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GOVERNMENT POLICIES IN A GRANULAR GLOBAL ECONOMY

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### **ABSTRACT**

We use the granular model of international trade developed in Gaubert and Itskhoki (2020) to study the rationale and implications of three types of government interventions typically targeted at large individual firms -- antitrust, trade and industrial policies. We find that in antitrust regulation, governments face an incentive to be overly lenient in accepting mergers of large domestic firms, which acts akin to beggar-thy-neighbor trade policy in sectors with strong comparative advantage. In trade policy, targeting large individual foreign exporters rather than entire sectors is desirable from the point of view of a national government. Doing so minimizes the pass-through of import tariffs into domestic consumer prices, placing a greater portion of the burden on foreign producers. Finally, we show that subsidizing 'national champions' is generally suboptimal in closed economies as it leads to an excessive build-up of market power, but it may become unilaterally welfare improving in open economies. We contrast unilaterally optimal policies with the coordinated global optimal policy and emphasize the need for international policy cooperation in these domains.

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# 1 Introduction

Large firms shape the landscape of national economies and even more so the patterns of international trade. [Gaubert and Itskhoki \(2020\)](#) show that “granular” forces (i.e., exports driven by large individual firms) contribute significantly to comparative advantage and trade patterns of countries. In this context, a number of micro-level policies targeted at individual firms may end up having non-trivial aggregate consequences. This is true in particular when these policies impact large exporters. We observe that such policies are common with governments taking policy actions that are sometimes very narrow and appear tailor-made to target individual firms rather than industries. In particular, antitrust regulation, antidumping policies, and international sanctions all target large individual foreign firms.<sup>1</sup>

In this paper, we study the rationale for and consequences of such “granular” policies. We are particularly interested in the impact these policies may have in a global economy. To do so, we adopt the quantitative model of trade with granular firms developed and estimated in [Gaubert and Itskhoki \(2020\)](#). We use the model to study the general equilibrium impact of national policies in a granular open economy by evaluating their effect on both the welfare of the home country and that of its trade partners. Across sectors, the model features classic Ricardian forces as in [Dornbusch, Fischer, and Samuelson \(1977\)](#); crucially, within sectors, it features a discrete (but potentially large) number of heterogeneous firms that compete oligopolistically. The model is quantified to match patterns of domestic sales and exports of French manufacturing firms. In particular, the distribution of firm size is very skewed, so that some large firms have sectoral market shares well above single digits even in sectors comprised of a large number of home and foreign firms. We use this framework to characterize the qualitative and quantitative properties of various government interventions.

We first shed light on merger policy, by studying the potential merger of two domestic firms who are leaders in their sector. We find that the desirability of such a merger, from the perspective of the home government, depends crucially on how open the economy is. In general, mergers lead to some cost savings and productivity gains; however, they also lead to an increase in monopoly power, which reduces overall efficiency and leads to a transfer of surplus from consumers to producers. In a relatively closed economy, the efficiency loss due to an increase in monopoly power tends to make mergers undesirable.

However, in a more open economy, mergers lead to a transfer of surplus to the merged home firm which is done, in part, at the expense of the foreign consumer surplus. Therefore,

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<sup>1</sup>Recent examples of international antitrust regulations are the 2007 case of the European Commission (EC) against Microsoft Corporation and the 2017 fine imposed by the EC on Google. A very recent case of a granular trade war is [the 292% tariff](#) imposed by the US on a particular jet produced by the Canadian Bombardier. “Granular” tactics are particularly widespread in antidumping retaliation (see [Blonigen and Prusa 2008](#)) and international sanctions (as in the recent case of [the US against the Chinese ZTE](#)).

the more open the economy is, the more a given home merger is desirable from the point of view of the home government, especially in sectors where home firms are export champions. Contrasting the attitudes of the home and foreign governments towards the same domestic mergers reveals an international conflict, whereby the home antitrust is excessively lenient towards mergers in comparative advantage sectors. Finally, we compare unilateral optimal decisions in merger policy to the coordinated global planner’s solution. Our estimated model suggests that the negative spillover effects on the foreign country and aggregate welfare are significant quantitatively, and are particularly pronounced in the most granular and open sectors. This underlines the need for international cooperation over M&A policies to avoid an excessive build-up of market power.

In a second exercise, we turn to trade policy. We are interested in the incentives faced by governments to impose an import tariff on a single large foreign exporter, rather than imposing it on all firms in a given sector. Narrow trade restrictions and antidumping duties that target a narrow set of firms have indeed been regularly emphasized in the policy debate. To make progress on this question, we assume that the foreign country is passive and does not retaliate. In this context, all unilateral import tariffs shift surplus towards the home economy, and the corresponding cost is born by the foreign country (including the deadweight loss of the policy).

The question that we focus on is whether the breadth of tariff imposition matters for revenue-equivalent sets of tariffs. Specifically, we compare the welfare effects of imposing two different tariff schemes designed to raise the same revenue — a granular tariff and a sector-wide tariff. We find that, in a granular world, a country prefers to impose an import tariff on the largest foreign exporter, rather than imposing a uniform tariff on all sectoral imports. This is particularly true in sectors where its trade partner enjoys a granular comparative advantage. The reason is that by taxing the largest foreign firm, a country takes advantage not only of the general equilibrium terms-of-trade effect, operating via a reduction in the foreign wage rate, but also of the industry level terms-of-trade improvement due to the incomplete pass-through of the tariff as a result of markup adjustment by the large foreign firm.

In the last exercise, we study industrial policies that subsidize national champions. We show that they are generally suboptimal in closed economies due to an excessive build-up of market power, yet may become welfare improving when used unilaterally in open economies.

**Related literature** We contribute to the literature that studies the influence of large individual firms on macro aggregates, referred to as “granularity” in the macro literature following [Gabaix \(2011\)](#). This literature typically focuses on the positive question of what share of aggregate fluctuations is driven by idiosyncratic productivity shocks (see [Acemoglu, Car-](#)

valho, Ozdaglar, and Tahbaz-Salehi 2012, Carvalho and Gabaix 2013, Carvalho and Grassi 2019, Grassi 2017) or what share of trade flows can be traced to firm-level shocks (see di Giovanni and Levchenko 2012, di Giovanni, Levchenko, and Méjean 2014, Gaubert and Itskhoki 2020). We complement these studies by investigating, in contrast, the normative policy implications of granularity.

Our study is related to the vast literature on trade policy and market structure, summarized in Helpman and Krugman (1989), Brander (1995) and Bagwell and Staiger (2004). In particular, early contributions that study profit-shifting motives for trade policy under oligopoly include Dixit (1984), Brander and Spencer (1984) and Eaton and Grossman (1986). These papers focus on stylized models with homogeneous firms. A more recent literature explores how optimal trade policy is impacted by the presence of heterogeneous firms that self-select into exporting as in Melitz (2003) (see Demidova and Rodríguez-Clare 2013, Felbermayr, Jung, and Larch 2013, Bagwell and Lee 2020, Haaland and Venables 2016). These analyses all rely on monopolistically competitive models and study a uniform tariff imposed on all firms. Closer to what we do, Costinot, Rodríguez-Clare, and Werning (2020) study non-uniform tariffs imposed on heterogeneous firms in a Melitz (2003) framework. They keep the focus on a setup with monopolistic competition with constant markups; in contrast, our quantitative analysis features strategic interactions between firms and variable markups. Our contribution to this literature is to study granular trade policy in a quantitative model of oligopolistic competition with many firms, which captures the salient features of the market structure of modern manufacturing industries.

We also contribute to the literature studying merger policy. In international trade, merger policy is often viewed as part of the toolkit that policymakers use to affect foreign market access (see e.g. Bagwell and Staiger 2004, Chapter 9), yet systematic studies of merger policies in this context still remain scarce. Early contributions, focusing typically on homogeneous firms, have expanded the merger analysis from a closed economy context studied in IO to open economies (Barros and Cabral 1994, Head and Ries 1997), as well as considered merger and trade policy jointly Horn and Levinsohn (2001), Richardson (1999), De Stefano and Rysman (2010). Closer to our quantitative analysis, Breinlich, Nocke, and Schutz (2019) use a two-country trade model with oligopolistic competition to study, in partial equilibrium, when merger policy designed to minimize local consumer prices is too tough or too lenient from the viewpoint of the foreign country. We set up our analysis in general equilibrium and consider a more general welfare function, which accounts for producer surplus in addition to consumer surplus. We decompose the contribution of each channel to the total welfare effects of mergers.

The rest of the paper is structured as follows. Section 2 reviews the theoretical framework of [Gaubert and Itskhoki \(2020\)](#) and its quantification, which serve as a basis for the policy analysis that follows. Section 3 lays out how we evaluate granular policies in general equilibrium in this context. Section 4 studies merger policy, Section 5 examines import tariffs and Section 6 discusses industrial policy. Section 7 concludes.

## 2 A Quantified Granular Model

This section sets up a granular model of international trade, following [Gaubert and Itskhoki \(2020\)](#), and discusses its quantification.

### 2.1 Theoretical Framework

We study a two-country multi-sector model, which combines a Ricardian [Dornbusch, Fischer, and Samuelson \(1977\)](#) model across sectors with the [Eaton, Kortum, and Sotelo \(2012\)](#) model of granular firms within each sector.<sup>2</sup> The two countries are Home and Foreign, which represents the rest of the world. Households inelastically supply  $L$  and  $L^*$  units of labor at Home and in Foreign, respectively, with  $L/L^*$  measuring the relative size of the home country. We describe first the laissez-faire equilibrium in an economy without government policies.

**Preferences** There is a unit continuum of sectors  $z \in [0, 1]$ , with a *finite* number of product varieties  $i \in \{1, \dots, K_z\}$  in each sector. The numbers of varieties offered in each country,  $K_z$  at home and  $K_z^*$  abroad, is endogenous, as described further below.

Households have Cobb-Douglas preferences over consumption in each sector, which is itself a CES aggregate of each product variety, that is:

$$Q = \exp \left\{ \int_0^1 \alpha_z \log Q_z dz \right\} \quad \text{with} \quad Q_z = \left[ \sum_{i=1}^{K_z} q_{z,i}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad (1)$$

and  $\int_0^1 \alpha_z dz = 1$ . Parameters  $\alpha_z$  measure expenditure shares on sectors  $z \in [0, 1]$  and  $\sigma > 1$  is the within-sector elasticity of substitution, common across sectors.

Using the properties of the CES demand aggregator, consumer expenditure on variety  $i$  in sector  $z$  in the home market is given by:

$$r_{z,i} \equiv p_{z,i} q_{z,i} = s_{z,i} \alpha_z Y \quad \text{with} \quad s_{z,i} \equiv \left( \frac{p_{z,i}}{P_z} \right)^{1-\sigma}, \quad (2)$$

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<sup>2</sup>The [Eaton, Kortum, and Sotelo \(2012\)](#) model is a granular version of the [Melitz \(2003\)](#) model in its [Chaney \(2008\)](#) formulation. The model nests as special cases both the DFS-Melitz model, as firms become infinitesimal, as well as the Ricardian DFS model, as varieties of products become perfect substitutes and fixed costs tend to zero.

where  $p_{z,i}$  is the price of variety  $i$  in sector  $z$ ,  $P_z = \left[ \sum_{i=1}^{K_z} p_{z,i}^{1-\sigma} \right]^{1/(1-\sigma)}$  is the sectoral price index,  $s_{z,i}$  is the within-sector market share of the product variety, and  $Y$  is aggregate income (expenditure) at Home.

**Production** Each firm produces a distinct product variety using local labor as input. The technology has constant returns to scale,  $y_{z,i} = \varphi_{z,i} \ell_{z,i}$ , where  $\varphi_{z,i}$  denotes the productivity of the firm that produces product  $i$  in sector  $z$ . The output of the firm can be marketed domestically as well as exported. Exports incur an iceberg trade cost  $\tau \geq 1$ . The marginal cost of supplying the home market is therefore constant and equal to:

$$c_{z,i} = \begin{cases} w/\varphi_{z,i}, & \text{for a home variety,} \\ \tau w^*/\varphi_{z,i}^*, & \text{for a foreign variety,} \end{cases} \quad (3)$$

where  $w$  and  $w^*$  are the home and foreign wage rates, respectively. Symmetrically, the marginal cost of serving the foreign market is denoted  $c_{z,i}^*$ . In each market, we sort all potential sellers in increasing order of their marginal cost  $c_{z,i}$  ( $c_{z,i}^*$  in foreign). The index  $i$  therefore refers to the marginal cost ranking of a firm in a given market, so that the same firm is in general represented by different indexes in different markets.

To access a given market, firms have to pay a fixed cost  $F$  in units of labor of the destination country. The fixed cost is independent of the origin of the firm. As a result, the differential selection of domestic and foreign firms into the local market is driven only by iceberg trade costs, not by a differential fixed cost to access the market, in order to simplify equilibrium characterization.

**Productivity draws** We denote with  $M_z$  a potential (shadow) number of domestic products in sector  $z$ .  $M_z$  is the realization of a Poisson random variable with parameter  $\bar{M}_z$ . Each of the  $M_z$  potential entrants takes an *iid* productivity draw  $\varphi_{z,i}$  from a Pareto distribution with shape parameter  $\theta$  and lower bound  $\underline{\varphi}_z$ . Given this structure, the combined parameter:

$$T_z \equiv \bar{M}_z \cdot \underline{\varphi}_z^\theta \quad (4)$$

is a sufficient statistic that determines the expected productivity of a sector. Intuitively, a sector is more productive either if it has more potential entrants ( $\bar{M}_z$ ) or if the average productivity of a potential entrant (proportional to  $\underline{\varphi}_z$ ) is high. Symmetrically, foreign expected sectoral productivity in sector  $z$  is  $T_z^*$ , so that the ratio  $T_z/T_z^*$  determines the expected relative productivity of the two countries in sector  $z$ , a measure of the *fundamental* comparative advantage.

