Essays on International Trade and Strategic Behavior

PhD dissertation

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2017
Preface

This thesis was written in the period from September 2014 to April 2016 during my enrollment as a PhD student at the Department of Economics an Business at Aarhus University. I am extremely grateful to the department and the Tuborg Research Centre for Globalization and Firms for the financial support and outstanding research environment.

My sincere gratitude goes to my supervisors Valerie Smeets, Allan Sorensen and Anders Laugesen for their guidance from the very beginning. I also thank Philipp Schroder and all the members of the Tuborg Research Centre for Globalization and Firms. Their comments substantially improved my thesis. A special mention goes to Ray Riezman for sharing his vast experience with me. Finally, I would like to thank Boris Georgiev who has taught me a lot during the two years in which we shared the office.

Between August and November 2016, I visited the Department of Economics at Oxford University. I would like to thank the department for its hospitality. Especially, I thank Peter Neary for arranging and sponsoring my visit.

I would also like to thank Susan Stilling, Ingrid Lautrup and Susanne Christensen for lending me a hand whenever I need it.
Summary

This thesis consists of three chapters. The first chapter is independent from the others and deals with the channels through which a trade liberalization affects the economy. The main conclusion that is derived from it is that in a Melitz model with standard demand systems, the import competition channel does not capture pro-competitive effects. Chapter two and three split the study of a mechanism which generates home-bias patterns. While chapter two analyzes the phenomenon from a theoretical point of view, chapter three provides a quantification of it.

Chapter 1: New Trade Models and the Absence of Pro-Competitive Effects of Import Competition. In the last decade, several frameworks to introduce firm heterogeneity have emerged in the International Trade literature. Following Melitz (2003), it has been standard to incorporate this feature in a monopolistic competition setting where firms make entry decisions without knowing their productivity and learn their efficiency ex post. By embedding firm heterogeneity in this fashion, it was expected that the effects of different channels could be captured in this more realistic setting. One such channel is that of foreign competition and its potential disciplinary effect on domestic producers. Following trade liberalization, it is expected that domestic firms become subject to tougher import competition, inducing both a reduction of their markups and aggregate-productivity increases through the exit of the least-productive firms.

In that chapter, I show that, contrary to what is expected, models à la Melitz under standard demand systems are unable to capture these pro-competitive effects of import competition. Specifically, tougher import competition has no impact on either the price or quantity set by domestic firms and the domestic survival productivity cutoff. Thus, regarding the domestic market, all of the adjustment takes place through the mass of incumbent firms. Essentially, the conclusion of the paper can be reexpressed by asserting that, in a Melitz framework, the import-competition channel has no bearing on both the decisions made by domestic firms and their productivity distribution. In this sense, we might say that our paper extends Melitz’s (2002, 2003) insight to the bulk of standard demand systems that it is the pull of the export opportunities, rather than the push of import competition, what drives the model. Among the demand
systems which are covered, it can be mentioned non-necessarily symmetric versions of the CES, logit, affine translations of these two, demands derived from an additive direct utility as in Krugman (1979), Melitz and Ottaviano’s (2008) linear demand, Feenstra’s (2003) translog demand, demands from an additive indirect utility as in Bertoletti and Etro (2015), Simonovska’s (2015) Stone-Geary demand, and Behrens and Murata’s (2007) demands from an exponential utility.

Chapter 2 and 3 study theoretically and empirically, respectively, a mechanism that creates endogenously home-bias patterns. Consistent with a long-run view of the market structure determination, I conceive an environment in which firms make entry choices, decide on prices and also, as in Sutton (1991,1998), sunk expenditures that enhance demand. These investments might include outlays on a disparity of variables such as advertisement, introduction of new varieties, adaptation of products to local tastes and expansion of distribution networks to make the product more widely available. In addition, following Porter (2011) I acknowledge that local firms have an advantage over those which serve the market without being established in the market. These advantages are materialized through the possibility for domestic firms of sinking investments in their home market prior to importers. In this setup, big firms (henceforth, BFs), that is, firms which are nonnegligible to the market, internalize that importers make their entry decisions conditional on the demand-enhancing expenditures incurred by them and act strategically.

Comparing the situation against a benchmark where domestic firms and importers decide on the expenditures simultaneously, I show that BFs invest more heavily on demand-enhancing expenditures in their domestic market. Thus, a first-mover advantage emerges, rationalizing outcomes in line with the home bias. First, there is an expansion of BFs in their home market. The mechanism is through an exit of firms that is, in part, at the expense of the importers. This crowding out of foreign competition creates a bias toward consumption of domestic varieties. Moreover, domestic BFs increase their home revenue and, hence, end up with a lower share of exports relative to the total firm’s sales. In relation to this, the result is consistent with an empirical regularity that I show: the higher the domestic market share of a firm, the greater its domestic share of own total sales.
Chapter 2: *Home-Bias Patterns and the Strategic Gains of Domestic Leaders: Theory.* In that chapter, I study the mechanism described in a theoretical way. To study the mechanism, different reasons determine the need of relying on a parsimonious approach. The incorporation of nonzero measure firms, heterogeneity and multidimensional strategies might introduce complex strategic interactions and turn the search of a solution into an unwieldy task. This calls for building up a framework that puts some structure on the problem analyzed. I do this by incorporating two features to my setup. First, I consider a demand system that allows me to describe the strategic interactions between firms through the theory of aggregative games. This technique, recently put forward by Acemoglu and Jensen (2013), is particularly well suited for setups with firm heterogeneity and multidimensional strategies. Remarkably, it covers the standard demand systems used for tackle empirical questions. Specifically, it allows for (non-necessarily symmetric) augmented versions to non-price choices of the CES, Logit, affine translation of those two, the linear demand and the translog, among others. In addition, to keep the extensive-margin adjustments tractable, I exploit the advantages of their incorporation through a continuum of firms. In my setup, small firms (hereafter, SFs) are modelled as in Melitz (2003) and embedded into a market structure with a fixed number of BFs.

One concern that arises in models where large firms are incorporated is the potential lack of result robustness. The concern turns to be especially acute when a set of incumbents move earlier than the rest of the firms. Thus, I assess the existence of the mechanism in relation to two matters. First, demand-enhancing investments encompass instruments with a different nature in terms of pricing. Thus, it is perfectly compatible to conceive investments that boost firms’ demand and, concurrently, increase or decrease the prices set by the firm. I show that there is overinvestment independent of how the investments affects the pricing decisions. In addition, I show that unlike typical two-stage oligopoly models, generically encompassed by Fudenberg and Tirole (1984), the overinvestment also arises irrespective if the competition is on quantities or prices. The key for this is that, while those models assume a given number of firms, I incorporate an extensive-margin dimension. The intuition behind is that if an incumbent underinvests to not induce a tougher competitive environment
at the market stage, it would leave profits unexploited. Given the presence of an unbounded pool of potential entrants, this type of strategy would foster entry and turn futile the initial attempt of garnering higher rents.

Chapter 3: Home-Bias Patterns and the Strategic Gains of Domestic Leaders: Evidence from Denmark. In that chapter, I proceed to study empirically the mechanism. To quantify the mechanism, different reasons determine the need of relying on a structural approach. With the aim of taking the model to the data, I depart from the general framework of the previous chapter and make use of an augmented CES that incorporates demand-enhancing investments. Importantly, the approach to quantify the model predictions remains widely applicable as it only requires information on BF’s market shares and the determination of two parameters, one of them being the elasticity of substitution. In particular, information related to small firms (henceforth, SFs) is not needed.

I quantify the outcomes for the industries belonging to the Danish manufacturing. Some features of the information make it suitable for the analysis. First, given that my procedure requires information on firms’ market share in each industry, I exploit the fact that the information is presented at the firm-product level. Furthermore, the information on international transactions and firms’ sales are disaggregated at the 8-digit product level, with the former encompassing imports and exports by both manufacturing and nonmanufacturing firms. Thus, I am able to allocate each firm-product to a properly defined market, and account for an accurate measure of the import competition for each industry.

In terms of the results, first-mover advantages reveal themselves as an important determinant in shaping the structure of the economy and as an explanation of home-bias patterns, exhibiting a lot of heterogeneity between industries. In addition, by using the distinction of goods by Rauch (1999), I found that first-mover advantages are acquired predominantly by firms in differentiated industries. However, consistent with other studies, firms producing homogeneous goods in Food & Beverages and Chemicals sectors, also obtain these gains.
References


Resume


I dette kapitel viser jeg, at mod forventning er modeller a la Melitz under standard efterspørgselssystemer ikke i stand til at opfange disse konkurrencefremmende virkninger af importkonkurrence. Særligt har hårdere importkonkurrence ingen indvirkning på hverken prisen eller mængden, der er fastsat af indenlandske virksomheder, og skæringspunktet for produktiviteten for indenlandske overlevelse. Hele justeringen på det indenlandske marked sker således ved mængden af eksisterende virksomheder. Konklusionen af papiret kan i det store hele udtrykkes ved, at i en Melitz sammenhæng har importkonkurrence kanalen ingen indflydelse på de indenlandske virksomheders beslutninger og deres produktivitetsfordeling. I den forstand


varetyper. Ydermere øger indenlandske BFer deres indenlandske indtægter og ender dermed med en lavere eksportandel i forhold til virksomhedens samlede salg. I relation til dette er resultatet i overensstemmelse med en empirisk regelmæssighed, som jeg viser: jo højere indenlandsk markedsandel virksomheden har, jo større er dens hjemlige andel af dens samlede salg.

Kapitel 2: Home bias mønstre og indenlandske lederes strategiske gevinster: teori.

En bekymring, der kan opstå i modeller, hvor store virksomheder indgår, er at resultaterne potentielt savner robusthed. Bekymringen bliver særligt akut, når et sæt etablerede virksomheder agerer tidligere end de øvrige virksomheder. Derfor vurderer jeg, om mekanismen eksisterer i forhold til to spørgsmål. For det første omfatter efterspørgselsfremmende investeringer en anden slags instrumenter hvad angår prisfastsættelse. Det er således helt kompatibelt at forestille sig investeringer, der øger virksomhedernes efterspørgsel og samtidig øger eller mindsker de priser,


Hvad angår resultaterne, så viser first-mover fordele sig som en vigtig faktor i
Chapter 1
New Trade Models and the Absence of Pro-Competitive Effects of Import Competition*

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Abstract

Tougher import competition is expected to reduce domestic markups and force the least-productive firms to exit. We study the occurrence of this phenomenon in a setting akin to Melitz (2003) in which there is monopolistic competition, free entry and firms uncertain of their productivity prior to entry. Our main finding is that, under standard demand systems, the setup is unable to capture these pro-competitive effects: import competition only affects the mass of incumbents but it does not change the domestic prices or the domestic survival productivity cutoff. Thus, in this regard, embedding standard alternative demands to the CES into a Melitz model do not represent a richer framework. The insensitivity to import competition also applies to any other non-price choices, such as quality and number of products, and is independent of the productivity distribution, the foreign supply structure, and the nature (finite or infinite) of the demand choke price. (JEL D43, F10, F12, L13)

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*I thank Michael Koch, Anders Laugesen, Omar Licandro, Philipp Schröder, Valerie Smeets, Allan Sørensen, Raymond Riezman and participants at various seminars for the helpful suggestions. I especially thank David Lander and Francisco Roldán whose comments improved substantially the paper. All errors are my own.

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"Nevertheless, the model should also be interpreted with caution as it precludes another potentially important channel for the effects of trade, which operates through increases in import competition."

Melitz (2003)

1 Introduction

In the last decade, several frameworks to introduce firm heterogeneity have emerged in the International Trade literature. Following Melitz (2003), it has been standard to incorporate this feature in a monopolistic competition setting where firms make entry decisions without knowing their productivity and learn their efficiency ex post. By embedding firm heterogeneity in this fashion, it was expected that the effects of different channels could be captured in this more realistic setting. One such channel is that of foreign competition and its potential disciplinary effect on domestic producers. Following trade liberalization, it is expected that domestic firms become subject to tougher import competition, inducing both a reduction of their markups and aggregate-productivity increases through the exit of the least-productive firms.

In this paper, we show that, contrary to what is expected, models à la Melitz under standard demand systems are unable to capture these pro-competitive effects of import competition. Specifically, tougher import competition has no impact on either the price or quantity set by domestic firms and the domestic survival productivity cutoff. Thus, regarding the domestic market, all of the adjustment takes place through the mass of incumbent firms.

The result is independent of assumptions concerning the supply side such as the productivity distribution or the market structure of foreign countries. As we show, it is determined completely by demand features. We cover the usual demand systems which the field makes use of, for instance, the CES, the logit, affine translations of these two, demands derived from an additive direct utility as in Krugman (1979), Melitz and Ottaviano’s (2008) linear demand, Feenstra’s (2003) translog demand, demands from an additive indirect utility as in Bertoletti and Etro (2015), Simonovska’s

We also cover usual demands with nested structures defined by country of origin or firm’s products bundle. In addition, the baseline case is extended to cover non-price choices, which includes quality and the number of products chosen by multi-product firms. Under this framework, the main conclusion still remains valid: non-price variables are also insensitive to import competition.

Essentially, the conclusion of the paper can be reexpressed by asserting that, in a Melitz framework, the import-competition channel has no bearing on both the decisions made by domestic firms and their productivity distribution. In this sense, we might say that our paper extends Melitz’s (2002, 2003) insight to the bulk of standard demand systems that it is the pull of the export opportunities, rather than the push of import competition, what drives the model.

At first glance, the conclusion might appear surprising given that alternatives to the CES demand were supposed to overcome some of the restrictive properties implied by the CES. In particular, regarding trade liberalization, their incorporation have been usually motivated to reflect the effects of fiercer import competition on markups. Nonetheless, the experiment of liberalizing an economy has different channels working concurrently, thus confounding each of them.

Specifically, any trade liberalization trigger effects in a sector which entails i) variations in import competition, ii) changes in exporting opportunities, and iii) wage modifications due to labor market adjustments. Even if we restrict our focus to unilateral liberalizations in environments where wages are pinned down by a homogeneous sector, the contribution of each channel is not identified. The main reason is that any

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1 There is vast literature referring to both subjects. To list some of the most recent contributions, regarding quality, see Hallak (2006), Verhoogen (2008), Khandelwal (2010), Fajgelbaum, Grossman, and Helpman (2011) and Antoniades (2015). As far as multiproduct firms under monopolistic competition go, we can mention Arkolakis and Muendler (2010), Bernard, Redding, and Schott (2010), Dhingra (2013), and Mayer, Melitz, and Ottaviano (2014).

2 In Melitz (2002), he argues that “...the most obvious cause explaining the exit of the least productive domestic firms would be the new competition from the entry of the more productive firms into the domestic market. However, this intuition is incorrect... If the current model were amended to allow for the new import competition without introducing any export opportunities, then this trade opening would not induce any distributional changes among firms.”
new exporting possibility of foreign countries introduces feedback that modifies the exporting conditions of the liberalizing country, turning infeasible an isolation of the effects from i) and ii). Our results imply that, once that we isolate the effects stemming from each channel, import competition can only affect the mass of incumbents.

The underlying mechanism of the result is easy to grasp once we notice that all the demand systems covered share a key property: the existence of a composite variable which sums up the aggregate conditions of the industry. An aggregator could be, for instance, a price index or a demand choke price. This feature of the demand determines that the aggregator is the only variable that firms consider to make decisions. In other terms, the aggregator has the property of being a sufficient statistic to determine optimal prices and, hence, optimal profits. Given that optimal profits are completely determined by the aggregator, so does the survival domestic productivity cutoff. Thus, as long as the aggregator do not vary, the domestic prices and the domestic productivity cutoff do not change.

By this property, the determination of the domestic aggregator becomes key for the analysis of how trade affects the economy. Our result implies that, by embedding this demand system in a Melitz (2003) setup, we are in fact adding structure enough to the model such that the decisions made by foreign firms have no bearing on the determination of the domestic aggregator. In other terms, if we isolate the changes of the exporting and labor conditions, a unique value of the domestic aggregator is pinned down.

To give some intuition for the outcome, it is crucial that in a model à la Melitz, firms make entering decisions before knowing their productivity. This implies that firms are homogeneous ex ante. In addition, there is free entry of firms, reflected in an expected zero-profits condition. But as long as the exporting opportunities remain the same, there is only one value of expected domestic profits, and so of the domestic aggregator, consistent with the condition. As a consequence, tougher import competition affects the mass of domestic incumbents that the market can support, but not the domestic pricing decisions or the domestic productivity cutoff of those firms.\textsuperscript{3}

\textsuperscript{3}Importantly, even when firms receive different draws of productivity ex post, the continuum of firms turns the aggregator nonstochastic by an application of the law of large numbers. This implies that what firms expect is what actually happens.
Our paper makes several contributions. First, by identifying a common feature of the standard demand systems, we are able to provide a unified framework to analyze models of monopolistic competition with firm heterogeneity. In particular, the nature of the demands determines that the model is part of the theory of large aggregative economies considered in Acemoglu and Jensen (2010, 2015), extended to incorporate an endogenous number of players.\footnote{Large economies refer to models where agents taken altogether determine the conditions of the market but individually are negligible to it. Moreover, the economy is aggregative when the conditions of the market can be summed up through an aggregator.} The main advantage of these models is that equilibrium conditions can be characterized in a simple and transparent way. Furthermore, the setup constitutes a fruitful venue for exploring others classes of models with firm heterogeneity and, also, exploiting the availability of different theorems, specially concerning comparative statics.

Regarding the literature in the International Trade field, our conclusions have different implications. First, it is relevant to shed some light on the mechanisms at work following a trade liberalization, as well as the aspects we are capturing from that experiment. For instance, it highlights that embedding the linear demand by Melitz and Ottaviano (2008) or the translog by Feenstra (2003) in a Melitz framework does not enable us to capture pro-competitive effects from fiercer import competition. In particular, in cases where wages are determined by an exogenous sector like in Melitz and Ottaviano (2008), any effect from a trade liberalization must come exclusively from changes in the exporting conditions. In this sense, alternative demands to the CES might constitute tractable functional forms to deal with situations where we expect that the bulk of pro-competitive effects generated by trade are due to an exposure to new exporting opportunities. On the other hand, they become less appropriate the more important the import competition is.\footnote{There are different examples of circumstances where the use of the alternatives to the CES considered might be inappropriate. One case is the analysis of a highly-inefficient domestic sector that is only able to serve their own market due to government protection and is subject to tough import competition. Additionally, we could consider a unilateral liberalization in a small open economy, such that exporting conditions of the liberalizing country remain the same before and after the opening of the economy.}

In addition, our findings provide some insight into the magnitude of gains of trade estimations derived from structural models. Alternative demand systems to the CES with variable markups have been embedded in a Melitz model to capture new mecha-
nisms through which trade could affect welfare. One salient application is Arkolakis, Costinot, Donaldson, and Rodriguez-Clare (2012) who, with the sake of pursuing generality, incorporate a demand system that encompasses standard functional forms. Their main conclusion is that, relative to models with constant markups, the gains are “elusive”, and even negative. Through the lens of our paper, and given that their demand system is covered by our setup, we can provide some interpretation to their finding. Their approach represents a parsimonious way to capture additional gains relative to the CES and, in terms of domestic markups, it is successful to capture effects due to variations of the exporting opportunities and the labor market conditions. On the contrary, as far as the import channel goes, the outcome should be taken with caution as their estimations do not capture the disciplinary effects of foreign competition on prices and productivity. In other words, regarding this channel, their general demand system display a similar behavior to the CES. Moreover, our findings show some alternative modifications to the original setup which would be futile.

The paper proceeds as follows. In Section 2, we provide an illustration that lays bare the key aspects in order to get the main conclusions of our paper. In Section 3 we begin by presenting the general setup of the model we deal with. After this, we prove a proposition that enables us to conclude that out of the total effects, that is including general equilibrium effects, the import-competition channel has no bearing on domestic prices and the productivity cutoff. In Section 4, we extend this result to the case of non-price choice variables as well as demands with nested structures. The last section offers some concluding remarks.

2 An Illustration

Through this illustration, our goal is to shed some light on the key aspects which determine the impossibility of typical demand systems used as an alternative to the CES

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6In terms of Arkolakis, Costinot, Donaldson, and Rodriguez-Clare (2015), this demand system corresponds to the case where $\beta = 0$. This includes the translated CES demand which is the functional form they make use for the empirical application.

7For instance, their result is derived assuming a Pareto distribution of productivity. In this paper, we show that a consideration of alternative distributions (bounded or unbounded) would not make the import-competition channel reemerge.
to capture the disciplinary effects of tougher import competition on domestic prices and productivity distribution. With this aim, we consider a unilateral liberalization in a specific sector which, depending on the context, might entail three effects working concurrently: an increase in the foreign competition, changes in the exporting conditions, and variations of wages to restore trade balance. To cast aside any other channel we are not interested in, we appeal to the simplest scenario we can think of to show as neat as possible the mechanisms at work.

We concentrate on a sector in isolation in which domestic firms serve their own market but do not export, and wages are determined exogenously.\footnote{This could be rationalized by conceiving, for instance, a sector, among a continuum of them, comprised of highly inefficient domestic firms that survive due to strong government protection.} Given its prominence and adequacy for illustration purposes, our example makes use of the linear demand function of Melitz and Ottaviano (2008). We proceed by setting up the model and then reflecting on the main conclusions we can obtain from it.

It is worth bearing in mind that the simplifications incorporated in the example have the goal of unveiling as stark as possible the reasons of why the import competition only affects the mass of domestic firms in the sector. Nonetheless, the main conclusions hold in more general environments as we show in subsequent sections.

### 2.1 Setup and Equilibrium

Consider two countries (domestic and foreign) engaging in trade in a specific sector. We assume that, in the sector, domestic firms are not exporting and wages are determined exogenously. Thus, the interaction between countries takes place only through the possibility of domestic consumers purchasing varieties from the foreign country. We simplify the foreign supply structure by assuming that there is a fixed number $M_F$ of active firms which set the same price $p_F$. The domestic supply structure is monopolistic and firms pay a sunk cost $F$ to get both a draw of marginal costs $c$ as well as an assignation of a variety $\omega$. The draws of marginal costs come from a continuous cumulative distribution $G$ with support $[c, \bar{c}]$. Once that firms know their costs, they decide on whether serving the market or not. We also assume that there are no overhead costs and that $G$ is such that an equilibrium exists and is unique. Let $J$ and $M$ be
the measure of domestic incumbents and active firms, respectively, and \( N := M + M_F \) the mass of total varieties in the domestic country.

Following Melitz and Ottaviano (2008), suppose the following demand function for variety \( \omega \) with a unit mass of consumers:

\[
q(\omega) := \frac{\alpha}{\eta N + \gamma} - \frac{1}{\gamma} p(\omega) + \frac{\eta}{\eta N + \gamma} \mathbb{P},
\]

where \( \mathbb{P} := \int_{\omega \in [0,M]} p(\omega) \, d\omega + M_F p_F \) and \( \alpha, \gamma, \eta > 0 \).

As is well known, this demand displays a non-constant price elasticity and, in addition, has a choke price given by

\[
p_{\text{max}}(N, \mathbb{P}) := \frac{\alpha \gamma}{\eta N + \gamma} + \frac{\eta}{\eta N + \gamma} \mathbb{P}.
\]

Crucially for our purposes, we can reexpress the demand function in term of the choke price:

\[
q(\omega) = p_{\text{max}}(N, \mathbb{P}) - p(\omega).
\]

The variable \( p_{\text{max}}(N, \mathbb{P}) \) represents a statistic which summarizes the conditions of the market in which the firm is operating and, consistent with a monopolistic competition structure, it cannot be influenced by any firm unilaterally. Importantly, conditional on values of \( p_{\text{max}} \) and \( p(\omega) \), the demand is completely determined and, hence the composition of \( p_{\text{max}} \) is irrelevant. Thus, different combinations of \((N, \mathbb{P})\) that result in the same value of choke price are considered equivalent from the firm’s point of view.

For a given value of \( p_{\text{max}} \), a domestic active firm with marginal costs \( c \) sets the following optimal prices

\[
p(p_{\text{max}}, c) := \frac{p_{\text{max}} + c}{2}
\]

and its optimal profits are

\[
\pi(p_{\text{max}}, c) := \frac{1}{4\gamma} (p_{\text{max}} - c)^2.
\]

Making use of the optimal domestic profits, the survival cost cutoff \( c^* \) can be determined. It is defined as the marginal cost \( c^* \) that makes the firm indifferent between
serving the market or not:

\[ c^* = p_{\text{max}}^* \]  

(3)

Given a mass of domestic incumbents \( J \), the equilibrium at the market stage requires that all firms are optimizing simultaneously. Since for each firm with marginal cost \( c \), optimal prices (2) are determined by the value of \( p_{\text{max}} \), the equilibrium can be expressed in the following way.

