Sectoral vs. Firm-Level Sanctions in Trade Policy

Clément Montes[†]

In progress – Do not circulate please

Latest version: February, 2026

Abstract

This paper develops a quantitative two-country model of heterogeneous firms to compare the incentives and consequences of imposing sanctions targeting firms rather than entire sectors. I focus on fully prohibitive sanctions, banning both the export patterns and production processes of one or more firm. I document a new stylized fact: sanctions against specific firms have become more prevalent than sectoral ones. I decompose the sanction imposition in three components: scale, objective and type within objective effects and show that the shift is solely driven by the type of sanction used. I then employ my quantitative framework to distinguish the impacts of a sanction on the welfare of both economies. Results indicate that the economic burden of a sectoral sanction is supported by the domestic economy. In the case of a firm-specific sanction, the burden shifts to the foreign economy instead.

JEL classification: *E61; E65; F13; F51; L14*

Keywords: *Economic sanction; Firm-level trade policy; Granularity; International trade*

[†]CREST, Institut Polytechnique de Paris, IRSEM. I am very grateful to my advisor Alessandro Riboni. I am thankful to Gregory Corcos, Matthieu Crozet, Cecile Gaubert, Clément Malgouyres, Isabelle Mejean, Riccardo Norbiato, Mathieu Parenti, Pedro Vergara Merino and Yoto V. Yotov for insightful discussions. I also thank participants in Drexel sanction, EARIE, ETSG, and GRIEP workshops, UC Berkeley Trade lunch seminar for helpful comments. I also acknowledge supports from the CIEDS of IP Paris and Agence d'Innovation de Défense (AID). All errors are mine. *E-mail address*: clement.montes@ensae.fr

1 Introduction

This paper studies the incentive to design fully prohibitive economic sanctions at a granular level. Large firms play a crucial role in their domestic economy, both within their national borders and in international trade. In geopolitical conflicts, targeting these firms can significantly damage the economy due to their substantial contributions to export and import activities. Consequently, large firms become strategic targets for foreign economies during conflicts. The attacking economy could at the same time affect the export of the target with traditional trade policies, and its production process by cutting supply of its domestic firms to the target. This combination of "granular" policy[1] and supply chain disruption may have unanticipated impact on the welfare of both economies.
Given that large firms are deeply involved in cross-border supply chains, fully sanctioning them is likely to have negative repercussions on the firms in the sanctioning economy as well. Therefore even the most granular sanction hurts the sanctioning economy. This compromise between hurting and being hurt raises the question: What is the most cost-efficient way to apply fully prohibitive trade sanctions?

I begin by documenting that there are more programs enforcing targeted sanctions than sectoral sanctions. To ensure this trend is not simply driven by scale or geopolitical effects, I decompose the number of active sanctions into the scale, the political objective, and the type of sanction. Conditional on the two formers, the shift in trends is completely explained by a change in the type of sanctions. To rationalize this shift in type of sanction, I compare the welfare impact of an economic sanction targeting either a single firm or a whole sector. To do so, I extend the granular model of trade with heterogenous firms of Gaubert and Itskhoki (2021) by adding import of inputs decisions, following Amiti et al. (2014). My model features firms big enough to internalize their impact on their sectors but infinitesimal within the economy as a whole. Every firm produces according to a constant return to scale technology, using domestic labour and inputs sourced either domestically or abroad depending on relative prices. The general equilibrium objects depend on individual firms in the model. A sanction against a single firm can thus change the prices, wages and the aggregate expenditures. I then turn to a quantification exercise and calibrate the model with elasticities estimated by the literature. I simulate the model to study the differences in the consumer and firms surplus of both type of sanctions. I am mainly interested in the normative implication of sanctions and more precisely in its use as strategic trade policy.

The mechanisms driving welfare impacts originate from three sources: import ban, supply chain disruption and propagation through linkages. In an import ban, the exclusion from the

[1] *Granular policy* is here defined following Gaubert et al. (2021) as a policy targetting a single large foreign firm rather than all firms inside a sector.

domestic market lowers the competition across remaining firms and increase prices in the sanctioning economy. To that respect, the domestic economy should prefer a granular sanction. The supply chain disruption increases the cost of the target, thus lowering its productivity relatively to not sanctioned firms in the same sector. This allows for domestic firms exporting to that market to increase their markup, without loosing market share. To that regard, the domestic economy should prefer a sectoral sanction. These effects propagate to other sectors through supply chain linkages, affecting even purely domestic firms through increased input prices and general equilibrium effects on wages.

The disparity in welfare impact between firm-level and sectoral sanctions arises because the increase of cost of a single targeted firm is not fully passed through, whereas a sector-wide shock is almost completely passed through to final prices. The analysis of an import ban indicates that the domestic consumer bears the cost of sectoral sanctions, while the foreign economy primarily suffers under firm-level sanctions. Quantitatively, the welfare losses for the domestic economy are over four times higher in the case of sectoral sanctions compared to firm-level sanctions. This is however no surprise given the different set of firms impacted by the sanction in both scenarii.

Related literature

This paper contributes to the macroeconomic literature examining the influence of large individual firms on macro aggregates, building on the foundational work of Gabaix (2011). Most subsequent research focuses on the positive implications of firm granularity on macro aggregates. One strand of literature examines how idiosyncratic productivity shocks in firms impact aggregate variables, as seen in studies by Carvalho and Gabaix (2013) and Carvalho and Grassi (2019) both studying macroeconomic variations. Another line of research, including works by Di Giovanni et al. (2014), Di Giovanni et al. (2024) or Gaubert and Itskhoki (2021) rather documents the magnification of trade flows enabled by granularity.
Few papers adress the normative implications of granularity on trade policies yet. A notable exception is Gaubert et al. (2021) who study antitrust, trade and industrial policies. They conclude that tariffs should target large foreign exporting firms rather than entire sectors. My paper extends this conclusion when taking into account supply chain propagations for the study of fully prohibitive sanctions. By doing so, I allow sanctions to have impact on foreign technology and foreign markets as well.

This paper also contributes to the literature on the impact of international shocks on firms behaviours. My paper combines the incomplete pass through and strategic complementarity described in Amiti et al. (2019), with the sourcing decision of firms from Amiti et al. (2014) which is a granular version of the Caliendo and Parro (2015) model. These two models mainly work in partial equilibrium, I extend them when adding general equilibrium. To do so, I rely on

Di Giovanni et al. (2024) who combine the exporting and importing channels of firms decisions into a general equilibrium model. However they focus on exogenous markups for firms. I relax this assumption by explicitly endogenizing them.

I apply the insights and tools from these literatures to the growing theoretical literature on cost efficient economic sanctions. Two noticeable example are Becko (2024) which studies the optimal sanction in a model with representative firm and household. He finds that the optimal sanction is analogous to optimal tariffs manipulating terms of trade. I add to that framework the heterogeneity of firms, the input-output linkages and relax the perfect competition assumption. The most closely related paper to mine is De Souza et al. (2022) which also studies the most cost-efficient sanction design. They examine the optimal level of tariffs corresponding to the willingness to pay for political benefits. While De Souza et al. (2022) focus on tariffs, my study extends this by examining comprehensive sanctions affecting both import markets but also supply chains. I relax their assumption of monopolistic competition to allow firms to have endogenous markups. Firms can adjust their markup to a shock and decide on their pass-through according to the elasticity of demand they face.

My paper combines empirics, quantification, and analytical results to highlight the role of incomplete pass-through in sanction designs. To my knowledge, I am the first to document the shift of burden result and obtain normative results on the optimal type of comprehensive sanctions given a government objective function.