**Market structure** In a given market, entrants play an oligopolistic price setting game, following [Atkeson and Burstein \(2008\)](#). Firms are large in their own sectors, so that they internalize their influence on the sectoral price index  $P_z$  when they maximize profits. On the other hand, they are infinitesimal for the economy as a whole, hence take economy-wide aggregates  $(w, Y)$  as given.

We consider both a Bertrand and a Cournot oligopolistic setting.<sup>3</sup> The Nash equilibrium in these oligopolistic games is a markup price setting rule:

$$p_{z,i} = \mu_{z,i} \cdot c_{z,i}, \quad \text{where} \quad \mu_{z,i} \equiv \frac{\varepsilon_{z,i}}{\varepsilon_{z,i} - 1} \quad (5)$$

$$\text{and} \quad \varepsilon_{z,i} \equiv \varepsilon(s_{z,i}) = \begin{cases} \sigma(1 - s_{z,i}) + s_{z,i}, & \text{under Bertrand,} \\ [\sigma^{-1}(1 - s_{z,i}) + s_{z,i}]^{-1}, & \text{under Cournot,} \end{cases} \quad (6)$$

with the market share of the firm  $s_{z,i}$  defined in (2), and  $\varepsilon_{z,i} \in [1, \sigma]$  measuring the effective elasticity of residual demand for the product of the firm. Both Bertrand competition in prices and Cournot competition in quantities result in the same qualitative patterns: the elasticity of residual demand  $\varepsilon_{z,i}$  is decreasing in the firm's market share  $s_{z,i}$ , so that in turn the markup  $\mu_{z,i}$  increases with the firm's market share.

Given the set of entrants and their marginal costs  $\{c_{z,i}\}_{i=1}^{K_z}$ , the equilibrium, characterized by each firm's price and market share, is unique and has the property that prices  $p_{z,i}$  increase with marginal costs  $c_{z,i}$ , while markups  $\mu_{z,i}$  and market shares  $s_{z,i}$  decrease with  $c_{z,i}$ . We turn next to characterizing the endogenous set of entrants in each market.

**Entry** Firms enter a market if they make a positive profit there. Profits from serving the home market, for instance, are given by:<sup>4</sup>

$$\Pi_{z,i} \equiv \Pi_z(s_{z,i}) = \frac{s_{z,i}}{\varepsilon(s_{z,i})} \alpha_z Y - wF, \quad (7)$$

where given the markup pricing (5), the elasticity  $\varepsilon(s_{z,i})$  equals the ratio of revenues  $s_{z,i} \alpha_z Y$  to operating profits (before subtracting the fixed cost), and  $\Pi_{z,i}$  monotonically increases in  $s_{z,i}$ .

The setup detailed above opens the possibility of multiplicity in entry patterns. In order to select a unique equilibrium, we consider a sequential entry game. Specifically, in each market separately, firms with lower marginal costs of serving the market move first and de-

<sup>3</sup>Formally, in the case of Bertrand competition, for example, the profit maximization problem of firm  $i$  in the home market is to choose its price  $p_{z,i}$  such that  $\Pi_{z,i} = \max_{p_{z,i}} \left\{ (p_{z,i} - c_{z,i}) \frac{p_{z,i}^{-\sigma}}{\sum_{j=1}^{K_z} p_{z,j}^{1-\sigma}} \alpha_z Y - wF \right\}$ , taking as given the prices of its competitors  $\{p_{z,j}\}_{j \neq i}$  and  $(w, Y)$ . Under Cournot, the firm instead takes the quantities of its competitors  $\{q_{z,j}\}_{j \neq i}$  defined by (2) as given.

<sup>4</sup>Notice that due to the linearity of the production function, each firm's profit maximization problem is separable across markets, and hence can be considered one market at a time.

cide whether or not to enter. With this equilibrium selection, the entry game has a unique cutoff equilibrium, so that only firms with marginal costs below some cutoff enter the market. This entry game results in the equilibrium number of entrants  $K_z$ , with  $\Pi_{z,i} \geq 0$  for all  $i \in \{1, \dots, K_z\}$ , and such that  $\Pi_{z,K_z+1} < 0$  if the next firm were to enter. Similarly,  $K_z^*$  is the number of firms that enter in the foreign market, yet the sets of firms entering in the two markets are in general not the same.

**General equilibrium** The general equilibrium vector contains wage rates and aggregate incomes  $(w, w^*, Y, Y^*)$  such that labor markets clear in both countries and aggregate incomes equal aggregate expenditures (which implies trade balance). In particular, in the home country the latter condition holds if:

$$Y = wL + \Pi, \quad (8)$$

where  $\Pi$  are aggregate profits of all home firms distributed to home households:

$$\Pi = \int_0^1 \left[ \sum_{i=1}^{K_z} \iota_{z,i} \Pi_z(s_{z,i}) + \sum_{i=1}^{K_z^*} (1 - \iota_{z,i}^*) \Pi_z^*(s_{z,i}^*) \right] dz, \quad (9)$$

with profit function  $\Pi_z(s_{z,i})$  defined in (7); the indicator function  $\iota_{z,i} \in \{0, 1\}$  is 1 if firm  $i$  is of local origin in the home market, while  $\iota_{z,i}^*$  plays the same role for the foreign market.

Labor market clearing requires that aggregate labor income  $wL$  equals the total expenditure of all firms on domestic labor:

$$wL = \int_0^1 \left[ \alpha_z Y \sum_{i=1}^{K_z} \iota_{z,i} \frac{s_{z,i}}{\mu(s_{z,i})} + \alpha_z Y^* \sum_{i=1}^{K_z^*} (1 - \iota_{z,i}^*) \frac{s_{z,i}^*}{\mu(s_{z,i}^*)} + w F K_z \right] dz. \quad (10)$$

The three terms on the right-hand side of (10) correspond, respectively, to expenditure on domestic labor for (i) production for the domestic market, (ii) production for the foreign market, and (iii) entry of firms in the domestic market (of both home and foreign origin). A parallel market clearing condition to (10) holds in the foreign country. We normalize  $w = 1$  as the numeraire.

Conditional on the sectoral equilibrium vectors  $\mathbf{Z} \equiv \{K_z, \{s_{z,i}\}_{i=1}^{K_z}, K_z^*, \{s_{z,i}^*\}_{i=1}^{K_z^*}\}_{z \in [0,1]}$ , the vector of general equilibrium quantities  $\mathbf{X} \equiv (w, w^*, Y, Y^*)$  solves conditions (8), (10) and their foreign counterparts.<sup>5</sup> In turn, given the aggregate equilibrium vector  $\mathbf{X}$ , the solution to the entry and price-setting game in each country-sector yields the sectoral equilibrium vector  $\mathbf{Z}$ . The resulting fixed point  $(\mathbf{X}, \mathbf{Z})$  is the equilibrium in the granular economy.

<sup>5</sup>One of the four aggregate equilibrium conditions is redundant by Walras Law, and is replaced by the numeraire normalization. Also note that in the closed economy conditions (8) and (10) are equivalent, and amount to  $Y/w = \bar{\mu}[L - FK]$ , where  $K = \int_0^1 K_z dz$  is the total number of firms serving the home economy and  $\bar{\mu} = [\int_0^1 \alpha_z \sum_{i=1}^{K_z} s_{z,i} / \mu(s_{z,i})]^{-1}$  is the (harmonic) average markup.

## 2.2 Fundamental and granular comparative advantage

In our analysis, we focus on two sector-level characteristics: (i) a measure of the overall sectoral comparative advantage, and (ii) a measure of its granular component that extracts the contribution to comparative advantage of the idiosyncratic productivities of large firms. The first is captured by the sectoral *home share* abroad:

$$\Lambda_z^* \equiv \frac{X_z}{\alpha_z Y^*} = \sum_{i=1}^{K_z^*} (1 - \iota_{z,i}^*) s_{z,i}^*, \quad (11)$$

where  $X_z$  is total home exports and  $\alpha_z Y^*$  is total foreign absorption in sector  $z$ . Therefore,  $\Lambda_z^*$  equals the cumulative market share of all home firms serving the foreign market, capturing the export stance of home in sector  $z$ . It is a random variable that depends on the market shares (hence the realized productivity draws) of Home firms in sector  $z$  in the foreign market. Conveniently, this statistic is an observable measure of the effective comparative advantage of home in sector  $z$ , irrespective of the source of this comparative advantage.

In our granular model, this sectoral outcome  $\Lambda_z^*$  is driven by two forces: an expected value based on sectoral characteristics and the contribution of idiosyncratic firm draws around this expected value. Specifically, the expectation of firms' productivities in the sector is formally pinned down by the *fundamental* comparative advantage of the sector,  $T_z/T_z^*$ . Given  $T_z/T_z^*$ , the *expected* home share abroad is:

$$\mathbb{E}\{\Lambda_z^*\} = \frac{1}{1 + (\tau\omega)^\theta \cdot T_z^*/T_z}. \quad (12)$$

Across sectors, this expected share is increasing in  $T_z/T_z^*$ , while in all sectors it decreases with trade costs  $\tau$  and the relative home wage  $\omega \equiv w/w^*$ .

Furthermore, as our model features granularity, the home share  $\Lambda_z^*$  is shaped in part by idiosyncratic realizations of firm productivities, especially when the underlying productivity distribution is fat-tailed. As a result, the realized export stance of a country-sector may differ markedly from its expected value, driven by a handful of firms with outsized productivity draws. We therefore decompose  $\Lambda_z^*$  into its expected value based on sectoral characteristics and the contribution of idiosyncratic firm draws around this expected value:

$$\Lambda_z^* = \mathbb{E}\{\Lambda_z^*\} + \Gamma_z^* \quad (13)$$

We refer to  $\Gamma_z^* \equiv \Lambda_z^* - \mathbb{E}\{\Lambda_z^*\}$  as the *granular residual* that captures departures of realized comparative advantage from its expectation, driven by outstanding firms (or the lack thereof). In what follows, we study how welfare benefits of government policies vary across sectors with different overall and granular comparative advantage.

## 2.3 Model quantification

The model is estimated to match salient features of French firm-level data on domestic and export sales, and in particular their variation across 119 manufacturing industries, as discussed in detail in [Gaubert and Itskhoki \(2020\)](#). To quantify the model, we first parameterize the distribution of fundamental comparative advantage across sectors as a log-normal distribution:

$$\log(T_z/T_z^*) \sim \mathcal{N}(\mu_T, \sigma_T^2), \quad (14)$$

where the mean parameter  $\mu_T$  controls home’s absolute advantage and the dispersion parameter  $\sigma_T$  controls the extent of the fundamental comparative advantage. With this parametrization, in order to quantify the model, we need to estimate the six parameters of the model,  $\Theta \equiv (\sigma, \theta, \tau, F, \mu_T, \sigma_T)$ , as well as calibrate the Cobb-Douglas shares  $\alpha_z$ . We describe the estimation procedure and moment fit in [Appendix A.3](#), and we report the estimated parameters in [Table 1](#), which we use as the benchmark in our quantitative policy counterfactuals.

Table 1: Estimated parameters

Parameter	Estimate	Std. error	Auxiliary variables	
$\sigma$	5	—	$\kappa = \frac{\theta}{\sigma-1}$	1.096
$\theta$	4.382	0.195	$w/w^*$	1.130
$\tau$	1.342	0.101	$L^*/L$	1.932
$F (\times 10^5)$	1.179	0.252	$Y^*/Y$	1.710
$\mu_T$	0.095	0.150	$\Pi/Y$	0.180
$\sigma_T$	1.394	0.190		

We point out a few features of the estimated parameters. First, the combined parameter  $\kappa \equiv \theta/(\sigma - 1)$  controls the Pareto shape of the sales distribution, and hence the strength of granular forces. It is estimated to equal 1.096, corresponding to a somewhat *thinner* tail relative to Zipf’s law (see [Gabaix 2009](#)). We estimate  $\mu_T$  to be positive, albeit small, implying an overall mild productivity advantage of French firms relative to their average foreign competitor, consistent with a French wage rate  $w$  which is 13% higher than that in a typical French trade partner  $w^*$ . The estimated value of  $\sigma_T = 1.39$  is large, suggesting that a one standard deviation increase in fundamental comparative advantage across sectors corresponds to a four-fold increase in the relative productivity  $T_z/T_z^*$ . We find that the iceberg trade costs are  $\tau = 1.34$ , broadly in line with the estimates in the literature (see [Anderson and van Wincoop 2004](#)).<sup>6</sup>

<sup>6</sup>The estimated model implies that France is about two times smaller than the rest of the world in terms of population. This is, of course, an abstraction of a two-country model with a common iceberg trade cost  $\tau$  separating the two regions. The appropriate interpretation of  $L^*/L$  in the model is the relative size of the rest of the world in which the individual countries are discounted by their economic distance to France (i.e., if countries trade little with France, their population weight is heavily discounted).

Finally, the model implies an aggregate share of profits in GDP,  $\Pi/Y$ , equal to 18%, broadly in line with the national income accounts.

Armed with the estimated model, we are ready to study the impact of various policies in this granular environment.

### 3 Evaluating Granular Policies

A range of policies specifically target large firms, and our model is well-suited to study the impact of such policies on trade flows and the welfare of countries. Indeed, this question cannot be analyzed using standard ‘continuous’ trade models where, even in the presence of heterogeneity, every firm is infinitesimal. In contrast, in a granular model, firms are large and their response to policy can affect sectoral productivity and trade flows. In the rest of the paper we explore in turn three different granular policies, while in this section we outline the general methodology we follow to compute and decompose the welfare effects of policies.