Define a function \( \Gamma \) such that

\[ \Gamma (p_{\text{max}}, J) := \frac{\alpha \gamma + \eta \mathbb{P} (p_{\text{max}}, J, M_F p_F)}{\eta \mathbb{N} (p_{\text{max}}, J, M_F) + \gamma} \]

where \( \mathbb{P} (p_{\text{max}}, J, M_F p_F) := \int_{c^*}^{p_{\text{max}}} p (p_{\text{max}}; c) dG (c) + M_F p_F \) and \( \mathbb{N} (p_{\text{max}}, J) := JG (p_{\text{max}}) + M_F \). Notice that \( \Gamma \) is defined in such a way it incorporates that \( c^* = p_{\text{max}} \) and \( \frac{M}{G(c^*)} = M^E \).

The function \( \Gamma \) takes \( p_{\text{max}} \) as input, and provides a value \( \Gamma (p_{\text{max}}^*, M^E, M_F p_F) \) as output. This output is the choke price that would self-generated by the decision of agents if they based their decisions on the value of \( p_{\text{max}} \) taken as input. Thus, an equilibrium at the market stage is given by a fixed point \( p_{\text{max}}^* \) of \( \Gamma \) so that \( p_{\text{max}}^* \) is consistent with the optimizing behavior of firms and the mass of firms that determines. Formally,

\[ \Gamma (p_{\text{max}}^*, J, M_F p_F) - p_{\text{max}}^* = 0. \]  

(4)

Finally, also incorporating that \( c^* = p_{\text{max}} \), the free-entry condition in the domestic market is,

\[ \int_{c^*}^{c^*} \frac{1}{4 \gamma} (p_{\text{max}}^* - c)^2 \ dG (c) = F \]  

(5)

2.2 Analysis of the Equilibrium

To describe the equilibrium of the economy, it is necessary to determine the optimal prices, the survival-marginal-cost cutoff and the measure of incumbents. Optimal prices and the marginal-cost cutoff are given by equations (2) and (3) and, in turn, determined by the value of \( p_{\text{max}} \). Thus, the equilibrium of the economy can be completely characterized by a pair \( (p_{\text{max}}^*, J^*) \) such that conditions (4) and (5) hold. Once
that the couple is determined, the rest of the equilibrium values are completely determined.

By inspection of condition (5), the free-entry conditions pin down the value of \( p^{\text{max}*} \), independently of the value of \( J^* \). Thus, irrespective of its composition, there is a unique value of \( p^{\text{max}} \) consistent with the equilibrium. Given this value \( p^{\text{max}*} \), the condition (4) establishes the value of \( J^* \) such that the market stage is at equilibrium. Thus, \( J^* \) plays the role of a residual variable which adjusts so that the good market clears.

### 2.3 Import Competition

Once that we established how the equilibrium is determined, let’s proceed to explore the consequences of an increase in import competition, regardless of whether this takes the form of a reduction of import prices or an increase in the mass of foreign active firms. By noting that this shock only affects in a direct way the condition (4), and \( p^{\text{max}} \) and \( c^* \) are pinned down irrespective of this equation, we conclude that tougher foreign competition cannot affect either the domestic productivity cutoff, the quantities or prices set by their firms. Changes in the competition from abroad is only reflected through the mass of domestic incumbents. As a consequence, we have that the mere introduction of a demand system with non-constant price elasticity is not sufficient to display pro-competitive effects stemming from import competition.

To get some intuition of the relevant assumptions to make the result hold, note the importance of the existence of a continuum of firms and the fact that they are symmetric before entering. The former implies that there is no uncertainty regarding the choke price and so this can be treated as if it were a deterministic variable. This is because, even though firms’ productivities are random, by a suitable application of the law of large numbers, we have that the choke price collapses to a real number. Thus, given that firms are ex ante symmetric, any variation on the mass of incumbents determines that firms receive new draws of productivity that exactly replicate the whole distribution of productivities that the domestic economy was already having. In this sense, once that we have identified the aggregate conditions of the market as well as the domestic productivity cutoff through the free-entry and zero-profits
conditions, the mass of incumbents can perfectly substitute imports.

2.4 Discussion

Some additional comments are in order. First, note that even though we have assumed that the country under analysis is not exporting and the sector has no impact on the wages, the intuition provided by the example can be used for a more general setting in which there is two-way trade and the analyzed sector affects wages. In that case, the insensitivity of domestic prices and the productivity distribution should be understood in terms of the import-competition channel, that is, the portion out of the total effects ceteris paribus the exporting activities and wage adjustments.

Second, by inspection of the demand function, we can obtain some guidance for possible modifications of it in order to make the pro-competitive effects from import competition reemerge. If, for example, we consider the same demand function as in the illustration but with the parameter $\gamma$ depending positively on the mass of foreign firms, the conditions of the domestic market would not be exclusively determined by the choke price. Then, under some restrictions on the parameters’ values, we could get the expected results: an increase on the number of foreign varieties would decrease the domestic cost cutoff and also the domestic prices of the firms which remain active. From this, we infer that the robustness of our conclusions to standard demand specifications does not preclude the possibility of minor modifications on them with the aim of restoring the import-competition channel.

Finally, notice that in case we dispense with the free-entry condition and deal with a fixed number of incumbents, import competition induces the typical pro-competitive effects: the least-productive domestic firms shut down their production, while the active domestic-firms charge a lower price. Hence, if we concentrate on short-run outcomes as in Chen, Imbs, and Scott (2009), the model behaves in the expected way.

3 The Melitz Model

In this section we present the results in a general environment. We proceed in several steps. First, we establish a framework in line with trade models of monopolistic
competition and firm heterogeneity as in Melitz (2003). Then, we proceed by adding some structure to the demand which encompasses the standard functional forms used in the literature and constitutes the key for our arguments. After this, we solve for the equilibrium in a restricted model with exporting and foreign variables taken as given. This provides us with a result which allows us to show that when we embed the model in a general equilibrium setting, the import-competition channel has no bearing in the domestic survival productivity cutoff and the markups.

3.1 Domestic Structure

We begin by establishing the general features of the framework we use throughout the text. This is done by referring to a generic country $i$ in a world economy comprised of $C$ countries and two sectors.

In country $i$, there is a unit measure of agents which supply one unit of labor inelastically. This is the only factor of production and firms can hire as many workers as they want by paying wages $w_i$. Sector 0 consists of a homogenous good supplied under a technology with constant returns to scale, which requires one unit of labor to produce one unit of the good. We take this good as the numéraire and assume that is freely traded and produced in $i$ in equilibrium such that wages are fixed as long as there are no changes in this sector. By keeping wages fixed along the analysis, we can isolate the effects of import competition and exporting opportunities in a specific sector. The other sector consists of a differentiated good.

The preferences of the numéraire and the differentiated sector are quasilinear. Let $Q$ be the subutility function of the differentiated sector. We assume the sector is composed of a set of horizontally differentiated varieties $\Theta$. The subutility function $Q$ for the sector is given by $Q := u \left[ \left( q(\omega) \right)_{\omega \in \Theta} \right]$ where $q(\omega)$ is the quantity of a variety $\omega$. We denote $\Omega_{ji} := [0, M_{ji}]$ the set of varieties from $j$ which are consumed in $i$ and endow it with the Lebesgue measure. We denote $M_i := \sum_{j=1}^{C} M_{ji}$ the total mass of varieties consumed in $i$.

Instead of specifying the properties of the subutility function, we take the demands of a variety $\omega$ as our primitive. We assume the dependence on firms’ prices in $i$ is summed up through functions $P^k_i$ with $k = 1, \ldots, K$ which we refer to as price ag-
gregators. Formally, for a function $H_{i}^{k}$, we have $\mathbb{P}_{i}^{k} := H_{i}^{k} \left[ \left( p_{ji} \right)_{j=1,\ldots,C} \right]$ where $p_{ji} := \left( p_{ji} \left( \omega \right) \right)_{\omega \in \Omega_{ji}}$ is the vector of prices of all varieties produced in $j$ and sold in $i$. We suppose that any $k$ price aggregate can be defined by $\mathbb{P}_{i}^{k} := \sum_{j=1}^{C} \int_{\omega \in \Omega_{ji}} h_{j}^{k} \left( p_{ji} \left( \omega \right) \right) \, d\omega$ for (integrable) functions $\left( h_{j}^{k} \right)_{j=1}^{C}$. The assumption serves to two purposes. First, it formalizes the idea that any domestic firm is unable to influence the conditions of the market and so it treats the price aggregates as given. Furthermore, even though firms do not know their productivity before the entering decisions and hence prices are random variables, it implies that, by a suitable application of the law of large numbers, there is no aggregate uncertainty. Thus, each price aggregate collapses to real a number.\footnote{The assumption on the specific functional of the price aggregates is in concordance with all the standard demands considered in the literature. Nonetheless, all the conclusions hold more generally under the case where we leave the aggregates undefined and suppose that no firm can influence the value of any $\mathbb{P}_{i}^{k}$ and each $\mathbb{P}_{i}^{k}$ is a real-valued function. The latter property reflects the fact that, even when firms have random productivities before entering to the market, there is no aggregate risk in terms of the price aggregate.}

The demand of a variety $\omega$ produced by a firm from $j$ selling to $i$ is thus given by

$$q_{ji} \left( \omega \right) := q \left[ \mathbb{P}_{i}, M_{i}, p_{ji} \left( \omega \right) \right],$$

where $\mathbb{P}_{i} := \left( \mathbb{P}_{i}^{1}, \mathbb{P}_{i}^{2}, \ldots, \mathbb{P}_{i}^{K} \right)$. We assume that there exists a $\mathbb{P} \in \mathbb{R}^{+} \cup \{ \infty \}$ such that $q \left[ \cdot, \cdot, \mathbb{P} \right] = 0$. This means that there is a choke price which can be finite or infinite.

The differentiated sector in $i$ has a supply side as in Melitz (2003). There is an unbounded pool of prospective entrants which are ex-ante identical. To enter, they consider paying a fixed (sunk) entry cost $F_{i} > 0$ which enables them to receive a productivity draw $\varphi$ and an assignation of a variety $\omega$. The random variable representing productivity has nonnegative support with bounds $\underline{\varphi}_{i}$ and $\overline{\varphi}_{i}$, where we allow for $\overline{\varphi}_{i}$ being infinite, and a cumulative distribution function $G_{i}$. Once that firms know their productivity, they make decisions regarding serving each country. They can choose not to sell in country $j$ or incur in an overhead fixed cost $f_{ij} \geq 0$\footnote{Equivalently, in terms of Uhlig (1996), they collapse to a random variable with a degenerate distribution.} and produce with constant marginal costs $c \left( \varphi, \tau_{ij} \right)$, where $\tau_{ij}$ represents a trade cost that a firm in $i$ has to incur for one unit to arrive at destination $j$. We adopt the convention that $\tau_{ii} := 1$.

\footnote{We assume that if there is an infinite choke price, then $f_{ij} > 0$. The possibility of $f_{ij} = 0$ is included as it is usually employed under the presence of a finite choke price.}
Each active firm from $i$ in country $j$ makes a decision on price $p_{ij}(\omega) \in P := [0, \bar{p}]$. We assume that markets are segmented, so that firms can establish different prices in each country. We denote the measure of incumbents in country $i$ as $J_i$ which determines that the measure of active firms in $i$ selling to $j$ is given by $M_{ij} := [1 - G_i(\varphi_{ij})] J_i$ where $\varphi_{ij}$ is the productivity cutoff of a firm from $i$ to break even in country $j$.

**Definition 1.** The conditions in $i$ are à la Melitz when they are given by a setup as the one described above with smooth functions.

### 3.2 Demand System

Once we have defined the generalities of the setup, we add some structure to the demand side in order to encompass the bulk of standard demand systems used in the literature. This plays a crucial role for the analysis given the properties that imply for the optimal prices and profits and, hence, the characterization of the equilibrium conditions.

The features shared by all of the demands can be captured by the assumption that the demand function satisfies weak separability of firm’s price from the price aggregates and the mass of varieties. This means that we can define $A_i := \Lambda_i(P_i, M_i)$ for some function $\Lambda_i$ that sums up the conditions of the sector in $i$ and we refer to as the aggregator. Incorporating this, $i$’s demand of a variety $\omega$ produced in country $j$ can be expressed as $q_{ji}(\omega) := q[A_i, p_{ji}(\omega)]$. The aggregator plays the role of a single sufficient statistic that gathers all the effects of the sector and turns irrelevant its composition for the demand determination. Notice that, as there is no uncertainty regarding price aggregates, the aggregator can be also treated as a real-valued function.

For further references, we state the assumptions on the demands formally.

**Assumption 3.1.** The demand $q_{ji}(\omega)$ of a variety $\omega$ produced by a firm from country $j$ and sold in $i$ is defined in terms of price aggregates of the form $\|\|_i^k := \sum_{j=1}^C \int_{\omega \in \Omega_{ji}} h_j^k(p_{ji}(\omega)) \, d\omega$ for $k = 1, \ldots, K$ and satisfies weak separability of $p_{ji}(\omega)$ with respect to $\|\|_i^1, \|\|_i^2, \ldots, \|\|_i^K$ and $M_i$. The latter implies that we can express the demand by $q_{ji}(\omega) := q[A_i, p_{ji}(\omega)]$ where $A_i := \Lambda_i(P_i, M_i)$ for some function $\Lambda_i$. 
Although not readily noticeable at first sight, the structure given by (3.1) is common across a lot of demand systems. Some examples are:

- constant expenditure demands, including the CES and Cobb-Douglas,
- attraction demand models (Luce, 1959), including the logit,
- demands derived from an additive direct utility, as in Krugman (1979),
- Melitz and Ottaviano’s (2008) linear demand,
- the translog demand, including Feenstra’s (2003) version,
- the Stone-Geary demand, including Simonovska’s (2015) version,
- affine translations of the CES demand, as in Arkolakis, Costinot, Donaldson, and Rodríguez-Clare (2015),
- the demand derived from an exponential utility, as in Behrens and Murata (2007), and
- demands derived from an additive indirect utility as in Bertoletti and Etro (2015).

In the appendix, we provide a description of these demand systems, including others which are not on the list. In addition, in the appendix, we also provide a differential characterization of weak separability due to Leontief (1947) and Sono (1961) which can be used to check whether a demand system is captured by our framework. We proceed throughout assuming that proper Inada and curvature conditions apply to (3.1) such that optimization problems can be characterized by first-order conditions.

### 3.3 Partial Effects of an Exogenous Shock

Before analyzing the complete model, we derive a proposition in a restricted version of it where some variables are taken as given. Remarkably, this is all we need in order to draw conclusions about the import-competition channel when we embed the model in general equilibrium and consider the simultaneous determination of variables in each country.

We denote $\pi_{ij}(\varphi)$ the profits of a $\varphi$-type firm from $i$ earned in a country $j \neq i$ and assume that those as well as $\varphi_{ij}, \Omega_{ji}$ and $p_{ji}(\omega)$ for $j \neq i$ are exogenously given. This implies that the conclusions we are about to get depend only on the domestic structure of a specific country. In other terms, assumptions on the foreign market structure
are irrelevant. For a given \( (\pi_j (\varphi), \varphi_{ij}, \Omega_{ji}, p_{ji})_{j \neq i} \), the equilibrium conditions are that \( i \)'s firms choose prices optimally, have nonnegative expected profits and earn nonnegative profits in each market, and market-clearing conditions in \( i \) hold for each variety.

Let the domestic demand \( \mathbf{q}_{ii} (\omega) \) be consistent with (3.1). By making use of the first-order condition to get an implicit characterization of optimal prices set by a \( \varphi \)-type firm from \( i 

\[ p_{ii} (A_i; \varphi) = \begin{cases} \mu (A_i; \varphi) c (\varphi) & \text{if } \varphi \geq \varphi_{ii} \\ \bar{p} & \text{otherwise} \end{cases} \]  

where \( \varphi_{ii} \) represents a cutoff level of productivity such that a firm from \( i \) breaks even in its own country and \( \mu (A_i; \varphi) \) is the firm’s markup, that is, \( \mu (A_i; \varphi) := \frac{\varepsilon (A_i; \varphi) - 1}{\varepsilon (A_i; \varphi)} \) with \( \varepsilon (A_i; \varphi) := -\frac{\partial \ln q (A, p)}{\partial \ln p} \bigg|_{p = p_{ii} (A_i; \varphi)} \).

Conditional on entry, the optimal variable profits a \( \varphi \)-type firm from \( i \) gets in its domestic market are,

\[ \pi_{ii} (A_i; \varphi) := \begin{cases} q [A_i, p_{ii} (A_i; \varphi)] [p_{ii} (A_i; \varphi) - c (\varphi)] & \text{if } \varphi \geq \varphi_{ii} \\ 0 & \text{otherwise} \end{cases} \]  

Given a value of \( A_i \), the zero-profit condition of a firm from \( i \) selling domestically is then,

\[ \pi_{ii} (A_i; \varphi_{ii}^*) = 0 \]  

Regarding the free-entry condition in country \( i \), it is given by,

\[ \int_{\varphi_{ii}^*}^{\bar{p}_i} [\pi_{ii} (A_i^*; \varphi) - f_{ii}] dG_i (\varphi) + \sum_{j \neq i} \int_{\varphi_{ij}}^{\bar{p}_i} [\pi_{ij} (\varphi) - f_{ij}] dG_i (\varphi) = F_i \]  

As far as the market-clearing conditions for \( i \) go, given a mass of incumbents \( J_i \), variety-markets clear when, up to a set of measure zero, all firm choose prices optimally. By exploiting the structure of the problem, we can characterize this condition in a straightforward way. First of all, note that, by (8), we can determine an implicit solution for the productivity cutoff \( \varphi_{ii}^* := \varphi_{ii} (A_i) \). Moreover, by (6), each optimal price is completely determined by the value of the aggregator and so does the profile of optimal prices \( p_{ii}^* := (p_{ii} (A_i; \varphi))_{\varphi \geq \varphi_{ii} (A_i)} \). Taken together, they imply that variety-
markets clear if and only if,

\[ \Lambda_i^* = \Lambda_i (P_i^*, M_i^*) \]

(10)

Overall, for a given value of \( \left( (\pi_{ij}(\varphi))_{\varphi}, \varphi_{ij}, \Omega_{ji}, p_{ji} \right)_{j \neq i} \), the structure added to the model determines that the equilibrium can be completely characterized by the triple \( (J_i^*, \varphi_{ii}^*, A_i^*) \) such that conditions (8), (9) and (10) hold.

We are now in a position of providing a result which constitutes the base of the subsequent conclusions under a full solution. Given the importance that has itself and that could be used it for other comparative-static exercises, we state it as a proposition.

**Proposition 3.2.** Suppose that the structure of \( i \) is à la Melitz and the domestic demand for each variety is given by (3.1). If \( \left( (\pi_{ij}(\varphi))_{\varphi}, \varphi_{ij}, \Omega_{ji}, p_{ji} \right)_{j \neq i} \) is taken as given and there is a shock to \( i \)'s aggregator then, in terms of domestic variables, the shock only impacts the mass of domestic firms: the domestic productivity cutoff as well as the prices and quantities set by any firm from \( i \) remain the same.

Note that this result holds regardless of the type of the shock under consideration (infinitesimal or discrete) or its nature. In particular, given that \( P_i^* \) include import’s prices and the mass of varieties from \( j \neq i \) as exogenous, it determines that any variation in the import competition, keeping exporting opportunities constant, cannot affect either the domestic markups or the productivity cutoff.

Furthermore, in principle, we could suspect that the assumption that each firm is negligible with respect to the sector, and its consequence that firms cannot affect the aggregator, plays a determinant role for the result. But, actually, what is key is the existence of an aggregator which satisfies both being nonstochastic and a sufficient statistic to determine optimal prices and profits. Thus, if we consider an oligopolistic structure where there exists an aggregator with those characteristics, all the results we derive below also hold. In the appendix, we provide an example of this.\(^{12}\)

\(^{12}\)Specifically, we consider a demand that, over and above the conditions given by (3.1), admits an aggregator which is additive separable. Joint with the assumption of homogeneous firms as in Krugman (1979), it determines that markups and any non-price choice is insensitive to import competition. Demand functions which satisfy the requirements of the aggregator are, for instance, the CES, logit, affine translations of both, demands derived from an additive indirect utility, the linear demand, the translog, the Cobb-Douglas and the Stone-Geary demands.
3.4 General Equilibrium and the Import-Competition Channel

Equipped with proposition (3.2) and assuming that the conditions in i are à la Melitz, we can inquire upon the consequences of a trade liberalization in a general equilibrium setting with two-way trade. This implies that exporting and importing conditions are endogenous. With this aim, we distinguish between the effects on domestic variables in terms of two channels. We define the import-competition channel as the total effect due to changes in foreign variables, ceteris paribus the exporting conditions. The export channel is defined analogously.

It is important to remark on the fact that, given the general-equilibrium nature of the model, even when we deal with a unilateral trade liberalization in i, variations in the access conditions of j to i trigger indirect effects which imply modifications in j’s market conditions (and possibly other countries) and, as a consequence, i’s exporting conditions are altered too. In other terms, the export and import channels are confounded. In addition, this interrelation between countries also determines that the disentangling effects is a more complex task than merely shutting down the exporting conditions and then introducing a shock as this experiment would only capture the direct effects of it.

As we have derived the result in proposition (3.2) without specifying the market structure of countries different from i, we are not able to get a characterization of how i’s conditions affect other countries. Nonetheless, that piece of information is only relevant as long as our goal is making an explicit account of each channel. Importantly, it does not preclude us to conclude, by use of proposition (3.2), that, irrespective of the form of the feedback between countries, the sum of direct and the general-equilibrium indirect effects that take place through the import channel can only impact the mass of domestic firms. Hence, we can state the following.

**Corollary 3.3.** Suppose that the structure of i is monopolistic with firm heterogeneity and the domestic demand for each variety is given by (3.1). If there is either a bilateral or a unilateral liberalization with i as the liberalizing country then the import-competition channel has no effect on either i’s domestic survival productivity cutoff or the domestic prices and quantities set by any firm from i.
In order to fix ideas, let’s consider a specific case so that we can get an explicit characterization of the channels. Consider only two countries, \( i \) and \( j \), where the market structure of both is given by what we have defined as monopolistic competition with firm heterogeneity and with demands (3.1) in each country. We analyze the case of a change in \( \tau_{ji} \), so that there is a change in the access conditions of \( j \) to \( i \), and keep the trade costs \( \tau_{ij} \) fixed at its original value.

Let’s focus on country \( i \). Regarding the domestic market, as we have already shown, by (6) and (7), the optimal prices and profits of are completely determined by \( A_i \) and \( \phi_{ii} \). By (8) we can also determine an implicit solution \( \phi_{ii}^* := \phi_{ii} (A_i) \). Thus, by knowledge of \( A_i \) we are able to determine the domestic prices and the domestic productivity cutoff. In terms of export conditions, a firm with \( \phi \geq \phi_{ij}^* \) sets its price through \( p_{ij} (\hat{A}_j; \phi) = \mu (\hat{A}_j; \phi) c (\phi, \tau_{ij}) \) and so its profits can be expressed by a function \( \pi_{ij} (\hat{A}_j; \phi) = q \left[ p_{ij} (\hat{A}_j; \phi) \right] \left[ p_{ij} (\hat{A}_j; \phi) - c (\phi, \tau_{ij}) \right] \). Likewise, given a value of \( \hat{A}_j \), the zero-profit condition of a firm from \( i \) selling in \( j \) is \( \pi_{ij} (\hat{A}_j, \phi_{ij}) = f_{ij} \), which determines \( \phi_{ij}^* := \phi_{ij} (\hat{A}_j) \). In this way, for the country \( i \), changes in its exporting opportunities are summed up by modifications of the aggregator \( \hat{A}_j \). By use of these results, the free-entry condition in \( i \) can be expressed by

\[
\int \frac{\nabla_i \left[ \pi_{ii} (\hat{A}_i; \phi) - f_{ii} \right]}{\phi_{ii} (\hat{A}_i)} \, dG_i (\phi) + \int \frac{\nabla_i \left[ \pi_{ij} (\hat{A}_j, \phi) - f_{ij} \right]}{\phi_{ij} (\hat{A}_j)} \, dG_i (\phi) = F_i,
\]

from which we can get an implicit solution \( \hat{A}_i (\hat{A}_j) \). By the same token, for country \( j \), we have that its free-entry condition determines a relation \( \hat{A}_j (\hat{A}_i; \tau_{ji}) \). Note that there is no direct dependence of \( \hat{A}_i \) on the term \( \tau_{ji} \), only through \( \hat{A}_j \).