The remainder of this article is organized as follows. Section 2 presents a new dataset of firm-level sanctions and establishes basic facts on the use of firm-level vs. sectoral sanctions. Section 3 presents the theoretical framework and the government's problem. Section 4 calibrates the model to study the relative importance of every sanction components on welfare. Section 5 concludes.

2 Empirical trends

I have compiled a new dataset on firms sanctioned by the European Union (EU) and integrated it with the latest comprehensive dataset that consolidates all existing databases in the literature. Meanwhile the consolidated dataset is exhaustive, it only flags countries implicated in the sanction. My dataset allows to track precisely the targets. By studying trends, I establish the new prevalence of firm-level sanctions compared to sectoral ones.

2.1 Data

2.1.1 Sector-wide sanction

The primary source of data at the sectoral level is the Global Sanction DataBase (GSDB) by Syropoulos et al., 2024[2]. It repertoriates every sanction case enforced by one country or group of, against a country. It covers sanction cases enforced between 1949 and 2023. Sanctions are labeled by types: arms, military, financial, travel and other sanctions. They can be either partial, such as targeting only imports or only exports, or complete, as is the case in my model. It is the most comprehensive and up to date dataset, encompassing all others from the literature.

It covers 1547 sanction programs without detailing the precise target inside the country. It is thus useful to catch the type of embargoes enforced the world, but needs to be complemented when studying the specific target inside the country.

2.1.2 Firm-level sanction

I have compiled data on every sanction imposed by the EU to specific firms related to countries most famously known for their links with terrorism and political oppression. This new granular dataset enables to keep track of the specific timing of sanctions for all entities specifically targeted since the creation of the European Council.

My dataset covers 24 publicly traceable multilateral sanction programs enforced between 2001 and 2024. I disaggregate those programs to identify 3270 entities that were, are or have been sanctioned by the EU. For most entities, I gather the addresses of all establishments targeted by the EU. My dataset also precisely tracks the period of the threat of sanction, the starting point of the sanction, and the lift of sanction. 2126 entities in my dataset are not sanctioned anymore today. They are of interest given the lift of their sanction is mostly related to compliance.

After the enforcement of the sanction, All European firms are prohibited from supplying to or demanding goods from the targeted firms. This is what I will later call supply chain disruption. In addition, European citizens cannot access goods produced by these entities. This is what I will later call import ban.

The only sender in my dataset is the EU. Given its importance in trade, stopping trade with the EU is likely to create a sizable shock: both by creating a demand shock because of the cut of part of international demand to the target, but also a supply shock since every European firm must stop its trade with targets. All in all, my dataset gets into the case of the most effective and impactful sanctions of Bapat and Kwon (2015) and **?** (mimeo).

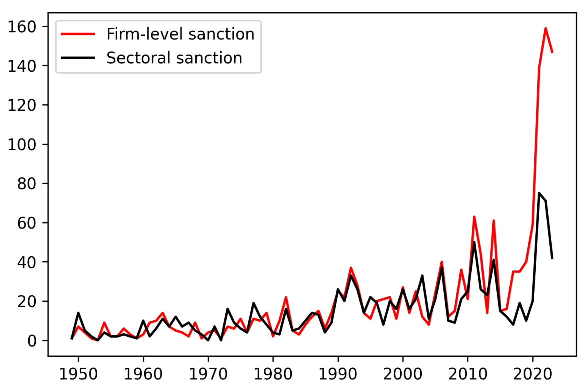
[2]See also Felbermayr et al., 2020 and Kirikakha et al., 2021

2.2 Basic trends

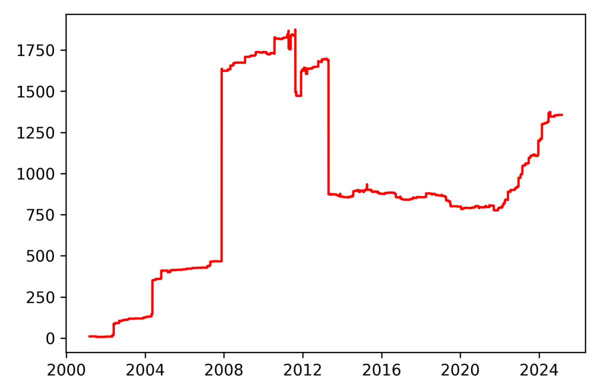
To demonstrate the prevalence of firm-level sanction in the realm of sanctions, I first show that the number of text of law enforcing sanctions against specific firms is increasing quicker than the number of text of law enforcing sectoral sanctions. Given the aggregation of the GSDB, I can not disentangle between sanctions targeting firms and the one targeting persons. I thus use my dataset to ensure that the trend is also valid when looking at the number of firms sanctioned.
First, I make use of the GSDB to compare the worldwide number of sanction programs active every year that are either enforced against a whole sector, or targeting a specific entity. Using the GSDB's classification of types, I categorize sanctions as firm-level if they are financial, travel-related or other. The remaining types are classified as sectoral. The intuition comes from the fact that firms targeted are often associated with specific shareholders and/or owners. I then plot for each type the number of sanction programs that are active every year.

However a sanction program may encompass different number of sectors and firms. It may be that text of laws enforcing firm-level sanctions target very few firms when texts for sectoral sanctions have many targets. It may also be the case that travel sanctions inflate the trend by adding sanctions targeting individuals. To rather study the inside structure of sanction program, I narrow the scope to the EU and make use of my dataset. I represent at every date the exact number of firms that are designated by the EU. I then document two simple facts.

Figure 1: Temporal evolution of firm-level and sectoral sanction cases and counting of firms designated by firm-level cases of sanctions in the EU



(a) New Sanctions Cases per Year



(b) Firms actively Sanctioned per Year

Notes: *Left hand-side.* Computations based on GSDB. A sanction case corresponds to a legal text: it does not reflect the number of firms or sectors targeted. *Right hand-side.* Computations based on my dataset. An observation corresponds to a firm actively sanctioned at that date.

Relatively more firm level than sector-wide sanctions. From Figure 1a, it comes that the two types of sanctions were indifferently used up to early 2010's. However since 2010, the number of sanction programs targeting specifically firms or individuals are increasing faster than the use of sector-wide ones. In fact, there are now twice as many sanctions targeting specific firms or individuals as there are sectoral sanctions.

More firm sanctions in absolute term. To ensure that this trend is not driven solely by travel bans, but also applies to sanctions against firms, I use my firm-level dataset to illustrate the evolution of active sanctions by the EU. The EU represents 55% of multilateral sanction senders according to Syropoulos et al. (2024) and thus accounts for a large share of sanction cases in Figure 1a. The increasing trend in figure 1b shows that more and more firms are targeted by sanctions.

To rationalize the increasing use of firm-level sanctions, I build a model of sanctions at the firm or sectoral level and study the impact of sanctions on the surplus of both firms and consumers. I want to explore the incentive to precisely target firms, assessing whether it may be because those sanctions are less costly to the sender or imply more costs to the target than the sectoral sanctions.