**Welfare decomposition** The welfare of a representative consumer at home is given by  $\mathbb{W} = Y/P$ , where  $Y$  is aggregate home income and  $P = \exp \left\{ \int_0^1 \alpha_z \log P_z dz \right\}$  is the home price index. In general, aggregate income can be decomposed as  $Y = wL + \Pi + TR$ , where  $wL$  is labor income,  $\Pi$  is aggregate profits defined in (9), and  $TR$  is government policy revenues distributed lump-sum to workers. Since labor is supplied inelastically and the home wage is the numeraire, the log-change in home welfare in response to a policy can be expressed as follows:<sup>7</sup>

$$\hat{\mathbb{W}} \equiv d \log \frac{Y}{P} = \frac{d\Pi}{Y} + \frac{dTR}{Y} - \int_0^1 \alpha_z d \log P_z dz, \quad (15)$$

The three components in (15) correspond to the respective changes in producer surplus, government revenues, and consumer surplus in general equilibrium.

We are interested in the general equilibrium impact of policies targeted at large firms, and in particular, in contrasting the effects they have in granular versus non-granular sectors.<sup>8</sup> The direct partial equilibrium effect of a policy change in sector  $z$  is  $\left[ \frac{d\Pi_z + dTR_z}{\alpha_z Y} - d \log P_z \right] \alpha_z dz$  and has an order of magnitude  $\alpha_z dz$ . In addition, the general equilibrium impact of the policy on  $(w, w^*, Y, Y^*)$  is also of the order  $\alpha_z dz$ , which in turn affects every sector  $z' \in [0, 1]$ , and hence needs to be taken into account on par with the direct effect.<sup>9</sup>

<sup>7</sup>Note that the change in the real wage is fully accounted for by the changes in the price level  $P$  since nominal wage  $w = 1$  by our choice of the numeraire; otherwise, there would be an additional term  $\frac{wL}{Y} d \log w$ .

<sup>8</sup>Note that all sectors are *ex ante* symmetric (aside from their expenditure size  $\alpha_z$ ); however, *ex post*, sectors differ both in their fundamental comparative advantage  $T_z/T_z^*$  and in the realized granular productivity draws, which makes some sectors more granular than others (i.e., featuring relatively larger top firms).

<sup>9</sup>Formally, the general equilibrium system composed of (8)–(10) and their foreign counterparts can be written as a system of linear equations in the equilibrium vector  $(w, w^*, Y, Y^*)$ . The coefficients in this system are

Given that the model features a continuum of sectors, a policy that impacts a sector in isolation has an infinitesimal aggregate effect (indeed, proportional to  $\alpha_z dz$ ). Thus, to capture the overall quantitative general equilibrium effect of a policy, we study a given policy change in a positive measure of sectors  $Z$  that have similar levels of granularity and comparative advantage. Concretely, we bin sectors into percentiles of granular residual  $\Gamma_z^*$  defined in (13) or into percentiles of realized export share  $\Lambda_z^*$  defined in (11). We then compute the corresponding welfare impact  $\hat{\mathbb{W}}_Z = d \log(Y/P)$  of the policy in bin  $Z$ , and report its *average* aggregate welfare effect, normalized by the size of set  $Z$ , given by:

$$\hat{W}_Z = \frac{1}{\int_{z \in Z} \alpha_z dz} \hat{\mathbb{W}}_Z. \quad (16)$$

In the limit, as sets  $Z$  become tight around individual sectors  $z$ , the aggregate welfare change  $\hat{\mathbb{W}}$  can be decomposed into sectoral contributions  $\hat{W}_z$ :<sup>10</sup>

$$\hat{\mathbb{W}} = \int_0^1 \alpha_z \hat{W}_z dz. \quad (17)$$

In this sense,  $\hat{W}_z$  are the general-equilibrium aggregate welfare gradients of sectoral policies.

Finally, we consider the decomposition of the average welfare effects  $\hat{W}_Z$  into the contribution of changes in the consumer and producer surplus, according to (15). Quantitatively, given the linearity of (15), a welfare impact  $\hat{W}_Z$  equal to 0.01 is equivalent to the welfare effect of a 1% sectoral productivity improvement or, equivalently, a 1% reduction in the sectoral price level holding income constant. We report the welfare effects in these units.

**Welfare approximation** To guide intuition, we complement the quantitative evaluation of policies with an analytical approximation, which for tractability we carry out in partial equilibrium holding  $w$  and  $Y$  constant and taking the set of active firms  $K_z$  as given. Typically, both the entry/exit margin and general equilibrium effects partially mute the aggregate response to policy changes, without changing the direction of the overall effect. We set up the welfare approximation in a closed economy, and then show how to accommodate an open economy and the various specific policies studied below.

We consider a shock (e.g., a merger, an industrial policy, or a tariff) which leads productivity  $\varphi_{z,i}$  and/or markup  $\mu_{z,i}$  to change for a subset of firms, which in turn triggers an equilibrium

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integrals of the sectoral allocations, and they shift by on order of magnitude  $\alpha_z dz$  when sector  $z$  is shocked, resulting in a corresponding shift in the equilibrium vector.

<sup>10</sup>Formally, consider the aggregate effect  $\hat{\mathbb{W}}$  of a policy profile  $\varsigma \equiv \{\varsigma_z\}_{z \in [0,1]}$ , where  $\varsigma_z$  corresponds to a policy implemented in sector  $z$ ; (17) is the decomposition of  $\hat{\mathbb{W}}$  into the weighted average of the general equilibrium welfare effects  $\hat{W}_z$  of individual sectoral policies  $\varsigma_z$ .

adjustment of prices by all firms in the market. We denote by  $\hat{\varphi}_{z,i}$  the proportional change in productivity. The markup is endogenous and we write its proportional change as:

$$\hat{\mu}_{z,i} = \hat{\varepsilon}_{z,i} - \frac{\varkappa_{z,i}}{1 - \varkappa_{z,i}}(\hat{p}_{z,i} - \hat{P}_z), \quad (18)$$

where by (6) and (2) the markup  $\mu_{z,i}$  is a decreasing function of the relative price  $p_{z,i}/P_z$ , and we denote its elasticity with  $\frac{\varkappa_{z,i}}{1 - \varkappa_{z,i}} \geq 0$ , and  $\hat{\varepsilon}_{z,i}$  is an exogenous markup shifter.<sup>11</sup> Combining (18) with the price setting equation (5) in log changes,  $\hat{p}_{z,i} = \hat{\mu}_{z,i} + \hat{c}_{z,i}$ , we can solve for the equilibrium log deviation of the firm's price:

$$\hat{p}_{z,i} = (1 - \varkappa_{z,i})[\hat{\varepsilon}_{z,i} - \hat{\varphi}_{z,i}] + \varkappa_{z,i}\hat{P}_z, \quad (19)$$

where we used  $\hat{c}_{z,i} = -\hat{\varphi}_{z,i}$ , since the wage rate  $w$  is held constant. Thus,  $\varkappa_{z,i} \in [0, 1)$  is the strategic complementarity elasticity with respect to competitor prices  $P_z$ , and  $1 - \varkappa_{z,i}$  is the cost pass-through elasticity (see [Amiti, Itskhoki, and Konings 2019](#)).

The log differential of the sectoral price index is given by:

$$\hat{P}_z = \sum_{i=1}^{K_z} s_{z,i} \hat{p}_{z,i} = \frac{1}{1 - \bar{\varkappa}_z} \sum_{i=1}^{K_z} s_{z,i} (1 - \varkappa_{z,i}) [\hat{\varepsilon}_{z,i} - \hat{\varphi}_{z,i}], \quad (20)$$

where the second equality substitutes in (19) and solves the fixed point for  $\hat{P}_z$  where  $\bar{\varkappa}_z \equiv \sum_{i=1}^{K_z} s_{z,i} \varkappa_{z,i}$ . Note that  $-\hat{P}_z$  captures the change in consumer surplus, which declines if the weighted average of exogenous markup shifts outweighs productivity increases, resulting in a higher sectoral price level.

The producer surplus can in turn be approximated as:<sup>12</sup>

$$\frac{d\Pi_z}{\alpha_z Y} \approx \sum_{i=1}^{K_z} \frac{s_{z,i}}{\mu_{z,i}} \hat{\mu}_{z,i} = \sum_{i=1}^{K_z} \frac{s_{z,i}}{\mu_{z,i}} \left[ \hat{\varphi}_{z,i} + (1 - \varkappa_{z,i})[\hat{\varepsilon}_{z,i} - \hat{\varphi}_{z,i}] + \varkappa_{z,i}\hat{P}_z \right]. \quad (21)$$

That is, producers capture a portion of the surplus from increased productivity, as they pass-through the rest with lower prices to consumers, and also benefit from increased markups. Note that the exogenous increase in markups for the firms directly affected by the shock is captured by  $(1 - \varkappa_{z,i})\hat{\varepsilon}_{z,i}$ , while  $\varkappa_{z,i}\hat{P}_z$  is the indirect markup effect from strategic complementarities in price setting for every firm in the industry.

<sup>11</sup>For example, a merger between producers  $i$  and  $j$  (studied in Section 4) leads the new firm to set markup based on the cumulative market share of the two products, which changes the perceived elasticity in (6) from  $\varepsilon(s_{z,i})$  to  $\varepsilon(s_{z,i} + s_{z,j})$ . Then, formally, we have  $\hat{\varepsilon}_{z,i} = \varepsilon'(s_{z,i}) \cdot s_{z,j}$  and symmetrically  $\hat{\varepsilon}_{z,j} = \varepsilon'(s_{z,j}) \cdot s_{z,i}$ .

<sup>12</sup>Indeed, using (7), we have  $\frac{d\Pi_z}{\alpha_z Y} = d \left[ \sum_{i=1}^{K_z} s_{z,i} \left( 1 - \frac{1}{\mu_{z,i}} \right) \right] = \sum_{i=1}^{K_z} \pi_{z,i} \hat{s}_{z,i} + \sum_{i=1}^{K_z} \frac{s_{z,i}}{\mu_{z,i}} \hat{\mu}_{z,i}$ , where  $\pi_{z,i} \equiv \frac{\Pi_{z,i} + wF}{\alpha_z Y} = \frac{s_{z,i}}{\varepsilon_{z,i}}$ . By the definition of market shares,  $\sum_{i=1}^{K_z} s_{z,i} \hat{s}_{z,i} = 0$ , and therefore  $\sum_{i=1}^{K_z} \pi_{z,i} \hat{s}_{z,i}$  is a second-order covariance term, which we omit. Then (21) is obtain with the use of (18) and (19).

Combining (20) and (21), we can write the change in the combined surplus (welfare) as:

$$\hat{W}_z = \frac{d\Pi_z}{\alpha_z Y} - \hat{P}_z = \sum_{i=1}^{K_z} \frac{s_{z,i}}{\mu_{z,i}} \hat{\varphi}_{z,i} - \frac{\bar{\mu}_z - 1}{\bar{\mu}_z} \hat{P}_z, \quad (22)$$

with  $\hat{P}_z$  given by (20) and  $\bar{\mu}_z > 1$  measuring the average markup in the economy;<sup>13</sup> and if the policy leads to government revenues,  $\hat{W}_z$  additionally features a  $\frac{dTR_z}{\alpha_z Y}$  term. Intuitively, (22) splits the overall change in welfare into the direct effect of the average productivity improvement (weighted by the cost shares  $s_{z,i}/\mu_{z,i}$ ) and the redistributive effect from the movement in the price level in the presence of markup pricing  $\bar{\mu}_z > 1$  (a wedge between consumer prices and producer costs resulting in a Harberger's triangle deadweight loss). Indeed, a change in  $\hat{P}_z$  has a non-zero welfare effect, as it redistributes surplus between consumers and producers, yet starting from an already distorted equilibrium. In an economy without markups ( $\mu_{z,i} \equiv 1$ ), the overall welfare effect simply reduces to the average improvement in productivity,  $\hat{W}_z = \sum_{i=1}^{K_z} s_{z,i} \hat{\varphi}_{z,i}$ . This summarizes the approach we take to the welfare approximation that we use in the context of specific policies in an open economy below.

## 4 Mergers, Acquisitions and Antitrust

We are now ready to analyze quantitatively a series of policies typically targeted at large firms, with antitrust policy regulating mergers of firms with significant market power being an obvious example. Specifically, we are interested in the merger of *large* domestic firms and under which conditions they can increase welfare at Home. Since these large domestic firms are typically also large exporters (Melitz 2003), such a merger likely has nontrivial implications for the foreign country as well. Does Foreign face an incentive to block the mergers of domestic superstar firms? How much does trade openness shape these considerations?

### 4.1 Merger analysis: setup

Typically, firms engage in merger and acquisition activities in order to realize cost synergies, to increase efficiency by transferring knowledge and best practices between entities, but also to increase their market power. When evaluating the desirability of such mergers, the policymaker typically trades-off the risk of increased market power in the economy against the efficiency benefits associated with the merger. We capture these channels as follows. First, we assume that, upon merging, the new firm continues to produce the two distinct product

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<sup>13</sup>Specifically,  $\bar{\mu}_z = \left[ \frac{\bar{\mu}'_z}{\bar{\mu}''_z} + \frac{1 - \bar{\mu}'_z}{\bar{\mu}''_z} \right]^{-1}$ , where  $\bar{\mu}'_z \equiv \frac{\sum_{i=1}^{K_z} s_{z,i} \mu_{z,i}}{\sum_{i=1}^{K_z} s_{z,i}}$  and  $\bar{\mu}''_z = \frac{\sum_{i=1}^{K_z} s_{z,i} (1 - \mu_{z,i}) [\hat{\varepsilon}_{z,i} - \hat{\varphi}_{z,i}]}{\sum_{i=1}^{K_z} s_{z,i} (1 - \mu_{z,i}) [\hat{\varepsilon}_{z,i} - \hat{\varphi}_{z,i}]}$ .

lines previously produced by the two separate firms, but it now sets prices to maximize the combined profits. As a consequence, the new firm's market power and markups increase.<sup>14</sup>

Second, we allow the merger to result in efficiency gains, as the new firm can reduce both fixed and variable costs. Specifically, we assume that the merged firm incurs only one fixed cost rather than two; we note however that this assumption is largely inconsequential quantitatively, as fixed costs are a very small fraction of revenues for the largest firms. Finally, we allow the merger to generate productivity spillovers between the merged entities: the less productive product inherits some of the efficiency of the more productive one, with the strength of the spillover governed by the parameter  $\varrho \in [0, 1]$ . Specifically, the productivity of the post-merger product,  $\varphi'_{z,2}$ , is parameterized as:

$$\varphi'_{z,2} = \varrho\varphi_{z,1} + (1 - \varrho)\varphi_{z,2},$$

where  $\varphi_{z,i}$  is the productivity of the pre-merger firm  $i \in \{1, 2\}$ .