As the domestic prices and domestic survival productivity cutoff are completely determined by the value of \( \hat{A}_i \), we can determine what portion out of the total changes is due to the import-channel through an analysis of variation in \( \hat{A}_i \). If we consider an infinitesimal variation of trade costs \( \tau_{ji} \), then

\[
\frac{d \hat{A}_i}{d \tau_{ji}} = \frac{\partial \hat{A}_i}{\partial \tau_{ji}} + \frac{\partial \hat{A}_i}{\partial \tau_{ij}} \kappa,
\]

where \( \kappa := \left( 1 - \frac{\partial \hat{A}_i}{\partial \tau_{ji}} \frac{\partial \hat{A}_i}{\partial \tau_{ij}} \right)^{-1} \) is a multiplier of each direct effect that captures all the
indirect effects. Given that $A_i$ only depends on $\tau_{ji}$ indirectly through $A_j$, we have that $\frac{\partial A_i}{\partial \tau_{ji}} = 0$ and, as a result, $\frac{dA_i}{d\tau_{ji}} = \frac{\partial A_i}{\partial \tau_{ji}} \frac{\partial \tau_{ji}}{\partial A_j} \kappa$ so that all the effects come from the export channel.

The expression also reveals the conditions for a unilateral liberalization to affect $i$'s domestic market. Specifically, it is required that $i$ represents a non-negligible market for $j$. Thus, variations in the access conditions from $j$ to $i$ would affect $j$'s domestic sector. In turn, this would impact on $i$’s exporting opportunities. By opposition, this gives rise to the following corollary.

**Corollary 3.4.** Suppose that the structure of $i$ is à la Melitz and the domestic demand for each variety is given by (3.1). If there is a unilateral liberalization with $i$ as the liberalizing country then, assuming that country $i$ is a small economy, there is only an impact on the mass of domestic firms: the productivity distribution in $i$ as well as the prices and quantities set by any active firm from $i$ remain the same.

It is worth noting that the fact that the import-competition channel does not entail pro-competitive effects does not necessarily imply an absence of effects on welfare through this channel. Although there are no productivity gains or reductions in the domestic markups, the changes in foreign markups and the mass of entrants in each country could have consequences for the gains from trade. In terms of our model, this means that, even though the aggregator determines the optimal prices and profits, it is not necessarily a sufficient statistic to determine welfare. Nonetheless, we emphasize that, whatever the impact on it, our main point still prevails: any consequence in the gains of trade does not stem from the disciplinary effects of tougher import competition.

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13The expression is derived by use of $\frac{dA_i}{d\tau_{ji}} = \frac{\partial A_i}{\partial \tau_{ji}} + \frac{\partial A_i}{\partial A_j} \frac{dA_j}{d\tau_{ji}}$ and $\frac{dA_j}{d\tau_{ji}} = \frac{\partial A_j}{\partial \tau_{ji}} + \frac{\partial A_j}{\partial A_i} \frac{dA_i}{d\tau_{ji}}$.

14Even if we were dispensing with the assumption of a homogeneous sector which pins down wages, the result would remain true if we deal with a negligible sector of $i$. Moreover, the result also helps us understand the effects on the survival productivity cutoff after a unilateral liberalization found by Demidova and Rodríguez-Clare (2013). Given that they deal with the case of a one-sector economy, the changes on this variable must come exclusively from adjustments in the labor-market channel.
4 Extensions

We consider two extensions. First, we show that the insensitivity to import competition also holds for non-price variables, such as quality and the number of products. After this, we prove that common nested structures used in the field can be expressed in a way consistent with (3.1) and so are able to be covered by our baseline case.

4.1 Non-Price Choices

The extension to non-price choices can be incorporated in a straightforward way as we could have specified a setup with a vector of choice variables instead of merely prices and where these decisions affect the demand and/or the marginal costs specific to the country the firm is serving. Specifically, consider the following setup. Assume that a firm from \( j \) selling to \( i \) and producing a variety \( \omega \) chooses prices and a vector of variables \( x_{ji}(\omega) \) and faces a demand

\[
q_{ji}(\omega) := q[A_i, p_{ji}(\omega), x_{ji}(\omega)],
\]

with \( A_i := \Lambda_i(X_i, N_i) \), \( X_i := (X^1_i, X^2_i, ..., X^K_i) \), \( X^k_i := H^k_i[(p_{ji}, x_{ji})_{\omega_{ji}}] \) and \( (p_{ji}, x_{ji}) := (p_{ji}(\omega), x_{ji}(\omega))_{\omega_{ji}} \) for some functions \( \Lambda_i \) and \( (H^k_i)_{k=1} \). Suppose also that no firm can exert influence on any of the aggregates \( X^k_i \) and that these are real-valued functions. Note that there are no restrictions on how the vector of choices are incorporated in terms of aggregates so that result is quite general in terms of the demands that we could consider. Moreover, in addition to the fixed costs, the costs of the domestic firms with productivity \( \phi \) are

\[
C_{ii}[\phi, q_{ii}(\omega), x_{ii}(\omega)] := q_{ii}(\omega) c_{ii}[\phi, x_{ii}(\omega)] + f[x_{ii}(\omega)],
\]

where \( c_{ii} \) are the marginal costs of serving the domestic market\(^{15}\) and \( f \) represents the costs of non-price domestic variables.

By assuming that no specific domestic firm is able to influence the vector of \( X_i \), the optimization problem of a firm from \( i \) with productivity \( \phi \) determines solutions

\(^{15}\)The possibility that the vector of non-prices variables could affect the marginal costs encompasses the case where higher quality products entail greater unitary costs.
in terms of the exogenous variables of the firm, so that \( x_{ii} (A_i, \varphi) \). Thus, optimal domestic profits are also a function of \((A_i, \varphi)\), and all the results follow in the same way as the baseline case.

### 4.2 Nested Demands Structures

To extend the results to the case of demands with nested structures, we can apply the results of the baseline case as long as each domestic firm has a demand that depends on an aggregator which concurrently gathers all the terms which are exogenous to it and is the same for all the domestic firms. There are two widespread types of nests in the trade literature suitable to be incorporated in that way: nests defined by country of origin, and multiproduct firms whose demands are nested in terms of varieties produced by the same firm.

Before considering them, let’s define generically demands with nested structures. Suppose we partition the set of total varieties consumed in \( i \) into \( L \) nests, and that for each country \( j \) we have that the set of varieties is \( \Omega_{ji} := \left( \Omega_{lji} \right)_{l=1}^{L} \). The demand of a firm from \( j \) producing a variety \( \omega \) belonging to nest \( l \) and selling to \( i \) is defined by

\[
q_{ji}^l (\omega) := q^l \left( \mathbb{P}_i, \mathbb{P}_{ji}^C, C_j = 1, N_i, p_{ji} (\omega) \right),
\]

where \( \mathbb{P}_i := H_i \left[ \left( \left( \mathbb{P}_{ji}^l \right)^C \right)^L \right] \) and \( \mathbb{P}_{ji}^l := h_i \left[ \left( p_{ji}^l (\omega) \right)_{\omega \in \Omega_{lji}} \right] \) for functions \( H \) and \( \left( h_i^l \right)_{l=1}^{L} \). We suppose that no firm can affect \( \mathbb{P}_i \) unilaterally and that this variable is a real-valued function. We proceed to analyze separately the two situations mentioned.

#### 4.2.1 Nests Defined by Within-Firm Varieties

As for multiproduct firms with nests defined in terms of within-firm varieties, we have that \( l \) is identified by the firm under consideration so that \( \mathbb{P}_{ji}^l \) is a composite function which depends on the prices of all the varieties produced by it. If we have that the demand can be expressed in terms of an aggregator \( A_i := \Lambda_i (\mathbb{P}_i, N_i) \), then, for a given number of products and \( x_{ii}^l := (p_{ii} (\omega))_{\omega \in \Omega_{ll}} \), the optimization problem of
a domestic firm $l$ would be given by $x_{il}^l(A_i)$, which in turn would determine $P_{ji}^l(A_i)$. Therefore, this could be considered as a special case of the framework with non-prices choices.

### 4.2.2 Nests Defined by Country of Origin

For the case of demands with nests defined in terms of country of origin, as long as we can show that the domestic demands can be expressed in terms of an aggregator common to all the firms belonging to the country, then we would get demands consistent with (3.1) and all the results would follow. Specifically, if $P_{ji}$ is the subnest in $i$ of firms belonging to country $i$, we need to be able to express the demand in terms of an aggregator $A_{iij} := \Lambda_i (P_l, P_{ji}, N_l)$.

In order to get a characterization that encompasses the bulk of widespread demands with nested structures used in the literature, we need to group them by using some criteria. We do this by a consideration of demands derived from subutility functions of the sector consistent with the Gorman polar form. This property is satisfied by different cases like CES, Cobb-Douglas, and affine translations of them. The statement of the result requires some lemmas, so we state only the final result.

**Proposition 4.1.** Let $E$ represent the expenditure allocated to the sector and that all the demands display income effects. Suppose we partition the set of varieties by country of origin. Let $p_l := (p(\omega)_{\omega \in \Omega_l})$. Suppose that $V$ is an indirect subutility function given by $V[(p_l^l)_{l=1}^L] := \frac{E}{G((p_l^l)_{l=1}^L)} - \frac{F((p_l^l)_{l=1}^L)}{G((p_l^l)_{l=1}^L)}$ with $G$ and $F$ linearly homogeneous. Let $G[(p_l^l)_{l=1}^L] := G(\mathbf{F})$ with $\mathbf{F} := H[(p_l^l)_{l=1}^L]$ and $p_{G}^l := \mathbf{G} \left[ \sum_{\omega \in \Omega_l} g_{\omega} \left[ p(\omega) \right] \right]$ for monotone functions $(g_l)_{l=1}^L$, and $F[(p_l^l)_{l=1}^L] := \mathbf{F}$ with $\mathbf{F} := \sum_{l=1}^L \mathbf{P}_l^l$ and $\mathbf{P}_l^l := \sum_{\omega \in \Omega_l} f_{\omega} \left[ p(\omega) \right]$. Then for any demand $q(\omega)$ of a variety belonging to country $i$ generated by $V[(p_l^l)_{l=1}^L]$ there exists an aggregator $\Lambda_i$ such that $q(\omega) := q[\Lambda_i, p(\omega)]$.

**Proof.** See Appendix. ■

The baseline case departs from a relation between sectors through a Cobb-Douglas utility function. Given that in some cases, like the nested Logit, it is common to assume that the relation between sectors is in terms of a quasilinear utility function, such that the sector displays no income effects, we also prove that case in the Appendix.
Although the statement of the result is less transparent than ones considered above, the important message we can get from this is that the common nested structures used in the literature can be covered by our baseline assumptions.

5 Conclusion

In this paper, we have analyzed the effects of import competition in a Melitz model. Our main conclusion is that the inclusion of demand systems with variable markups does not necessarily constitute a richer framework than under a CES demand. Thus, in order to make the import-competition channel reemerge, it is necessary to deal with models which fall outside the framework we have considered.

References


References


Appendices

A Proofs

A.1 Proof of Proposition 3.2

Proof. Suppose the variables are evaluated at the original equilibrium. Optimal prices and quantities of a \( \phi \)-type domestic are completely determined by \( A_i \). Define

\[
F'_i = F_i - \sum_{j \neq i} \int_{\phi_j} \int_{\phi_i} \left[ \pi_{ij}(\phi) - f_{ij} \right] dG_i(\phi).
\]

Then, the relevant equilibrium conditions are

\[
\pi_{ii}(A^*_i, \phi^*_ii) = f_{ii} \quad \text{and} \quad \int_{\phi_i} \phi_{ii} \pi_{ii}(A^*_i, \phi^*_ii) dG_i(\phi) = F'_i.
\]

These two equations determine the pair \((A^*_i, \phi^*_ii)\) at the original equilibrium. If there is a shock that only impacts directly \( i \)'s aggregator, and so not the zero-profits and free-entry conditions, then \((A^*_i, \phi^*_ii)\) have to remain at the values of the original equilibrium and so do the prices and quantities. Therefore, only \( J_i \) is free to adjust.

A.2 Proof of Proposition 4.1

We first state a lemma.

Lemma A.1. Suppose that \( P := H \left[ (P^l)_{l=1}^L \right] \) and \( P^l := g_l \left[ \sum_{\omega \in \Omega^l} g_\omega \left( p(\omega) \right) \right] \) where all functions are smooth and each \( g_l \) is monotone. Then, for any smooth monotone function \( G \) such that \( G(P) \), we have that for any \( \omega \in \Omega^l \), \( \frac{\partial G(P^l)}{\partial p(\omega)} \) displays weak separability of \( p(\omega) \) from \( P \) and \( (P^l)_{l=1}^L \) and the aggregator is the same for any element of the nest.

Proof. Let \( \omega \in \Omega^l \). We have \( \frac{\partial G(P^l)}{\partial p(\omega)} := \frac{\partial G}{\partial p} \frac{\partial p}{\partial p^l} \frac{\partial p^l}{\partial p(\omega)} \) and, in terms of dependence the first and second term depend, respectively, on \( P \) and \((P^l)_{l=1}^L \) and are the same for all nests.

Define \( A_l := \frac{\partial G}{\partial p} \frac{\partial p}{\partial p^l} \left[ P, (P^l)_{l=1}^L \right] \). Regarding \( \frac{\partial p^l}{\partial p(\omega)} \), given the additive separability of \( P^l \), we have that \( \frac{\partial p^l}{\partial p(\omega)} = g'_l \left[ g_l^{-1}(P^l) \right] \frac{\partial g_\omega[p(\omega)]}{\partial p(\omega)} \). Define \( A_l := g'_l \left[ g_l^{-1}(P^l) \right] \). Then, we have that there exists an aggregator for each nest \( \Lambda_l := A_l A_l \) such that \( \frac{\partial G(P)}{\partial p(\omega)} = \Lambda_l \frac{\partial g_\omega[p(\omega)]}{\partial p(\omega)} \) and so \( p^l(\omega) \) is weakly separable from \( P \) and \((P^l)_{l=1}^L \) and \( \Lambda_l \) is the same for all nests. ■ The proof of proposition (4.1) follows immediately by use of the following proposition. The continuum version arises as a limit case.
Proposition A.2. Let $E$ represent the expenditure allocated to the sector and that all the demands display income effects. Let $p^L := (p(\omega)_{\omega \in \Omega})$. Suppose that $V$ is an indirect subutility function given by $V \left[ (p^L)_{l=1}^L \right] := \frac{E}{G((p^L)_{l=1}^L)} - \frac{F((p^L)_{l=1}^L)}{G((p^L)_{l=1}^L)}$ with $G$ and $F$ linearly homogeneous. Let $G \left[ (p^L)_{l=1}^L \right] := G(\mathbb{P}_G)$ with $\mathbb{P}_G := H \left[ \left( \mathbb{P}^L_{G} \right)_{l=1}^L \right]$ and $\mathbb{P}^L_{G} := g_l \left[ \sum_{\omega \in \Omega^l} g_{\omega} \left[ p(\omega) \right] \right]$ for monotone functions $(g_l)_{l=1}^L$ and $F \left[ (p^L)_{l=1}^L \right] := \mathbb{P}_F$ with $\mathbb{P}_F := \sum_{l=1}^L \mathbb{P}^l_F$ and $\mathbb{P}^l_F := \sum_{\omega \in \Omega^l} f_{\omega} \left[ p(\omega) \right]$. Then for any demand $q(\omega)$ of a variety belonging to nest $l$ generated by $V \left[ (p^L)_{l=1}^L \right]$ there exists an aggregator $\Lambda_l$ such that $q(\omega) := q \left[ \Lambda_l, p(\omega) \right]$.

Proof. Let $\omega \in \Omega^l$. By Roy’s identity, we have that $q(\omega) := \frac{E - F((p^L)_{l=1}^L)}{G((p^L)_{l=1}^L)} \frac{\partial G((p^L)_{l=1}^L)}{\partial p(\omega^l)} + \frac{\partial F((p^L)_{l=1}^L)}{\partial p(\omega^l)}$. Also, by (A.1), we have that $\frac{\partial G((p^L)_{l=1}^L)}{\partial p(\omega^l)} = A_l \frac{\partial g_{\omega} \left[ p(\omega) \right]}{\partial p(\omega)}$. Moreover, $\frac{\partial F((p^L)_{l=1}^L)}{\partial p(\omega^l)} = \sum_{l=1}^L \mathbb{P}^l_{F} \frac{\partial g_{\omega} \left[ p(\omega) \right]}{\partial p(\omega)} + \sum_{l=1}^L \mathbb{P}^l_{F} \frac{\partial f_{\omega} \left[ p(\omega) \right]}{\partial p(\omega)}$. Then, $q(\omega) := \frac{E - F((p^L)_{l=1}^L)}{G((p^L)_{l=1}^L)} \frac{\partial g_{\omega} \left[ p(\omega) \right]}{\partial p(\omega)} + \sum_{l=1}^L \mathbb{P}^l_{F} \frac{\partial g_{\omega} \left[ p(\omega) \right]}{\partial p(\omega)} + \sum_{l=1}^L \mathbb{P}^l_{F} \frac{\partial f_{\omega} \left[ p(\omega) \right]}{\partial p(\omega)}$. Then, if we define $\Lambda_l := \frac{E - F((p^L)_{l=1}^L)}{G((p^L)_{l=1}^L)} A_l$, we have that for each $\omega \in \Omega^l$ the demand can be expressed by $q(\omega) := q \left[ \Lambda_l, p(\omega) \right]$. In the case of nests defined by country of origin, the proposition implies that all domestic demands in $i$ depend on an aggregator which is common for the whole country, that is, $A_i$. Then, each domestic demand $q_{ii}(\omega)$ is consistent with (3.1) and the result follows. In the baseline framework of what we have defined as monopolistic competition with firm heterogeneity we assume that the relation between sectors is in terms of a Cobb-Douglas function. Nonetheless, in some cases, for example with a nested Logit, it is common to define a relation between sectors through a quasilinear utility function. In that case, the sector under analysis does not display income effects. We extend the result to that case.

Proposition A.3. Let $p_0$ be the price of the quasilinear sector and suppose that $V$ is an indirect subutility function given by $V \left( \mathbb{P} \right) := \frac{E}{p_0} - \frac{G(\mathbb{P})}{p_0}$ with $\mathbb{P} := H \left( \left( \mathbb{P}^l \right)_{l=1}^L \right)$ and $\mathbb{P}^l := g_l \left[ \sum_{\omega \in \Omega^l} g_{\omega} \left[ p(\omega) \right] \right]$ for monotone functions $(g_l)_{l=1}^L$ and $G$ linearly homogeneous. Then, for any $\omega \in \Omega^l$ and demand $q(\omega)$ generated by $V \left( \mathbb{P} \right)$, there exists an aggregator $\Lambda_l$ such that $q(\omega) := q \left[ \Lambda_l, p(\omega) \right]$.

Proof. By Roy’s identity, the demand of a variety $\omega^l$ from nest $l$ is $q(\omega^l) := - \frac{\partial G(\mathbb{P})}{\partial p(\omega^l)}$. By an application of (A.1), the result follows.
B Demand Systems

B.1 Monopolistic Competition

Given that keeping track of the countries can be unwieldy, we refer to general demand systems which are consistent with 3.1. Some of the demand systems have particular cases which overlap with other families considered. Consider the following demand-per-capita of a variety \( \omega \) given a demand shifter \( E \) and total measure of varieties consumed \( N \). Any greek letter refers to a positive parameter.\(^{16} \)

- **Luce’s (1959)** attraction demand models \( q (\omega) := \frac{h[p(\omega)]}{\mathbb{A}} \) with \( \mathbb{A} := H (\mathbb{P}) \) and \( \mathbb{P} := \int_{\omega \in \Omega} h [p (\omega)] \, d\omega \) which, by defining \( h [p (\omega)] \) properly, include:
  - Multinomial Logit demand: \( h [p (\omega)] := \exp (\alpha - \beta p (\omega)) \)
  - Multiplicative Competitive Interaction demand: \( h [p (\omega)] := \alpha p (\omega)^{-\beta} \).

- **Constant expenditure demand systems** \( q (\omega) := \frac{E}{p(\omega)} \frac{h[p(\omega)]}{\mathbb{A}} \) with \( \mathbb{A} := H (\mathbb{P}) \) and \( \mathbb{P} := \int_{\omega \in \Omega} h [p (\omega)] \, d\omega \) which, by defining \( h [p (\omega)] \) properly, include:
  - CES: \( h [p (\omega)] := \alpha p (\omega)^{-\beta} \)
  - Exponential demand: by defining \( h [p (\omega)] := \exp (\alpha - \beta p (\omega)) \).

- **Melitz and Ottaviano’s (2008)** version of the linear demand \( q (\omega) := \mathbb{A} - \frac{1}{\gamma} p (\omega) \) with \( \mathbb{A} := \frac{\alpha}{\eta N + \gamma} + \frac{\eta}{\eta N + \gamma} \gamma \mathbb{P} \) and \( \mathbb{P} := \int_{\omega \in \Omega} p (\omega) \, d\omega \).

- **Simonovska’s (2015)** version of the Stone-Geary \( q (\omega) := \frac{\mathbb{A}}{p(\omega)} - \alpha \) with \( \mathbb{A} := \frac{\omega + \alpha \mathbb{P}}{N} \) and \( \mathbb{P} := \int_{\omega \in \Omega} p (\omega) \, d\omega \).

- **Feenstra’s (2003)** version of the translog demand \( q (\omega) := \frac{E}{p(\omega)} \left[ \mathbb{A} - \ln p (\omega) \right] \) where \( \mathbb{P} := \int_{\omega \in \Omega} \ln p_\omega \, d\omega \) and \( \mathbb{A} := \frac{1 + \gamma \mathbb{P}}{N} \).

- **Behrens and Murata’s (2007)** demands derived from an exponential utility \( q (\omega) := \mathbb{A} - \frac{1}{\alpha} \ln p (\omega) \) where \( \mathbb{P}_1 := \int_{\omega \in \Omega} p (\omega) \, d\omega, \mathbb{P}_2 := \int_{\omega \in \Omega} \ln \left[ \frac{p(\omega)}{\mathbb{P}_1} \right] \frac{p(\omega)}{\mathbb{P}_1} \, d\omega \) and \( \mathbb{A} := \frac{E}{\mathbb{P}_1} + \frac{\ln \mathbb{P}_1}{\alpha} + \frac{\mathbb{P}_2}{\alpha} \).

- **Arkolakis, Costinot, Donaldson, and Rodríguez-Clare’s (2012)** demand system \( \ln q (\omega) := -\alpha \ln p (\omega) + \beta \ln E + f [\ln p (\omega) - \ln \mathbb{P}] \) where \( \mathbb{P} \) is a price index. which includes the demand \( q (\omega) := \left( \frac{E}{p(\omega)} \right)^{\sigma} - \alpha \) used for the empirical analysis in Arkolakis, Costinot, Donaldson, and Rodríguez-Clare (2015).

\(^{16}\)For those demands which do not depend on income, we assume that the upper-tier utility between sectors is quasilinear instead of Cobb-Douglas, as we are assuming in the baseline setup.


- **Krugman’s (1979)** demands derived from an additive direct utility  This is a special case of Arkolakis, Costinot, Donaldson, and Rodríguez-Clare’s (2012) demand system as the authors show. Moreover, it covers the demands from the Pollak-family used in Neary (2015), which defines the exhaustive list of utility functions which are additively separable and consistent with the Gorman Polar form.\(^{17}\) Two cases covered by this family are worth mentioning: the translated-CES utility and the so-called Generalized Quadratic utility by Neary (2015).

These can be encompassed by the utility

\[
U \left[ (q(\omega))_{\omega \in \Omega} \right] := \alpha \int_{\omega \in \Omega} [q(\omega) - \beta]^\theta d\omega \quad \text{which determines demands} \quad q(\omega) := \beta + A \left( \frac{p(\omega)}{\alpha} \right)^{1-\theta}
\]

with \(A := \frac{\mathbb{E}_1}{\mathbb{E}_2} - \frac{\mathbb{E}_2}{\mathbb{E}_1}, \mathbb{E}_1 := \int_{\omega \in \Omega} \beta p(\omega) d\omega, \mathbb{E}_2 := \int_{\omega \in \Omega} p(\omega) \left( \frac{p(\omega)}{\alpha} \right)^{1-\theta} d\omega,\)

and either

- \(\alpha > 0, \theta \in (0, 1)\) and \(q(\omega) > \beta,\) or
- \(\alpha < 0, \theta > 1,\) and \(q(\omega) < \beta.\)

- **Bertoletti and Etro’s (2015)** demands derived from an additive indirect utility

Given an indirect utility

\[
V \left[ (q(\omega))_{\omega \in \Omega} \right] := \int_{\omega \in \Omega} v \left( \frac{p(\omega)}{E} \right) d\omega \quad \text{which determines demands} \quad q(\omega) := \frac{v' \left( \frac{p(\omega)}{E} \right)}{\alpha}
\]

with \(A := \int_{\omega \in \Omega} v' \left( \frac{p(\omega)}{E} \right) p(\omega) \frac{E}{E} d\omega.\)

\section*{C  Additional Results}

\subsection*{C.1 Differential Characterization of Demand Systems}

For a general characterization of the demand system we have used in the main text, we restore to the following result in weak separability of functions.