2.3 A statistical decomposition on substituability of sanction types

The relative increase of firm-level sanction with respect to sectoral ones may come from three different sources: a scale effect, an increase in the use of a political objective only using firm-level sanction, or a shift in the pattern of imposing sanctions. Respectively, first, the scale effect may be a mechanical consequence of the increase in total number of cases. Assume an assymetry in the type of sanctions used ex ante where firm-level sanctions where slightly more used. The total increase of sanctions may accentuate this contrast and create that new prevalence of firm-level sactions. Second, one could think that, across the 9 different objectives available in the typology of the GSDB, some are using purely firm-level while some others only sectoral level, maybe due to uncaptured enforcement costs. The increase could then just follow a shift in geopolitics, focusing sanctions on one objective of sanctions using firm-level sanctions. Last, one could see a shift in the way of imposing sanctions, going from sectoral cases to firm-level cases to tailor the targets and reduce the economic costs. Put otherwise, there have been a substitution from one type of sanction to the other, conditional on geopolitics.

To disentangle the relative importance of those three mechanisms, I statistically decompose the number of sanction by types, following Shapiro and Walker (2018). To demonstrate that the increase in the firm-level sanctions relative to sectoral ones come from the substitution between those two types, rather than the complementarity between the two I study three types of sanctions: cases with solely firm-level sanctions, solely sectoral sanctions, or cases with a mixture of both. The two formers allows to study the substituability across sanction types, while the latter rather documents if sanction types have become more complementary. For each of those three types, I study the following decomposition:

$$\#(type, t) = Tot_t \times \sum_o s_{o,t} \theta_{o,t}(type) \tag{1}$$

where a type can be either firm-level, sectoral or a mixture of both, $\#(type, t)$ is the total number of active sanction of a given type at date t, Tot_t the total number of active sanctions at date t irrespective of type, $s_{o,t}$ the share of active sanction with an objective o at date t, and $\theta_{o,t}(type)$ the share of active sanction of a given type, inside of an objective o, at date t. This equation can be rewritten using vector notation, and omitting time subscripts as follows:

$$\#(type) = Tot \times \mathbf{s}' \ \theta(\mathbf{type})$$

with $\mathbf{s}$ and $\theta(\mathbf{type})$ vectors of dimensions $(O, 1)$ with O the total number of political objectives in the GSDB. Totally differentiating this equation and dividing both sides by $\#(type)$ yields:

$$\frac{\Delta\#(type)}{\#(type)} = \underbrace{\frac{\Delta Tot}{Tot}}_{\text{Scale}} + \underbrace{\frac{\Delta \mathbf{s}}{\mathbf{s}}}_{\text{Objectives}} + \underbrace{\frac{\Delta\theta(\mathbf{type})}{\theta(\mathbf{type})}}_{\text{Type}} \tag{2}$$

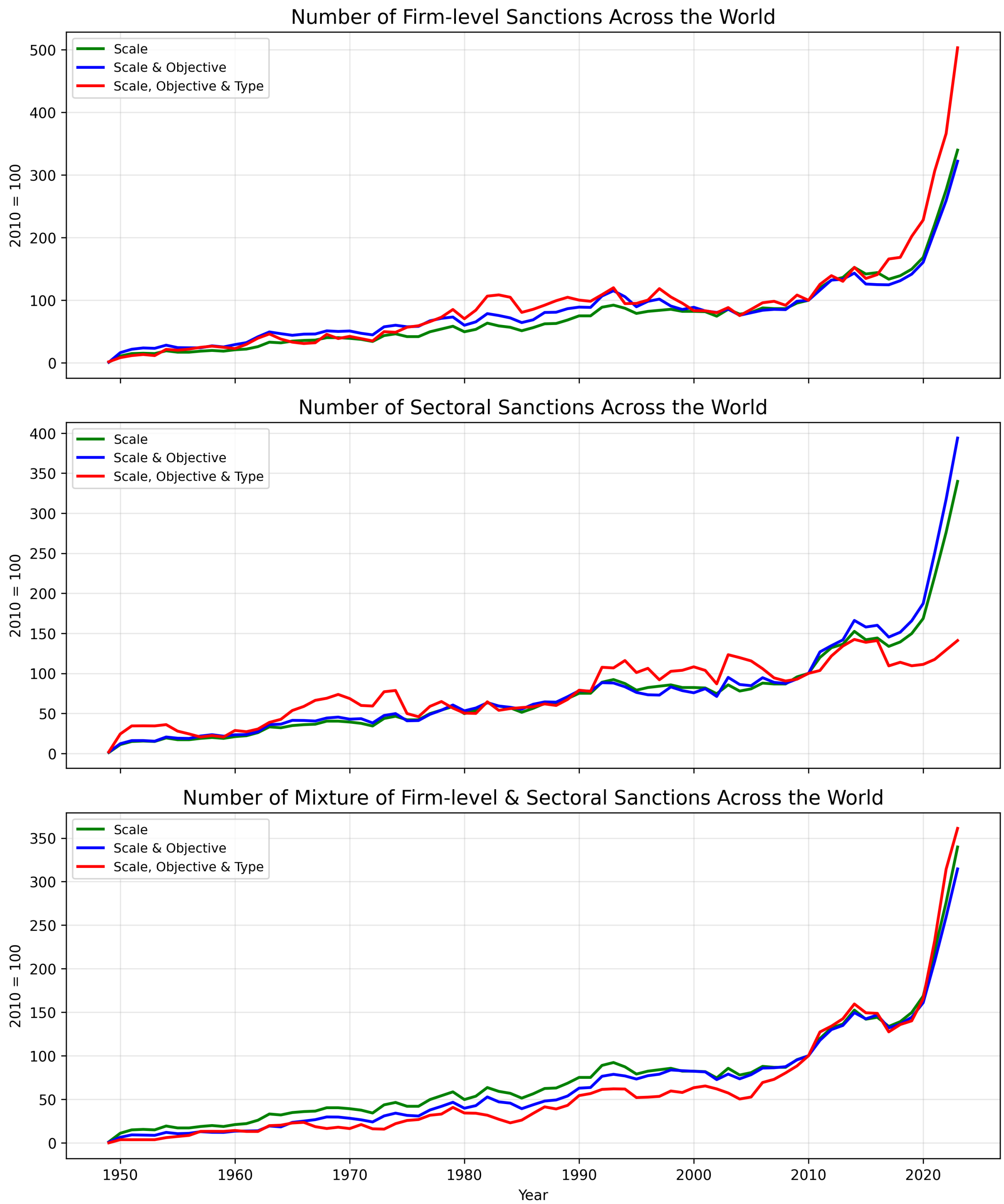
It is possible to estimate that decomposition by using the GSDB. The graph below captures sequentially the relative importance of those 3 mechanisms in the observed relative increase of firm-level to sectoral sanctions. I first create a partition of the types available in GSDB. I study sanction cases with only firm-level enforcement, only sectoral ones, or a mixture of the two. Empirically, for every type of sanction, I first hold fix the shares of objectives and the share of type (i.e. $\sum_o s_o \theta_o(type)$) to their value of 2010[3], to represent the green curve in Figure 2. In that counterfactual, the structure of sanction does not move since before the observed asymmetry, thus only the scale changes. Second, I keep fixed only the share of type inside a political objective (i.e. $\theta_o(type)$) to its 2010 level. The blue curve then captures the dynamic change of both the scale and the patterns in political objective. Eventually, I let all elements of the decomposition vary to obtain the observed count of active sanctions by type, represented in red in Figure 2. The red curve thus encompasses both the variation of the scale, the pattern of political objective, and the evolution of the sanction type within objective.

To observe the source of the asymmetry, one needs to study the decomposition for the three types of sanctions. If the asymmetry was explained by the increase in the mixture of the two, it should reflect an increasing complementarity of sanction types. If the asymmetry is explained simultaneously within objectives by a decrease of sectoral level and an increase of firm-level ones, then the two types of sanctions have become more substitutable.