Given this post-merger market structure and productivity distribution, we solve for the new entry game and price-setting equilibrium in each sector. To get at the full welfare effect of a merger, we simulate it for a positive measure of sectors  $z \in Z$ , and recompute the corresponding general equilibrium, as discussed in Section 3.

In our baseline analysis, we consider an economy where  $\tau = 1.34$ , as estimated in Table 1 for France, hence reflecting a fairly high level of trade openness typical of modern developed economies. Harder to calibrate is the value of the productivity spillover: we choose a value of  $\varrho = 0.35$ , that is a merger closes a third of the productivity gap between the first and the second product. With this value of the spillover parameter we can illustrate some of the most interesting policy trade-offs at play. We report the sensitivity of the analysis to alternative values of the merger spillovers as well as the trade openness below. The rest of the model parameters correspond to their benchmark values described in Table 1. We report results under Cournot competition for concreteness; the results under Bertrand competition are qualitatively similar, albeit somewhat attenuated quantitatively.

## 4.2 Welfare implications of a merger

The welfare consequences — at home and abroad — of merging the top two domestic firms in a given sector are considerably different across sectors, as we report in Figure 1. We split all sectors into deciles  $z \in Z$  based on their overall comparative advantage ( $\Lambda_z^*$ ; left panel) and its granular component ( $\Gamma_z^*$ ; right panel). We then report the welfare impact  $\hat{W}_Z$  (as defined

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<sup>14</sup>Given CES demand, the optimal markups are the same for both products and depend on their cumulative market share  $s'_{z,1} + s'_{z,2}$  in the new equilibrium, according to the same functional relationship as in (5) and (6).

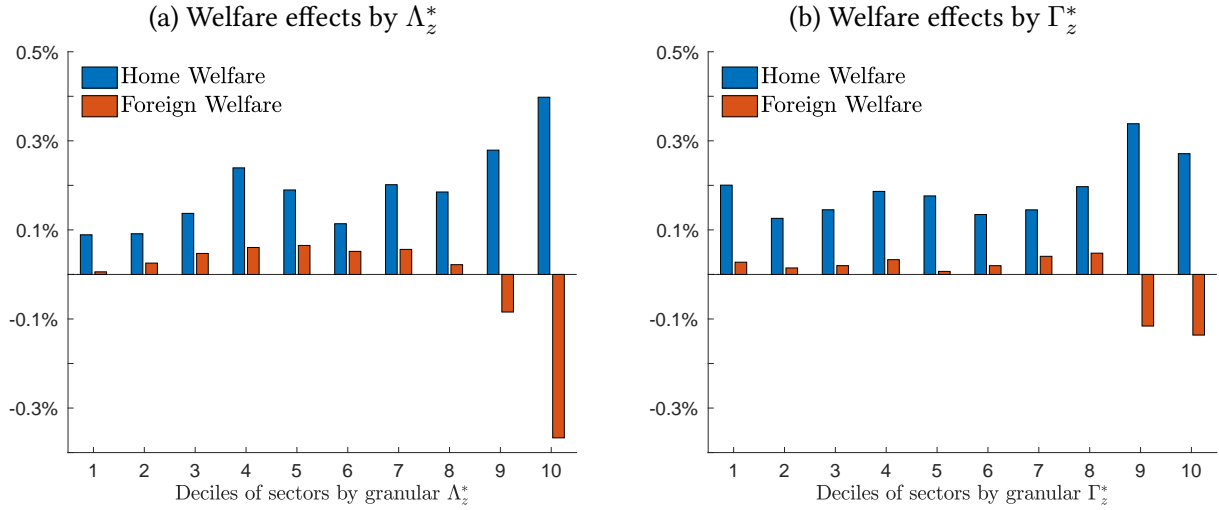


Figure 1: Welfare effects of mergers

Note: Welfare impact  $\hat{W}_Z$ , as defined in (16), at home and abroad, of a merger of the top two domestic firms, by deciles  $Z$  of sectors  $z \in [0, 1]$  sorted by overall home comparative advantage  $\Lambda_z^*$  and its granular component  $\Gamma_z^*$ .

in (16)) from a merger of the top two home firms in each sector in these deciles for Home and Foreign.

For the bottom 80% of sectors, be it in terms of comparative advantage  $\Lambda_z^*$  or in terms of granularity  $\Gamma_z^*$ , both Home and Foreign benefit from these top mergers, due to the productivity spillover. In each case, welfare gains are more modest for Foreign than for Home, as the market shares of home firms are smaller in the foreign market due to trade costs. In stark contrast, in sectors with the strongest (top 20%) comparative advantage or level of granularity, welfare gains are considerably larger for Home and significantly negative for Foreign.

What are the mechanisms behind the starkly heterogeneous results of Figure 1? A merger has two effects on economic outcomes. First, it increases productivity due to the spillover  $\varrho$ , which results in lower consumer prices. However, it also increases market power and markups, which results in higher consumer prices and higher firm profits. This second effect also has an international distributive consequence in an open economy, as part of the reduction in Foreign consumer surplus is redistributed towards Home through increased profits (producer surplus). This is one reason for the differential welfare effects of the same merger in the two countries.

More specifically, in low- $\Lambda_z^*$  or  $\Gamma_z^*$  sectors, the largest domestic firms tend to account for relatively small market shares, and especially so in the foreign market. In the model, consistent with the empirical evidence on decreasing cost pass-through with firm size (see [Amiti, Itskhoki, and Konings 2019](#)), markups are a convex function of market shares. As a result, the market power increase from a merger is less important in sectors where merged firms have relatively small market shares. Overall, the positive productivity effect (that scales propor-

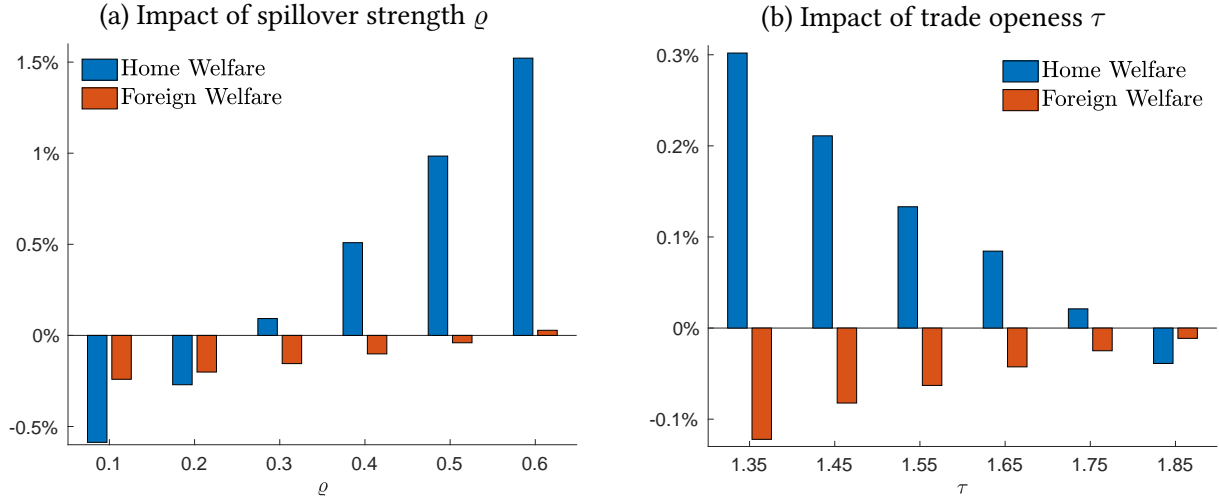


Figure 2: Impact of top mergers in comparative advantage sectors: the role of  $\rho$  and  $\tau$

Note: Welfare impact of mergers in the top 20% of sectors in terms of Home's export intensity  $\Lambda_z^*$ . See notes to Figure 1.

tionally with market shares) dominates the relatively more modest increase in market power (which is convex in market shares). Furthermore, the net gains are felt more strongly at Home, where the top two domestic firms have a more significant presence than abroad.

Matters are different in the top sectors in terms of both granularity and overall comparative advantage. In the foreign country, top domestic mergers now have significant negative welfare effects. The increased monopoly power of the top domestic firm destroys consumer surplus, and is not sufficiently compensated for by productivity gains of the merged firm. When the increase in markups dominates the reduction in costs, foreign consumers lose surplus due to increasing prices. The same effect plays out in the home market as well, and Home's consumer surplus declines too, but, crucially, it is more than offset by the increase in the producer surplus of the merged domestic firms. Indeed, the merged entity increases profits both in the home and the foreign market but channels them back to domestic workers. Through this mechanism, mergers in an open economy have a “beggar-thy-neighbor” spillover on the trading partners. This suggests a rationale for governments in open economies to be overly lenient towards domestic mergers, especially in more granular industries with strong comparative advantage, a topic we explore further below.

Overall, the welfare consequences of a top domestic merger are not trivial. In this baseline calibration, a merger between the top two firms in sectors with the strongest comparative advantage has the same welfare effect as a uniform 0.4% sectoral productivity increase at home and a 0.35% sectoral productivity reduction abroad.

Of course, these numbers hinge importantly on the strength of the productivity spillover  $\rho$ . We report their sensitivity to the intensity of the cost savings realized by a merger in the left

panel of Figure 2, focusing on mergers in the top 20% of sectors in terms of export share  $\Lambda_z^*$ . In short, greater  $\varrho$  increases welfare gains from mergers, both for Home and Foreign, but it does so much more strongly for Home, where the market shares of these firms are higher. If spillovers are limited, the mergers are particularly detrimental at Home, as the dominant impact comes from the increased market power and markups of the combined entity. The effect is also negative abroad, but is less pronounced. In contrast, as productivity spillover grows larger, Home starts to strongly benefit from mergers, while Foreign benefits much less and only when spillovers are very strong. The reason again is the transfer of foreign consumer surplus into the profits of domestic firms.

The level of trade openness, governed by the iceberg trade cost  $\tau$ , is also crucial to understand the results in Figure 1. At the current level of openness, or for even more open economies, the mergers in high export intensive sectors tend to be beneficial at home but detrimental abroad. In contrast, if we study countries that are sufficiently closed (large  $\tau$ ), we see in the right panel of Figure 2 that the consumer loss at Home will outweigh the producer gain, resulting in a net loss in domestic welfare, while effects on foreign welfare are still negative yet very limited, because countries trade little. This highlights the essential role of trade openness for the welfare analysis of granular mergers. Domestic mergers are particularly contentious abroad if they happen in granular comparative advantage sectors, especially if countries have a strong trade relationship.

**Welfare approximation** The quantitative effects discussed above can be conveniently illustrated using the welfare approximation introduced in (20)–(21) in Section 3. Since a merger “shocks” the productivity and markups of only the largest combined home firm directly, the consumer surplus effect is given by  $-\hat{P}_z = s'_{z,1} \frac{1-\kappa_{z,1}}{1-\kappa_z} [\hat{\varphi}_{z,1} - \hat{\varepsilon}_{z,1}]$ , where  $s'_{z,1}$  corresponds to the combined market share of the merged firm, and  $\hat{\varphi}_{z,1}$  and  $\hat{\varepsilon}_{z,1}$  capture the corresponding markup and productivity shifts.<sup>15</sup> A parallel expression captures the change in the consumer surplus abroad, with  $s^*_{z,1}$  and  $\hat{\varepsilon}^*_{z,1}$  now corresponding to the combined market share and markup change in the foreign market. In general, due to trade costs,  $s^*_{z,1} < s'_{z,1}$ , and thus we expect  $\hat{\varepsilon}_{z,1} > \hat{\varepsilon}^*_{z,1}$ , explaining why the effects on consumer surplus in Foreign are typically both muted and less adverse in most sectors.