**Lemma C.1.** (Leontief, 1947; Sono, 1961). Let \(f : X \to \mathbb{R}\) with \(X \subseteq \mathbb{R}^N_+.\) Consider a partition of the \(N\) variables into \(R\) groups \(
\{I^1, I^2, \ldots, I^R\}\) so that \(X := \times_{r=1}^R X^r.\) Denote generic elements by \(x \in X\) and \(x^r \in X^r.\) We say that each group \(r = 1, \ldots, R\) is weakly separable from all other variables in \(f\) if there exist functions \(H\) and \((h^r)_{r=1}^R\) such that \(f(x) = H \left[ h^1(x^1), \ldots, h^R(x^R) \right].\) If \(f \in C^1,\) group \(r\) is weakly separable from the rest of the variables in \(f\) if and only if the marginal rate of substitution between any two variables

\(^{17}\text{For a complete treatment see Pollak (1971), or Neary (2015) for the continuum case.}\)
belonging to the group $r$ are independent of any variable which does not belong to $r$. Formally,
\[ \frac{\partial^2 f(x)}{\partial x_i \partial x_j} = 0 \quad \text{for } i', i'' \in r \text{ and } j \notin r. \]

The demand system of a variety $\omega$ can be expressed by,
\[ q(\omega) := q\left[ p^1, p^2, \ldots, p^K, N, p(\omega) \right] \]
where $p^k := \int_{\omega \in [0,N]} h^k\left( p(\omega) \right) \, d\omega$. Applying the result to this function, the weak separability of the $(p^k)_{k=1}^K$ and $N$ with respect to $p(\omega)$ can be characterized in the following way.

**Corollary C.2.** $p(\omega)$ is weakly separable from $(p^k)_{k=1}^K$ and $N$ in $q(\omega)$ if and only the following two conditions hold simultaneously:

- $a\left( \frac{\partial q(\omega)}{\partial p^k} \right) = 0$ for all $k' = 1, \ldots, K$.
- $a\left( \frac{\partial q(\omega)}{\partial N} \right) = 0$ for all $k = 1, \ldots, K$.

### C.2 Oligopoly with Differentiated Products

The goal of this section is providing an example that reveals that the assumption that all firms are negligible in the sector is not what is necessarily driving the result. Thus, even when firms have market power and tougher import competition could reduce their scope to manipulate the aggregates, we show that, as long as the demand can be expressed by an aggregator which is nonstochastic and a sufficient statistic to determine the optimal firms’ choices and their profits, the result would hold. We depart from a framework like (1) and, to keep things simple, we assume that it holds for all countries. For a generic country $i$, we introduce the the following modifications. We assume that the distribution of productivity is degenerate and determines a marginal cost $c_{ii}$ and there are no market-specific costs, so that the firms have only to incur in the fixed cost $F_i$ in order to sell to any market. The set of horizontally differentiated varieties $\Theta$ is discrete and $M_i$ is the set of varieties which are produced in equilibrium in $i$. In order to avoid the integer problem, we assume that this is a real number so that the zero-profit condition holds with equality. We develop the case where firms
compete à la Bertrand and consider a symmetric equilibrium. Given that firms can influence the conditions of the sector by their prices choices, we need more stringent conditions on the aggregator such that firm’s decisions only depend on the value of the aggregator without the need to know the specific values of the variables that compose it. Let $x_{ji} (\omega)$ be a vector of decision variables of a firm in $j$ producing variety $\omega$ and selling in $i$. The following demand function accomplishes this.

**Assumption C.3.** The demand of a variety $\omega$ produced by a domestic firm from $i$ is given by

$$q_{ii} (\omega) := q [A_i, x_{ii} (\omega), p_{ii} (\omega)]$$

where $A_i := H_i [P + h_{N_i} (N_i)]$ with $P_i := \sum_j \sum_{\omega \in \Omega_i} h_i [P_j (\omega), x_{ji} (\omega)]$ for monotone functions $H_i$, $h_j$, and $h_{N_i}$. This means that the demand displays weak separability of firm’s price from the price aggregate and the number of varieties, and in addition, the aggregator is strongly separable in each firm’s variable decision and the number of varieties.

Notice that, given that we assume that all countries have a degenerate distribution of productivity, the aggregator is nonstochastic. To illustrate the generality of these demand systems, let’s consider the case of total varieties $\Omega$ with total mass $N$ and abstract from the procedence of the firm. Let $E$ denote the total expenditure and assume that any greek letter refers to a positive parameter. We consider the case with price as the only choice variable but we could incorporate the vector of non-price choices as long as it respects the functional form of the aggregate in (C.3).

- **Attraction demand models** (Luce, 1959) $q (\omega) := \frac{h[p(\omega)]}{A}$ with $A := H (P)$ and $P := \int_{\omega \in \Omega} h [p(\omega)] \, d\omega$.
- **Constant expenditure demand systems** $q (\omega) := \frac{E \cdot h[p(\omega)]}{p(\omega)}$ with $A := H (P)$ and $P := \int_{\omega \in \Omega} h [p(\omega)] \, d\omega$.
- **Linear demand** $q (\omega) := A - \beta p (\omega)$ with $A := \alpha + \beta$ and $P := \int_{\omega \in \Omega} p (\omega) \, d\omega$.

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\[^{18}\]With the aim of providing some insight for the assumption, consider an oligopoly with $N$ active firms which only decides on the price and each facing a demand $q (\omega) := q [A, p (\omega)]$. Firms set their optimal price by analyzing how it affects totally its demand, hence the relevant term to analyze is $\frac{\partial q(\omega)}{\partial p(\omega)} = \frac{\partial q (\omega)}{\partial A} \frac{\partial A}{\partial p(\omega)} + \frac{\partial q (\omega)}{\partial p(\omega)}$. Note, $\frac{\partial q (\omega)}{\partial A}$ and $\frac{\partial q (\omega)}{\partial p(\omega)}$ are functions of the pair $(A, p (\omega))$. On the contrary, if we do not impose any structure on the aggregator and merely assume that $A := H (P)$, then $\frac{\partial A}{\partial p(\omega)}$ is in principle dependent on all the prices and mass of varieties available.

\[^{19}\]For these where the demand does not depend on income, we assume that the upper-tier utility between sectors is quasilinear.
• Stone-Geary \( q(\omega) := \frac{A}{p(\omega)} - \alpha \) and \( A := \alpha P \) and \( P := \int_{\omega \in \Omega} p(\omega) \, d\omega \).

• Translog demand \( q(\omega) := \frac{E}{p(\omega)} \left[ A - \ln p(\omega) \right] \) where \( P := \int_{\omega \in \Omega} \ln p(\omega) \, d\omega \) and \( A := \alpha + \beta P \).

• Demands from an additive indirect demand utility as in Bertoletti and Etro (2015) Given an indirect utility \( V[(q(\omega))_{\omega \in \Omega}] := \int_{\omega \in \Omega} v \left[ \frac{p(\omega)}{E} \right] \, d\omega \), we get demands \( q(\omega) := \frac{v' \left[ \frac{p(\omega)}{E} \right]}{A} \) with \( A := \int_{\omega \in \Omega} v \left[ \frac{p(\omega)}{E} \right] \frac{p(\omega)}{E} \, d\omega \).

Regarding costs, consider that, gross of the entry cost, a domestic firm producing a variety \( \omega \) has the following cost function:

\[
C_{ii}[\varphi, q_{ii}(\omega), x_{ii}(\omega)] := q_{ii}(\omega) c_{ii} + f[x_{ii}(\omega)]
\]

Hence, the optimization problem of the firm is

\[
\max_{p, x} \pi_{ii}(\omega) = q[A_{ii}, x, p] [p - c_{ii}] - f[x]
\]

Let’s focus only the pricing decisions as the result for \( x_{ii}(\omega) \) follows the same lines. The first-order condition for price is,

\[
\frac{d\pi_{ii}(\omega)}{dp_{ii}(\omega)} = q[A_{ii}, x_{ii}(\omega), p_{ii}(\omega)] + \left( \frac{\partial q_{ii}(\omega)}{\partial p_{ii}(\omega)} + \frac{\partial q_{ii}(\omega)}{\partial A_{ii}} \frac{\partial h_{i}}{\partial p_{ii}(\omega)} \right) \left[ p_{ii}(\omega) - c_{ii} \right] = 0
\]

Except for \( \frac{\partial h_{i}}{\partial p_{ii}(\omega)} \), it is a straightforward to realize that the rest of the terms can be determined by a knowledge of \( A_{ii} \). As regards of \( \frac{\partial h_{i}}{\partial p_{ii}(\omega)} \), we have that,

\[
\frac{\partial A_{ii}}{\partial p_{ii}(\omega)} = H_{i}^{-1} \left[ H_{i}^{-1} \left( A_{ii} \right) \right] \frac{\partial h_{i} [p_{ii}(\omega), x_{ii}(\omega)]}{\partial p_{ii}(\omega)}
\]

where \( H_{i}^{-1} \) is the inverse function of \( H_{i} \). Thus, the value of \( \frac{d\pi_{ii}(\omega)}{dp_{ii}(\omega)} \), and by the same token \( \frac{d\pi_{ii}(\omega)}{dp_{ii}(\omega)} \) for each generic element \( x_{ii}(\omega) \) of \( x_{ii}(\omega) \), only depends on \( (A_{ii}, p_{ii}(\omega), x_{ii}(\omega)) \). Therefore, the optimal variables, as well as the the optimal profits, depend only on \( A_{ii} \), and all the results derived in the main text of the paper can be proven in the same fashion.
Chapter 2
Home-Bias Patterns and the Strategic Gains of Domestic Leaders: Theory*

Martín Alfaro†

Abstract

In this chapter, I formalize a first-mover advantage for domestic firms that generates home-bias patterns. I extend firms’ choices to include demand-enhancing investments and show that, relative to a benchmark where all firms invest simultaneously, there is an overinvestment by domestic firms. Thus, firms skew resources to their local markets and crowd out foreign firms. To analyze the mechanism, I develop a tractable framework that encompasses large firms making multiple choices and accounts for extensive-margin adjustments and firm heterogeneity. Unlike standard two-stage oligopolies with no entry, the overinvestment outcome is independent of competition at the market stage (prices or quantities). The result is also independent of the nature of investments regarding whether they increase or decrease consumers’ willingness to pay.

*I am extremely grateful to Valerie Smeets, Frederic Warzinsky, Philipp Schröder, and Raymond Riezman for their invaluable guidance and support. I also thank Boris Georgiev, David Lander, Anders Laugesen, Kalina Manova, Peter Neary, Allan Sørensen, Jim Tybout, and participants of several seminars for helpful comments. All remaining errors are my own.

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1 Introduction

After McCallum’s (1995) border puzzle and Trefler’s (1995) mystery of missing trade, a renewed interest for home-bias phenomena in international economies emerged. Obstfeld and Rogoff (2001) have even considered the subject as one of the six major puzzles in international macroeconomics. Empirically, this is manifested at two different levels. At an aggregate level, industries exhibit a tendency toward consumption of domestic goods. In addition, recent access to more disaggregated data has unveiled that it is also expressed at the firm level: the share of each firm’s exports relative to its total sales is less than its domestic portion.

Based on these facts, the inclusion of trade-costs parameters has become a standard feature of models. Irrespective of the specific form used, they have been incorporated to reflect exogenous asymmetries between domestic and international transactions that help get a better fit of the models.\footnote{Quantitative support to the importance of trade costs is provided by Eaton, Kortum, and Neiman (2016).} To these days, nonetheless, there is little understanding of the differences between the markets that they capture. Thus, delving into the sources of these asymmetries remains a key challenge (Bernard, Jensen, Redding, and Schott, 2012; Chaney, 2014).

In this paper, I formalize a mechanism in which home-bias patterns arise endogenously by the behavior of firms. Consistent with a long-run view of the market structure determination, I conceive an environment in which firms make entry choices, decide on prices and also, as in Sutton (1991,1998), sunk expenditures that enhance demand. These investments might include outlays on a disparity of variables such as advertisement, introduction of new varieties, adaptation of products to local tastes and expansion of distribution networks to make the product more widely available. In addition, following Porter (2011) I acknowledge that local firms have an advantage over those which serve the market without being established in the market.\footnote{Firms which are established in the market they are serving have a better knowledge regarding local conditions and are able to garner more reputation among costumers. Moreover, they have more experience regarding the regulatory environment and are better endowed to adapt to changes in the conditions of the market, thus creating a sluggish response by importers. For arguments in this line, see Porter (1980, pp. 281-287; 2011, Chapter 3).} These advantages are materialized through the possibility for domestic firms of sink-
ing investments in their home market prior to importers. In this setup, big firms (henceforth, BFs), that is, firms which are nonnegligible to the market, internalize that importers make their entry decisions conditional on the demand-enhancing expenditures incurred by them and act strategically.

To isolate the effects due to an asymmetry in the timing of choices, I compare the situation against a benchmark where domestic firms and importers decide on the expenditures simultaneously. Relative to that baseline, I show that BFs invest more heavily on demand-enhancing expenditures in their domestic market. Thus, a first-mover advantage emerges, rationalizing outcomes in line with the home bias. First, there is an expansion of BFs in their home market. The mechanism is through an exit of firms that is, in part, at the expense of the importers. This crowding out of foreign competition creates a bias toward consumption of domestic varieties. Moreover, domestic BFs increase their home revenue and, hence, end up with a lower share of exports relative to the total firm’s sales. In relation to this, the result is consistent with an empirical regularity that I show: the higher the domestic market share of a firm, the greater its domestic share of own total sales.

To study the mechanism, we need to attend that the incorporation of nonzero measure firms, heterogeneity and multidimensional strategies might introduce complex strategic interactions and turn the search of a solution into an unwieldy task. This calls for building up a framework that puts some structure on the problem analyzed. I do this by incorporating two features to my setup. First, I consider a demand system that allows me to describe the strategic interactions between firms through the theory of aggregative games. This technique, recently put forward by Acemoglu and Jensen (2013), is particularly well suited for setups with firm heterogeneity and multidimensional strategies. Remarkably, it covers the standard demand systems used for tackle empirical questions. Specifically, it allows for (non-necessarily symmetric) augmented versions to non-price choices of the CES, Logit, affine translation of those two, the linear demand and the translog, among others. In addition, to keep the extensive-margin adjustments tractable, I exploit the advantages of their incorporation through a continuum of firms. In my setup, small firms (hereafter, SFs) are modelled as in
Melitz (2003) and embedded into a market structure with a fixed number of BFs. The assumption is consistent with an interpretation where, although the number of BFs is given, the entry and exit of firms follow a productivity order.

One concern that arises in models where large firms are incorporated is the potential lack of result robustness. The concern turns to be especially acute when a set of incumbents move earlier than the rest of the firms. With the aim of assessing if the overinvestment pattern that generates home-bias outcomes hold within the class of models that I work with, I begin by conducting the analysis in a theoretical way. In particular, I evaluate its existence in relation to two matters. First, demand-enhancing investments encompass instruments with a different nature in terms of pricing. Thus, it is perfectly compatible to conceive investments that boost firms’ demand and, concurrently, increase or decrease the prices set by the firm. I show that there is overinvestment independent of how the investments affects the pricing decisions. In addition, I show that unlike typical two-stage oligopoly models, generically encompassed by Fudenberg and Tirole (1984), the overinvestment also arises irrespective if the competition is on quantities or prices. The key for this is that, while those models assume a given number of firms, I incorporate an extensive-margin dimension. The intuition behind is that if an incumbent underinvests to not induce a tougher competitive environment at the market stage, it would leave profits unexploited. Given the presence of an unbounded pool of potential entrants, this type of strategy would foster entry and turn futile the initial attempt of garnering higher rents.

The results of the model depict a situation with more concentration, less international trade relatively to the domestic counterpart, and possibly higher markups. In spite of this, consumers are not necessarily worse off. The reason is that the investments might take the form of non-price variables which are desirable for the con-

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3 In a context of symmetric firms within groups, Shimomura and Thisse (2012) and Parenti (2015) study models with the coexistence of small and large firms.

4 For instance, Feenstra and Ma (2007), Eaton, Kortum, and Sotelo (2012) and Gaubert and Itskhoki (2016). There, a sequential entry procedure is used to rule out equilibria where a subset of firms crowd out more efficient firms.

5 To illustrate this point, while the upgrade of a product increases the consumers’ willingness to pay, strategies to expand the customer base without modifying the product’s characteristics might imply reaching consumers with a lower marginal valuation of it.
Introduction

Martín Alfaro

Consumers (e.g. quality upgrades). The outcome echoes the core intuition of market contestability by Baumol, Panzar, and Willig (1982): even when a concentrated market is observed, the threat of entry, in opposition to actual entry, might discipline the incumbents in such a way that desirable welfare outcomes emerge. Thus, my model incorporates a channel through which trade improve the economies, as it is the effect of the tacit pressure of competition.

My paper contributes to different strands of the literature. First, it touches upon a growing literature that builds up empirical models recognizing the role of large firms as key players in international economies. Tightly connected to this, recently, several articles have emphasized on the importance of individual firms in aggregate outcomes. In general, these papers make use of a CES demand and assume either a fixed number of firms or resort to ad-hoc assumptions to model the mass of entrants. My contribution in this regard is developing a framework to analyze phenomena arising by the behavior of large firms. This approach is flexible enough to be applied to a wide range of cases, beyond to the one considered in this paper. In particular, it underscores the tool of aggregative games as a fruitful venue to model strategic interactions in empirical approaches.

Second, my paper speaks to a literature that studies endogenous mechanisms of home-bias patterns. While in general these papers resort to explanations concerning the production process or asymmetric preferences, I focus on a mechanism where large firms are at the center of the stage. Since I consider domestic firms as those

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7To name few, see Gabaix (2011), Acemoglu, Carvalho, Ozdaglar, and Tahbaz-Salehi (2012), Di Giovanni and Levchenko (2013), and di Giovanni, Levchenko, and Mejean (2014).

8For instance, Eaton, Kortum, and Sotelo (2012) and Gaubert and Itskhoki (2016) assume that the mass of firms is a random variable.

9In contexts with symmetric firms, several papers have remarked on the advantages of modeling oligopolies as aggregative games. See, for instance, Etro (2006), Parenti (2015), and Anderson, Erkal, and Piccinin (2016). In addition, Nocke and Schutz (2015) study multiproduct firms with quality heterogeneity, emphasizing on the incorporation of aggregative demands as a fruitful feature for coping with firm heterogeneity and, thus, structural quantifications.

10Different papers have provided and quantified an explanation for the home bias. Explanations from the supply side are provided, among others, by Hillberry and Hummels (2002), Yi (2010) and Chaney (2014). From the demand side, a vast literature, which goes back to at least Armington (1969), resorts to a taste for national goods. Recently, Caron, Fally, and Markusen (2014) explore the role of nonhomotheticities on home bias.
which are established in the market, these gains are also related to the strategic benefits that mature multinationals can garner from doing foreign direct investment.

Finally, the paper is related to a vast literature in Industrial Organization in which firms acquire first-mover advantages through sunk investments. My main contribution in this regard is exploiting the role of free entry to obtain an overinvestment pattern independently if the competition at the market stage is on prices or quantities.

2 On Sunk Investments and First Movers

In a setting where firms are nonnegligible in their own industry, the demand side constitutes the ground where firms exert influence on each other. For this reason, the incorporation of non-price choices expands the sources of strategic interactions between firms and the possibilities that they have to get a better position in the market. As my results hinge on this line of reasoning, in this section I expand upon it.

The idea that the competition between firms is broader than a mere choice of prices goes back to, at least, Schelling (1960). His main insight was that, in any game, once that is recognized that agents behave in a strategic way regarding their choices, it should also be acknowledged that they behave strategically concerning the game itself. That is, if agents have the opportunity, they do not take the rules of the game as given and make moves previous to the original game such that they alter it and achieve a better outcome. This idea has been applied to oligopolies to explain the actions chosen by incumbents with the aim of endogenously creating a profitable asymmetry. As Porter (1998) points out, “successful firms not only respond to their environment but also attempt to influence it in their favor.”

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11To see different models covered by this setup, see Shapiro (1989) or Gilbert (1989).
12Similar intuition has been noticed by Etro (2006, 2008) in an economy with incumbents and entrants coexisting. Relative to a baseline of the investments chosen by the entrants, he obtains an overinvestment pattern for the incumbents. In a context of symmetric entrants, Anderson, Erkal, and Piccinin (2016) extend his conclusion for the same benchmark I take as reference.
13Recent studies have provided evidence that the better performance of some firms relative to others is mainly due to differences in demand rather than costs (Foster, Haltiwanger, and Syverson, 2016; Hottman, Redding, and Weinstein, 2016).
In my setting, domestic firms’ advantages are materialized through an early choice of sunk expenditures that affect demand conditions.\footnote{Firms also have the possibility of sinking investments that affect production costs. As \cite{Sutton1991} argues, these expenditures affect all the markets that a firm serves, and so, in principle, there is no reason to believe that it entails an exclusive advantage in the firm’s home market.} These investments, by their sunk nature, once incurred cannot be recovered. Consequently, firms commit resources in a way that their decisions are irreversible and competitors have to condition their choices on these investments.\footnote{The sunk nature of investments plays an important role. Otherwise, if costs were fixed but not sunk, the decisions could be reverted and the interaction would be better described by a setting with simultaneous decisions. In terms of \cite{Schelling1960}, the sunk nature of the costs turns the decisions into a commitment.}

Different variables have been considered in the literature as endogenous sunk expenditures. The most prominent has been advertisement. Nonetheless, by definition, they include any expenditure which enhances the firm’s demand in subsequent stages of the market, thus encompassing a battery of investments. For instance, they include the introduction of new varieties, adaptation of the product to consumers’ tastes, and investments on distribution channels to make the product widely available.

In a context of international economies, first-mover advantages through sunk investments fit quite naturally given that domestic firms have established operations in the market they serve.\footnote{\cite{Foster2016} find empirical support for an active creation of a customer base by the firm as a more important determinant than a passive component of just being there.} This advantage arises by more information and experience regarding the home demand and country’s conditions. In addition, the better knowledge of the market might improve the effectiveness of firms’ strategies by creating more favorable conditions to tailor their strategies to the idiosyncrasies of the country.\footnote{Also, given the evidence of consumption inertia, that is consumers’ tendency to buy goods that they have purchased previously, an early presence could reduce the likelihood of consumers from switching to other brands (\cite{Bronnenberg2009}; \cite{Bronnenberg2012}).}

These advantages acquired by “being in the market” determines a head start over rivals and a sluggish response by entrants (\cite{Porter1998}) Moreover, under the definition of a domestic firm not by ownership but “being there", the strategic gains also relates to the benefits that mature multinational enterprises could reap from doing foreign direct investment.\footnote{\cite{Cosar2015} find empirical support for this argument. They carry out a}
3 The Setup

The setup can be understood as an extension of Melitz (2003) to account for non-price choices and large firms. Specifically, I assume that there are two type of firms coexisting, namely SFs and BFs. The former are of measure zero and I characterize them as in Melitz (2003). Likewise, there is a given number of BFs that know their productivity. Regarding the demand side, I embed a non-price choice into a demand system where interactions between firms take place through an aggregate measure of firms’ strategies. I discuss thoroughly each of these assumptions.

3.1 Generalities

There is a world economy comprised of $C$ countries, with $i$ as the reference country. In each country, there is a unit measure of agents which supply one unit of labor inelastically in a competitive market. Labor constitutes the only factor of production and firms can hire as many workers as they want by paying the same wage. Also, there is a sector which is competitive and consists of a homogeneous good. This is supplied under a freely available technology with constant returns to scale that requires one unit of labor to produce one unit of the good. I take this good as the numéraire and assume it is freely traded and produced in all the countries in equilibrium. As a result, wages in all countries are given and have a unit value.

In addition to this homogeneous sector, there is a differentiated sector composed of a set of horizontally differentiated varieties with a mixed measure: a continuum of potential varieties $\Omega^S \subseteq \mathbb{R}_+$ (endowed with the Lebesgue measure) and a finite discrete set $\Omega^B \subseteq \mathbb{N}$ of varieties (endowed with the counting measure). In turn, the set of varieties consumed in equilibrium is partitioned in terms of origins and destinations. Thus, $\Omega_{i}^{S}$ and $\Omega_{i}^{B}$ represent the sets of total varieties produced in $i$ by SFs and BFs, respectively, and consumed in country $j$.