The figure above shows two main messages. First, the graph at the bottom of Figure 2 the

[3] Results are robust to setting the year-value to 2000.

Figure 2: Decomposition of number of sanctions by type across time



Notes: : This figure plots observed and counterfactual trends in evolutions of total number of active sanctions by type based on the statistical decomposition from equation (2). The green line plots the counterfactual level of sanctions by type with the same composition of political objectives and relative use of sanction types inside every objective in 2010. The blue line represents the level of sanctions by type, with the same use of sanction types inside every political objective as in 2010. The red line represents the actual observed number of sanctions by type, which consists of changes to the scale, composition of objectives, and type of sanctions relative to 2010 values. The top panel does the decomposition for sanction cases solely using firm-level sanctions. The middle panel does the same decomposition for sanctions using solely sectoral sanctions. The bottom panel studies cases of sanction mixing firm-level and sectoral sanctions.

sanction cases encompassing both firm-level and sectoral sanctions are purely increasing due to a scale effect. Their composition across and inside political objective have not changed since 2010. Thus, the increasing asymmetry does not come from an increase in complementarity between sanction types. Second, the firm-level decomposition at the top of Figure 2 shows that both curves holding fixed the type of santion within objectives cannot replicate the observed trends in the red curve. The current increase in smart sanctions is thus mainly driven by an increase in the use of firm-level sanction conditional on the political objective. This rules out the possible story of political objective specialized in firm-level sanctions being increasingly used, since it would be translated into a gap explained by the blue curve, which should then coincide with the red curve. The sectoral sanctions are, on the contrary, increasing to a lower extent in practice than in counterfactual scenarios because of the change of type used conditional on political objective. It once again rules out the explanation stating that some political objective are specialized in sectoral-sanctions and are decreasingly being used. Combining those two analyses, it comes that the asymmetry observed in figure 1a comes from a reallocation of shares inside political objective from sectoral sanction to firm-level ones. Policymakers are thus substituting away from sectoral sanctions to firm-level ones.

2.4 Reduced form evidence

I am currently merging my dataset with ORBIS dataset (balance sheet data of more than 2 million firms around the world). I plan to use the date of threat of sanction as a shock and study in staggered difference in difference the markups of firms. The match provides me with 1300 firms in total. Preliminary results on the profit of the firm show a persistent decrease of the operating profit of the firm following a sanction. I now need to construct a measure of markups.

3 Quantitative framework

The framework is a granular trade model with oligopolistic competition based on Gaubert et al. (2021) to which I incorporate import decisions by firms a la Amiti et al. (2014). The model features both sectoral comparative advantage and granular comparative advantage within sectors, arising from idiosyncratic productivity draws of individual firms. In the model, governments only have one policy tool: sanction. The domestic economy will enforce sanctions against the foreign one, without any retaliation. This assumption omits 5% of sanction cases in the GSDB. In practice, when adding tariffs to the model, this assumption would become a strong one.

3.1 Theoretical Framework

The world consists of two economies: Domestic and Foreign. The Foreign economy represents the rest of the world and will be indexed by a star. It is modeled symmetrically to Domestic: the preferences, technologies and elasticities are identical. In the absence of sanction, countries trade freely intermediate goods. Trade in final goods is costly. There is a continuum of sectors, denoted z or k, included in $[0, 1]$. From now on, firms producing final goods will be denoted by i or j.

Representative household. There are L (resp. L^*) households in Domestic (resp. Foreign), inelastically supplying labor. They have Cobb-Douglas preferences in their consumption in all sectors C_z, with expenditure shares α_z. Utility is ordinal. I can assume without loss of generality that $\int_0^1 \alpha_z dz = 1$.

$$U = \exp(\int_0^1 \alpha_z \log(C_z) dz)$$

The maximization of the utility (detailed in Appendix A) yields that the household spends a constant share of her income I in a sector z: $P_z C_z = \alpha_z I$. It follows that the aggregate price index is:

$$P = \exp\left[\int_0^1 \alpha_z \log\left(\frac{P_z}{\alpha_z}\right) dz\right] \tag{3}$$

Production of intermediate goods. Sectors are comprised of heterogeneous firms. There is in each sector z a finite exogenous number K_z of firms producing each only one final good. Multiproduct firms must be thought of several distinct firms in this framework. Each horizontally differentiated varieties are aggregated in a CES function $Q_z = \left[\sum_{i=1}^{K_z} q_{z,i}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$ where σ represents the constant elasticity of subtitution across varieties, assumed identical across sectors and strictly greater than 1. $q_{z,i}$ is the quantity produced by a firm i in z. The program (detailed in Appendix B) of the intermediate good producer yields:

$$q_{z,i} = \left[\frac{p_{z,i}}{P_z}\right]^{-\sigma} Q_z \tag{4}$$

where I denote the sectoral price index of z:

$$P_z \equiv \left(\sum_{i=1}^{K_z} p_{z,i}^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{5}$$

Equation (4) characterizes the demand faced by firm i producing final good in sector z. The demand addressed to a firm i in z is decreasing in the price of the final good $p_{z,i}$. Equation (5)

defines the price of the intermediate good in a sector z. The intermediate good is respectively consumed by consumers or used as an input by firms producing final goods: $Q_z = C_z + M_z$.
The model directly inherits from the class of models using the roundabout assumption: intermediate goods are a fictional aggregation of final goods, and will be used to produce final goods. This assumption mainly makes sense when modeling the energy sector, which suits the latest sanctions imposed by the EU on the Russian energy sector.

Production of final goods. Each firm faces the downward sloping demand given by (4) in its distinct product variety. Their constant return to scale production technology mixes labor ($\ell_{z,i}$) supplied domestically with a bundle of intermediate inputs k sourced either domestically in sector k or from the same sector, in Foreign economy k^*: (${M_{z,i}}^{k,k^*}$). Labor is supplied inelastically by domestic workers. Intermediate goods are freely traded. I then assume that the production function of a firm i in sector z is $y_{z,i} = \ell_{z,i}^{\gamma_z} \exp\left[\int_0^1 \gamma_z^k \log({M_{z,i}}^{k,k^*})dk\right]$ with γ_z the constant share of operational profit spent on labor in sector z. γ_z^k represents the share spent on intermediate good from sector k by firms in sector z. Constant returns to scale ensure that $\int_0^1 \gamma_z^k = 1 - \gamma_z$. Technological parameters are identical across firms in a same sector. However, the input bundle is firm-specific: $\forall k \in [0;1] : {M_{z,i}}^{k,k^*} = [{m_{z,i}^k}^{\frac{\chi}{1+\chi}} + {\rho_z^k}^{\frac{1}{1+\chi}} {m_{z,i}^{k^*}}^{\frac{\chi}{1+\chi}}]^{\frac{1+\chi}{\chi}}$ where $m_{z,i}^k$ is the quantity of intermediate good k used by firm i in z, and $m_{z,i}^{k^*}$ is the analog quantity but sourced abroad. The substituability across locations for a given intermediate good k depends on the elasticity of substitution across locations χ assumed constant across sectors, the relative input prices (P_k/P_{k^*}) and the exogenous share of sourcing abroad constant across firms ρ_z^k.
In the free-trade benchmark, there is no heterogeneity in sourcing of inputs among firms. However, the price of imported input P_{k^*} is subject to change when the supply chain is disrupted. The input price from abroad to a firm i in sector z becomes $(1+\tau_{z,i}^{k^*})P_k^*$ when a sanction is imposed.

