	2.27	1.00	-	1.27	-
ROW	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
THA	1.06	1.00	1.00	1.01	1.00	1.12	1.00	1.00	1.04	1.00	1.22	1.00	1.05	1.00	1.55	1.01	1.00
URY	1.08	1.08	1.20	-	-	-	-	1.15	-	1.09	-	1.76	1.09	1.00	-	1.63	-
ZAF	-	1.03	1.01	-	1.04	-	-	1.00	-	1.00	-	1.04	-	1.00	1.00	-	1.85

This table reports estimated restrictiveness (g_{ij}) for all country pairs available in EDD. In the cases where there is no exporter information in EDD, we assume no trade between those country pairs (since we cannot estimate g_{ij} in those cases).

H.2 Estimating Trade Shares from the Model

An alternative to using λ_{ij} from the data is to predict trade shares with the structure of the model. Although this is more theoretically consistent, it also leads to some improbable trade shares, and for that reason we stick to the data in the benchmark analysis. Specifically, we can use the following gravity regression:

$$\ln \frac{\lambda_{ij}}{\lambda_{jj}} = \underbrace{\ln \left[J_i b_i^{\kappa} (c_i w_i)^{-\kappa+\gamma+1}\right]}_{\text{Origin FE}} - \underbrace{\ln \left[J_j b_j^{\kappa} (c_j w_j)^{-\kappa+\gamma+1}\right]}_{\text{Destination FE}} - (\kappa - \gamma - 1) \ln \frac{\tau_{ij}}{\tau_{jj}} + \ln \left(\frac{g_{ij}^{-\kappa} G_2(g_{ij})}{g_{jj}^{-\kappa} G_2(g_{jj})} \right) \tag{142}$$

where trade costs take an explicit form as as above (distance, etc.) plus an indicator for internal trade, and the last component is produced with estimated restrictiveness measures. Then, the measure of trade shares is the predicted value of $\frac{\lambda_{ij}}{\lambda_{jj}}$, which includes domestic shares that are produced with the approximated manufacturing gross output described above.

Table H.4 displays the results for trade shares if we were to back them out after estimating the gravity equation, instead of taking them straight from data.

Table H.4: Predicted Trade Shares

	BOL	CHL	COL	CRI	DNK	DOM	ECU	ESP	GTM	MEX	NIC	PER	PRY	THA	URY	ZAF
BOL	0.752	0.002	-	-	-	-	-	-	-	-	-	0.005	-	-	-	-
CHL	0.076	0.973	0.005	0.006	0.001	0.004	0.004	0.001	0.003	0.002	0.008	0.030	0.008	0.000	0.019	0.001
COL	0.022	0.003	0.948	0.022	-	0.017	0.023	0.002	0.007	0.002	0.022	0.029	0.002	-	0.004	-
CRI	-	0.000	0.001	0.870	-	0.003	0.001	0.000	0.002	0.001	0.061	0.002	-	-	0.000	-
DNK	0.004	0.000	0.001	0.002	0.990	0.003	0.001	0.002	0.000	0.001	-	0.002	-	0.000	0.001	0.001
DOM	-	-	0.001	0.001	-	0.907	-	0.000	0.001	0.000	-	-	-	-	-	-
ECU	0.004	0.001	0.010	0.006	-	0.005	0.939	0.001	0.002	0.000	-	0.018	-	-	-	-
ESP	0.025	0.005	0.007	0.013	0.004	0.016	0.006	0.980	0.005	0.004	0.029	0.013	0.006	0.001	0.010	0.005
GTM	-	0.000	0.001	0.008	-	0.004	0.001	0.000	0.907	0.003	0.035	0.001	-	-	-	-
MEX	0.045	0.006	0.015	0.049	0.002	0.035	0.013	0.008	0.067	0.983	0.163	0.023	0.007	0.001	0.016	0.004
NIC	-	-	-	0.011	-	-	-	-	0.002	0.000	0.665	-	-	-	-	-
PER	0.039	0.004	0.007	0.005	-	0.004	0.009	0.001	0.002	0.001	0.011	0.868	0.002	-	0.004	-
PRY	0.017	-	-	-	-	-	-	-	-	-	-	-	0.968	-	0.009	-
THA	0.009	0.002	0.003	0.007	0.002	0.003	0.003	0.003	0.003	0.002	0.005	0.006	0.003	0.998	0.007	0.006
URY	0.007	0.002	0.001	-	-	-	-	0.001	-	0.000	-	0.001	0.005	-	0.930	-
ZAF	-	0.001	0.001	-	0.000	-	-	0.001	-	0.000	-	0.002	-	0.000	-	0.982

This table reports λ_{ij} when we use the estimated relationship given by (142). The specification is run with gravity data and the restriction parameters estimated in the previous step.

H.3 Welfare Results

The following tables present summary statistics on domestic trade shares, restrictiveness, optimal standards, and the welfare results when all countries impose their optimal standard relative to a laissez-faire world. These correspond to the results in Figure 4.