The fall in consumer surplus in Home is partially or fully compensated by the increase in

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<sup>15</sup>Formally, in this case,  $\hat{\varphi}_{z,1} = \frac{s_{z,2}}{s_{z,1}+s_{z,2}} \log \frac{\varphi'_{z,2}}{\varphi_{z,2}}$  and  $\hat{\varepsilon}_{z,1} = \frac{s_{z,1}s_{z,2}}{s_{z,1}+s_{z,2}} [\varepsilon'(s_{z,1}) + \varepsilon'(s_{z,2})]$ , where  $(s_{z,1}, s_{z,2})$  are the pre-merger market shares of the two products. Thus,  $\hat{\varphi}_{z,1}$  and  $\hat{\varepsilon}_{z,1}$  are the sales weighted averages of changes in productivity and markups of the two merged products. Note that the direct effect on consumer surplus,  $s'_{z,1}[\hat{\varphi}_{z,1} - \hat{\varepsilon}_{z,1}]$ , is modified by the endogenous markup adjustment of all firms, captured by the multiplier  $\frac{1-\kappa_{z,1}}{1-\kappa_z}$ .

the producer surplus of home firms serving both home and foreign markets:

$$\frac{d\Pi_z}{\alpha_z Y} \approx \frac{s_{z,1}}{\mu_{z,1}} [\varkappa_{z,1} \hat{\varphi}_{z,1} + (1 - \varkappa_{z,1}) \hat{\varepsilon}_{z,1}] + \frac{s_{z,1}^*}{\mu_{z,1}^*} [\varkappa_{z,1}^* \hat{\varphi}_{z,1}^* + (1 - \varkappa_{z,1}^*) \hat{\varepsilon}_{z,1}^*].$$

The presence of this direct producer gain for home firms, absent for foreign firms, explains the international distributional conflict over domestic mergers between the home and the foreign governments. This conflict is particularly pronounced when  $s_{z,1}^*$  and  $\hat{\varepsilon}_{z,1}^*$  are large in the foreign market. Provided that trade costs are low, this occurs in sectors with pronounced domestic comparative advantage and granularity, consistent with the quantitative patterns in Figures 1 and 2.

### 4.3 Optimal M&A policy

We have seen above that countries may be impacted quite differently by the mergers of large firms. In practice, large mergers of multinational firms may be evaluated by the antitrust authority of each country in which those firms operate, not only in the country that hosts the headquarters of these firms. We now examine the incentives and optimal policies of each country when assessing merger proposals.

We call a *merger policy* a simple binary policy choice of whether or not to allow a merger. We consider a general objective function  $\hat{W}_z + \lambda \hat{W}_z^*$ , indexed by  $\lambda \geq 0$ , the relative weight of foreign welfare. Recall that  $\hat{W}_z$  is the domestic welfare impact of a merger defined in (16) and  $\hat{W}_z^*$  is the corresponding welfare impact abroad. The case with  $\lambda = 0$  captures the objective function of the home government,  $\lambda = \infty$  the objective of Foreign, and  $\lambda = L^*/L$  corresponds to a utilitarian global planner. We define a corresponding merger policy function:

$$m_\lambda(z) \equiv \mathbf{1}\{\hat{W}_z + \lambda \hat{W}_z^* > 0\},$$

i.e. an indicator function defined over the set of sectors  $z \in [0, 1]$  with  $m_\lambda(z) = 1$  if the merger of the top two domestic firms in  $z$  is welfare-increasing for a given value of  $\lambda$ .<sup>16</sup> We study the properties of  $m_\lambda(z)$  for different values of  $\lambda$ , tracing out the international spillover effects of domestic antitrust policy, focusing on the baseline case with productivity spillover  $\varrho = 0.35$ .

<sup>16</sup>We only focus on a potential merger of two home firms, mostly for technical reasons: it is computationally easier to evaluate a single fixed point problem in terms of  $m_\lambda(z)$  and the world GE vector  $(w, w^*, Y, Y^*)$ , rather than simultaneously solving for a Nash equilibrium in both  $m_0(z)$  at home and  $m_\infty(z)$  abroad. However, such a focus likely leads to little loss of generality in our analysis, as we anticipate the optimal M&A policy to be approximately a dominant strategy independently of the M&A policy abroad. We leave this conjecture for future quantitative evaluation. Another interpretation is that we focus on M&A in a large country, which trades with a continuum of small open economies, where M&A within each individual country is quantitatively inconsequential.

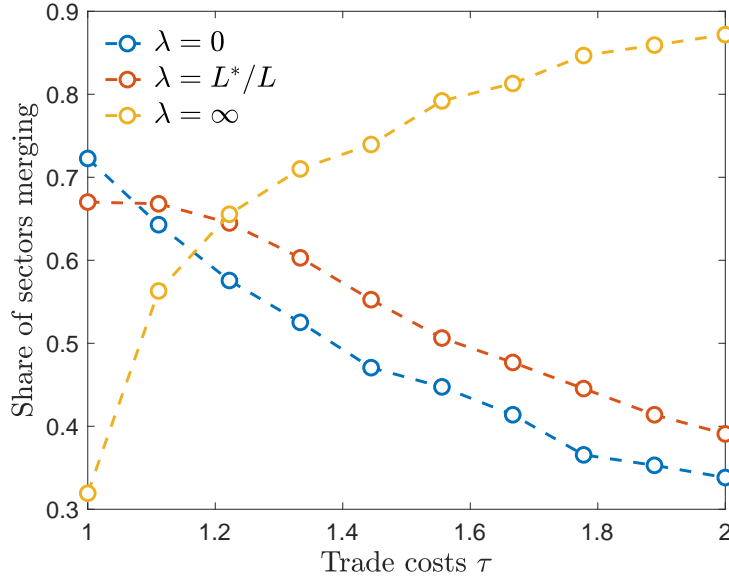


Figure 3: Optimal M&A policy and trade openness

Note: Share of sectors where a merger at the top leads to positive welfare effects — for the domestic government, the foreign government, and a utilitarian world planner, that is  $\int_0^1 m_\lambda(z)dz$  for  $\lambda \in \{0, \infty, L^*/L\}$ .

Figure 3 plots a first broad summary of the results. Specifically, it shows the fraction of sectors where a merger is beneficial,  $\int_0^1 m_\lambda(z)dz$ , for Home, Foreign and for a utilitarian global planner,  $\lambda \in \{0, \infty, L^*/L\}$ . These statistics change as a function of trade openness  $\tau$ , ranging from a closed economy to free trade. Interestingly, in an economy that is sufficiently closed (high  $\tau$ ), the foreign country benefits most from domestic mergers, as their market power impact is very limited abroad.<sup>17</sup> In contrast, the home government blocks the majority of mergers when the economy is closed to international trade, as mergers in the closed economy have a particularly strong market power effect — market shares are high due to a lack of foreign competition. As trade costs decline and Home and Foreign trade more with each other, the domestic government is more favorable towards the mergers, while they become increasing less welcome abroad. In particular, a utilitarian global planner would approve fewer mergers than the domestic government when economies are very open.

The summary statistics in Figure 3, however, hide dramatic heterogeneity in the subsets of sectors in which the various planners would see mergers with a favorable eye. This is the main source of international conflicts of interest over merger policies, which we illustrate in Figure 4. In this figure, we sort sectors into deciles of comparative advantage  $\Lambda_z^*$  in the left panel and deciles of granularity  $\Gamma_z^*$  in the right panel, using the baseline value of trade costs  $\tau = 1.34$ . We combine together the bottom six deciles as there is little variation across

<sup>17</sup>Note the difference with Figure 2, where we focused on the top-20% of sectors in terms of home export share, while in the current analysis we look at merger policy across *all* sectors.

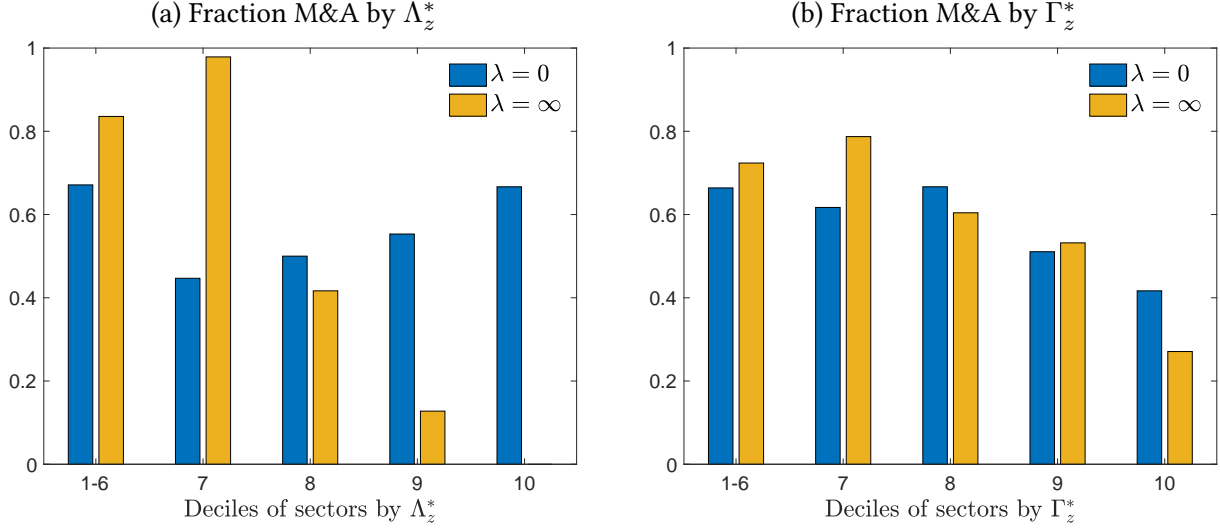


Figure 4: Optimal M&A policy across sectors

Note: Figure plots the fraction of sectors in which home mergers are welfare improving at home ( $\lambda = 0$ ) and abroad ( $\lambda = \infty$ ), by deciles of sectors in terms of home comparative advantage  $\Lambda_z^*$  and its granular component  $\Gamma_z^*$ . The bottom five deciles are binned together. Baseline parameters  $\varrho = 0.35$  and  $\tau = 1.34$ .

these lower deciles. We then plot the fractions of sectors within each bin for which the domestic ( $\lambda = 0$ ) and foreign ( $\lambda = \infty$ ) planners would favor a merger.

Two main insights emerge from the cross sectional analysis. The right panel indicates that both Home and Foreign dislike mergers in granular sectors compared to mergers in non-granular sectors. While they green-light the majority of mergers in sectors without large granular firms, Home would only allow mergers in 40% and Foreign in 25% of cases in the top decile of sectors by granularity. The reason is the excessive market power that firms generally hold in such sectors, which is particularly costly abroad as the loss in consumer surplus there is not compensated by any direct gains in producer surplus.

The pattern is somewhat different in the left panel of Figure 3. From the perspective of home welfare, the proportion of favorable mergers to a first approximation does not depend on sectoral comparative advantage — the home planner favors roughly 50–60% of mergers independently of  $\Lambda_z^*$ . In contrast, the foreign approval of domestic mergers decreases sharply with Home’s comparative advantage — while Foreign favors most mergers in low- $\Lambda^*$  sectors, it would want to block *every* merger in the top decile of home comparative advantage.

This pattern is not surprising: as we discussed, home mergers in comparative advantage sectors disproportionately hurt Foreign, due to a transfer of consumer surplus. This, in turn, is the reason why Home favors many mergers in high comparative advantage sectors. Nonetheless, such mergers can also be costly in the domestic economy due to their excessive concentration of market power, and this is the reason why the home planner would not favor all such

mergers. Appendix Figure A1 illustrates these conflicting welfare effects — sectors with strong comparative advantage have large consumer surplus losses at Home, which are however offset by large producer surplus gains.

Overall, this analysis suggests an important role for international cooperation over M&A policies in open economies to avoid excessive build-up of market power. Absent cooperation, each country will pursue excessive mergers, in particular in sectors with strong comparative advantage, resulting in a Prisoner-dilemma-like equilibrium. Furthermore, the beggar-thy-neighbor distributional conflict makes some mergers unfavorable for Foreign, even in situations when a utilitarian global planner may favor them. This suggests that the home decision-maker is typically too lenient to domestic mergers in comparative advantage sectors, while the foreign decision-maker would try to always block such mergers, sometimes at a cost to multilateral efficiency.

## 5 Granular Tariffs

We turn to another aspect of government policies that may affect and target large firms — trade policy. In fact, trade policy is often so narrow that it appears tailor-made to target individual firms rather than industries. Such “granular” tactics are particularly widespread in antidumping retaliation, international sanctions and trade wars. Our quantified model allows us to analyze the economic incentives faced by the home government when considering imposing such granular tariffs rather than industry-wide ones, putting aside the legal ramifications of such a decision.

Specifically, we study two alternative tariff policies in an open granular economy. We contrast a *uniform* tariff  $\bar{\varsigma}_z$  levied on all imports in sector  $z$  and a *granular* tariff  $\hat{\varsigma}_{z,1}$  levied exclusively on the largest foreign exporter in the same sector. For concreteness, we compare a 1% uniform tariff with a granular tariff  $\hat{\varsigma}_{z,1}$  that generates the same tariff revenue at the sectoral level. A government may prefer a granular tariff over a uniform one for two reasons. First, it may be more attractive in terms of domestic political economy, though perhaps more complex to impose legally. We leave aside these considerations. Second, it may be a more effective policy tool at extracting surplus from foreign producers and improving the home country’s terms of trade. As we shall shortly see, this latter consideration is indeed at play in our granular model with oligopolistic competition.

**General setup** Consider firm-specific tariffs  $\{\varsigma_{z,i}\}$  imposed by the home government on foreign firms  $i$  in sector  $z$ . In particular, if a foreign firm generates revenues  $r_{z,i} = s_{z,i}\alpha_z Y$  in the home market, it needs to pay  $\varsigma_{z,i}r_{z,i}$  to the home government, so that its net revenues are

$(1 - \varsigma_{z,i})r_{z,i}$ . The foreign firm's profit maximization problem in the home market is then:

$$\Pi'_{z,i} = \max_{p_{z,i}} \left\{ [(1 - \varsigma_{z,i})p_{z,i} - c_{z,i}] p_{z,i}^{-\sigma} \frac{\alpha_z Y}{\sum_{j=1}^{K_z} p_{z,j}^{1-\sigma}} - wF \right\} = (1 - \varsigma_{z,i})\alpha_z Y \frac{s'_{z,i}}{\varepsilon(s'_{z,i})} - wF,$$

with the solution for prices and markups as if its costs were increased to  $c'_{z,i} = c_{z,i}/(1 - \varsigma_{z,i})$ . We denote the resulting market shares by  $\{s'_{z,i}\}$  with the residual demand elasticity  $\varepsilon(s)$  still defined in (6). The foreign share in the home market is still given by  $\Lambda'_z = \sum_{i=1}^{K_z} (1 - \iota_{z,i})s'_{z,i}$ . However, the home government now collects tariff revenues  $TR_z = \alpha_z Y \sum_{i=1}^{K_z} (1 - \iota_{z,i})\varsigma_{z,i}s'_{z,i}$ , with the rest,  $\Lambda'_z \alpha_z Y - TR_z$ , being the export revenue of foreign firms. We describe the resulting changes to the general equilibrium conditions in Appendix A.2.