At the beginning of the period, the firm draws in a stochastic Pareto distribution a productivity parameter $\varphi_{z,i}$ that reduces its cost in a multiplicative way. Productivity is then fixed for the rest of the period. The firm produces in its domestic location. Firms can either sale goods solely domestically or choose to also export.
Exporting. When exporting, firms need to overcome an iceberg trade cost, denoted κ: for each unit sold in the Foreign market, a firm needs to send $(1 + \kappa)$ units. Similar to Atkeson and Burstein (2008), this model does not feature productivity cutoff at the extensive margins. All firms can export, as soon as they are productive enough to overcome the iceberg trade cost and obtain market share in the foreign market. The same acts for the imports, contrary to what is done in Amiti et al. (2014). Both exports and imports of a firm are subject to laws of the foreign economy. The laws applying to the export of firm j in z^* into the domestic economy is captured through and ad valorem term $(1 + \Gamma_{z^*,j})$. The Γ term captures the import ban (named

by adopting the point of view of the government). The laws applying to firm j in z^* importing from the sector k in Domestic economy is modeled by an ad valorem term $(1+\tau^k_{z^*,j})$. The τ term captures the supply chain disruption.
The cost-minimization program yields (details in Appendix C) the unit cost of a firm i in sector z:

$$c_{z,i} = \underbrace{\kappa(1+\Gamma_{z,i})}_{\substack{\text{Additional cost when}\\ \text{serving Foreign market}}} \times \underbrace{\frac{1}{\exp\left(\int_0^1 \gamma_z^k \log(b^k_{z,i})dk\right)}}_{\substack{\text{Enhancement of productivity}\\ \text{when sourcing abroad} \equiv B_{z,i}}} \times \underbrace{\frac{1}{\varphi_{z,i}}\left[\frac{w}{\gamma_z}\right]^{\gamma_z} \exp\left(\int_0^1 \gamma_z^k \log(\frac{P_k}{\gamma_z^k})dk\right)}_{\substack{\text{Unit cost of non-importing}\\ \text{and non-exporting firms} \equiv C^{\mathtt{CP}}_{z,i}}} \tag{6}$$

where I denote $b^k_{z,i} = \left[1+\rho^k_z\left(\frac{(1+\tau^{k^*}_{z,i})P^*_k}{P_k}\right)^{-\chi}\right]^{\frac{1}{\chi}}$. It represents the enhancement of productivity of firm i in z created by sourcing abroad the intermediate good k. This variable is greater than 1 and decreases in a multiplicative way the unit variable cost.

The first term of equation (6) accounts for multiplicative costs in exporting. The model does not feature tariffs. The *ad valorem* term $(1+\Gamma_{z,i})$ should then be interpreted as a legal cost of entering the foreign market, paid in unit of good. The cost of a domestic firm serving Domestic market does not encompass this first term. The second term captures the enhancement of productivity allowed by the import of an intermediate good k sourced abroad, for all sectors k of the economy. The sourcing decision will directly affect the unit cost through that term. The last term is the unit cost supported by firms producing with domestic inputs and serving the domestic market. It is similar to the cost derived in Caliendo and Parro (2015), except that it features an infinite number of sectors. In a free-trade benchmark, the only source of heterogeneity in costs across firms in a same sector z is their productivity $(\varphi_{z,i})_i$.

Impact of a sanction on the unit cost. Economic sanctions act through two channels: supply chain disruption and the ban of imports. The former impacts the cost of producing when serving domestic and foreign market, meanwhile the latter only impacts exports of the target. The ban of imports alone does not have any impact on the market where the firm is located.

Firm-level sanction against firm j in z^*. On the one hand, the import ban forbids any export from firm j to the domestic market. This component of the sanction will thus enter the cost of exporting of firm j in the first term of equation (6). The *ad valorem* legal cost $\Gamma_{z^*,j}$ will diverge to infinity. The unit cost of j to serve the domestic market is thus infinite, firm j will exit it. Practically, it reduces the productivity of Foreign firm j from z^* to 0 in the domestic market z. On the other hand, the sanction forbids all firms in the domestic economy to export their intermediate good to firm j. It follows that j must source domestically and thus for all sector k in

Domestic: $\tau^k_{z^*,j} = \infty$. Consequently $\forall k : b^k_{z^*,j} = 1$ by definition. The productivity enhancement term in the unit cost of firm j in z^* decreases to 1 which in turn increases the cost of firm j when serving the market z^*. In other terms, the sanction constraints the sourcing strategy of firm j and thus introduces heterogeneity in importing with respect to other unsanctioned firms in the market z^*. Note that if one is interested in only studying supply chain disruption without import ban, the disappearance of $B_{z^*,j}$ in equation (6) would affect the unit cost of serving both markets.

Sectoral sanction against a sector z^*. A sectoral sanction is defined as a sanction against all firms in sector z^*. Formally $\forall i \in [1, K_{z^*}], \forall k \in [0, 1] : (\Gamma_{z^*,i}, \tau^k_{z^*,i}) \to (\infty, \infty)$. For the domestic economy, the firm sanction case is nested in the sectoral sanction. However, in the foreign market, the sanction does not introduce heterogeneity in sourcing strategy anymore. All foreign firms in the sector will see their enhancement of productivity decrease to 1 after sanction imposition.

Strategic interaction of firms. Inside a sector z, firms play oligopolistic competition. Firms are big enough in the market to internalize their impacts on the sectoral aggregate. Their pricing strategy will thus internalize their impact on intermediate good price P_z and intermediate quantities Q_z. The Cobb-Douglass structure of preferences and technologies yields $Q_z = \frac{\alpha_z I}{P_z} + \frac{\Psi_z}{P_z}$ with $\alpha_z I$ the constant share of income spent by the consumer in sector z and Ψ_z the aggregate variable cost spent in the domestic sector z by every firms from Domestic and Foreign. Even if the firm is big within its sector, it is infinitesimal in the overall economy. Therefore it takes I and Ψ_z as given in its program. A complete formulation of Ψ_z in Appendix D further details its exogeneity to the program of the firm.

Using equation (4), the expenditure on variety i in sector z can be rewritten

$$p_{z,i}q_{z,i} = \left[\frac{p_{z,i}^{1-\sigma}}{P_z^{-\sigma}}\right](C_z + M_z) = \left[\frac{p_{z,i}^{1-\sigma}}{P_z^{-\sigma}}\right]\frac{1}{P_z}(\alpha_z I + \Psi_z) = s_{z,i}(\alpha_z I + \Psi_z)$$

where the within-sector z market share of the variety i is defined as follows:

$$s_{z,i} = \left(\frac{p_{z,i}}{P_z}\right)^{1-\sigma} \tag{7}$$

Equation (7) expresses that the higher the price of a firm, the lower its market share.
When playing *a la Bertrand*, every firm maximizes its profit taking prices of every other firms in the economy as given. The program is similar but with quantities for Cournot competition. The Nash equilibrium of the Bertrand game is given by the following pricing rule:

$$\frac{p_{z,i}}{c_{z,i}} = \frac{\epsilon_{z,i}}{\epsilon_{z,i}-1} - \frac{\gamma^z_z s_{z,i}}{\epsilon_{z,i}-1} + \gamma^z_z s_{z,i}\frac{b^z_{z,i}\left(1-(b^z_{z,i})^{-\chi}\right)}{\epsilon_{z,i}-1} \equiv \mu_{z,i} \tag{8}$$

where $\epsilon_{z,i} = [\sigma + s_{z,i}(1-\sigma)]$ represents the perceived elasticity of final demand. The more productive a firm is, the lower its price and so the less elastic the part of the demand curve it faces. Equation (8) defines the endogenous markup of firm i when serving market z, denoted $\mu_{z,i}$. The two terms adding to the standard Lerner formula come from the roundabout assumption. The second term comes from the derivative of the Caliendo and Parro's part of the cost with respect to the firm price. This negative term represents the fact that the firm i in z internalizes that increasing its price ($p_{z,i}$) will raise the price of the intermediate goods of its sector (P_z), which will in turn increase its cost of production. This decrease in the markup applies to all firms in the market z and is weighted by the firm reliance in the intermediate good from its own domestic sector.