The partition of firms in SFs and BFs is based on empirical grounds. Some concerns could be raised regarding how general the approach is, since there is a fixed study of the car industry and find evidence that consumers favor domestically producing brands even if these brands have originated in a foreign country.
number of BFs. Nonetheless, taking that BFs are more productive than SFs as a plausible assumption, the scenario reflects an entry and exit mechanism that follows an efficiency order. \footnote{In models of oligopolistic competition, equilibria where less efficient firms crowd out more efficient ones could exist. Due to this, a standard assumption in the literature has been that entry and exit follow a productivity ranking. For instance, Feenstra and Ma (2007), Eaton, Kortum, and Sotelo (2012) and Gaubert and Itskhoki (2016) assume this sequential entry procedure.}

3.2 Supply Side

In each country, two types of firms, small and big, are operating. Each SF is negligible in terms of the industry while a BF is of nonzero measure and, hence, can influence industry-aggregate variables. From now on, I use the subscript $ij$ to refer to $i$ as the origin and $j$ as the destination.

Regarding SFs in country $i$, the supply side is as in Melitz (2003). There is an unbounded pool of prospective entrants which are ex ante identical. To enter, they consider to pay a fixed (sunk) entry cost $F_i^S$ which enables them to receive a productivity draw $\varphi$ and an assignation of a variety $\omega$. The random variable representing productivity has a nonnegative support $\Phi_i^S$ with bounds $\varphi_i^S$ and $\varphi_i^S$, and a cumulative distribution function $G_i^S$. I suppose that $\varphi_i^S$ is finite since below I will impose conditions consistent with the fact that any BF is more productive than a SF. The decisions regarding serving each country are made once that SFs know their productivity. They have the option of not selling in country $j$ or incurring an overhead fixed cost $f_{ij} \geq 0$ to sell in $j$. \footnote{I assume that, if there is an infinite choke price, then $f_{ij} > 0$. The possibility that $f_{ij} = 0$ is usually employed under the presence of a finite choke price as it is sufficient to generate selection of the most efficient firms into exports.} The production technology determines constant marginal costs $c(\varphi, \tau_{ij})$, where $\tau_{ij}$ represents a trade cost that a firm in $i$ has to incur to have one unit arriving at destination $j$. I adopt the convention that $\tau_{ii} := 1$ and make the usual assumption that costs are such that if the firm self-selects into exporting then it is also active in the domestic market. The marginal costs function $c(\cdot)$ is smooth and satisfies $\frac{\partial c(\varphi, \tau_{ij})}{\partial \varphi} < 0$ and $\frac{\partial c(\varphi, \tau_{ij})}{\partial \tau_{ij}} > 0$. In words, $\varphi$ is a variable that represents efficiency, and trade costs increase the marginal costs of the firm.

If the SF from $i$ decides to pay the overhead cost $f_{ij}$, then it makes a decision on
prices in $j$. Formally, $p_{ij}^S(\omega) \in P := [0, \bar{p}] \cup \{\infty\} \text{ with } \bar{p} > 0$.\footnote{I simplify the problem by assuming that SFs do not make decisions on non-price variables. This could be easily incorporated. The conclusions are independent of this assumption.} I suppose that setting an infinite price captures the situation in which the firm has decided not paying the overhead cost and so remaining inactive in country $j$.

The measure of incumbent SFs in country $i$ is denoted by $J_i^S$. Thus, the measure of active firms in $i$ selling to $j$ is given by $M_{ij}^S := [1 - G_i^S(\varphi_{ij})] J_i^S$ where $\varphi_{ij}$ is the productivity cutoff of a SF from $i$ to break even in country $j$.

As far as BFs in country $i$ go, there is a given number $J_i^B$ of them, where each firm has a variety $\omega$ and productivity $\varphi_\omega$ assigned. The set of productivities of these firms is denoted by $\Phi_i^B$ where $\underline{\varphi}_i^B := \inf \Phi_i^B$ and $\overline{\varphi}_i^B := \sup \Phi_i^B$. BFs’ productivities are common knowledge among all the firms. I suppose that the least productive BF is more productive than the most productive SF, that is, $\underline{\varphi}_i^B > \overline{\varphi}_i^S$. This implies that the entry and exit of firms in a market respects an order of productivity. Put it differently, in each equilibrium where there is a coexistence of SFs and BFs, the entry and exit of firms is in terms of SFs. I simplify the problem by assuming that BFs do not pay an overhead cost in order to produce in market $j$. Regarding the production technology, the marginal costs take the same functional form as SFs’.

Each BF makes two choices in each country. For country $j$, it decides on prices $p_{ij}^B(\omega) \in P$ and investments $z_{ij}(\omega) \in Z := [0, \bar{z}]$ with $\bar{z} > 0$. The cost of $z_{ij}(\omega)$ entails a sunk expenditure given by a smooth convex function $f_\varepsilon [z_{ij}(\omega)]$. Notice that, given that BFs choose prices, it is implicitly assumed that competition in the market is à la Bertrand. A setup à la Cournot is considered in Appendix C.1.

Throughout the paper, I suppose that, in equilibrium, both types of firms are always active.\footnote{This requires as a necessary condition that the differences in productivity between SFs and BFs are not extremely pronounced.}

### 3.3 Demand Side

Instead of deriving demands from consumers’ preferences, I take them as a primitive. Unlike the approach followed so far, I also enumerate the assumptions regarding the demand side to keep track of them and show their role in the results.
One of the main challenges in frameworks with nonzero measure firms, several choices, heterogeneity and a variable number of firms, is the proliferation of dimensions to which the game may be subject to. Due to this, the problem without additional structure becomes unwieldy. This plays a central role given my ultimate goal of building a structural model to deal with the empirical side.

Attending to this, I impose a demand system that is apt to describe the strategic interactions through a real-valued function that aggregates the strategies of all the firms. This function could be understood as a single sufficient statistic that describes the industry conditions. Examples of aggregators are the price index of a CES demand and the choke price of a linear demand.

By this feature of the demand, it is possible to make use of Aggregative Games tools, which we exploit throughout the paper. In formal terms, the fact that the demand is apt to be expressed in terms of an aggregator can be stated formally in the following way.

**Assumption 1.** The demand function of a variety \( \omega \) produced by a firm from \( i \) and sold in \( j \) is a smooth function such that for a BF it can be expressed by \( Q_{ij}^B(\omega) := Q[A_j, z_{ij}(\omega), p_{ij}^B(\omega)] \) and for a SF it is \( Q_{ij}^S(\omega) := Q[A_j, p_{ij}^S(\omega)] \) where \( A_j \) is an aggregator for country \( j \).

To reduce the notation burden, let a strategy for a BF and SF from \( i \) producing variety \( \omega \) and selling in \( j \) be defined, respectively, by \( x_{ij}^B(\omega) := \left(z_{ij}(\omega), p_{ij}^B(\omega)\right) \) and \( x_{ij}^S(\omega) := \left(p_{ij}^S(\omega)\right) \). The vector of strategies for each type of a firm from \( i \) in country \( j \) are \( x_{ij}^B := \left(x_{ij}^B(\omega)\right)_{\omega \in \Omega_{ij}^B} \) and \( x_{ij}^S := \left(x_{ij}^S(\omega)\right)_{\omega \in \Omega_{ij}^S} \). More compactly, denote \( x_{ij} := \left(x_{ij}^S, x_{ij}^B\right) \) the strategies set by firms from \( i \) in country \( j \). Regarding the space of strategies, let \( X_{ij}^S, X_{ij}^B \) refer to the space of strategies for each type of firm and \( X_{ij} \) to the space of \( x_{ij} \).

Following Jensen (2016), throughout the text I distinguish between \( A_j \left[\left(x_{ij}\right)_{i=1}^C\right] \) and \( A_j \). While the former is called an *aggregator*, which is a function of all the strategies chosen by the firms, the latter is an *aggregate*, that is, a specific value of the function.

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23 The theory of Aggregative Games is initiated by Selten (1970). They are defined as those where agents make decisions taking into account only the aggregate response of other players. For some general reference, see Corchón (2013) or Jensen (2016).
Without any additional structure on the aggregator, its derivatives could still depend on some of the aggregator’s arguments. This becomes relevant since the characterization of optimal strategies through first order conditions requires knowledge of the marginal profits. Assuming that the aggregator is additively separable ensures that the derivatives are a function of the aggregate.24 Following Acemoglu and Jensen (2013) and adapted to our context, I define an aggregator as an additive separable function of firms’ strategies.

Definition 1. An aggregator $\mathcal{A}_j : \times_{i=1}^{C} X_{ij} \rightarrow \mathbb{R}_+$ for country $j$ is a smooth function such that for each country $i$ there are smooth strictly monotone functions such that $H_j : \mathbb{R} \rightarrow \mathbb{R}_+$, $h^B_\omega : X^B_{ij} \rightarrow \mathbb{R}_+$ and $h^S_i : X^S_{ij} \rightarrow \mathbb{R}_+$ where $h^C_i$ is measurable, such that $\mathcal{A}_j \left[ \left( x_{ij} \right)_{i=1}^{C} \right] := H_j \left[ \mathbb{P}_j \left[ \left( x_{ij} \right)_{i=1}^{C} \right] \right]$ and,

$$H_j \left[ \mathbb{P}_j \left[ \left( x_{ij} \right)_{i=1}^{C} \right] \right] = \sum_{i=1}^{C} \left[ \int_{\omega \in \Omega^S_{ij}} h^S_i \left[ x^S_{ij} (\omega) \right] d\omega + \sum_{\omega \in \Omega^B_{ij}} h^B_\omega \left[ x^B_{ij} (\omega) \right] \right]$$

In words, an aggregator as in Definition 1 is any function of the firms’ strategies such that, after a monotone transformation, it can be expressed as an additive separable function.25

Although at first glance demand functions that depend on an additive separable aggregator could seem restrictive, they actually give enough flexibility. In Appendix A, I provide several examples of standard demands expressed as function of prices that admit an additive separable aggregator. Among others, it covers demands belonging to the constant expenditure system, including the CES, attraction demand models (Luce, 1959), including the Multinomial Logit, the translog demand, a linear-in-prices demand, demands derived from an additive indirect utility, the Stone-Geary demand, and affine translations of the CES as in Arkolakis, Costinot, Donaldson, and Rodríguez-Clare (2015). Departing from the demands depending on only prices, they can be augmented to incorporate non-price choices.

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24 Cornes and Hartley (2012) show that additive separability is not only sufficient but also necessary for this to hold when proper monotonicity conditions are met. In this sense, the results are as general as possible.

25 The fact that the aggregators accept monotone transformations entails that they are not uniquely determined.
In addition, notice that \( h^B_\omega \) represents possibly asymmetric functions. As a result, price and non-price parameters could be firm-dependent, allowing for firm heterogeneity on the demand side. For instance, with a CES demand and in a setting where firms only make price decisions, it allows for elasticity of substitution which are heterogeneous across firms. In Appendix C.3, I show that the model could be extended to incorporate multiproduct firms with nested-CES demands where groups are defined by varieties produced by the same firm.

Finally, I add some assumptions concerning the demand and the aggregator in line with the situation I intend to capture. First, I incorporate monotonicity assumptions consistent with a investments that are demand enhancing. Besides, I make assumptions such that the aggregator could be interpreted as a measure of toughness of competition: the greater the value of the aggregate, the lower firm’s demand. Consistent with this interpretation too, I suppose that decreases in prices and increases in the investments determine a tougher competitive environment.

**Assumption 2.** The demand is consistent with assumption 1 where the aggregator is as in definition 1. Moreover, for any type of firm \( t = \{S,B\} \), I assume that \( \frac{\partial H_j(P_j)}{\partial P_j} < 0 \), \( \frac{\partial Q_{ij}(\omega)}{\partial h_{ij}} < 0 \), \( \frac{\partial Q_{ij}(\omega)}{\partial p_{ij}(\omega)} < 0 \), and \( \frac{\partial h^S_{ij}(\omega)}{\partial p_{ij}(\omega)} < 0 \). Besides, \( \frac{\partial Q_{ij}(\omega)}{\partial z_{ij}(\omega)} > 0 \) and \( \frac{\partial h^B_{ij}(\omega)}{\partial z_{ij}(\omega)} > 0 \).

I neither assume that prices are strategic complements or substitutes or the sign of the cross derivative of the demand with respect to the investments and own prices. Nonetheless, I assume these signs are monotone so that there are either increasing or decreasing differences globally in each case.

The assumptions imply that goods are substitutes. Notice that I do not constrain either the choke price to be finite or infinite.

### 4 The Model

Following Fudenberg and Tirole (1991), strategic gains are captured by a comparison of the strategies chosen in the open-loop and closed-loop equilibrium. These concepts refer to the equilibria of two different game structures. The closed-loop equilibrium corresponds to the case where domestic BFs choose the investments prior to the com-
petitors’ decisions. Thus, rival firms condition their decisions on the choices made by domestic BFs. The outcome is compared with a benchmark given by an open-loop equilibrium, scenario where all BFs make simultaneous choices on investments at the market stage. In other terms, importers do not condition their decisions on the behavior of domestic BFs. From a comparison between both, the gains and consequences of the asymmetries in the timing of choice are isolated.

In what follows, I describe and solve the model under each scenario. Then, I proceed to compare their solutions. A backward-induction procedure is used to solve both cases.

4.1 Simultaneous Case

Consider country $i = 1, \ldots, C$. The timing of the simultaneous game is as follows (see Figure 1).

[i] SFs of each country $i$ decide whether to pay the sunk entry cost $F_i$ to get a draw of productivity $\varphi$ and a variety $\omega$ assigned.

[ii] The market stage in each country $i$ takes place. Let $j = 1, \ldots, C$.

- The SFs from $j$ which paid $F_i$ decide whether to serve country $i$ by paying the fixed cost $f_{ji}$ or exit. If they serve country $i$, they make a price decision for it.
- BFs from $j$ make choices on the strategic investments for country $i$.
- BFs from $j$ choose prices for country $i$.

**Figure 1: Timing of the Simultaneous Case**
4.1.1 Optimal Decisions at the Market Stage

At this stage, the mass of SFs $J^S := (J_i^S)_{i=1}^C$ is given. Endowing the strategic interactions with an aggregative feature results in that the optimal decisions can be described in terms of replacements functions instead of best-reply functions. A replacement function expresses an optimal strategy as a function of the aggregate strategies, that is, including not only other firms’ strategies but also own firm’s strategy. While best-reply and replacements functions can be used interchangeably to characterize equilibrium conditions, the latter has the advantage of allowing for an easier description of the solutions. In addition, it is well suited and natural for models which incorporate, partially or totally, a monopolistic competition structure.

The description of the solution for SFs follows the standard procedure of models of monopolistic competition with firm heterogeneity. A SF from $i$ with productivity $\varphi$ has to make two choices regarding market $j$: whether serving the market $j$ by paying a fixed cost $f_{ij}$, and the price it would set in case it decides to be active in that market. The decisions are characterized through a survival productivity cutoff and an optimal price. Formally, if setting an infinite price in $j$ is interpreted as not serving the market, the optimization problem is the following,

$$
\max_{(p_{ij})_{j=1}^C} \pi_i^S (p_{ij}; \varphi) = \sum_{j=1}^C \mathbb{1}_{(p_{ij} < \infty)} \left\{ \pi_{ij}^S (A_j, p_{ij}; \varphi) - f_{ij} \right\},
$$

where $\pi_{ij}^S (A_j, p_{ij}; \varphi) := Q (A_j, p_{ij}) \left[ p_{ij} - c_{ij} (\varphi) \right]$ represents firm’s gross profits.

As any SF is is negligible in any market $j$, it takes the aggregate $A_j$ as given. Thus, the optimal price of an active firm $p_{ij}^S (A_j; \varphi)$ is characterized implicitly by the following equation,

$$
\frac{\partial \pi_{ij}^S (A_j, p_{ij}; \varphi)}{\partial p_{ij}} = 0 \text{ for } j = 1, ..., C.
$$

By denoting $\pi_{ij}^S (A_j; \varphi)$ the gross profits evaluated at the optimal prices, the sur-

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26There is no consensus on how these functions are called. I follow Cornes and Hartley (2012) by using the term replacement function. Acemoglu and Jensen (2013) refer to them as backward-reply functions and Anderson, Erkal, and Piccinin (2016) as cumulative best-reply functions.
vival productivity cutoff \( \varphi_{ij}^* \) is determined by the zero cutoff profit condition,

\[
\pi^S_{ij} \left( A_j, \varphi_{ij}^* \right) = f_{ij} \text{ for } j = 1, ..., C. \quad (3)
\]

Given that, in terms of endogenous variables, the left-hand side of equation (3) only depends on \( A_j \), we have that \( \varphi_{ij}^* = \varphi_{ij}(A_j) \).

As regards of BFs, given other firms’ strategies, a firm from \( i \) with productivity \( \varphi \) chooses prices and the level of the non-price variable by solving the following optimization problem,

\[
\max_{(p_{ij}, z_{ij})} \sum_{j=1}^{C} \pi^B_{ij} \left( A_j, p_{ij}, z_{ij}; \varphi \right), \quad (4)
\]

where \( \pi^B_{ij} (A_j, p_{ij}, z_{ij}; \varphi) := Q(A_j, p_{ij}) \left[ p_{ij} - c_{ij}(\varphi) \right] - f_z(z_{ij}). \) Unlike SFs, BFs make decisions taking into account their influence on the aggregate conditions of the market. Given rivals’ strategies, the optimal prices and non-price decision of a BF are characterized by,

\[
\frac{\partial \pi^B_{ij} (A_j, p_{ij}, z_{ij}; \varphi)}{\partial p_{ij}} + \frac{\partial \pi^B_{ij} (A_j, p_{ij}, z_{ij}; \varphi)}{\partial A_j} \frac{\partial A_j}{\partial p_{ij}} = 0 \text{ for } j = 1, ..., C, \quad (5a)
\]

\[
\frac{\partial \pi^B_{ij} (A_j, p_{ij}, z_{ij}; \varphi)}{\partial z_{ij}} + \frac{\partial \pi^B_{ij} (A_j, p_{ij}, z_{ij}; \varphi)}{\partial A_j} \frac{\partial A_j}{\partial z_{ij}} = 0 \text{ for } j = 1, ..., C. \quad (5b)
\]

By the additive separability of the aggregator, \( \frac{\partial A_j}{\partial p_{ij}} \) and \( \frac{\partial A_j}{\partial z_{ij}} \) can be expressed as functions of the aggregate. In other terms, the aggregate is a sufficient statistic to make all the decisions. Therefore, the solutions are \( p^B_{ij} (A_j; \varphi) \) and \( z_{ij} (A_j; \varphi) \).

### 4.1.2 Market-Stage Equilibrium and Determination of the SFs’ Mass

By making use of these optimal decisions, I proceed to characterize the equilibrium of the market stage. This requires adding the market-clearing conditions of all countries, or, equivalently, determining a Nash equilibrium.

By exploiting the structure of the problem, a profile of strategies is a Nash equilibrium if and only if there exists a value of aggregate such that all firms are optimizing
simultaneously. Formally, define the aggregate replacement function of country \( i \) by,
\[
\Gamma \left( A_i; J^S \right) := \sum_{j=1}^{C} \left[ f_j^S \int_{\varphi_{ji}(A_i)}^{\varphi_i} h_j^S \left[ p_{ji}^S \left( A_i; \varphi \right) \right] dG_j^S \left( \varphi \right) + \sum_{\varphi_{\omega}} h_{\omega}^B \left[ p_{\omega j}^B \left( A_i; \varphi_{\omega} \right), z_{ji} \left( A_i; \varphi_{\omega} \right) \right] \right],
\]
where I have used the fact that \( \frac{M_{\omega j}^S}{1-G_j^S(\varphi_{ji})} = J_j^S \). A Nash equilibrium is reduced to find a fixed point of \( \Gamma \) for each country \( i \), that is, a \( \left( A_{i}^* \right)_{i=1}^{C} \) such that,
\[
\Gamma \left( A_{i}^*; J^S \right) = A_{i}^* \quad \text{for} \quad i = 1, \ldots, C. \tag{6}
\]
By solving the \( C \) equations of (6), a solution \( A_{i}^* := A_i \left( J^S \right) \) for each \( i = 1, \ldots, C \) is obtained.

Regarding the determination of the SFs’ mass \( J^S \) in each country \( i \), SFs enter until the following free-entry conditions are satisfied:
\[
\sum_{j=1}^{C} \int_{\varphi_{ji}(A_i)}^{\varphi_i} \left\{ \pi_{ij} \left[ A_j \left( J^S \right); \varphi \right] - f_{ij} \right\} dG_j^S \left( \varphi \right) = F_i \quad \text{for} \quad i = 1, \ldots, C.
\]

### 4.2 Sequential Case

Consider country \( i = 1, \ldots, C \). The timing of the sequential game is as follows (see Figure 2).

1. Domestic BFs from \( i \) make choices on the investments for their home country.
2. SFs of each country \( i \) decide whether to pay the (sunk) entry cost \( F_i \) to get a draw of productivity \( \varphi \) and a variety \( \omega \) assigned.
3. The market stage in each country \( i \) takes place.
   - The SFs from \( j = 1, \ldots, C \) which have paid the entry cost decide whether to serve country \( i \) by paying the fixed cost \( f_{ji} \) or exit. If they serve country \( i \), they make a price decision for it.
   - BFs from \( j \neq i \) make choices on the investments for country \( i \).
   - BFs from \( i \) and \( j \neq i \) choose prices for country \( i \).
4.2.1 Market-Stage Equilibrium and Determination of the SFs’ Mass

The description of SFs’ decisions is as is in the baseline case. A SF from $i$ solves the optimization problem (1). Its pricing decisions and productivity cutoffs are determined by equations (2) and (3). They determine the same solutions $p^S_{ij}(A_i; \varphi)$ and $\varphi_{ij}(A_j)$.

Concerning BF, at this stage, the decision regarding the investments of a firm producing variety $\omega$ in the domestic market has been made. Denote its value by $\bar{\pi}_{ii}^{\omega}$. BF make decisions regarding prices in all the markets, and strategic investments in all markets $j \neq i$. These choices are described by equations (5a) and (5b), respectively. The solutions are functions $p^B_{ij}(A_i; \varphi_{\omega})$ and $z_{ij}(A_i; \varphi_{\omega})$ for $j \neq i$, and $p^B_{ii}(A_i; \varphi_{\omega_1}, \varphi_{\omega_2})$.

Denote $J^S := \left( J^S_i \right)_{i=1}^C$ and $z_{\text{dom}} := \left( \bar{\pi}_{ii}^{\omega} \right)_{i=1}^C$. As in the case of a simultaneous decision, define the aggregate replacement function of country $i$ by,

$$r(A_i; J^S, z_{\text{dom}}) := \sum_{j=1}^C \int_{\varphi_j(A_i)}^{\bar{\varphi}_{j}} k_{j}^S \left[ p^B_{ij}(A_i; \varphi) \right] d\bar{G}_{i}^S(\varphi) + \sum_{j=1}^C \sum_{\varphi_{\omega}} k^S \left[ p^B_{ij}(A_i; \varphi_{\omega}), z_{ij}(A_i; \varphi_{\omega}) \right] + \sum_{\varphi_{\omega_1}, \varphi_{\omega_2}} k^S \left[ p^B_{ii}(A_i; \varphi_{\omega_1}, \varphi_{\omega_2}), \bar{\pi}_{ii}^{\omega} \right].$$

Given $J^S$ and $z_{\text{dom}}$, variety-markets clear in all countries if and only if there exists a $\left( A^*_i \right)_{i=1}^C$ such that

$$r(A^*_i; J^S, z_{\text{dom}}) = A^*_i \text{ for } i = 1, ..., C.$$ (7)

By solving the $C$ equations (7), we get the solution $A^*_i := A_i(J^S, z_{\text{dom}})$ for each $i = 1, ..., C$.

Finally, given $z_{\text{dom}}, J^S$ is determined by the following free-entry conditions,

$$\sum_{j=1}^C \int_{\varphi_j(A_j; J^S, z_{\text{dom}})}^{\bar{\varphi}_{j}} \left\{ \pi_{ij} \left[ A_j \left( J^S, z_{\text{dom}} \right) ; \varphi \right] - f_{ij} \right\} d\bar{G}_{i}^S(\varphi) = F_i \text{ for } i = 1, ..., C.$$ (8)

Denote the solution to (8) by $J^S(z_{\text{dom}})$. Also, denote $A_j(z_{\text{dom}}) := A_j \left( J^S \left( z_{\text{dom}} \right) ; z_{\text{dom}} \right)$. 