The resulting change in home welfare from the tariff policy  $\{\varsigma_{z,i}\}$  is described by the general expression in (15), which allows us to decompose the overall welfare effect into tariff revenue, and changes in consumer and producer surplus respectively. We again calculate the “welfare derivatives”  $\hat{W}_z$ , as described in (16), by studying the tariff policy in a subset of sectors with similar characteristics. This is necessary to appropriately capture the general equilibrium effects from the sectoral tariffs on overall welfare, which are of the same order of magnitude as the direct sectoral effect.<sup>18</sup>

**Results** Using the general framework above, we now compare two alternative tariff policies: (a) a uniform tariff with  $\varsigma_{z,i} = \bar{\varsigma}_z = 0.01$  for all foreign firms  $i$  selling in the home market in sector  $z$ ; and (b) a granular tariff  $\hat{\varsigma}_{z,1}$  levied only on the largest foreign exporter to the home market in sector  $z$ , with the value of the tariff given by  $\hat{\varsigma}_{z,1}s'_{z,1} = \bar{\varsigma}_z \bar{\Lambda}'_z$ , that is, the same as in case (a). We report here the results when competition takes the Cournot form, with the results for Bertrand competition being qualitatively similar, albeit quantitatively attenuated as markups are less variable in that case. Figure 5 compares the domestic welfare effects of each policy, contrasting sectors with different comparative advantage of the foreign country,  $\Lambda_z$ .<sup>19</sup> We find that imposing a granular tariff has clear welfare benefits from the point of view of Home, all the more in the sectors in which Foreign has a larger share of the home market.

To understand the forces behind these results, we decompose these domestic welfare effects in Figure 6: namely, we report its three components, following equation (15) — tariff revenues, consumer surplus, and producer surplus. A clear picture emerges. First, by construction, tariff revenues are equivalent between a granular and a uniform tariff in all sectors and increase

<sup>18</sup>The direct effect is first-order within the sector, but comes with a weight  $\alpha_z dz$  in aggregation, while the indirect general equilibrium effect (on wages and price levels) is also of the order  $\alpha_z dz$ , via general equilibrium conditions. We implement the policy in a subset of sectors  $z \in Z$  with cumulative expenditure weight  $\int_{z \in Z} \alpha_z dz$ , and scale the resulting welfare effect by  $\int_{z \in Z} \alpha_z dz$ , as in (16).

<sup>19</sup>Results are very similar when we group sectors by their level of foreign granularity  $\Gamma_z$ .

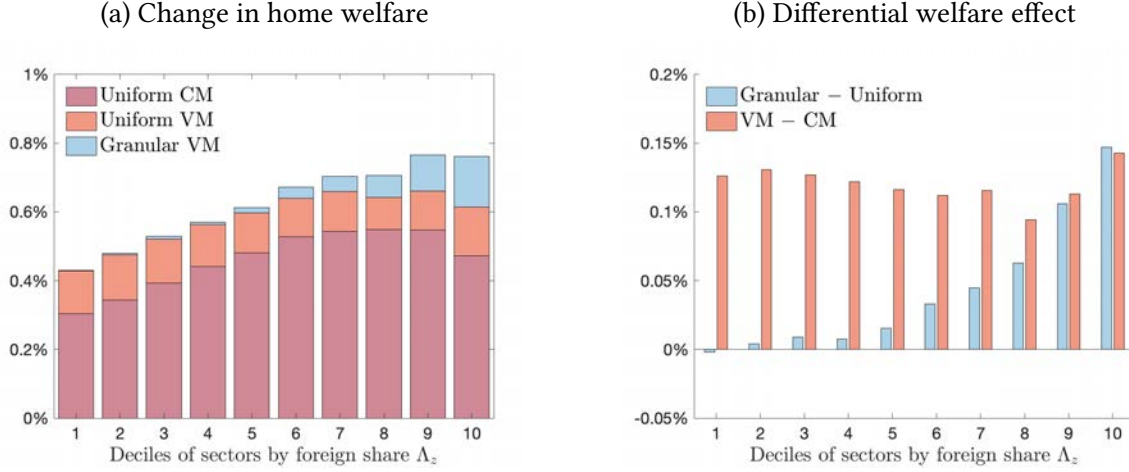


Figure 5: Granular tariff: welfare effect

Note: CM stands for constant markup counterfactual and VM is the variable markup baseline. The figures plot the welfare effects  $\hat{W}_Z$  of tariff policy by deciles of foreign comparative advantage (foreign share  $\Lambda_z$  in the home market). The left panel plots  $\hat{W}_Z$  in the case of a uniform tariff under CM (pink bars), under VM (pink+red bars), and a granular tariff under VM (pink+red+blue bars). The right panel zooms in on the differential welfare effects of the uniform tariff over the counterfactual case with constant markups (red bars), as well as the differential welfare effect of the granular vs the uniform tariff (both VM; blue bars).

proportionally with the ex post sectoral import share  $\Lambda'_z$ . Second, the impact of these tariffs on domestic producer surplus is small, as these effects are indirect. Therefore, third, the major driver of the net welfare effects is the loss in domestic consumer surplus that these policies induce, offsetting a large part of the gains from tariff revenues. This is where the difference between uniform and granular tariffs plays a key role. Home consumers are hurt more by the uniform tariff levied on all foreign exporters than by the granular tariff concentrated on a single largest foreign exporter.

The reason for this result is that with a granular tariff, the pass-through of the import tariff to consumer prices at home is much lower. The tariff hits the largest foreign firm, which typically has a double-digit market share in the home market in high  $\Lambda_z$  (or  $\Gamma_z$ ) sectors. This firm exerts significant power in the home market, and absorbs part of the increase in marginal costs coming from the tariff by lowering its markups (see [Amiti, Itskhoki, and Konings 2019](#)). Overall, the increase in prices is therefore lower for home consumers than if the tariff were levied uniformly on all foreign firms in the sector. Put differently, the leading firm prices strategically to keep its market share high and reduces its markup significantly in response to a loss in relative efficiency. If, instead, all foreign firms are subject to a (smaller) uniform tariff, their relative stance is largely unchanged, so that markup adjustments are smaller. This makes granular tariff an efficient policy tool for the home government as it allows to extract the same tariff revenue at a minimal cost in terms of the loss in consumer surplus due to the

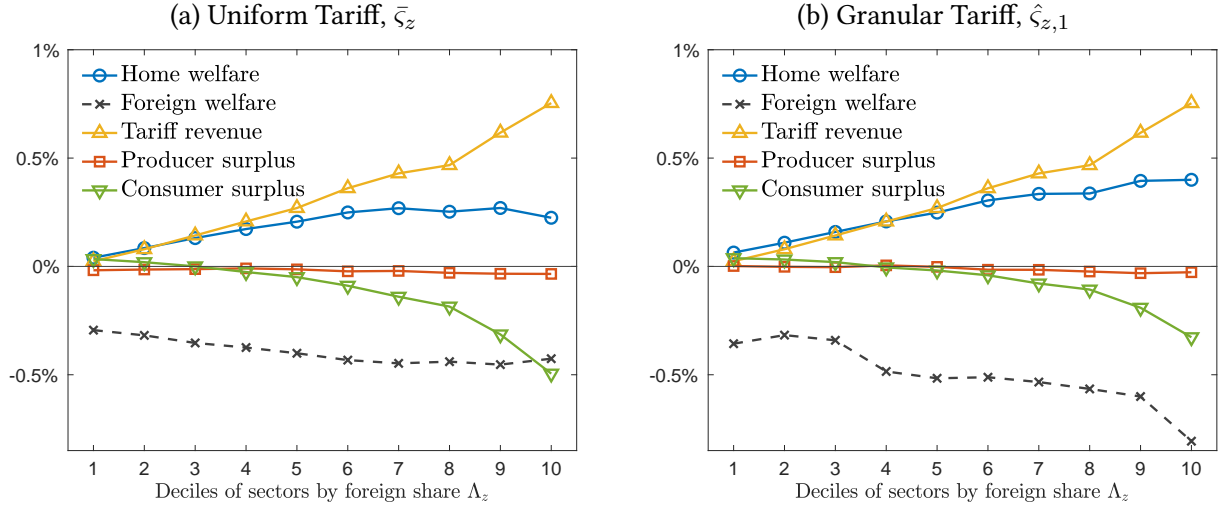


Figure 6: Welfare effect of a tariff: Decomposition

Note: Decomposition of the welfare effect  $\hat{W}_Z$  at home into three components according to (15), and the welfare effect abroad, from a uniform and a granular tariff, by deciles of sectors split by foreign comparative advantage.

lower tariff pass-through into prices.<sup>20</sup>

Notice that this effect is not present in Costinot, Rodríguez-Clare, and Werning (2020), who study a constant markup case with a continuum of heterogeneous firms that all exhibit a complete pass-through of the tariff. We find that the pass-through effect, which operates even in partial equilibrium, is quantitatively large — the loss in consumer surplus is cut by more than half in the most import-intensive sectors compared to the constant markup case. Notice further that this pass-through effect is present even when we apply a uniform tariff to the whole sector, so long as markups are variable and the foreign share  $\Lambda_z < 1$ . This can be seen in Figure 5 where we compare the welfare impact of a uniform tariff against a counterfactual case with constant markups set at the monopolistically competitive level,  $\frac{\sigma}{\sigma-1}$ . The incomplete pass-through effect is maximized by imposing a granular tariff, which targets the firm with the lowest pass-through rate in the industry, thus minimizing the loss of consumer surplus for a given amount of tariff revenues.

Quantitatively, Figure 5 shows that the home welfare gain from a uniform tariff in a variable markup environment is about a third higher than in a constant markup counterfactual. This gap is roughly constant across all sectors, independently of the foreign share  $\Lambda_z$ . In contrast, the additional gains from setting a non-uniform granular tariff are only present in sectors

<sup>20</sup>In Appendix A.2, we provide a formal analysis of these effects, using the welfare approximation introduced in Section 3. In particular, we show that the main difference between the tariffs is driven by the loss in consumer surplus, which in general is given by  $\hat{P}_z = \frac{1-\bar{\pi}_z^F}{1-\bar{\pi}_z^F} \bar{\zeta}_z \Lambda_z'$ , where  $1 - \bar{\pi}_z^F$  is the average pass-through of the tariff among the affected foreign firms. A granular tariff minimizes this pass-through, and thus dominates a uniform tariff (or any other tariff profile which yields the same tariff revenue).

with substantial foreign comparative advantage. In sectors with large foreign firms, using a granular tariff increases the home welfare gain by another third. In other sectors, even the largest foreign firm has a small market share in the domestic market, insufficient to result in a significantly lower pass-through of the granular tariff.

This analysis suggests that variable markups and the incomplete pass-through of large firms are crucial quantitative components of the optimal tariff analysis. Moreover, it shows that governments likely have strong economic incentives to target only the largest foreign firms with tariffs as an effective way of extracting foreign producer surplus with minimal consequences for domestic consumer surplus.

## 6 Industrial Policy in a Granular World

To conclude, we briefly consider an extension of the model in which firms can make a one-time investment in boosting their productivity. We explore under which circumstances the planner wants to subsidize such investments in comparative advantage sectors and in particular by the industrial champions — the largest firms in the economy.

**Setup economy** Consider an extension of the granular open economy in which a firm in sector  $z$  can invest

$$v_{z,i} = \kappa \alpha_z \frac{\varphi_{z,i}^\delta}{\sum_{j=1}^{K_z} \varphi_{z,j}^\delta} x_{z,i} \quad (23)$$

to boost its productivity from  $\varphi_{z,i}$  to  $\varphi'_{z,i} = \varphi_{z,i}(1+x_{z,i})^{1/\zeta}$  for some  $\kappa, \delta > 0$  and  $\zeta > \sigma - 1$ . We are interested in the home planner's allocation of investment  $\{v_{z,i}\}$  and associated productivity boosts  $\{x_{z,i}\}$ , and for concreteness limit the planners budget to  $V$ , so that:

$$\int_{z \in [0,1]} \left( \sum_{i=1}^{K_z} \iota_{z,i} v_{z,i} \right) dz \leq V. \quad (24)$$

In a counterfactual closed economy with constant markups, a planner is simply maximizing aggregate productivity given by:

$$\Phi = \exp \int_{z \in [0,1]} \frac{\alpha_z}{\sigma - 1} \log \left( \sum_{i=1}^{K_z} \varphi_{z,i}^{\sigma-1} (1+x_{z,i})^{\frac{\sigma-1}{\zeta}} \right) dz. \quad (25)$$

In an open economy with variable-markup pricing, the planner chooses  $\{v_{z,i}, x_{z,i}\}$  to maximize the change in welfare  $\hat{W} = d \log(Y/P)$ , as defined in (15), subject to (23) and (24).

For concreteness we consider a total budget  $V = \kappa \zeta / 100$  so that a uniform 1% productivity

improvement ( $x_{z,i} \equiv \bar{x} = \zeta/100$ ) is feasible for every firm in every sector.<sup>21</sup> We ask the question under which circumstances the planner would indeed favor such a uniform allocation of investment and when she would prefer to skew the investment towards certain sectors and firms, in particular national champions.