Table H.5: Summary Stats for Counterfactual and Welfare Relative to Laissez-Faire

origins	λ_{jj}	g_{jj}	g_{opt}	$tariff^{opt}$	$dlnW_{\forall j}$	$dlnW_{only\ j}$	$dlnW_{\forall \neq j}$	$dlnW^{NoToT}_{\forall \neq j}$	$dlnW^{NoEntry}_{\forall \neq j}$
BOL	0.456	1.328	1.169	1.312	0.024	0.003	0.109	0.02	0
CHL	0.576	1.066	1.247	1.337	0.042	0.011	0.017	0.013	0.003
COL	0.813	1.028	1.439	1.395	0.125	0.091	0.007	0.006	0.002
CRI	0.192	1.175	1.001	1.172	0.025	0	0.031	0.023	0.007
DNK	0.599	1.080	1.274	1.344	0.038	0.016	0.002	0.002	0
DOM	0.713	1.097	1.370	1.374	0.075	0.048	0.009	0.008	0.001
ECU	0.647	1.097	1.314	1.359	0.073	0.024	0.023	0.019	0.004
ESP	0.692	1.274	1.348	1.376	0.066	0.04	0.004	0.003	0.001
GTM	0.750	1.110	1.395	1.383	0.094	0.061	0.011	0.009	0.002
MEX	0.681	1.333	1.323	1.377	0.062	0.038	0.003	0.002	0.001
NIC	0.431	1.010	1.002	1.290	0.012	0	0.024	0.02	0.005
PER	0.755	1.062	1.368	1.392	0.096	0.056	0.01	0.009	0.002
PRY	0.738	2.274	1.418	1.488	0.082	0.087	0.004	0.003	0.001
THA	0.663	1.550	1.335	1.395	0.056	0.036	0.011	0.001	0
URY	0.721	1.625	1.384	1.418	0.081	0.06	0.002	0.004	0
ZAF	0.576	1.846	1.282	1.403	0.034	0.02	0.004	0.003	0.001
Total	0.625	1.30	1.27	1.363	0.0616	0.035	0.011	0.009	0.002

This table presents the welfare results described in the left side of Panel (A) in Figure 4. The first four columns summarize estimated λ_{jj}, g_{jj}, optimal standards (set at home) and optimal tariffs for each destination, j. $dlnW_{\forall j}$ represents the welfare when all countries each impose their optimal regulations. $dlnW_{only\ j}$ represents welfare change when each j imposes regulations unilaterally. $dlnW_{\forall \neq j}$ represents welfare change for j for *all other countries* impose their optimal regulation. $dlnW^{NoToT}_{\forall \neq j}$ represents the previous column setting all wage changes to 0 (now the international spillover is only through the entry effect). $dlnW^{NoEntry}_{\forall \neq j}$ represents the international spillover while shutting off entry.

Table H.6 presents the average changes in welfare resulting from different counterfactual scenarios. The three columns report the average welfare change across all 16 countries under the baseline case when all channels operate (*Baseline*), the case when the ToT channel is shut off (*No Terms of Trade*), and the case where the entry channel is shut off (*No Entry*). The table also includes two separate rows showing the average welfare change when: i) each country implements their optimal regulations individually (Only j); and ii) all countries except j enforce their optimal regulations (All But j). In each case, welfare is computed relative to having no regulations.

The first row is useful to examine to what degree each channel contributes to the level of optimal regulation each country sets unilaterally. This means that there will be no changes in relative income by setting $\hat{w}_i = \hat{y}_i = 1$, $\forall i$. Unlike tariffs, more restrictive regulations tend to worsen the ToT, leading to lower welfare. This is apparent in the second column of the table, where welfare change is 33% larger than the baseline case. Shutting off entry leads to reductions in welfare as it shuts off the main channel through which the composition effect raises welfare.

The second row, by allowing all foreign countries *except j* to impose regulations, demonstrates the relative strength of each channel in driving the international spillover. First, the international spillover itself is almost one-third as large as the baseline welfare effect of countries imposing their own regulations. Shutting down only the relative wages/incomes leaves about 80% of the externality intact – notice the baseline should now give the highest welfare as both channels are positive. Shutting down only entry leaves intact 20% of the externality, therefore the entry channel is more important (by around 4 times). This decomposition strengthens our discussion in Section 3.4 by providing evidence on the operation of both channels in their role for cooperation.

Table H.6: Average Welfare Change under Alternative Specifications

	Baseline	No Terms of Trade	No Entry
Average %Δ W (Only j)	0.037	0.049	-0.066
Average %Δ W (All But j)	0.011	0.009	0.002

This table presents the simple average welfare changes (across 16 countries) from setting optimal regulations (relative to having no restrictiveness at all) under several counterfactual scenarios. The three columns report: 1. the baseline case when all channels operate (*Baseline*), 2. the case when the ToT channel is shut off (*No Terms of Trade*), and 3. the case where the entry channel is shut off (*No Entry*). To compute the latter two cases, we leave one channel (e.g. $\hat{J}$) as is, given the solution to the endogenous system of equations after the policy changes, and set the other to zero (e.g. $\hat{w}_i = \hat{y}_i = 0$). In each counterfactual, we provide two cases, separated by rows: i) each country implements their optimal regulations individually (Only j); and ii) all countries except j enforce their optimal regulations (All But j).