---

**Figure 2: Timing of the Sequential Case**

<table>
<thead>
<tr>
<th>Early Domestic Moves in each country $i$</th>
<th>Entry Stage in each country $i$</th>
<th>Market Stage in each country $i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Domestics</td>
<td>Small Firms</td>
<td>Big Importers</td>
</tr>
<tr>
<td>investments $z_{ii}$</td>
<td>pay or not entry cost $F_i$</td>
<td>pay fixed cost $f_{ii}$ or exit</td>
</tr>
<tr>
<td>Small Firms</td>
<td>(to know productivity $\varphi$)</td>
<td>prices $p^B_{ii}$</td>
</tr>
<tr>
<td>Big Domestics</td>
<td></td>
<td>investments $z_{ji}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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4.2.2 Analysis of the Subgame

Before analyzing BFs’ decisions regarding their domestic investments, I establish some properties of the equilibrium corresponding to the subgame studied so far. The goal of this analysis is to simplify the understanding of how domestic investments decisions are made. To keep track of these features, I state them as properties. They follow by simple inspection of the equilibrium conditions.

In the subgame where domestic investments have been already chosen, the vector \( \mathbf{z}_{\text{dom}} \) is treated as exogenously given, and the equilibrium is determined by the equations (7) and (8). Furthermore, given the structure of the problem, the equations are completely determined by the values of \( J^S \) and \( (A_i)_{i=1}^C \). From an inspection of the optimal decisions, it can be observed that the following property holds.

**Subgame-Equilibrium Property P1.** Consider SFs and BFs from \( i \). Then,

[i] for any \( j = 1, \ldots, C \), the optimal decisions made by SFs and the survival productivity cutoff are completely determined by \( A_j \), and

[ii] for any \( j \neq i \), the optimal decisions made by BFs are completely determined by \( A_j \).

This implies that, conditional on \( A_j \), all these decisions are independent of \( J^S \), \( \mathbf{z}_{\text{dom}} \) and \( (A_i)_{j \neq i} \).

Property (P1) includes all the decisions made by SFs as well as the choices by BFs except those regarding the domestic market. For domestic choices, the following property holds.

**Subgame-Equilibrium Property P2.** For a BF from \( i \) producing a variety \( \omega \), its optimal domestic price is completely determined by \( A_i \) and \( \mathbf{z}_{\text{dom}}^{\omega} \). In particular, this implies that, conditional on \( A_i \) and the firm’s own investments, its domestic pricing decision is independent of \( J^S \), \( (A_i)_{j \neq i} \), \( \left( \mathbf{z}_{\text{dom}}^{\omega_j} \right)_{\omega \in \Omega_j} \) and \( \left( \mathbf{z}_{\text{dom}}^{\omega'} \right)_{\omega' \neq \omega} \).

It is worth of remark that property (P2) on its own does not imply that the domestic pricing choices are independent of the different variables that affect the market conditions. The property states that if any variable has an effect on domestic prices, it has to be indirectly and through \( A_i \). The same caveat applies to (P1). Thus, the analysis of how \( A_i \) is determined and the variables which influence its value in equilibrium become crucial for how domestic decisions are made.
In order to understand how the aggregates are determined, by inspection of condition \( (8) \), observe that \( J^S \) does not influence directly the expected profits of a SF. In other terms, conditional on \( (A_i)_{i=1}^C \), the expected profits of a SF are completely determined. Therefore, given that in the subgame \( (A_i)_{i=1}^C \) and \( J^S \) are the endogenous variables that completely characterize the equilibrium, the following is concluded.

**Subgame-Equilibrium Property P3.** The free-entry conditions \( (8) \) pin down the equilibrium value of \( (A_i)_{i=1}^C \) independently of \( J^S \). As a result, given the equilibrium value \( (A_i^*)_{i=1}^C \), the equilibrium value of \( J^S \) is completely determined by the system of equations \( (7) \).

Property \( (P3) \) has an intuitive interpretation. In equilibrium, the optimal profits of SFs in each country are completely determined by the aggregate conditions of the country. Once that the free-entry conditions are added, the aggregate conditions of all countries are pinned down. Given an exogenous number of BFs, this means that the mass of SFs is a residual variable which adjusts to be consistent with the equilibrium values of the aggregates. All the properties stated so far lead to the following conclusion in terms of how domestic investments are chosen.

**Subgame-Equilibrium Property P4.** \( z_{dom} \) does not affect directly the expected profits of SFs. Thus, by property \( (P3) \), \( z_{dom} \) cannot affect the equilibrium value of \( (A_i)_{i=1}^C \) and only affects the equilibrium value of \( J^S \).

### 4.2.3 Investments Decisions by Domestic Firms

I begin by stating the the domestic investments decisions without considering any of the subgame-equilibrium properties derived. After this, I add those results and characterize the decision.

At this stage and by the backward-induction procedure, the problem of a BF from \( i \) is,

\[
\max_{z_{ii}} \pi_{ii}^B \left[ A_i (z_{dom}), p_{ii}^B [A_i (z_{dom}), z_{ii}; \varphi; \omega], z_{ii}; \varphi; \omega \right].
\]  

\[ (9) \]
The first-order condition is\footnote{From now on, to not overcomplicate the notation, I state the arguments of functions only once in each equation and use \texttt{\{\}} when they should be repeated.},
\[
\frac{d\pi^B_{ii} [\cdot]}{dz_{ii}} = \frac{\partial \pi^B_{ii} [\cdot]}{\partial z_{ii}} + \frac{\partial \pi^B_{ii} [\cdot]}{\partial A_i} dA_i(z_{\text{dom}}) + \frac{\partial \pi^B_{ii} [\cdot]}{\partial p_{ii}} dp_{ii}(A_i(z_{\text{dom}}), z_{ii}, \varphi, \omega) = 0. \tag{10}
\]

Notice that regarding the third term of \text{(10)}, \[
\frac{dp_{ii}(A_i(z_{\text{dom}}), z_{ii}, \varphi, \omega)}{dz_{ii}} = \frac{\partial p_{ii}[\cdot]}{\partial z_{ii}} + \frac{\partial p_{ii}[\cdot]}{\partial A_i} dA_i(z_{\text{dom}}). \]

By property (P4), the domestic investment cannot influence the equilibrium value of the aggregates, and, therefore, \[
\frac{dA_i(z_{\text{dom}})}{dz_{ii}} = 0. \]
To make explicit that \(A_i(z_{\text{dom}})\) does not depend on \(z_{\text{dom}}\) and it can be treated exogenously given by the firm, denote its equilibrium value by \(A_i^*\).

Incorporating this result, equation \text{(10)} can be reexpressed as,
\[
\frac{d\pi^B_{ii} [A_i^*, p_{ii}^B(A_i^*, z_{ii}; \varphi, \omega), z_{ii}; \varphi, \omega]}{dz_{ii}} = \frac{\partial \pi^B_{ii} [\cdot]}{\partial z_{ii}} + \frac{\partial \pi^B_{ii} [\cdot]}{\partial p_{ii}} \frac{dp_{ii}^B(A_i^*, z_{ii}; \varphi, \omega)}{dz_{ii}} = 0 \tag{11}
\]

Equation \text{(11)} is composed of two terms. The first term represents the effect of the investments on profits ignoring the aggregate conditions of the market and the pricing decisions. This term is taken into account by any firm, irrespective if it is large or small.

The second term reflects a strategic effect. This is present even when, by property (P4), the investments cannot influence the equilibrium value of the aggregate. The reason is that there is an asymmetry in terms of how a firm chooses the investments and prices. At the moment of choosing prices, the mass of firms is given. Hence, prices are set considering the effect on the aggregate, determining that BFs follow a less aggressive pricing strategy. This introduces a strategic effect as the choice of the investments modifies the incentives to choose a specific price. Although in equilibrium the value of the aggregate is the same, the mass of entrants depend on the type of competition that firms expect at the market stage. Consequently, by pricing more aggressively, BFs can capture a greater portion of the market.
4.3 On Demand-Enhancing Variables

Before analyzing the results, I add some structure consistent with the idea that investments are demand enhancing. Basically, the assumptions rule out the case in which investments provide incentives to increase the prices and the effect is big enough that the firm could end up facing a lower demand. In fact, as it is shown below, it is enough that the investments are revenue enhancing, allowing for even decreases in the quantities demanded as long as they are compensated through a sufficient increase of prices.\footnote{To understand why it is not ensured that investments are demand enhancing, notice that increases in the investments affect the demand not only directly but also indirectly through prices. Since at least Spence (1975) it is well known that, even when it is assumed that the direct effect boosts firm’s demand, the increments of the strategic variable may impact positively or negatively on the prices. The latter case might arise if, for instance, investments allow the firm to expand the market and reach consumers with a lower propensity to spend on the good.}

I state the assumptions formally and then provide an interpretation of them.

**Assumption A2a.** Let $A_i^*$ be the equilibrium value of the aggregate. Then, either:

\[ i) \quad \frac{\partial p_i^0(A_i^*, z_{ii}; p_{wi})}{\partial z_{ii}} \leq 0, \text{ or} \]

\[ ii) \quad \frac{\partial p_i^0(A_i^*, z_{ii}; p_{wi})}{\partial z_{ii}} > 0, \text{ then } \frac{dA_i}{dz_{ii}} \left[ (x_i)_{j=1}^C \right] := \frac{\partial A_i}{\partial p_i} \frac{\partial p_i^0(A_i^*, z_{ii}; p_{wi})}{\partial z_{ii}} + \frac{\partial A_i}{\partial z_{ii}} > 0. \]

**Assumption A2b.** Let $A_i^*$ be the equilibrium value of the aggregate. Then, either:

\[ i) \quad \frac{\partial p_i^0(A_i^*, z_{ii}; p_{wi})}{\partial z_{ii}} \leq 0, \text{ or} \]

\[ ii) \quad \frac{\partial p_i^0(A_i^*, z_{ii}; p_{wi})}{\partial z_{ii}} > 0, \text{ then } \frac{dA_i}{dz_{ii}} \left[ (x_i)_{j=1}^C \right] := \frac{\partial A_i}{\partial p_i} \frac{\partial p_i^0(A_i^*, z_{ii}; p_{wi})}{\partial z_{ii}} + \frac{\partial A_i}{\partial z_{ii}} > 0 \text{ and either} \]

\[ \frac{\partial Q_{ii}}{dz_{ii}} \left[ A_i^*, z_{ii}; p_i^0(A_i^*, z_{ii}; p_{wi}); p_{wi} \right] > 0, \text{ or } \frac{\partial Q_{ii}}{dz_{ii}} \left[ A_i^*, z_{ii}; p_i^0(A_i^*, z_{ii}; p_{wi}); p_{wi} \right] > 0. \]

Notice that Assumption (A2b) holds then assumption (A2a) holds too. In fact, Assumption (A2b) is the same as (A2a) but with an additional condition regarding \( ii) \).

Condition \( i) \) of both assumptions has a straightforward interpretation. It captures that investments have a negative impact on prices.

Condition \( ii) \) in both assumptions deal with the case where investments increase the prices set. Regarding condition \( ii) \) in (A2a), it means that direct effects of $z_{ii}$ on $A_i$ dominate the indirect effects of $z_{ii}$ through prices. Thus, greater investments create a tougher competitive environment, even if prices end up being higher.
The additional condition of \( \text{ii)} \) in Assumption (A2b) is composed of two alternatives: one where increase the quantities sold in equilibrium and other when at least it increases the firm’s revenue.

### 4.4 Results

In what follows, I present the results that emerge from the comparison of the simultaneous and sequential scenarios. This allows me to identify the impact stemming from the asymmetry of opportunities between domestic firms and importers, I state them as propositions and provide some intuitions about them, relegating all the proofs to Appendix B.

The following outcome concerns the profits of BFs, and it does not need of either Assumption (A2a) or (A2b).

**Proposition 4.1**

Denote \( \pi_{i}^{\text{seq}}(\varphi_\omega) \) and \( \pi_{i}^{\text{sim}}(\varphi_\omega) \) the equilibrium total profits of a BF from \( i \) with productivity \( \varphi_\omega \). Then, \( \pi_{i}^{\text{seq}}(\varphi_\omega) \geq \pi_{i}^{\text{sim}}(\varphi_\omega) \).

Proposition 4.1 follows trivially once that the following is noticed. As long as the group of SFs is active, any deviation of a BF in the sequential equilibrium would impact the mass of SFs around the world, but the market conditions, summarized by the aggregate, would remain the same. In particular, the equilibrium tuple \( (\bar{A}_i \bar{C})_{i=1} \) would be the same in the simultaneous and sequential equilibrium. Thus, a BF chooses the optimal investments in the sequential scenario with the possibility of attaining the same profits as under the simultaneous case.\(^{29}\)

Regarding the characterization of BFs’ decisions, the following proposition formalizes the overinvestment in the domestic market.

\(^{29}\)Notice that the result would not necessarily be true if the value of the aggregates would not co-incide under both equilibria. In that case, it cannot be ruled out that the choice of domestic strategic variable in the sequential scenario increases the competition among the firms and so, in equilibrium, firms end up worse off.
Proposition 4.2

Suppose that \((A2a)\) holds at the simultaneous equilibrium. Then, for a BF from \(i\) with productivity \(\varphi_\omega\), \(z_{ii}^{\text{seq}}(\varphi_\omega) > z_{ii}^{\text{sim}}(\varphi_\omega)\).

To fix ideas and show as stark as possible how a domestic BF chooses the level of the investments, consider the case in which investments do not affect prices in equilibrium. In the simultaneous game, the investments are chosen through equation \((5b)\) at the market stage. In that stage, the mass of entrants is given and any BF takes into account that its investments affect the aggregator. Taken in isolation this effect and ceteris paribus, the greater the investment, the greater the value of the aggregator, and hence the lower the firm’s demand. On the other hand, in the sequential scenario, BFs choose the investments completely ignoring how the aggregate is determined. In other terms, they make the choice as if they were monopolistic. Thus firms are more aggressive relative to the simultaneous case.

Under the possibility that investments influence the firm’s pricing, depending on if there is a positive or negative effect, the firm modifies its behavior. If \(\frac{\partial p_{ii}^B(A_\ast_i, z_{ii}; \varphi_\omega)}{\partial z_{ii}} < 0\) the firm behaves even more aggressively, while if that term is positive, the assumption \((A2a)\) ensures that this indirect effect is not as large as the direct effect that investments have on the aggregator. Hence, the investment in the sequential scenario is greater than under the simultaneous case.

The next two propositions make use of the assumption \((A2b)\). Proposition 4.3 establishes that BFs obtains more revenues in the domestic market under the sequential scenario.

Proposition 4.3

Suppose that \((A2b)\) holds. Then, for a BF from \(i\) with productivity \(\varphi_\omega\), \(R_{ii}^{\text{seq}}(\varphi_\omega) > R_{ii}^{\text{sim}}(\varphi_\omega)\) where \(R_{ii}(\varphi_\omega)\) is the domestic revenue of the firm in equilibrium.

In standard models of monopolistic competition, the existence of trade costs creates a friction between markets such that home biases at the consumption and production levels arise. Proposition 4.4 shows that same outcomes arise endogenously in my model.
Proposition 4.4

Suppose that the C countries are symmetric and \((A2b)\) holds. Then, in country \(i\), comparing the sequential and simultaneous cases, the share of sales corresponding to domestic firms increases relative to imports’.

4.5 Consumer Welfare

The theoretical results depict a situation of more concentration, more intranational trade and potentially higher markups. The picture might raise some concerns regarding whether consumers end up worse off.

General conclusions in relation to consumer welfare within the framework are not possible to obtain.\(^{30}\) The fact that the demand system depends on an aggregator that sums up the conditions of the whole market does not necessarily imply that the aggregator is also a sufficient statistic for welfare.\(^{31}\) In addition, the general results of my framework have been obtained by considering a demand system as a primitive, without requiring integrability of the demand, i.e. that there exists a utility function from which the demands are derived.

Under these circumstances, I proceed by analyzing demand systems where the aggregator is a single sufficient statistic for welfare.\(^{32}\) Examples of these types of demands are the augmented version of the CES that I use for my empirical setting and the multinomial Logit. Although it constitutes a particular case, it allows me to lay bare a welfare channel present in my setting that is not in standard models of monopolistic competition.\(^{33}\)

\(^{30}\)This is even more pervasive in contexts where agents have preferences for the characteristics of the goods. For instance, as Behrens, Kanemoto, and Murata (2014) show for the case where consumers have a love for variety, the main issue lies in that there is no one-to-one mapping between equilibrium outcomes and consumers’ well-being.

\(^{31}\)Abstracting from non-price choices, an example is a linear-on-prices demand which depends only on the average price of the sector, but it can be derived from an indirect utility function that depends on both the variance and the average prices of the sector.

\(^{32}\)In a framework with absence of non-price characteristics of products, Anderson, Erkal, and Piccinin (2016) study the conditions for having aggregators with welfare meaning. Nocke and Schutz (2015), also in a setup without non-price variables but multiproduct firms, define a class of demands with such characteristic.

\(^{33}\)In the Appendix C.2, I provide a characterization of indirect utility functions and demands derived from it that are completely determined by the same aggregator.
The fact that demand-enhancing investments incurred by the firm are embedded into the aggregator implies that firms make choices on investments that are valued by the consumers. For instance, they could imply upgrades in the quality of their products, better after-sale services, or increases in the number of varieties available. Once that the aggregator takes the same value in the simultaneous and sequential equilibrium, consumers end up with the same utility in both scenarios. The reason lies in the effects of tacit competition. In the sequential equilibrium, the threat of entry, even when it is not executed, provide domestic BFs with incentives to invest more heavily on non-price variables. Thus, the latent competition determines that firms overinvest to gain a better position in the market. This implies that the impact of less varieties available due to the exit of SFs is exactly compensated by the provision of varieties produced by BFs with better non-price characteristics.

This insight is line with the main result of contestable markets by Baumol, Panzar, and Willig (1982): even when there is a market dominated by few firms, a competitive behavior could arise if entrants can easily dispute the incumbents’ position. Thus, the tacit possibility of entry, in opposition to actual entry, might discipline the incumbents in such a way that competitive outcomes emerge.

Finally, notice also that, relative to a monopolistic competition setting à la Melitz (2003), BFs have positive profits in equilibrium. If we adopt the view that these profits are passed back to consumers, the agents of the economy would be, in fact, better off.\footnote{Given the quasilinear utility function, the additional disposable income would be spent on the numéraire.}

5 Conclusion

In this paper I have studied a mechanism that creates an endogenous asymmetry between firm’s opportunities in the domestic and foreign markets in order to explain outcomes consistent with a home bias.

My explanation was based on the role of investments chosen by firms to boost up their demand. When these expenditures are incurred by large domestic firms, they
are used strategically to gain a better position in the local market, thus creating first-mover advantages. Due to this, two results emerge. First, differences between domestic and exporting opportunities arise, determining that firms skew more resources to their home market. Furthermore, the expansion of the domestic firms results in a crowding out of firms, in particular, of foreign firms, explaining the bias towards the consumption of domestic goods.

On the theoretical side, the emergence of the phenomenon is not guaranteed. First, in standard setups with no entry and incumbents moving previous to entrants, the results might be contingent on the type of competition at the market stage. Specifically, an under or overinvestment could be optimal, depending if competition is on prices or quantities. Additionally, the incorporation of non-prices choices opens up different possibilities that need to be considered. Even if the variables are demand enhancing, they could either increase or decrease the optimal prices set by the firm. I showed that the results emerge independently of these details.

The model combines the technical advantages of different setups. First, I exploited the parsimonious way of Melitz (2003) to account for extensive-margin adjustments with firm heterogeneity. In addition, I resorted to tools of Aggregative Games to incorporate interactions between heterogeneous firms making choices on multiple variables. This turns a potentially complex multidimensional problem into a tractable unidimensional one and, at the same time, it encompasses augmented versions of standard demands used for empirical work. Furthermore, since the setup is flexible enough, it is easy to turn it into a structural model to tackle empirical questions. Thus, it constitutes a fruitful methodology for exploring and quantifying situations with large firms at the core of the analysis.

References


References


References


References


Appendices

A Examples of Demands Covered

In the main text, I have argued that some standard demand systems can be expressed through an aggregator which is additive separable. Here, I show some examples for the cases in which demands only depend on prices. Starting from those, they can be extended to incorporate non-price choices. Consider a variety $\omega$ and a mass of firms $\Omega$. I consider the case of a continuum of firms to keep it simple. Any Greek letter represents a positive parameter, and I remark on their possible dependence on $\omega$ to show that the demand system allows for firm heterogeneity. In some cases, each demand has a list of subitems which describe special cases. In case the upper-tier utility function is quasilinear, two standard demand systems considered in the literature are encompassed.

- **Attraction demand models** (Luce, 1959) $Q(\omega) := \frac{h_\omega[p(\omega)]}{\bar{A}}$ with $\bar{A} := H \left[ \int_{\omega \in \Omega} h_\omega[p(\omega)] \, d\omega \right]$.
  - Multinomial Logit demand: $h_\omega[p(\omega)] := \exp(\alpha_\omega - \beta_\omega p(\omega))$
  - Multiplicative Competitive Interaction demand: $h_\omega[p(\omega)] := \alpha_\omega p(\omega)^{-\beta_\omega}$.

- **Linear demand** $Q(\omega) := \alpha_\omega + A - \gamma_\omega p(\omega)$ with $A := \int_{\omega \in \Omega} \beta_\omega p(\omega) \, d\omega$.

The following demand systems are expressed assuming that they display income effects. I present them in that way because they are usually presented in settings where there is only one sector or the upper tier utility function is not quasilinear. Let $E$ the income or the expenditure allocated to the sector.

- **Constant expenditure demand systems** $Q(\omega) := \frac{E}{p(\omega)} \frac{h_\omega[p(\omega)]}{\bar{A}}$ with $\bar{A} := H \left[ \int_{\omega \in \Omega} h_\omega[p(\omega)] \, d\omega \right]$.
  - CES: $h_\omega[p(\omega)] := \alpha_\omega p(\omega)^{-\beta_\omega}$
- **Translog demand** $Q(\omega) := \frac{E}{p(\omega)} [\alpha_\omega + A - \gamma_\omega \ln p(\omega)]$ with $A := \int_{\omega \in \Omega} \beta_\omega \ln p(\omega) \, d\omega$.
- **Stone-Geary** $Q(\omega) := \frac{E}{p(\omega)} [\alpha_\omega - A - \gamma_\omega \ln p(\omega)]$ with $A := \int_{\omega \in \Omega} \beta_\omega \ln p(\omega) \, d\omega$.
- **Demands from an additive indirect demand utility** Given an indirect utility $V[(Q(\omega))_{\omega \in \Omega}] := \int_{\omega \in \Omega} v_\omega \left[ \frac{p(\omega)}{E} \right] \, d\omega$, we get the following demand for vari-
ety $\omega$: $Q(\omega) := \frac{v'_{\omega}}{\bar{h}}$ with $A := \int_{\omega \in \Omega} v'_{\omega} \left[ \frac{p(\omega)}{\bar{E}} \right] \frac{p(\omega)}{\bar{E}} \, d\omega$.

- **Arkolakis, Costinot, Donaldson, and Rodríguez-Clare’s (2012) demand system**, restricted to an additively separable aggregator $\ln Q(\omega) := -\alpha_\omega \ln p(\omega) + \beta_\omega \ln E + f_\omega [\ln p(\omega) - \ln A]$ with $A := H \left[ \int_{\omega \in \Omega} h_\omega [p(\omega)] \, d\omega \right]$.

  - It includes the demand $Q(\omega) := \left( \frac{p}{\bar{p}(\omega)} \right)^{\alpha_\omega} - \alpha_\omega$ used for the empirical analysis in Arkolakis, Costinot, Donaldson, and Rodríguez-Clare (2015) where $\bar{p}$ is the usual price index of a CES.

## B Proofs of Section 4.4

### B.1 Technical Assumptions

In this section, I establish some assumptions which are necessary for the proofs.\(^{35}\) I suppose that the profits a firm garners in each country, that is each term of the sums of equations (1), (4) and (9) are strictly pseudo concave in firm’s own strategy.\(^{36}\) Moreover, I assume that Inada conditions hold for firm’s own strategy in each situation, respectively. These two assumptions ensure that firms’ optimal choices do not lie in the boundary, and that the solution of the first-order condition is a global optimum. Different set of assumptions can be stated in order to ensure that the there exists an equilibrium and this is unique. For the proofs, it is sufficient to assume that those properties hold. Nonetheless, I establish some remarks on some sufficient conditions which could be used. The zero-profits and free-entry conditions determine the survival productivity cutoff and the value of the aggregate. The monotonicity of demand in relation to the aggregate in Assumption 2 and the fact that productivity decreases marginal costs monotonically, determine that if there exists a solution for each of them, it is unique.\(^{37}\)

Regarding the Nash equilibrium at the market stage, it is

\(^{35}\)I keep assuming that all functions are twice continuously differentiable.

\(^{36}\)Pseudo-concavity is similar to but somewhat stronger than quasiconcavity. Essentially, the difference lies in the behavior at points where the derivative vanishes. At those points, quasiconcavity cannot distinguish between a saddle point and an optimum. In other terms, the first-order conditions are not sufficient to identify an optimum, while pseudo concavity ensures it. For further references, see, for instance, Takayama (1993).