**Closed economy** Consider first a closed economy, using our welfare approximation developed in Section 3. The log productivity improvement is  $\hat{\varphi}_{z,i} \equiv \log(\varphi'_{z,i}/\varphi_{z,i}) \approx x_{z,i}/\zeta$ . Using (20) and (21), the reduction in sectoral price levels and the increase in profits is given by:

$$\hat{P}_z = -\frac{1}{1 - \bar{\kappa}_z} \sum_{i=1}^{K_z} s_{z,i} (1 - \kappa_{z,i}) \hat{\varphi}_{z,i} \quad \text{and} \quad \frac{d\Pi_z}{\alpha_z Y} = \sum_{i=1}^{K_z} \frac{s_{z,i}}{\mu_{z,i}} \kappa_{z,i} (\hat{\varphi}_{z,i} + \hat{P}_z), \quad (26)$$

as the firms increase their markups by  $\hat{\mu}_{z,i} = \kappa_{z,i} (\hat{\varphi}_{z,i} + \hat{P}_z)$  according to (19), absent any exogenous shifts in markups. Therefore, the overall welfare effect can be evaluated as:<sup>22</sup>

$$\hat{W}_z = \frac{d\Pi_z}{\alpha_z Y} - \hat{P}_z = \sum_{i=1}^{K_z} s_{z,i} \hat{\varphi}_{z,i} - \text{cov} \left( \hat{\varphi}_{z,i}, \frac{\kappa_{z,i}}{\varepsilon_{z,i}} + \frac{(\bar{\kappa}_z/\varepsilon_z)}{1 - \bar{\kappa}_z} \kappa_{z,i} \right), \quad (27)$$

where the covariance term is market-share weighted and  $(\bar{\kappa}_z/\varepsilon_z) \equiv \sum_{i=1}^{K_z} s_{z,i} \kappa_{z,i} / \varepsilon_{z,i}$ .

Equation (27) has a number of implications. First, in a counterfactual economy with constant markups, that is with complete pass-through  $1 - \kappa_{z,i} \equiv 1$  and thus with  $\kappa_{z,i} \equiv 0$ , the distribution of productivity boosts across firms (and sectors) does not matter, and a sufficient statistic is the average productivity growth,  $\sum_{i=1}^{K_z} s_{z,i} \hat{\varphi}_{z,i}$ . This is a version of Hulten's theorem. As a result, the planner should simply maximize aggregate productivity (25) subject to her budget constraint (24). In this case, it is optimal to have  $\hat{\varphi}_{z,i}$  common across all firms ( $x_{z,i} = \bar{x}$  for all firms) when  $\delta = \sigma - 1$  in (23), while a smaller (larger)  $\delta$  favors investment into the largest (smallest) firms. In what follows, we focus on the case of  $\delta = \sigma - 1$ , which establishes an indifference benchmark in a counterfactual closed economy with constant markups, whereby the planner is indifferent on the margin which firms should receive the productivity boost. Indeed, per unit of investment expenditure, this results in the same aggregate productivity gains independent of the details of the allocation.

When markups are variable, both  $\kappa_{z,i}$  and  $\kappa_{z,i}/\varepsilon_{z,i}$  are increasing in the firm's market share  $s_{z,i}$ , as larger firms have both a greater strategic complementarity elasticity  $\kappa_{z,i}$  and a smaller elasticity of demand  $\varepsilon_{z,i}$ . Therefore, the planner can make the covariance term in (27) negative by allocating  $\hat{\varphi}_{z,i}$  towards the smaller firms. When  $\delta = \sigma - 1$ , the increase in the aver-

<sup>21</sup>Note that in this case,  $\int_{z \in [0,1]} (\sum_{i=1}^{K_z} v_{z,i}) dz = \kappa \bar{x}$ , as  $\sum_{i=1}^{K_z} \frac{\varphi_{z,i}^\delta}{\sum_{j=1}^{K_z} \varphi_{z,j}^\delta} = 1$  and  $\int_{z \in [0,1]} \alpha_z dz = 1$ .

<sup>22</sup>To derive this result, combine the expressions in (26) and simplify by using the fact that  $\mu_{z,i} = \varepsilon_{z,i}/(\varepsilon_{z,i} - 1)$ .

age productivity does not depend on the allocation of investments on the margin, as discussed above, and thus the preferences of the planner are shaped by the negative of the covariance term in (27). As a result the planner favors investment to increase productivity of the smallest firms. This result is intuitive, as such investment allows the smaller firms to catch up with the larger firms, thus eroding the monopoly power of the larger firms and bringing down the average markup in the closed economy. This reduces the deadweight loss and results in greater welfare gains for the same increase in the average productivity across firms. Another way to see this from (26) is that smaller firms have a greater pass-through  $1 - \varkappa_{z,i}$  of their productivity gains into reduction of consumer prices, while the larger firms retain a larger share  $\varkappa_{z,i}$  of productivity improvement by increasing their markups, which has a proportionally smaller (by a factor  $\mu_{z,i} > 1$ ) effect on aggregate welfare.

**Open economy** Matters are different in an open economy as the benefits of domestic productivity gains only partially accrue to domestic consumers, who buy a basket of home and foreign products, and also partially accrue to foreign consumers by means of their terms of trade appreciation. This provides an incentive for the home country to subsidize more intensively its comparative advantage sectors, which maximize the benefits from productivity improvements. In contrast, in comparative disadvantage sectors, the home country has an incentive to “free ride” on the foreign high productivity level, which translates into favorable terms of trade for the home country.<sup>23</sup>

Furthermore, the same force that made it disadvantageous to subsidize large firms in a closed economy, may render it desirable in an open economy. Specifically, the low pass-through  $1 - \varkappa_{z,i}$  of productivity improvements into consumer prices at home translates into greater profitability of home firms abroad. In other words, subsidizing productivity improvements for large exporters has disadvantages in the home market, yet allows to capture a greater share of enhanced competitiveness in the foreign market in the form of greater producer surplus. Indeed, the direct effect of productivity improvement on the producer surplus from exports is given by  $\sum_{i=1}^{K_z^*} (1 - \iota_{z,i}^*) \frac{s_{z,i}^*}{\mu_{z,i}^*} \varkappa_{z,i}^* \hat{\varphi}_{z,i}$ , and it is increasing in both the comparative advantage of a sector  $\Lambda_z^* = \sum_{i=1}^{K_z^*} (1 - \iota_{z,i}^*) s_{z,i}^*$  and in the average markup elasticity  $\varkappa_{z,i}^*$  of the subsidized firms, which is increasing in firm size.

<sup>23</sup>Formally, the increase in consumer surplus is given by:

$$-\hat{P}_z = \frac{1}{1 - \bar{\varkappa}_z} \sum_{i=1}^{K_z} \iota_{z,i} s_{z,i} (1 - \varkappa_{z,i}) \hat{\varphi}_{z,i} = (1 - \Lambda_z) \frac{1 - \bar{\varkappa}_z^H}{1 - \bar{\varkappa}_z} \frac{\sum_{i=1}^{K_z} \iota_{z,i} s_{z,i} (1 - \varkappa_{z,i}) \hat{\varphi}_{z,i}}{\sum_{i=1}^{K_z} \iota_{z,i} s_{z,i} (1 - \varkappa_{z,i})},$$

where  $1 - \Lambda_z = \sum_{i=1}^{K_z} \iota_{z,i} s_{z,i}$  is the home share and  $1 - \bar{\varkappa}_z^H = \frac{1}{1 - \Lambda_z} \sum_{i=1}^{K_z} \iota_{z,i} s_{z,i} (1 - \varkappa_{z,i})$  is the average pass-through rate among domestic firms. If the home government subsidizes proportionately every home firm in sector  $z$ , so that  $\hat{\varphi}_{z,i} = \hat{\varphi}_z$  for all  $i$ , then  $-\hat{P}_z = (1 - \Lambda_z) \frac{1 - \bar{\varkappa}_z^H}{1 - \bar{\varkappa}_z} \hat{\varphi}_z$ , which is increasing in the home share  $1 - \Lambda_z$ .

To summarize, the planner favors productivity gains by smaller firms in a closed economy, as it helps to bring down the average markup distortion. That is, in a closed economy, the planner is likely to adopt policies opposing the creation of “national champions” and granular firms. In an open economy, however, there exists a rationale to subsidize productivity gains in comparative advantage sectors and, furthermore, by the largest firms in such sectors, thus creating national champions in sectors of comparative advantage. The gains in producer surplus abroad may become the goal of the policy, in which case large firms with a low pass-through of productivity gains into foreign consumer prices may become the target of industrial policies. We leave the comprehensive quantitative evaluation of this hypothesis to future research.

## 7 Conclusion

Granular firms play a pivotal role in international trade. We analyze a series of policies aimed specifically at large individual firms in an open economy context, relying on the theoretical and quantitative framework developed in [Gaubert and Itskhoki \(2020\)](#). We study merger policies as well as ‘granular’ trade policy. In both cases, we find that the granular structure of the world economy offers powerful incentives for governments to adopt policies targeted at individual firms, and that they tend to create negative international spillovers.

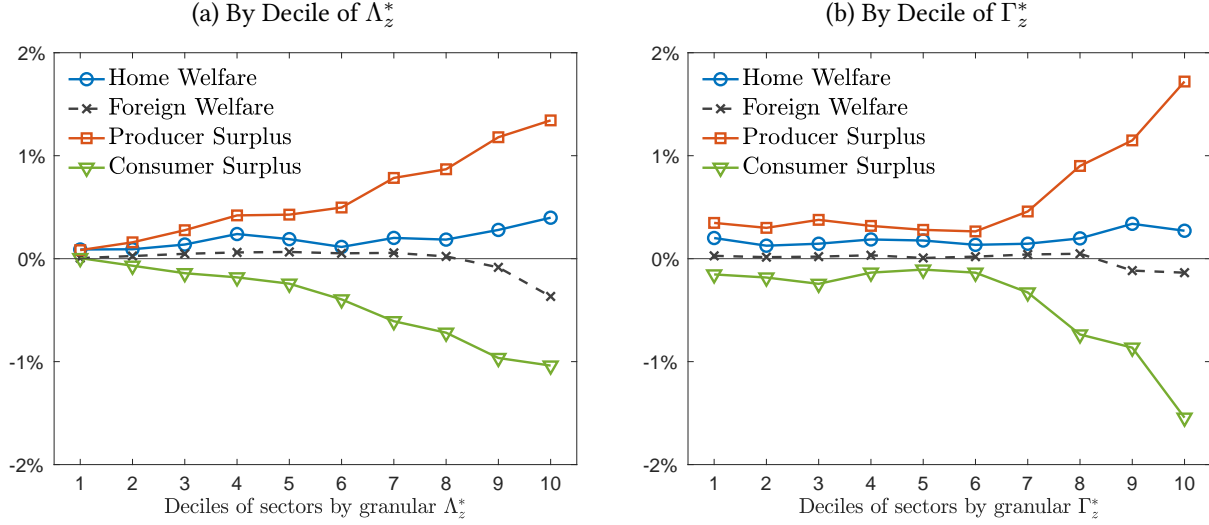
The key force underlying these results is that these large individual firms tend to enjoy substantial market power. In this context, lenient merger policy towards local firms allows national governments to help domestic firms build producer surplus at the expense of foreign consumers, a form of ‘beggar-thy-neighbor’ policy. Turning to trade policy, granular tariffs targeting large foreign exporters allow to leverage the fact that these firms have high markups, hence absorb a large fraction of import tariffs rather than passing them on to home consumers. As a result, granular trade policy can achieve the same tariff revenues at lower cost in terms of consumer surplus, compared to imposing a tariff on all firms in a sector.

Negative spillovers created by such unilateral policies could be addressed with international cooperation mechanisms. In particular, the analysis puts forth a clear rationale for international cooperation on merger and antitrust policy. Our work has analyzed the incentives faced by governments when deciding on unilateral antitrust and trade policies, assuming that its trade partners do not retaliate. This leaves a set of interesting questions for future research. Next on the agenda should be the analysis of incentives to retaliate by the foreign country, and the Nash equilibrium that ensues. Another one is to distinguish between two sources of large firms’ market power, which may have very different implications for these open-economy policies: market power on the output market and market power on the input markets.

# A Appendix

## A.1 Additional Figures

Figure A1: Welfare effects of a merger: Decomposition into producer and consumer surplus



Note: Decomposition of home welfare effects from the merger policy according to (15). See Figures 1 and 4.

## A.2 Granular Tariff

Consider firm-specific tariff profile  $\{\varsigma_{z,i}\}$  imposed by the home government on foreign firms  $i$  in sector  $z$ . Then the foreign firm's profit maximization results in the same prices and markups as if the firm has its costs increased to  $c'_{z,i} = c_{z,i}/(1 - \varsigma_{z,i})$ , or equivalently productivity draw reduced to  $\varphi'_{z,i} = \varphi_{z,i}(1 - \varsigma_{z,i})$ . We denote the resulting market shares  $\{s'_{z,i}\}$ , and the resulting profits for foreign firms are  $\Pi'_{z,i} = (1 - \varsigma_{z,i})\alpha_z Y \frac{s'_{z,i}}{\varepsilon(s'_{z,i})} - wF$ , where  $\varepsilon(s)$  is as defined in (6).<sup>24</sup>

The expenditure on foreign goods in the home market is still given by  $s'_{z,i}\alpha_z Y$ , and the foreign share is still  $\Lambda'_z = \sum_{i=1}^{K_z} (1 - \iota_{z,i})s'_{z,i}$ . However now, the home government collects  $TR_z = \alpha_z Y \sum_{i=1}^{K_z} (1 - \iota_{z,i})\varsigma_{z,i}s'_{z,i}$ , while the rest  $(\Lambda'_z \alpha_z Y - TR_z)$  is the revenue of foreign firms, which are split between production labor  $\alpha_z Y \sum_{i=1}^{K_z} (1 - \iota_{z,i})(1 - \varsigma_{z,i}) \frac{s'_{z,i}}{\mu(s'_{z,i})}$ , fixed costs  $wF \sum_{i=1}^{K_z} (1 - \iota_{z,i})$ , and profits  $\sum_{i=1}^{K_z} (1 - \iota_{z,i})\Pi'_{z,i}$ , where  $\mu(s) = \frac{\varepsilon(s)}{\varepsilon(s)-1}$ .