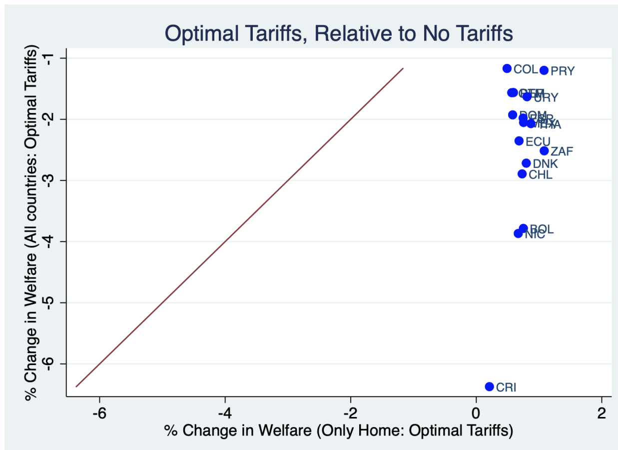
H.4 Welfare Effects of Optimal Tariffs and Comparison to Optimal Standards

Panel (A) of Figure H.1 presents evidence for counterfactual welfare changes where we compare to the case where the tariff policy is laissez-faire (i.e. welfare gain of optimal tariffs starting from $g_{ij} = 1, t_{ij} = 1, \forall i, j$). The optimal tariff is computed similarly to the optimal restrictiveness, where for each destination, we search across their level of tariffs that maximizes welfare given all else equal (i.e. the starting equilibrium). In this case, we assume that the imposing country imposes the same tariff on all origin countries to calculate the optimal tariff. The x-axis assumes country j imposes their optimal tariff and the rest do nothing. The y-axis is the change in welfare when *all countries except for* j impose their optimal tariff at the same time, though unilaterally.

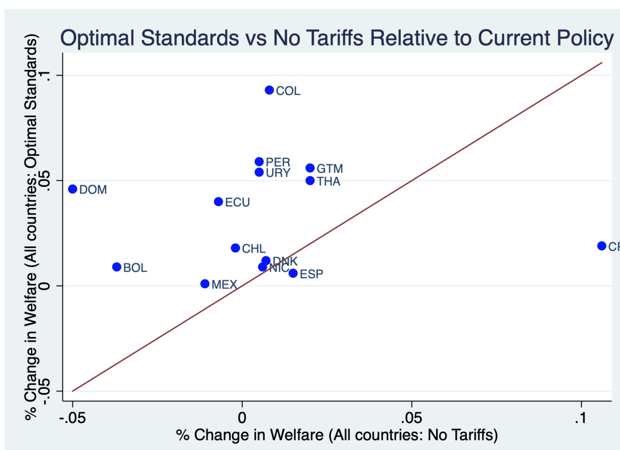
Panel (B) of Figure H.1 compares the gains from moving to the optimal regulatory restrictiveness to the case of removing current tariffs. In both cases, we compute welfare changes relative to the initial (current) level of tariffs and restrictiveness. The x-axis displays the change in welfare for each country when all tariffs are eliminated and the y-axis reports welfare changes for the case when *all* countries set their optimal regulations (together but not cooperatively). Notice that in this case countries can either raise or lower their standards depending on whether their current restrictiveness levels are too high or too low. An advantage of our quantitative exercise is to identify in which direction countries should take their policies.

Figure H.1: Welfare Effects of Optimal Tariffs and Comparison to Optimal Standards

(A) Optimal Standards and Tariffs relative to Laissez-Faire: All Countries set Policy vs One at a Time



(B) Optimal Standards and No Tariffs relative to Current Policy: All Countries set Policy vs Unilateral



This figure displays the % change in welfare for countries in several scenarios. In **panel (A)**, we compute the welfare gain of optimal tariffs, comparing to the case where the policy is laissez-faire We compute the welfare gain of each country j when: i) j sets optimal tariffs unilaterally (x-axis); and ii) all trade partners *except for* j set their optimal standards (y-axis). In **panel (B)**, we compare the welfare gain for each country when *all countries* of move from the *current policy* (currently estimated standards/measured tariffs) to either optimal standards (y-axis) or no tariffs (x-axis). In all cases, after altering policy through either $\hat{g}_{jj}$ or $\hat{t}_{ij}$, we then compute $\hat{J}_j$, $\hat{w}_j$, $\hat{y}_j$ and $\hat{g}_{ij}(i \neq j)$ as a response, which produces the equivalent variation in income according to (77).