\(^{37}\)There exist different assumptions to ensure existence. One set of sufficient conditions is the following. Given that strategies are defined in a compact set, $A_j \in \left[ \underline{A}_j, \bar{A}_j \right]$. Then, the conditions are
described by a solution of equations (6) and (7) in the simultaneous and sequential scenario, respectively. I focus on the latter since the sequential case could be analyzed in a similar way for given value of domestic investments. Analysis of the equilibrium in aggregative games is usually conducted by mean of share functions (Cornes and Hartley, 2009). Specifically, define a BF’s share function as its weight in the aggregate, that is, \( \frac{h^B_{ii}(r)}{K_i} \). Likewise, the aggregate share function in country \( i \) is defined as,

\[
\Phi \left( A_i; J^S \right) := \frac{1}{A_i} \Gamma \left( A_i; J^S \right).
\]

Then, for a given \( J^S \), a Nash equilibrium for the market stage can be characterized by \( (A_i^*)^C \) such that \( \Phi \left( A_i^*; J^S \right) = 1 \) for \( i = 1, \ldots, C \). By using an index approach, it can be shown that a sufficient condition to have a unique equilibrium in country \( i \) is that for any \( A_i^* \) such that \( \Phi \left( A_i^*; J^S \right) = 1 \), then \( \frac{d\Phi(A_i)}{dA_i} \bigg|_{A_i=A_i^*} < 1 \) is satisfied. \(^{38}\)

### B.2 Proofs

**Proof of Proposition (4.2).** The investments’ marginal profits in the simultaneous case are

\[
\gamma^{\text{sim}} \left( A_{ii}, z_{ii}, p_{ii}; \varphi, \omega \right) := \frac{\partial \pi^B_{ii}(A_{ii}, z_{ii}, p_{ii}; \varphi, \omega)}{\partial z_{ii}} + \frac{\partial \pi^B_{ii}(A_{ii}, z_{ii}, p_{ii}; \varphi, \omega)}{\partial A_{ii}} \frac{\partial A_{ii} \left( x_{ij}^C \right)}{\partial \varphi}.
\]

In the sequential case, note that pricing decisions are carried out by

\[
\frac{d\pi^B_{ii}(A_{ii}, z_{ii}, p_{ii}; \varphi, \omega)}{dp_{ii}} = 0
\]

which implies

\[
\frac{\partial \pi^B_{ii}(A_{ii}, z_{ii}, p_{ii}; \varphi, \omega)}{\partial z_{ii}} = \frac{\partial \pi^B_{ii}(A_{ii}, z_{ii}, p_{ii}; \varphi, \omega)}{\partial A_{ii}} \frac{\partial A_{ii} \left( x_{ij}^C \right)}{\partial \varphi}.
\]

Thus, investments’ marginal profits are

\[
\gamma^{\text{seq}} \left( A_{ii}, z_{ii}, p_{ii}; \varphi, \omega \right) := \frac{\partial \pi^B_{ii}(A_{ii}, z_{ii}, p_{ii}; \varphi, \omega)}{\partial z_{ii}} - \frac{\partial \pi^B_{ii}(A_{ii}, z_{ii}, p_{ii}; \varphi, \omega)}{\partial A_{ii}} \frac{\partial A_{ii} \left( x_{ij}^C \right)}{\partial \varphi}.
\]

In both, the simultaneous and sequential cases, the value of aggregate in equilibrium \( A_i^* \) and the pricing best-response \( p_{ii}^B \left( A_{ii}, z_{ii}; \varphi, \omega \right) \) are the same. Denote the domestic prices of the firm at the simultaneous equilibrium by

\[
p_{ii}^{\text{sim}} \left( \varphi, \omega \right) := p_{ii}^B \left( A_{ii}^*, z_{ii}^{\text{sim}} \left( \varphi, \omega \right); \varphi, \omega \right).
\]

Then, evaluating the marginal profits at the simultaneous equilibrium, we get

\[
\gamma^{\text{sim}} \left[ A_{ii}^*, z_{ii}^{\text{sim}} \left( \varphi, \omega \right); p_{ii}^{\text{sim}} \left( \varphi, \omega \right); \varphi, \omega \right] = 0.
\]

Given the pseudoconcavity of the profits, if we show that \( \gamma^{\text{seq}} \left[ A_{ii}^*, z_{ii}^{\text{sim}} \left( \varphi, \omega \right); p_{ii}^{\text{sim}} \left( \varphi, \omega \right); \varphi, \omega \right] > 0 \), then the result follows. Denote

\[
\pi_{ij}^S \left( \varphi, \omega \right) := \pi_{ij}^D \left( \varphi, \omega \right) - f_{ij} - F > 0 \quad \text{and} \quad \pi_{ij}^S \left( \varphi, \omega \right) := \pi_{ij}^D \left( \varphi, \omega \right) - f_{ij} - F < 0 \quad \text{for each } j.
\]

\(^{38}\)In some cases, characterizing the equilibrium through share functions entails some advantages. For instance, this occurs when best-response functions fail to be monotonic, while the share function displays that property. In addition, for some demand functions, the share function have an intuitive interpretation as they correspond to the firm’s market shares. This is the case for constant expenditure systems (e.g., CES, Cobb Douglas) and the attraction demands (e.g., Multinomial Logit). In the former the market share is defined in terms of sales while in the latter in terms of quantities.
Of Section 4.4

B.4 Proofs of Section 4.4

Martín Alfaro

fine, \( \Delta [A^*_i, z^\text{sim}_i (\varphi_{i, j}), p^\text{sim}_{ij} (\varphi_{i, j}) ; \varphi_{i, j}] := \gamma^\text{seq} [\cdot] - \gamma^\text{sim} [\cdot] \), then we need to show that \( \Delta [A^*_i, z^\text{sim}_i (\varphi_{i, j}), p^\text{sim}_{ij} (\varphi_{i, j}) ; \varphi_{i, j}] > 0 \). Denote \( \left( x^\text{sim}_{ij} \right)^C \) the strategies evaluated at the simultaneous equilibrium. Then,

\[
\Delta [A^*_i, z^\text{sim}_i (\varphi_{i, j}), p^\text{sim}_{ij} (\varphi_{i, j}) ; \varphi_{i, j}] = \frac{\partial p^B_i (\cdot)}{\partial z_{ij}} \frac{\partial A_i (\cdot)}{\partial z_{ij}} + \frac{\partial p^B_i (\cdot)}{\partial x_{ij}} \frac{\partial A_i (\cdot)}{\partial x_{ij}} + \frac{\partial p^B_i (\cdot)}{\partial \varphi_{i,j}} \frac{\partial A_i (\cdot)}{\partial \varphi_{i,j}}
\]

\[
\Rightarrow \Delta [A^*_i, z^\text{sim}_i (\varphi_{i, j}), p^\text{sim}_{ij} (\varphi_{i, j}) ; \varphi_{i, j}] = \frac{\partial p^B_i (\cdot)}{\partial z_{ij}} \frac{\partial A_i (\cdot)}{\partial z_{ij}} + \frac{\partial p^B_i (\cdot)}{\partial x_{ij}} \frac{\partial A_i (\cdot)}{\partial x_{ij}} + \frac{\partial p^B_i (\cdot)}{\partial \varphi_{i,j}} \frac{\partial A_i (\cdot)}{\partial \varphi_{i,j}}
\]

Given that \( \frac{\partial p^B_i (\cdot)}{\partial z_{ij}} < 0 \), we need to show that the term in brackets is positive. If \( \frac{\partial p^B_i (\cdot)}{\partial z_{ij}} \leq 0 \), the result follows immediately. Otherwise, note that the term in brackets can be reexpressed as \( \frac{\partial p^B_i (\cdot)}{\partial z_{ij}} \frac{\partial A_i (\cdot)}{\partial z_{ij}} \), which is positive and so the result follows again. ■

Proof of Proposition (4.3).

I first add a lemma and then proceed to the proof of (4.3).

Lemma B.1. For a given aggregate \( A^*_i \), sgn \( \left[ \frac{\partial p^B_i (A^*_i, z_{ij}; \varphi_{i, j})}{\partial z_{ij}} \right] = (-1) \text{ sgn} \left[ \frac{\partial A_i^B (A^*_i, z_{ij}; \varphi_{i, j})}{\partial z_{ij}} \right] \)

Proof of Lemma. The first-order conditions for prices determine that \( p^B_{ij} (A^*_i, z_{ij}; \varphi_{i, j}) = \mu_{ij} (A^*_i, z_{ij}; \varphi_{i, j}) \), where \( \mu_{ij} (A^*_i, z_{ij}; \varphi_{i, j}) \) is the markup by \( \mu_{ij} (A^*_i, z_{ij}; \varphi_{i, j}) \). Then,

\[ \frac{\partial p^B_i (A^*_i, z_{ij}; \varphi_{i, j})}{\partial z_{ij}} = \frac{\partial \mu_{ij} (A^*_i, z_{ij}; \varphi_{i, j})}{\partial z_{ij}} c_{ij} (\varphi_{i, j}) \]

We also know that \( \mu_{ij} (\cdot) = \frac{\varepsilon_{ij} (\cdot)}{1 - \varepsilon_{ij} (\cdot)} \) and so

\[ \frac{\partial \mu_{ij} (\cdot)}{\partial z_{ij}} = \frac{1}{[1 - \varepsilon_{ij} (\cdot)]^2} \]

and the result follows. ■

Proof of Proposition (4.3). Consider \( \frac{\partial p^B_i (A^*_i, z_{ij}; \varphi_{i, j})}{\partial z_{ij}} \leq 0 \). Given optimal prices, optimal domestic profits are defined by \( \pi_{ij} (A^*_i, z_{ij}; \varphi_{i, j}) := \pi_{ij} (A^*_i, z_{ij}; \varphi_{i, j}) \), then,

\[ \pi_{ij} (A^*_i, z_{ij}; \varphi_{i, j}) = \frac{R_i (A^*_i, z_{ij}; \varphi_{i, j})}{e_{ij} (A^*_i, z_{ij}; \varphi_{i, j})} - f_z (z_{ij}) \]

and this from, \( \frac{d\pi_{ij} (A^*_i, z_{ij}; \varphi_{i, j})}{d z_{ij}} = \frac{dR_i (A^*_i, z_{ij}; \varphi_{i, j})}{d z_{ij}} - \frac{e_{ij} (A^*_i, z_{ij}; \varphi_{i, j})}{z_{ij} \frac{d\pi_{ij} (A^*_i, z_{ij}; \varphi_{i, j})}{d z_{ij}}} \) and \( \frac{d\pi_{ij} (A^*_i, z_{ij}; \varphi_{i, j})}{d z_{ij}} > 0 \) for any \( z_{ij} \). So, for \( z_{ij} = \left[ z^\text{sim}_i (\varphi_{i, j}), z^\text{seq}_i (\varphi_{i, j}) \right] \), we have, \( \frac{d\pi_{ij} (A^*_i, z_{ij}; \varphi_{i, j})}{d z_{ij}} > 0 \) for \( z_{ij} = \left[ z^\text{sim}_i (\varphi_{i, j}), z^\text{seq}_i (\varphi_{i, j}) \right] \). Hence, by the fundamental theorem of calculus, \( R_i [z^\text{seq} (\varphi_{i, j})] - R_i [z^\text{sim} (\varphi_{i, j})] = \int_{z^\text{sim} (\varphi_{i, j})}^{z^\text{seq} (\varphi_{i, j})} d\pi_{ij (\cdot) d z_{ij}} > 0 \) which implies \( R_i [z^\text{seq} (\varphi_{i, j})] > R_i [z^\text{sim} (\varphi_{i, j})] \).

Consider the case with \( \frac{d\pi_{ij} (A^*_i, z_{ij}; \varphi_{i, j})}{d z_{ij}} > 0 \) and \( \frac{dQ_{ij} (A^*_i, z_{ij}; \varphi_{i, j})}{d z_{ij}} > 0 \). We
know that \( \frac{\partial R_{ii}(\cdot)}{\partial z_{ii}} = \frac{\partial p^B_{ii}(\cdot)}{\partial z_{ii}} Q_{ii}(\cdot) + p^B_{ii}(\cdot) \frac{\partial Q_{ii}(\cdot)}{\partial z_{ii}} \). Given that \( \frac{\partial p^B_{ii}(\cdot)}{\partial z_{ii}} > 0 \) and if \( \frac{\partial Q_{ii}(\cdot)}{\partial z_{ii}} > 0 \), then \( \frac{\partial R_{ii}(\cdot)}{\partial z_{ii}} > 0 \) for any \( z_{ii} \). Thus, \( R_{ii}[z^{\text{seq}}(\varphi_w)] > R_{ii}[z^{\text{sim}}(\varphi_w)] \). Otherwise, if we assume that \( \frac{\partial Q_{ii}(\cdot)}{\partial z_{ii}} < 0 \), note that

\[
\frac{\partial \ln R_{ii}(\cdot)}{\partial \ln z_{ii}} = \frac{\partial \ln p^B_{ii}(\cdot)}{\partial \ln z_{ii}} + \frac{\partial \ln Q_{ii}(\cdot)}{\partial \ln z_{ii}}
\]

and given that

\[
\frac{\partial \ln p^B_{ii}(h^*_i z_{ii}; \varphi_w)}{\partial \ln z_{ii}} > \left[ \frac{\partial \ln Q_{ii}(h^*_i z_{ii}; \varphi_w)}{\partial \ln z_{ii}} \right],
\]

the result follows too. \( \blacksquare \)

**Proof of Proposition (4.4).** By proposition (4.3), the sales of the BFs in the domestic market increase. To show that the sales by domestic firms increase relative to imports, we need to show that this is not exactly compensated by a reduction of sales by domestic SFs. We know that the same \( A_i^* \) holds in the simultaneous and sequential cases. Moreover, by property (P3), the equilibrium value \( A_i^* \) for each \( i \) is determined independently of \( J^S \) and \( z_{\text{dom}} \). This implies that variations of \( z_{\text{dom}} \) do not alter the choices made by BFs from abroad. Moreover, the pricing decisions and the survival cutoff are completely determined by \( A_i^* \), and so, by property (P4), variations of \( z_{\text{dom}} \) only affect the mass of incumbents. As a result, we need to show that the increase of domestic sales by BFs is not exactly compensated by a exclusive reduction of \( J^S \). Given the symmetry of the equilibrium, in equilibrium \( A_i^* \) and \( J^S \) are the same for all countries. Let \( z^u \) be the strategic choice of a firm with productivity \( \varphi_w \). By differentiating equation (8) for country \( i \), we can infer a relation between \( J^S \) and \( z_{\text{dom}} \):

\[
(-1) \sum_{\varphi_w} \frac{\partial h^B_{\varphi_w}}{\partial z^u} \left[ p^B_{ii}(A_i^*; \varphi_w, z^u), z^u \right] = \sum_{j=1}^C \frac{\partial J^S}{\partial z^u} \int_{\varphi_j(h_j^* \varphi)} \frac{h^S [p^S_{ji}(A_j^*; \varphi)]}{dG^S(\varphi)}.
\]

Denote \( \kappa^S_{ji} := \int_{\varphi_j(h_j^* \varphi)} h^S [p^S_{ji}(A_j^*; \varphi)] dG^S(\varphi) \) which remains fixed if \( z^u \) changes. Let \( \alpha_i := \sum_{\varphi_w} \frac{\partial h^B_{\varphi_w}[\cdot]}{\partial z^u} \). Thus, we can reexpress the equation for \( i \) as

\[
(-1) \sum_{\varphi_w} \frac{\partial h^B_{\varphi_w}[\cdot]}{\partial z^u} = \sum_{j=1}^C \kappa^S_{ji} \frac{\partial J^S}{\partial z^u}.
\]

By assumption (A2b), we know that \( \frac{\partial h^B_{\varphi_w}[\cdot]}{\partial z^u} > 0 \). Hence, \( \frac{\partial J^S}{\partial z^u} < 0 \) and the result follows. \( \blacksquare \)
C Additional Theoretical Results

C.1 Cournot Competition

In this part, I consider a setup with quantity competition at the market stage and show that the domestic overinvestment also arises in this scenario. The strategies are now defined in terms of quantities and the investments. Formally, let’s denote the strategies of BFs and SFs, respectively, by $x^B_{ij}(\omega) := \left(z_{ij}(\omega), q^B_{ij}(\omega)\right)$ and $x^S_{ij}(\omega) := \left(q^S_{ij}(\omega)\right)$. Denote the vector of strategies for each type of firm from $i$ in country $j$ by $x^B_{ij} := \left(x^B_{ij}(\omega)\right)_{\omega \in \Omega^B_{ij}}$ and $x^S_{ij} := \left(x^S_{ij}(\omega)\right)_{\omega \in \Omega^S_{ij}}$. Also, let $x_{ij} := \left(x^S_{ij}, x^B_{ij}\right)$ be the strategies set by firms from $i$ in country $j$. Assume that the inverse demand function for a BF from $i$ producing a variety $\omega$ sold in $j$ is given by a smooth function

$$p^B_{ij}(\omega) := p\left[A_{ij}, z_{ij}(\omega), q^B_{ij}(\omega)\right]$$

where $A_{ij}$ is an aggregator for country $j$. By the same token, for a SF, the demand is expressed by,

$$p^S_{ij}(\omega) := p\left[A_{ij}, q^S_{ij}(\omega)\right].$$

Define the aggregator in the same fashion as in the Bertrand case, that is,

$$A_j \left[(x_{ij})^C_{i=1}\right] := \sum_{i=1}^{C} \int_{\omega \in \Omega^B_{ij}} h^S_i \left[q^S_{ij}(\omega)\right] d\omega + \sum_{\omega \in \Omega^B_{ij}} h^B_i \left[q^B_{ij}(\omega), z_{ij}(\omega)\right].$$

Assume that, for any type of firm $t \in \{S, B\}$, $\frac{\partial p^t_i(\omega)}{\partial A_{ij}} < 0$, $\frac{\partial h^B_i(\omega)}{\partial q^B_{ij}(\omega)} > 0$, and $\frac{\partial h^B_i(q^B_{ij}(\omega), z_{ij}(\omega))}{\partial z_{ij}(\omega)} > 0$. Consistent with demand-enhancing investments, suppose that for a given value of $A^*_i$, $\frac{\partial q^B_{ij}(A^*_i, z_{ii}; \varphi_{\omega})}{\partial z_{ii}}$ where $q^B_{ij}(A^*_i, z_{ii}; \varphi_{\omega})$ is the optimal quantities chosen by a BF with productivity $\varphi_{\omega}$. Proceeding as for Bertrand competition, it can be shown that overinvestment arises if

$$\Delta \left[A^*_i, z^\text{sim}_{ii}(\varphi_{\omega}), q^\text{sim}_{ii}(\varphi_{\omega}); \varphi_{\omega}\right] := -\frac{\partial q^B_{ij}(\cdot)}{\partial h_i} \left[\frac{\partial h_i}{\partial q^B_{ij}} \left(x^\text{sim}_{ij}\right)^C_{i=1} + \frac{\partial h_i}{\partial z_{ij}} \left(x^\text{sim}_{ij}\right)_{i=1}^C \right] > 0.$$ 

Given $\frac{\partial q^B_{ij}(\cdot)}{\partial h_i} < 0$, and that all the terms within the brackets are positive, the result
follows.

C.2 The Aggregator as a Measure of Consumer Welfare

In this section, I present demands with an aggregator that has a welfare meaning. The assumptions for indirect utility functions to generate this outcome are quite stringent. However, it covers common functional forms like the CES and the multinomial Logit. Besides, it gives some scope for flexible extensions of these demands. I illustrate this by showing that it encompasses the demand system proposed in Nocke and Schutz (2015), extended to incorporate non-price choices. That demand system takes the CES and the Logit as special cases. I present the results for a specific country in a closed economy, omitting any index of it. I keep assuming an upper tier utility function that is quasilinear in the homogeneous good. The homogeneous good has a normalized price equal to be one and I suppose that income is high enough so that there is a positive consumption of it. To keep matters simple, I consider a set $\Omega$ of varieties of the differentiated good and ignore any partition among small and large firms. In other terms, I assume that all firms behave like if they were large and make choices concerning prices and a non-price variable. The representative consumer has an income given by $Y$. I consider the possibility that either the consumer’s income is given by its wage, or that the consumer also owns the firms and profits are passed back to it. Formally, this implies that either $Y := w$ or $Y := w + \Pi$ where $\Pi$ is the fraction of total profits that the consumer receives. The income is taken as a parameter by each consumer. Denote $p := (p(\omega))_{\omega \in \Omega}$ and $z := (p(\omega))_{\omega \in \Omega}$. To have that the aggregator is sufficient statistic for welfare, we require that the indirect utility function $V(p, z, Y)$ is apt to be expressed by a function $V(P, w)$ where $P$ represents an aggregator for the differentiated sector. The use of $P$ instead of $A$ is to emphasize that the aggregator has a welfare meaning. Given the quasilinear form between the homogeneous and the differentiated goods, and given a smooth monotone function $F$, the indirect utility function is,

$$V(P, Y) := Y + F(P)$$
where \( F(P) := F[\sum_{\omega \in \Omega} h_{\omega}[p(\omega), z(\omega)]] \). To see the type of restriction that this imposes on the demand, by Roy’s identity,

\[
q(\omega) = -\frac{\partial V(p, z, Y)}{\partial p(\omega)} - \frac{\partial h_{\omega}(p(\omega), z(\omega))}{\partial p(\omega)}.
\]

Note that \( \frac{\partial V(p, Y)}{\partial Y} = 1 \). Also, \( \frac{\partial V(p, Y)}{\partial p(\omega)} = F'(P) \frac{\partial p}{\partial p(\omega)} \) and \( \frac{\partial h_{\omega}(p(\omega), z(\omega))}{\partial p(\omega)} \). Thus,

\[
q(\omega) = -F'(P) \frac{\partial h_{\omega}[p(\omega), z(\omega)]}{\partial p(\omega)}.
\]

For the case that \( Y \) is only composed by the wages, then it is immediate to note that \( V(P, w) \). When it is assumed that profits are passed back to consumers, in order to have that \( P \) is a sufficient statistic for welfare, it is necessary that \( Y := w + \Pi \) satisfies \( Y(P, w) \). As shown in the main text, given a demand that depends on an additive separable function, firms choose prices and investments in such a way that profits are only a function of the aggregate. Then, \( V(P, w) \) again. To show some cases that are covered, let’s consider an augmented version of the demand system by Nocke and Schutz (2015). Specifically,

\[
V(P, Y) := Y + \beta \ln \left[ \sum_{\omega \in \Omega} h_{\omega}[p(\omega), z(\omega)] \right].
\]

In that case, the demand of a variety \( \omega \) is given by,

\[
q(\omega) = \frac{-\frac{\partial h_{\omega}[p(\omega), z(\omega)]}{\partial p(\omega)}}{\sum_{\omega \in \Omega} h_{\omega}[p(\omega), z(\omega)]}.
\]

In the Multinomial Logit, we have that \( h_{\omega} [p(\omega), z(\omega)] := \exp \left[ \alpha + \beta z(\omega) - \beta p p(\omega) \right] \) where \( \alpha, \beta, \beta_p > 0 \) are parameters. In the main text, it is considered an augmented CES by \( h_{\omega} [p(\omega), z(\omega)] := [p(\omega)]^{1-\sigma} [z(\omega)]^\delta \) where greek letters are positive parameters. Nonetheless, other options are possible. This endows the approach of using aggregators with some flexibility. For instance, I could have considered a non-homothetic in strategies CES by taking, \( h_{\omega} [p(\omega), z(\omega)] := \beta \left[ \alpha + [p(\omega)]^{1-\sigma} [z(\omega)]^\delta \right]^{\frac{\sigma}{\delta}} \) for greek letters that are positive parameters. Also, I
could have assumed a functional form for \( h_\omega \) such that the cross derivative of price and the non-price variable is zero, that is, \( h_\omega [p(\omega), z(\omega)] := \beta_p [p(\omega)]^{1-\sigma} + \beta_z [z(\omega)]^\delta \) where \( \beta_p, \beta_z > 0 \).