The third term comes from the derivative of the productivity enhancement terms. This positive term indicates that the more a firm sources abroad, the lesser it will internalize the increase of cost $c_{z,i}$ following an increase of price $p_{z,i}$. Note that it is possible that this last terms overshoots the second term and increases the endogenous markup.

One can reformulate equation (8) and include Cournot case as follows $\frac{p_{z,i}}{c_{z,i}} = \frac{\xi_{z,i}}{\xi_{z,i}-1}$ where the residual elasticity to demand is:

$$\xi_{z,i} = \begin{cases} \frac{(\sigma + s_{z,i}[1-\sigma-\gamma_z^z+\gamma_z^z b_{z,i}^z\left(1-(b_{z,i}^z)^{-\chi}\right)]}{1-\gamma_z^z s_{z,i}[1-b_{z,i}^z\left(1-(b_{z,i}^z)^{-\chi}\right)]} & \text{under Bertrand} \\ TBC & \text{under Cournot} \end{cases} \tag{9}$$

The partial equilibrium of sector z is defined as the Nash equilibrium where the best-response functions of all firms in sector z cross. Formally, taking $(w, (P_k)_{k\neq z})$ as given, the Nash equilibrium of sector z is given by the vector $(p_{z,i}, s_{z,i})_{i=1}^{K_z}$ such that every firms in z maximizes its profit, taking the prices of its competitors as given. Equation (5) directly provides intermediate price for every sector at their equilibrium.

At the equilibrium markups $\mu_{z,i}$ and market shares $s_{z,i}$ decrease with unit costs $c_{z,i}$. It directly follows that profits increase when unit costs decrease. Given the sources of heterogeneity in the model, productivity draws drive the *laissez-faire* allocation between firms at the sectoral equilibrium. Productivity draws and sourcing decisions drive the allocation post sanction.

Impact of a sanction on the markup. From equation (8), it appears that a sanction will affect markups both directly and indirectly. The direct impact comes from the constrained nullity of the third term, since a sanction forces $b_{z,i}^z = 1$. Once the supply chain is disrupted, the sanctioned firm must source domestically and face the internalization of its own price on its cost. Supply chain disruption thus constraints the firm markup.

The indirect adjustment results from partial equilibrium movements in market shares. After sanction enforcement, the unit cost of producing increases for the sanctioned firm. The firm then faces a trade off between passing it through to its final price at the cost of facing a more elastic demand, or lowering its markup to serve the same part of demand curve for its variety.

General equilibrium. The expenditure for every sector z is denoted $X_z = P_z Q_z$. The general equilibrium vector contains wages and expenditures for every sector in the world (w, w^*, X_z, X_{z^*}) such that labor and good markets clear in both countries and trade is balanced.

The total labor compensation is equal to the sum of all the expenses on labor done by domestic firms.

$$wL = \int_0^1 \left[\sum_{i=1}^{K_z} \gamma_z \underbrace{\frac{s_{z,i}}{\mu_{z,i}} X_z}_{\substack{\text{Operational profit of i} \\ \text{serving Domestic market}}} \nu_{z,i} + \sum_{j=1}^{K_{z^*}} \gamma_z \underbrace{\frac{s_{z^*,j}}{\mu_{z^*,j}} X_{z^*}}_{\substack{\text{Operational profit of j} \\ \text{serving Foreign market}}} (1 - \nu_{z^*,j}) \right] dz \tag{10}$$

with $\nu_{z,i}$ a dummy being one if firm i in z is from domestic origin, zero if firm i exported to market z. The first term in bracket corresponds to the share of operating profit of domestic firms producing for the domestic market devoted to pay labor. The second one designates the analogous for domestic firms producing for the foreign market. Both production use domestic labor. Note that when writing (10) for the Foreign economy, a $1/(1+\Gamma)$ would appear, as Foreign firms can have an import ban.

The market of goods and services clears in domestic trade and exports. Aggregate expenditure is equal to the sum of the aggregate revenue of the sector.

$$X_z = \int_0^1 \left[\sum_{i=1}^{K_k} \underbrace{\beta_{k,i}^z \frac{s_{k,i}}{\mu_{k,i}} X_k}_{\substack{\text{Revenue supplying} \\ \text{Domestic firms i} \in k}} \nu_{z,i} + \sum_{j=1}^{K_{k^*}} \underbrace{\beta_{k^*,j}^z \frac{s_{k^*,j}}{\mu_{k^*,j}} X_{k^*}}_{\substack{\text{Revenue supplying} \\ \text{Foreign firms j} \in k^*}} (1 - \nu_{z^*,j}) \right] dk + \alpha_z I \tag{11}$$

with I the aggregate income of the domestic household and $\beta_{k,i}^z = \gamma_k^z \frac{P_z^{-\chi}}{P_z^{-\chi} + \rho_k^z P_{z^*}^{-\chi}}$ the expenditure share of domestic firm i in sector k to the domestic intermediate good z, and $\beta_{k^*,j}^z = \gamma_k^z \frac{P_z^{-\chi}}{P_{z^*}^{-\chi} + \rho_k^z \left[(1+\tau_{k^*,j}^z) P_z\right]^{-\chi}}$ the expenditure share of foreign firm j in sector k^* to the domestic intermediate good z.

The first term in brackets corresponds to the aggregate revenue of supplying intermediate good z to firms in the domestic market from all possible sectors. The second term is similar but for firms in the foreign market. The term outside brackets corresponds to the final demand of consumers.

The household aggregate expenditure equals at the equilibrium to its income. The latter is composed of labor compensation, the aggregate profit of firms producing in the economy Π, and the trade balance D. This amounts to have:

$$I = wL + \Pi + D \tag{12}$$

The aggregate profit is composed of all the profits of domestic firms operating either on the domestic market or in the foreign one. It is distributed to the shareholders in the domestic economy and enters the income of the consumer.

$$\Pi = \int_0^1 \left[\sum_{i=1}^{K_z} \nu_{z,i} \Pi_{z,i}(s_{z,i}) + \sum_{i=1}^{K_z^*} (1 - \nu_{z,i}^*) \Pi_{z,i}^*(s_{z,i}^*) \right] dz \tag{13}$$

The general equilibrium is obtained by taking total labor force L and trade deficit D as given. They are actually both exogenous in this paper, notably because the model is static. The general equilibrium is conditional on partial equilibrium. Equilibrium wages, expenditures, income and profits are given by equations (10), (11), (12) and (13). Aggregate price can be obtained *via* equation (3). Note that equations are almost symmetric for the foreign economy and that Walras law allows to set the domestic wage as the numeraire in the model. This system of equations fully characterizes the general equilibrium of the model.

Welfare decomposition. The welfare of an economy is measured by the real income of its consumers: $W = \frac{I}{P}$ with I the aggregate income defined in (12) of the economy and P the aggregate price index defined in (3).