<sup>24</sup>Note that a non-uniform tax creates a computational challenge for the entry game, as the effective condition for entry becomes  $\alpha_z Y \frac{s'_{z,i}}{\varepsilon(s'_{z,i})} \geq \frac{wF}{1 - \varsigma_{z,i}}$ , and ranking firms on  $c'_{z,i}$  (and hence  $s'_{z,i}$  does not guarantee monotonicity of  $\Pi'_{z,i}$ . We assume, however, that for a small enough  $\varsigma_{z,i}$  (as is the case in our simulation), the approximation  $F/(1 - \varsigma_{z,i}) \approx F$  is sufficiently accurate in the entry game. Indeed, recall that entry is a discrete zero-one decision, in which most entering firms are inframarginal, with  $\Pi'_{z,i} \gg 0$  due to the Zipf's law.

Therefore, there are changes to the three general equilibrium conditions (8)–(10). In particular, (8) becomes:

$$Y = wL + \Pi + TR, \quad \text{where} \quad TR = Y \int_0^1 \alpha_z \left[ \sum_{i=1}^{K'_z} (1 - \iota_{z,i}) \varsigma_{z,i} s'_{z,i} \right] dz,$$

and where the profits of home firms  $\Pi$  are still expressed as in (9). Foreign aggregate income is still  $Y^* = w^*L^* + \Pi^*$ , where now aggregate foreign profits reflect import tariffs imposed by the home government:

$$\Pi^* = \int_0^1 \left[ \sum_{i=1}^{K_z} (1 - \iota_{z,i}) \left( (1 - \varsigma_{z,i}) \alpha_z Y \frac{s'_{z,i}}{\varepsilon(s'_{z,i})} - wF \right) + \sum_{i=1}^{K_z^*} \iota_{z,i}^* \left( \alpha_z Y^* \frac{s_{z,i}^*}{\varepsilon(s_{z,i}^*)} - w^*F \right) \right] dz.$$

Finally, the current account balance becomes:

$$\Lambda'Y - wFK_F - TR = Y^*\Lambda^* - w^*F^*K_H^*,$$

where  $\Lambda' = \int_0^1 \alpha_z \left[ \sum_{i=1}^{K_z} (1 - \iota_{z,i}) s'_{z,i} \right] dz$ ,  $K_F = \int_0^1 \left[ \sum_{i=1}^{K_z} (1 - \iota_{z,i}) \right] dz$  and similarly for  $\Lambda^*$  and  $K_H^*$ , as now the foreign income from exporting is reduced by  $TR$ .

**Welfare approximation** We now adapt the welfare approximation introduced in (20)–(21) in Section 3 to the case of the import tariff. In this case,  $\hat{W}_z$  has an additional component, namely, government tariff revenue  $\frac{dTR_z}{\alpha_z Y} = \bar{\varsigma}_z \Lambda_z$  (equivalently under the granular tariff  $\hat{\varsigma}_{z,1}$ ), levied on foreign exporters who in turn partially pass it through to home consumers. From the point of view of home consumers, a tariff is equivalent to an adverse productivity shock to foreign products,  $\hat{\varphi}_{z,i} = -\varsigma_{z,i}$ , and there is no direct effect on Home's producer surplus (only a second-round effect on their markups). As a result, using (20), the decline in consumer surplus is given by  $\hat{P}_z = \frac{1 - \bar{\varkappa}_z^F}{1 - \bar{\varkappa}_z} \bar{\varsigma}_z \Lambda_z$ , where  $1 - \bar{\varkappa}_z^F$  is the average pass-through rate of the tariff among the affected foreign firms. Thus,  $\bar{\varkappa}_z^F$  is equal to  $\frac{1}{\Lambda_z} \sum_{i=1}^{K_z} (1 - \iota_{z,i}) \varsigma_{z,i} \varkappa_{z,i}$  under the uniform tariff and  $\varkappa_{z,1}^F$  under the granular tariff. This erosion of consumer surplus is partially offset by an increase in producer surplus, as home firms increase their markups and prices by  $\varkappa_{z,i} \hat{P}_z$  according to (19).

Therefore, the net effect of a tariff on home welfare is given by:

$$\hat{W}_z = \bar{\varsigma}_z \Lambda_z - \left[ 1 - (1 - \Lambda_z) \frac{\bar{\varkappa}_z^H}{\bar{\mu}_z^H} \right] \hat{P}_z = \bar{\varsigma}_z \Lambda_z \left[ \frac{\bar{\varkappa}_z^F - \bar{\varkappa}_z}{1 - \bar{\varkappa}_z} + (1 - \Lambda_z) \frac{\bar{\varkappa}_z^H}{\bar{\mu}_z^H} \frac{1 - \bar{\varkappa}_z^F}{1 - \bar{\varkappa}_z} \right],$$

where  $\bar{\varkappa}_z^H$  and  $\bar{\mu}_z^H$  are the average strategic complementarity elasticity and the average markup among domestic firms. We see that  $\bar{\varkappa}_z^F > \bar{\varkappa}_z$  is sufficient (but not necessary) for a positive

welfare effect of an import tariff on home welfare.<sup>25</sup> This condition is equivalent to the pass-through rate being lower among foreign exporters relative to an average firm serving the home market,  $1 - \bar{\pi}_z^F < 1 - \bar{\pi}_z$ . We generally expect this condition to hold due to the Melitz selection force of larger firms into the foreign market and pass-through being lower among the firms with greater market shares. Adopting a granular tariff maximizes  $\bar{\pi}_z^F$  and minimizes the tariff pass-through  $1 - \bar{\pi}_z^F$ , thus delivering larger welfare gains to Home, especially in sectors where the largest foreign firm commands a substantial market share in the home market.

This discussion requires two remarks. First, it focuses exclusively on partial equilibrium effects, thus omitting the standard general equilibrium terms-of-trade effect, which is usually the focus of the optimal tariff argument. The welfare effect of a tariff in our partial equilibrium approximation would be altogether absent if the model were to feature constant markups and complete pass-through,  $\pi_{z,i} = 0$  for every firm. Our numerical analysis above combines both partial and general equilibrium forces, thus delivering a complete quantitative evaluation of the welfare consequences of different tariffs. Second, we note that the welfare consequences of a tariff are always negative if the impact on foreign countries, in particular on foreign producers, is taken into account. Indeed, the loss in foreign producer surplus is greater than the welfare benefit at home due to the increased Harberger's triangle and deadweight loss, independently of the type of tariff adopted.<sup>26</sup>

### A.3 Model Quantification

The model is estimated to match salient features of French firm-level data, as discussed in detail in [Gaubert and Itskhoki \(2020\)](#). Here we briefly summarize the main steps.

To estimate the model, we rely on French firm-level balance sheet data, which in particular reports sales at home and abroad, as well as the firm industry. This data is merged with international trade data from Comtrade, to get the aggregate imports and exports of France in each industry.

The estimation proceeds in two steps. In the first step, we calibrate Cobb-Douglas shares  $\{\alpha_z\}$  to equal the sectoral expenditure shares in the French data. We also calibrate  $w/w^* = 1.13$ , which corresponds to the ratio of wages in France to the average wage of its trading partners weighted by trade values. Lastly, in our estimation, we find that the elasticity of substitution  $\sigma$  and the productivity parameter  $\theta$  are only weakly separately identified. Therefore, we choose

<sup>25</sup>For example, when  $\bar{\pi}_z^H = \bar{\pi}_z^F = \bar{\pi}_z > 0$  (e.g., if  $\pi_{z,i} > 0$  and constant across all firms),  $\hat{W}_z > 0$  provided that  $\Lambda_z \in (0, 1)$ . Indeed, tax pass-through is incomplete iff the tax is levied on some but not all firms in the industry *and* firms feature incomplete cost pass-through. In contrast, if  $\bar{\pi}_z^F = 0$  and  $\bar{\pi}_z^H > 0$ , the partial equilibrium effect of a tariff on home welfare is negative, as consumers bear out the full cost of the tariff on foreign firms and in addition home firms raise their prices in response to increased prices of foreign competitors.

<sup>26</sup>The loss in foreign producer surplus is given by  $\bar{\varsigma}_z \Lambda_z \left[ \frac{1}{\bar{\varepsilon}_z^F} + \frac{\bar{\pi}_z^F}{\bar{\mu}_z^F} \left( 1 - \frac{1 - \bar{\pi}_z^F}{1 - \bar{\pi}_z} \Lambda_z \right) \right]$ .

Table A1: Moments used in SMM estimation

Moments				Data	Model	Loss (%)
1.	Log number of firms,	mean	$\log \tilde{M}_z$	5.631	5.429	1.9
2.		— st. dev.		1.451	1.230	3.9
3.	Top-firm sales share,	mean	$\tilde{s}_{z,1}$	0.197	0.205	3.0
4.		— st. dev.		0.178	0.148	4.5
5.	Top-3 sales share,	mean	$\sum_{j=1}^3 \tilde{s}_{z,j}$	0.356	0.343	2.0
6.		— st. dev.		0.241	0.176	12.2
7.	Imports/dom. sales,	mean	$\tilde{\Lambda}_z$	0.365	0.354	1.5
8.		— st. dev.		0.204	0.266	15.2
9.	Exports/dom. sales,	mean	$\tilde{\Lambda}_z^{*'} $	0.328	0.345	3.9
10.		— st. dev.		0.286	0.346	7.2
11.	Fraction of sectors with exports > dom. sales		$\mathbb{P}\{\tilde{X}_z > \tilde{D}_z\}$	0.185	0.095	39.7
Regression coefficients: <sup>†</sup>						
12.	export share on top-firm share		$\hat{b}_1^*$	0.215 (0.156)	0.240 (0.104)	2.2
13.	export share on top-3 share		$\hat{b}_3^*$	0.254 (0.108)	0.222 (0.090)	2.6
14.	import share on top-firm share		$\hat{b}_1$	−0.016 (0.097)	−0.011 (0.079)	0.1
15.	import share on top-3 share		$\hat{b}_3$	0.002 (0.074)	0.008 (0.069)	0.1

Note: Last column reports the contribution of the moment to the SMM loss function.

<sup>†</sup>Moments 12–15 are regression coefficients of  $\tilde{\Lambda}_z^{*'}$  and  $\tilde{\Lambda}_z$  on  $\tilde{s}_{z,1}$  and  $\sum_{j=1}^3 \tilde{s}_{z,j}$  (pairwise), controlling in all cases for the size of the sector with the log domestic sectoral expenditure  $\tilde{Y}_z$ ; OLS standard errors in brackets.

to fix  $\sigma$  at a conventional value in the trade literature ( $\sigma = 5$ ; see [Broda and Weinstein 2006](#)), and estimate the constrained model with five parameters  $\Theta' = (\theta, \tau, F, \mu_T, \sigma_T)$ .

In the second step, we use simulated method of moments (SMM) to estimate the remaining parameters. We search for parameter values that minimize the distance between data moments and their model counterpart. We are particularly interested in the following salient feature of the data: (a) heterogeneity across sectors in top firm concentration, (b) heterogeneity across sectors in export stance and, importantly, (c) the extent to which the two are correlated, capturing granular forces at play in shaping sectoral outcomes.

To that end, we choose to target three types of moments, summarized in [Table A1](#). The first set of moments is informative about the prevalence of large firms in domestic sectoral sales (a). Namely, we target the average and standard deviation across sectors of two measures of within-industry concentration (the relative sales shares of the largest and top-3 largest French firms within-industry relative to other French firms). We also target the average (log) number of French firms operating within sectors, as well as its standard deviation. This en-

sures that the model captures simultaneously the large number of firms operating in French sectors with the high concentration of sales. These moments particularly help inform the estimation of the fixed costs  $F$ , as well as the productivity dispersion parameter  $\theta$ .

The second set of moments are informative about the intensity of sectoral exports (b). Specifically, we match the average and standard deviation of foreign shares in the French market  $\tilde{\Lambda}_z$ , and the French export intensity  $\tilde{\Lambda}_z^{*}$ . We also target the fraction of French sectors in which export sales exceed the overall domestic sales of French firms. These trade moments help inform the estimation of the size of the trade cost  $\tau$  and the average productivity advantage of France  $\mu_T$ .

Finally, the third set of moments is informative about the joint distribution of firm concentration and sectoral exports (c). We target four moments describing the correlation between French import and export shares and the sectoral sales concentration at home. Specifically, we target the regression coefficients of  $\tilde{\Lambda}_z$  and  $\tilde{\Lambda}_z^{*}$  separately on  $\tilde{s}_{z,1}$  and  $\sum_{j=1}^3 \tilde{s}_{z,j}$ , controlling in all four regressions for the size of the sector ( $\log$  total domestic expenditure,  $\log \tilde{Y}_z$ ). These moments are instrumental for identifying the relative importance of fundamental and granular forces in shaping trade patterns.

The parameter values resulting from this SMM estimation are reported in Table 1. Table A1 reports the model-based values of the 15 moments used in the estimation, and compares them with their empirical counterparts. The table also reports the percentage contribution of each moment to the SMM loss function. Overall, the model provides a good fit to the data for the 15 moments targeted in the estimation.

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