To guide intuition on the evolution of endogenous variables following the introduction of a sanction in the model, I compute the log-deviation of variables of interests, following the approach of Dekle et al. (2007). Since the trade balance is exogenous ($\widehat{D} = 0$) , labour is supplied inelastically and domestic wage is the numeraire ($\widehat{wL} = 0$), a log change (represented by a hat on the variable) in welfare following a sanction is as follows:

$$\widehat{W} \equiv d\log(W) = \frac{d\Pi}{I} - \int_0^1 \alpha_z \widehat{P_z} dz \tag{14}$$

The two components in (14) correspond to the respective changes in producer surplus and consumer surplus in general equilibrium. Note that a change in relative wage would be added for the symmetric version of (14) in the Foreign economy.

3.2 Sectoral vs. firm-level sanction in the model

To further guide intuition on the mechanisms through which firms adjust their pricing decision following a sanction, I compute the log change in partial equilibrium following a shock. I thus fix all aggregate variables: wages, expenditures and income. I then compute analytical approximation for the change in strategic interaction between firms. To simplify notations, I write $\Omega_{z,i}^z \equiv$

$[1-\sigma-\gamma_z^z+\gamma_z^z b_{z,i}^z\left(1-(b_{z,i}^z)^{-\chi}\right)]$ the perceived elasticity of demand (both final and intermediate).

$$\widehat{\mu_{z,i}} = \frac{s_{z,i}(\Omega_{z,i}^z+\sigma)}{(\sigma+s_{z,i}\Omega_{z,i}^z)(1-s_{z,i})}\widehat{s_{z,i}} + \frac{s_{z,i}(\Omega_{z,i}^z+\sigma+\gamma_z^z-1)}{(\sigma+s_{z,i}\Omega_{z,i}^z)}[1+(\chi-1)(b_{z,i}^z)^{-\chi}][\widehat{P_z}-\widehat{P_z^*}] \tag{15}$$

Equation (15) shows that the markup of a firm increases following a shock when the market share and/or terms of trade increase. Intuitively, everything else equal, the increase of its market share will make the firm face a part of the demand curve which is less elastic. On the other hand, holding everything equal, the appreciation of the terms of trade in the sector of the firm will decrease the cost of producing of the firm. However, since its market share is held equal, it can still exploit the inelasticity of the demand it has been facing to increase its markup. Given the structure of the sourcing decision in my model, this applies uniformly to all firms in an economy, as soon as the firm is not sanctioned.

The point of a sanction is to hurt the target to make it comply. It is then natural to compute the log change of the cost following a sanction.

$$\widehat{c_{z,i}} = \underbrace{\widehat{(1+\Gamma_{z,i})}}_{\texttt{Leave For. market}} - \left(\int_0^1 \gamma_z^k \left[\widehat{P_k} + \underbrace{\frac{(b_{z,i}^k)^\chi - 1}{(b_{z,i}^k)^\chi}\frac{\widehat{P_k}}{\widehat{P_k^*}}}_{\texttt{Rel change of ToT}}\right] dk\right) \tag{16}$$

Equation (16) shows that the change of cost is threefolds. First, if firm i in z face an import ban then it has to leave the market. Second, the first term in brackets shows a change of cost that will apply to every firms sourcing from domestic sector k. This part captures the colateral impact of sanctions described by Hall and Seyfi (2021). Third, the last term in brackets shows that the change of cost follows the term of trades, to the extent of the relative change in sourcing strategy of firm before and after the shock.

3.3 Calibration

I now turn to a quantitative exercise to estimate welfare loss associated with different scenarios of sanctions. Using the features of my model, I can compare a sanction with only an import ban, a sanction with only a supply chain disruption, and both components at the same time.

3.3.1 Data

The primary data source for calibrating final consumption and technology parameters is the World Input Output Database (WIOD), compiled by Timmer et al. (2015). This database integrates national input-output tables with data on bilateral trade flows to construct a comprehensive matrix detailing all intra- and international flows of goods and services between sectors and final consumers. I use the 2016 release of the WIOD, which encompasses 43 countries (plus an aggregate for the rest of the world) and 56 sectors categorized according to the ISIC Revision 4 classification. The WIOD dataset is instrumental in estimating: i) the sectoral income expenditure shares (α_z); ii) the shares of labor (γ_z) and intermediate inputs (γ_z^k) in production functions; and iii) the shares of imported inputs (ρ_z^k).

3.3.2 Parameters

Table 1: Parameter values from the literature

Parameter	Value	Source
σ	5	Broda and Weinstein (2006)
θ	4.4	Gaubert et al. (2021)
κ	1.3	Gaubert et al. (2021)
μ_T	.095	Gaubert et al. (2021)
σ_T	1.4	Gaubert et al. (2021)
$\forall z : \alpha_z$	56 values	WIOD (2015)
$\forall z : \gamma_z$	56 values	WIOD (2015)
$\forall (k,z) : \gamma_k^z$	(56 x 56) values	WIOD (2015)
$\forall (k,z) : \rho_k^z$	(56 x 56) values	WIOD (2015)
χ	2.4	Blaum et al. (2018)

Notes: This table summarizes the parameter values used in the calibration.

Table 1 summarizes the calibration used in my simulation. I set the elasticity of substitution across final goods to be 5 following Broda and Weinstein (2006). The parameters μ_T and σ_T governing the relative comparative advantage of sectors in the economy, the shape parameter θ of the Pareto distribution of productivites and the iceberg trade cost κ are all based on the estimations of Gaubert and Itskhoki (2021). The parameters governing share spent by household on every sector α_z, share of labor γ_z used to produce, share of income from other sectors γ_z^k and share sourced abroad ρ_z^k are calibrated on the WIOD. The elasticity of substitution of import of inputs between domestic and foreign destination is calibrated based on Blaum et al. (2018). Both the estimation of Gaubert and Itskhoki (2021) and Blaum et al. (2018) rely on French firm-level data. I then use WIOD to calibrate parameters related to sourcing decisions when considering France and other countries as Rest of the World, weighted by their trade share in French imports.

4 Quantitative results

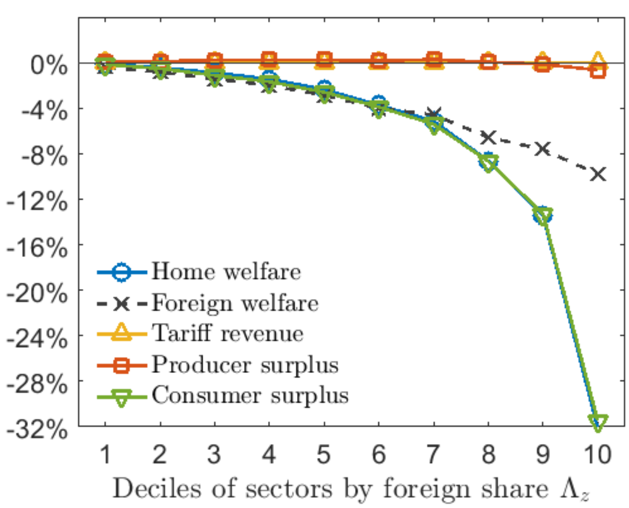
The structure of the theoretical framework allows to disentangle between the different components of an economic sanction. This is essential for understanding the predominant mechanisms at play in sanctions. It also sheds light on situations where one type of sanction may be more appropriate than another.

4.1 Import ban

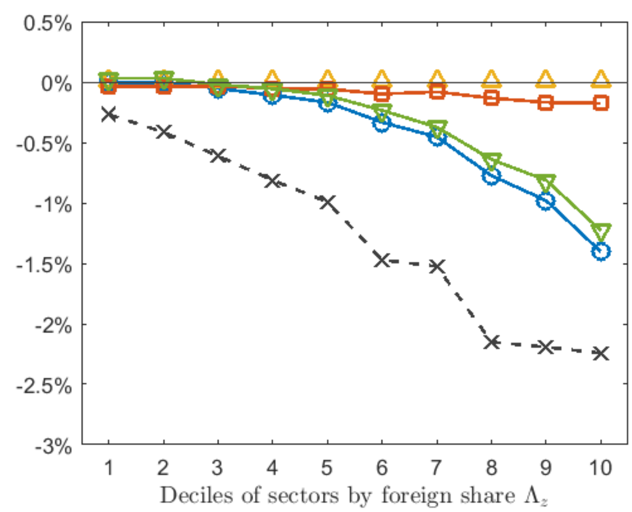
4.1.1 Without supply linkages

I first study the impact of an import ban in the model[4] with no intermediate input. I thus set $\gamma_z = 1$ for every sector z. In that case, my model coincides with the one of Gaubert et al. (2021), except that I focus on short term horizon. I thus fix as exogenous the number of firms active in each sector. I compare two scenarios of import bans where either a whole sector in foreign is forbidden to export to the domestic economy (ie. for a given z, $\forall i, \Gamma_{z,i} = \infty$), or where only the most productive firm is targeted (ie. if firms are ranked by productivity in a given z. The most productive observe a change in the *ad valorem* legal cost, $\Gamma_{z,i} = \infty$ and others not $\forall i \geq 2, \Gamma_{z,i} = 0$). The rationale for targeting the biggest firm of the sector is that it is the most likely to transmit an international shock as Di Giovanni et al. (2024) documented.

Figure 3: Welfare Decomposition of the Impact of the import ban component of sanctions.



(A) Sectoral Sanction



(B) Firm-level Sanction

Notes: Decomposition of the welfare effect $\widehat{W_z}$ at home into two components according to equation (14), and the welfare effect abroad, from a sectoral and a firm sanction against the most productive firm of the sector, by deciles of sectors split by foreign comparative advantage. The y-axis represents the percentage change compared to a benchmark of free trade.

Two main conclusions arise from this graph. First, the welfare loss for Domestic is up to 16 times bigger when switching from firm sanction to sector-wide one. This result is predictable

[4]This case of study corresponds to the definition of partial import sanction in the GSDB.

given the nested nature of sectoral sanction in my framework. However the welfare loss is up to 4 times bigger when switching from firm to sectoral sanction in the foreign economy. But the definition of sanction is not nested on the foreign side. When decomposing the welfare of foreign economy, it appears that the effect is driven by the loss of profit of foreign firms. Nothing happens for foreign consumers since the model is perfectly separable across markets.

Second, the burden of the sanction is borne by the foreign economy in the case of a firm-specific import ban, whereas the domestic economy bears the cost if an entire sector is targeted. This comes from the loss for variety and the loss for competition and the incomplete pass through. Note that this result is not present in the paper of Gaubert et al. (2021) studying finite tariffs in the same framework. The difference may arise from the temporal horizon of the shock. When they allow for adjustement of the shock on the margin of the prices and the entry of new firms, I block the second channel so that I study short run impact of sanctions.

4.1.2 With supply linkages

4.2 Supply chain disruption

TBC

4.3 Complete sanction

TBC

5 Conclusion

TBC

References

Amiti, M., Itskhoki, O., and Konings, J. (2014). Importers, Exporters, and Exchange Rate Disconnect. *American Economic Review*, 104(7):1942–1978.

Amiti, M., Itskhoki, O., and Konings, J. (2019). International Shocks, Variable Markups, and Domestic Prices. *The Review of Economic Studies*, 86(6):2356–2402.

Atkeson, A. and Burstein, A. (2008). Pricing-to-Market, Trade Costs, and International Relative Prices. *American Economic Review*, 98(5):1998–2031.

Bapat, N. A. and Kwon, B. R. (2015). When Are Sanctions Effective? A Bargaining and Enforcement Framework. *International Organization*, 69(1):131–162.

Becko, J. S. (2024). A theory of economic sanctions as terms-of-trade manipulation. *Journal of International Economics*, 150:103898.

Blaum, J., Lelarge, C., and Peters, M. (2018). The Gains from Input Trade with Heterogeneous Importers. *American Economic Journal: Macroeconomics*, 10(4):77–127.

Broda, C. and Weinstein, D. E. (2006). Globalization and the Gains From Variety. *The Quarterly Journal of Economics*, 121(2):541–585.

Caliendo, L. and Parro, F. (2015). Estimates of the Trade and Welfare Effects of NAFTA. *The Review of Economic Studies*, 82(1):1–44.

Carvalho, V. and Gabaix, X. (2013). The Great Diversification and its Undoing. *The American Economic Review*, 103(5):1697–1727.

Carvalho, V. M. and Grassi, B. (2019). Large Firm Dynamics and the Business Cycle. *American Economic Review*, 109(4):1375–1425.

De Souza, G., Hu, N., Li, H., and Mei, Y. (2022). (Trade) War and Peace: How to Impose International Trade Sanctions. Technical report, Federal Reserve Bank of Chicago.

Dekle, R., Eaton, J., and Kortum, S. (2007). Unbalanced Trade. *American Economic Review*, 97(2):351–355.

Di Giovanni, J., Levchenko, A. A., and Mejean, I. (2014). Firms, Destinations, and Aggregate Fluctuations. *Econometrica*, 82(4):1303–1340.

Di Giovanni, J., Levchenko, A. A., and Mejean, I. (2024). Foreign Shocks as Granular Fluctuations. *Journal of Political Economy*, 132(2):391–433.

Felbermayr, G., Kirilakha, A., Syropoulos, C., Yalcin, E., and Yotov, Y. V. (2020). The global sanctions data base. *European Economic Review*, 129:103561.

Gabaix, X. (2011). The Granular Origins of Aggregate Fluctuations. *Econometrica*, 79(3):733–772.

Gaubert, C. and Itskhoki, O. (2021). Granular Comparative Advantage. *Journal of Political Economy*, 129(3).

Gaubert, C., Itskhoki, O., and Vogler, M. (2021). Government policies in a granular global economy. *Journal of Monetary Economics*, 121:95–112.

Hall, C. M. and Seyfi, S. (2021). Tourism and sanctions. In Van Bergeijk, P. A., editor, *Research Handbook on Economic Sanctions*. Edward Elgar Publishing.

Kirikakha, A., Felbermayr, G. J., Syropoulos, C., Yalcin, E., and Yotov, Y. V. (2021). The Global Sanctions Data Base (GSDB): an update that includes the years of the Trump presidency. In Van Bergeijk, P. A., editor, *Research Handbook on Economic Sanctions*. Edward Elgar Publishing.

Shapiro, J. S. and Walker, R. (2018). Why Is Pollution from US Manufacturing Declining? The Roles of Environmental Regulation, Productivity, and Trade. *American Economic Review*, 108(12):3814–3854.

Syropoulos, C., Felbermayr, G., Kirilakha, A., Yalcin, E., and Yotov, Y. V. (2024). The global sanctions data base–Release 3: COVID-19, Russia, and multilateral sanctions. *Review of International Economics*, 32(1):12–48.

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., and de Vries, G. J. (2015). An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production. *Review of International Economics*, 23(3):575–605. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/roie.12178.