### C.3 Multiproduct Firms and Nested Demands

Although in the main text I suppose that prices and investments are unidimensional, it could be easily extend to allow for each of them to be vectors as in the case of multiproduct firms. To illustrate how this can be done, let’s keep it simple and focus on a single country. Assume there is a set of firms \( \Omega \) only composed by BFs and where each firm \( f \) is producing a set \( \Omega_f \) of varieties. In this scenario, each firm \( f \) makes choices regarding \( p_f := (p(\omega))_{\omega \in \Omega_f} \) and \( z_f := (z(\omega))_{\omega \in \Omega_f} \). The demand of a variety \( \omega \) produced by firm \( f \) is,

\[
Q(\omega) := Q_\omega (A, p_f, z_f)
\]

where \( A := H(\bar{p}) := \sum_{f \in \Omega} h_f [p_f, z_f] \). It is also easy to see that this demand allows for firm-heterogeneity. Thus, for multiproduct firms, it encompasses the pervasive case of a nested-CES demand where groups are defined by varieties produced by the same firm.
Chapter 3
Home-Bias Patterns and the Strategic Gains of Domestic Leaders: Evidence from Denmark*

Martín Alfaro†

Abstract
In this chapter, I quantify the mechanism studied in the previous chapter where first-mover advantages for domestic firms generate home-bias patterns. I adapt the general model to a structural one and estimate it using a rich dataset at the firm-product level of all the Danish manufacturing industries. The results indicate that first-mover advantages are important in shaping the structure of the economy and as an explanation of home-bias patterns, exhibiting a lot of heterogeneity across industries and firms. Furthermore, I find that first-mover advantages are acquired predominantly by firms in differentiated industries. However, consistent with other studies, firms producing homogeneous goods in Food & Beverages and Chemicals sectors, also obtain these gains.

*I am extremely grateful to Valerie Smeets, Frederic Warzinsky, Philipp Schröder, and Raymond Riezman for their invaluable guidance and support. I also thank Boris Georgiev, David Lander, Anders Laugesen, Kalina Manova, Peter Neary, Allan Sørensen, Jim Tybout, and participants of several seminars for helpful comments. All remaining errors are my own.

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1 Introduction

In the previous chapter, we have studied theoretically a mechanism that generates home-bias patterns. The same departs from a long-run view of the market-structure determination, such that firms make entry choices and also decide on prices and enhancing-demand investments. The results follow from the comparison of two situations. First, I envision a scenario where local BFs invest before importers make any decision. Then, I consider a benchmark situation where domestic firms and importers decide on the demand-enhancing expenditures simultaneously.

By a comparison of these two scenarios, I have shown that BFs invest more heavily on demand-enhancing expenditures in their domestic market. The emerging first-mover advantage rationalizes home-bias outcomes. First, there is an expansion of BFs in their home market that crowds out importers which creates a bias toward consumption of domestic varieties. Moreover, since domestic BFs increase their home revenue, they end up with a lower share of exports relative to the total firm’s sales.

In this chapter, we proceed to study the phenomenon empirically. To quantify the mechanism, different reasons determine the need of relying on a structural approach. In alternative approaches, e.g. hedonic regressions, estimations of the effects on the demand from observable non-price instruments taken in isolation have shown a small and short-lived impact (Bagwell, 2007). Although there is evidence that these instruments are profitable, it requires several years to materialize their advantages, and, the complementarities between the investments suggest that their effectiveness emerge when they are part of an integral strategy by the firm (Bronnenberg, Dubé, and Gentzkow, 2012). All these arguments suggest that detecting effects requires information that spans several years, or even decades as suggested by Bronnenberg, Dubé, and Gentzkow (2012), and comprises exhaustively the instruments used by firms. While both aspects seem to be at the core of firms strategies’ effectiveness, gathering such detailed information becomes an extremely difficult enterprise. Over and above, in order to isolate the first-mover gains by domestic firms, I make a compari-

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1 For a meta-analysis of the impact of advertisement on demand, see Sethuraman, Tellis, and Briesch (2011).

2 Even using marketing costs as a proxy, they do not capture potentially important ways to influence the demand like, for instance, the provision of after-sale services.
son against a counterfactual where there are no asymmetries in the timing of decisions between domestic and foreign firms. This situation is seldom, if ever, observed. My choice of developing a structural approach for the empirical side responds to these reasons.

With the aim of taking the model to the data, I depart from the general framework of the previous chapter and make use of an augmented CES that incorporates demand-enhancing investments.\(^3\) Importantly, the approach to quantify the model predictions remains widely applicable as it only requires information on BFs’ market shares and the determination of two parameters, one of them being the elasticity of substitution. In particular, information related to small firms (henceforth, SFs) is not needed.

I quantify the outcomes for the industries belonging to the Danish manufacturing. Some features of the information make it suitable for the analysis. First, given that my procedure requires information on firms’ market share in each industry, I exploit the fact that the information is presented at the firm-product level. Furthermore, the information on international transactions and firms’ sales are disaggregated at the 8-digit product level, with the former encompassing imports and exports by both manufacturing and nonmanufacturing firms. Thus, I am able to allocate each firm-product to a properly defined market, and account for an accurate measure of the import competition for each industry.

In terms of the empirical results, first-mover advantages reveal themselves as an important determinant in shaping the structure of the economy and as an explanation of home-bias patterns. The results exhibit a lot of heterogeneity across industries and firms. In addition, by using the distinction of goods by Rauch (1999), I find that first-mover advantages are acquired predominantly by firms in differentiated industries. However, consistent with other studies, firms producing homogeneous goods in Food & Beverages and Chemicals sectors also obtain these gains.

To the best of my knowledge, my paper is the first to structurally quantify these

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\(^3\)Specifically, I make use of a CES with a demand shifter. In the last years, this functional form has been used in different papers to include perceived quality in the demand. For instance, Baldwin and Harrigan (2011), Kugler and Verhoogen (2012), Hallak and Sivadasan (2013), Gervais (2015), Hottman, Redding, and Weinstein (2016) and Redding and Weinstein (2016).
advantages and their consequences on home-bias patterns. Since I consider domestic firms as those which are established in the market, these gains are also related to the strategic benefits that mature multinationals can garner from doing foreign direct investment.

2 Empirical Regularities

In this section, I list some empirical regularities that guide my research questions and methodology. The stylized facts draw on information from Danish manufacturing sectors. Throughout the paper, I refer to a sector as a 2-digit industry and reserve the term industry when it is defined at the 4-digit level, according to the NACE rev. 1.1 classification.

Fact 1. Even accounting for competition from abroad, concentration of industries is widespread. Moreover, the typical market structure is such that few large firms coexist with a myriad of small firms.\(^4\)

Fact 1 provides some support towards using Denmark to infer conclusions that might hold more generally. Specifically, in line with other studies and even acknowledging that Denmark is a small open economy, the country displays a pronounced concentration.

In principle, we could conjecture that if a country is subject to tough import competition, the emergence of large domestic firms is prevented. Indeed, in Figure 1a, the share of imports out of the total value is substantial in some of the sectors.\(^5\) Nonetheless, this remains a partial picture of the economy performance regarding concentration. Concentration requires a definition of the market, and so, a take on the set of

\(^4\)Evidence of a mixed market structure has been obtained for USA (Axtell, 2001; Hottman, Redding, and Weinstein, 2016), and Taiwan (Edmond, Midrigan, and Xu, 2015). Also, indirect evidence can be found when it is analyzed the patterns of exports among the firms. Specifically, big and small exporters are shown to be the rule in France (Eaton, Kortum, and Kramarz, 2004, 2011; Arkolakis, 2010), India (Goldberg, Khandelwal, Pavcnik, and Topalova, 2010) and several other European countries (Mayer and Ottaviano, 2008).

\(^5\)All the patterns described remain true by using alternative measures of concentration. Specifically, this is the case if domestic sales come from firm’s own production or its imports. My choice of total production responds to that, even considering own production, the patterns appear.
firms that are competing with each other. Markets defined by 2-digit industries represent a more aggregated measure than what seems plausible. In this sense, at best, the import penetration reflects only the conditions of the most important industries in terms of value.

When the relevant market of a firm is defined as its own 4-digit industry, substantial heterogeneity of foreign competition appears. As an example of how the data looks like, Figure 1b displays information on several industries belonging to the beverage sector. It suggests the existence of two type of industries: those in which the domestic firms account for the bulk of the total sales and others where the imports dominate the market.

Figure 1: Import Shares

![Figure 1a: Manufacturing Sectors](image1a)

![Figure 1b: Beverages](image1b)

**Note:** Shares measured in terms of total sales. Domestic share consists of the sales by firms which report positive production in the country. Import Shares correspond to sales by firms which we do not label as domestic.

Once that it is recognized that some of the industries are dominated by domestic firms, patterns of concentration within local firms become informative. In Figure 2a I present the Herfindahl index without accounting for import competition. Since, among domestic firms, BFs garner the bulk of sales, sectors with a moderate import presence in general display concentration even accounting for import competition. As an illustration, Figure 2b shows the market share of the biggest four domestic firms in industries belonging to the beverage sector.
Figure 2: Concentration

(a) Herfindahl Index

(b) Concentration Ratio (4 firms)

Beverages

Note: Herfindahl index calculated in terms of sales by domestic firms exclusively. Herfindahl index for each sector is an average of the indices for industries defined at the 4-digit level. Concentration ratio for the beverage sector is calculated using total sales, including imports.

Proceeding to a more detailed analysis of the industries, it is also revealed that the presence of large domestic firms does not preclude the existence of a myriad of small firms. Figure 3 displays a scatter plot of domestic firms’ market shares, accounting for import competition. Each vertical line corresponds to a different industry while the vertical axis measures firm’s market share. By looking at the bottom of the graph, the presence of a competitive fringe is revealed.
Fact 2. Define domestic leaders as those which belong to the top four firms with greatest domestic market share in at least one industry. Then, among the exporters, the domestic intensity of firms, defined as the share of firm’s domestic sales relative to its total sales, is higher for the domestic leaders.

One of the facts through which home bias might be reflected is the domestic intensity of firms. This is defined as the firm’s share of domestic sales relative to its total sales. I proceed to analyze this phenomenon among the exporters, splitting the firms according to whether they are also domestic leaders or not.

In Figure 4a, the vertical axis measures the domestic intensity of the firms. Along the horizontal axis, firms are ranked based on their domestic intensity. They are ordered from left to the right, starting with the firms that have the lowest intensity. The curves of each graph correspond to the cumulative distribution of domestic intensity among domestic leaders that export (blue curve) and the rest of exporters (red line). Also, for a comparison, I have included a 45 degrees dashed gray line, corresponding to a uniform distribution.

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6Home bias measured through domestic intensity has been documented for several European countries in Mayer and Ottaviano (2008). For USA, this is also reported in Bernard, Jensen, Redding, and Schott (2007, 2012, 2016).
The main conclusion that emerges out of it is that that domestic leaders skew more their resources to the domestic market relative to the rest of exporters. Even though it may happen that these regularities are not present in all sectors, Figure 4b show that, in fact, similar conclusions can be obtained sector by sector.

Proceeding to a more formal analysis, in Table 1, I show that at the firm-industry level there is a positive correlation between the domestic market share and domestic intensity of firms, even controlling for industry and firm fixed effects. The data also points out to a positive but decreasing relation, with a quadratic term of market shares improving the fit.
Table 1: Domestic Intensity at the Firm-Industry Level

<table>
<thead>
<tr>
<th></th>
<th>Domestic Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Domestic Share</td>
<td>0.101***</td>
</tr>
<tr>
<td></td>
<td>(0.00351)</td>
</tr>
<tr>
<td>Exporter Dummy</td>
<td>-0.745***</td>
</tr>
<tr>
<td></td>
<td>(0.0178)</td>
</tr>
<tr>
<td>Dom. Share Square</td>
<td>-0.00937***</td>
</tr>
<tr>
<td></td>
<td>(0.000869)</td>
</tr>
<tr>
<td>Observations</td>
<td>6,286</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.358</td>
</tr>
<tr>
<td>Industry FE</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm FE</td>
<td>No</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Domestic intensity measured at the firm-industry level and defined as firm’s domestic sales relative to its own total sales. Domestic Market Shares are relative to the industry’s total sales, accounting for import competition. Exporter Dummy indicates whether the firm exports in that industry specifically.

Figure 5: Domestic Intensity and Domestic Market Shares at the Firm-Industry Level

(a) In Deviations of Industry Averages

(b) In Deviations of Industry and Firm Averages

Note: Sample of Figure 5a restricted to exporters. Sample of Figure 5b restricted to exporters that sell in at least two industries. All variables expressed in logarithms.
3 Taking the Model to the Data

In this part, I transform the general model of the previous chapter into a structural model. This requires not only choices of functional forms, but also expressing the model in such a way that the model can be taken to the data.

Remarkably, the structural model allows me to quantify all the results by knowledge of BFs’ variables. There is no need to have information regarding SFs. In addition, only two parameters need to be specified, one of them being the elasticity of substitution of a typical CES demand.

Instead of deriving the simultaneous and sequential models fully, I only focus on the specific parts of the model which I need to quantify the results. In particular, I derive the solutions exclusively for the BFs.

4 Functional Forms Chosen

For the demand side, I resort to an augmented CES that incorporates a demand shifter. This is interpreted as a composite good that captures all the firm’s sunk investments. Throughout, I use the same notation as in the general framework. Suppose that country \( i \)’s demand system is derived from a representative consumer. This maximizes a utility function that is quasilinear in the homogeneous good. The subutility function for the differentiated good is,

\[
Q_i := \left\{ \sum_{j=1}^{C} \left[ \int_{\omega \in \Omega_{ji}^C} \left[ Q_{ji}(\omega) \right]^{\frac{\sigma-1}{\sigma}} d\omega + \sum_{\omega \in \Omega_{ji}^B} \left[ z_{ji}(\omega) \frac{\delta}{1-\sigma} Q_{ji}(\omega) \right]^{\frac{\sigma-1}{\sigma}} \right] \right\}^{\frac{1}{\sigma-1}}
\]

where \( \sigma > 1 \) and \( \delta < 1 \). Given that \( z_{ij} \) is embedded into the utility function, it represents a valued variety’s attribute for the consumer.

Given the quasilinear upper tier utility function, the demand of variety \( \omega \) can be obtained by optimizing the subutility of the differentiated good subject to a normal-

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7This functional form is isomorphic to how quality is incorporated in diverse models. As quality is embedded in the utility function, it reflects not only vertical attributes but also subjective differences in tastes. In view of this, the variable has been referred to as perceived quality (Sutton, 2012) or appealing (Hottman, Redding, and Weinstein, 2016).
ized expenditure equal to one. Through standard optimization procedures, it can be shown that the demand of a consumer from \(j\) of a variety \(\omega\) produced by a BF from \(i\) is,

\[
Q_{ij}^B(\omega) := (P_j)^{\sigma-1} [z_{ij}(\omega)]^\delta \left[p_{ij}^B(\omega)\right]^{-\sigma}
\]

where \((P_j)^{\sigma-1} := \sum_{i=1}^C \int_{\omega \in \Omega^p_{ij}} [p_{ij}^S(\omega)]^{1-\sigma} d\omega + \sum_{\omega \in \Omega^p_{ij}} [p_{ij}^B(\omega)]^{1-\sigma} [z_{ij}^B(\omega)]^\delta\).

Notice that the demand is consistent with an aggregator defined by \(A_j := (P_j)^{1-\sigma}\) with \(h^S[p_{ij}^S(\omega)] := [p_{ij}^S(\omega)]^{1-\sigma}\) and \(h^B[p_{ij}^B(\omega), z_{ij}(\omega)] := [p_{ij}^B(\omega)]^{1-\sigma} [z_{ij}^B(\omega)]^\delta\).

For the cost side, I suppose that \(f_z[z_{ij}(\omega)] := f_zz_{ij}(\omega)\) where \(f_z > 0\) and leave unspecified the functional form of \(c_{ij}(\varphi, \tau_{ij})\).

All the solutions’ derivations are in Appendix A. The calculations to conduct the empirical analysis do not require a characterization of SFs or the choices of BFs for other markets which are not the domestic. Given values of the parameters \(\delta, \sigma\) and \(f_z\), the solutions of prices and investments for a firm producing variety \(\omega\) with market share \(s_{ii}^\omega\) and productivity \(\varphi_{ij}\) can be expressed as \(p_{ii}(s_{ii}^\omega, \varphi_{ij}), z_{ii}^{sim}(s_{ii}^\omega)\) and \(z_{ii}^{seq}(s_{ii}^\omega)\) where \(sim\) and \(seq\) refer to the simultaneous and sequential case, respectively.\(^8\)

Below, I show that it is not necessary to specify a value of \(f_z\) to obtain the results.

### 4.1 Simultaneous Case

I denote by \(P_i\) is a specific value of the domestic price index and \(P_i(x_{ii})\) the price index as a function of the strategies chosen by all the firms selling in country \(i\). In addition, I denote by \(s_{ii}^\omega\) the domestic market share of a domestic BF in \(i\) producing variety \(\omega\) with productivity \(\varphi_{ij}\). Given how market shares are defined in equation (5) and abusing a little bit of notation, \(s_{ii}^\omega\) could be a specific value of market share or a function of \((P_i, z_{ii}(\omega), p_{ij}^B(\omega))\). To keep notation simple in the simultaneous case, I do not emphasize such distinction. I also denote \(z_{ii}^\omega\) the investments incurred by the same firm.

I begin by showing some auxiliary calculations about how BF’s decisions impact the price index. Specifically, it can be shown that \(\frac{\partial \ln h^B[p_{ij}^B(\omega), z_{ii}^\omega]}{\partial \ln z_{ii}^\omega} = \delta, \frac{\partial \ln h^B[p_{ij}^B(\omega), z_{ii}^\omega]}{\partial \ln p_{ij}^B(\omega)} = \delta\).

\(^8\)Importantly, after the removal of industries in the datasets, the range of market shares are such that the relation between market shares and investments on the strategic variable is monotone.
\[ \sigma - 1, \quad \frac{\partial \ln P_i(x_{ii})}{\partial \ln n_{ii}} = s_{ii}^\omega. \]  
By using these results, I determine that \[ \frac{\partial \ln P_i(x_{ii})}{\partial \ln n_{ii}} = \frac{\delta}{1-\sigma} s_{ii}^\omega, \]
\[ \frac{\partial \ln P_i(x_{ii})}{\partial \ln n_{ii}} = s_{ii}^\omega. \]  
Also, \[ \frac{\partial \ln s_{ii}^\omega}{\partial \ln z_{ii}} = \delta \] and \[ \frac{\partial \ln s_{ii}^\omega}{\partial \ln P_i} = 1 - \sigma. \]

With these results at hand, I can determine the optimal prices chosen by a domestic BF given a pair \((s_{ii}^\omega, \varphi_{\omega})\). First of all, it is well known that for any demand, the first-order conditions for prices determine that the optimal price has to satisfy the following equation

\[ p_i^B (\omega) = \mu_{ii}^B (\omega) c_{ii} (\omega) \]

where \( \mu_{ii}^B (\omega) := \frac{\varepsilon_{ii}(\omega)}{\varepsilon_{ii}(\omega)-1} \) is the markup and \( \varepsilon_{ii}(\omega) := \left| \frac{\ln Q_i^B(\omega)}{\ln P_i^B(\omega)} \right| \) is the price elasticity of demand. For the demand under analysis, \( \varepsilon (s_{ii}^\omega) := \sigma - s_{ii}^\omega (\sigma - 1) \). Therefore, working out the markup expression,

\[ p_i^B (s_{ii}^\omega, \varphi_{\omega}) = \frac{\sigma}{\sigma - 1} \left( 1 + \frac{1}{\sigma - 1} - s_{ii}^\omega \right) c_{ii} (\varphi_{\omega}) \]

(2)

In particular, expression (2) implies that the price set by a SF with productivity \( \varphi_{\omega} \) is the limit case of a BF with \( \varphi_{\omega} \) and zero market share. Thus, when a BF has a negligible market share, the solution converges to the monopolistic competition case. The domestic profits that a firm analyzes when it has to choose the level of investments are,

\[ \max_{z_{ii}^\omega} \pi_{ii} \left[ P_i (x_{ii}), P_i^B (\omega), z_{ii}; \varphi_{\omega} \right] := Q_{ii} \left[ P_i (x_{ii}), P_i^B (\omega), z_{ii}^\omega \right] \left[ p_i^B (\omega) - c_{ii} (\varphi_{\omega}) \right] - f_z z_{ii}. \]

The first-order condition is,

\[ \frac{d \pi_{ii} [\cdot]}{d z_{ii}} := \frac{\partial \pi_{ii} [\cdot]}{\partial z_{ii}} + \frac{\partial \pi_{ii} [\cdot]}{\partial P_i} \frac{\partial P_i (x_{ii})}{\partial z_{ii}^\omega} + \frac{\partial \pi_{ii} [\cdot]}{\partial P_i^B (\omega)} \frac{\partial P_i^B (\omega)}{\partial z_{ii}} = 0. \]

(3)

When the firm chooses optimal prices, \( \left( \frac{\partial \pi_{ii} [\cdot]}{\partial P_i^B (\omega)} + \frac{\partial \pi_{ii} [\cdot]}{\partial P_i (x_{ii})} \frac{\partial P_i (x_{ii})}{\partial P_i^B (\omega)} \right) = 0. \) Moreover,

\[ \frac{\partial \pi_{ii} [\cdot]}{\partial z_{ii}} := \frac{\partial \pi_{ii} [\cdot]}{\partial Q_{ii}} \frac{\partial Q_{ii}}{\partial z_{ii}^\omega} - f_z \]

\[ = \left[ p_i^B (\omega) - c_{ii} (\varphi_{\omega}) \right] \frac{\delta Q_{ii} (\omega)}{z_{ii}^\omega} - f_z \]

\[ = \frac{s_{ii}^\omega}{\varepsilon (s_{ii}^\omega)} \frac{\delta}{z_{ii}^\omega} - f_z, \]

where the last line uses the fact that, at the optimal price, \( Q_{ii} (\omega) \left[ p_i^B (\omega) - c_{ii} (\varphi_{\omega}) \right] = \)
Regarding \( \frac{\partial \pi_i}{\partial P_i} \) and \( \frac{\partial \ln P_i}{\partial z_i} \), using the same fact following optimal prices and \( \frac{\partial \ln P_i}{\partial z_i} = \frac{\delta s_i}{1 - \sigma z_i} \),

\[
\frac{\partial \pi_i}{\partial P_i} = \left( \frac{\partial \pi_i}{\partial Q_i} \right) \left( \frac{\partial \ln Q_i}{\partial P_i} \right) \left( \frac{\delta s_i}{1 - \sigma z_i} \right)
\]

Using these results, I can reexpress the first-order condition (3) by,

\[
\frac{d \pi_i}{dz_i} = \frac{s_i}{\varepsilon (s_i)} \delta \frac{1 - s_i}{z_i} - f_z = 0.
\]

Working out the expression, I get firm’s optimal expenditure on domestic investments,

\[
f_z z_{ii}^{\text{sim}} (s_i) = \frac{\delta s_i (1 - s_i) - f_z}{\varepsilon (s_i)}.
\]

Also, optimal domestic profits are,

\[
\pi_{ii}^{\text{sim}} (s_i) = \frac{s_i}{\varepsilon (s_i)} \left[ 1 - \delta (1 - s_i) \right].
\]

### 4.2 Sequential Case

I use the same notation as in the simultaneous case. Consider a domestic BF from \( i \) producing a variety \( \omega \) with productivity \( \varphi_\omega \). The expression for the optimal price is the same as in the simultaneous, so it is given by equation (2). In addition, at the stage where domestic firms make investments decisions the domestic investment cannot influence the equilibrium value of the price index. Thus, it can be treated exogenously by the firm. I denote the equilibrium value of the price index by \( P_i^* \). The firm solves,

\[
\max_{z_i, p_i, \varphi_\omega} \pi_i(P_i, p_i, z_i, \varphi_\omega) \quad \text{s.t.} \quad P_i = P_i^*, \quad p_i = P_i^*, \quad z_i = z_i^*, \quad \varphi_\omega
\]

Introducing the two restrictions into the objective function, the optimization problem becomes,

\[
\max_{z_i} \pi_i \left[ P_i^*, p_i^B(P_i^*, z_i^*, \varphi_\omega), z_i^*, \varphi_\omega \right] = Q_i \left[ P_i^*, p_i^B(P_i^*, z_i^*, \varphi_\omega), z_i^* \right] \left[ p_i^B(P_i^*, z_i^*, \varphi_\omega) - c_i(\varphi_\omega) \right] - f_z z_i^*.
\]
The first-order condition is,
\[
\frac{d\pi_{ii}}{dz_{ii}} = \frac{\partial \pi_{ii}}{\partial z_{ii}} + \frac{\partial \pi_{ii}}{\partial p^B_{ii}} \frac{dp^B_{ii}}{dz_{ii}} + \frac{\partial \pi_{ii}}{\partial p^w_{ii}} \frac{dp^w_{ii}}{dz_{ii}} = 0.
\]
We have already calculated for the simultaneous case \(\frac{\partial \pi_{ii}}{\partial z_{ii}} = s_{ii}^w \varepsilon^{(s_{ii}^w)}(1 - s_{ii}^w)\varepsilon^{(s_{ii}^w)}\varepsilon^{(s_{ii}^w)}\). Besides, regarding \(\frac{\partial \pi_{ii}}{\partial p^w_{ii}}\), by the first-order condition of prices,
\[
\frac{\partial \pi_{ii}}{\partial z_{ii}} = - \left( \frac{\partial \pi_{ii}}{\partial Q_{ii}} \frac{\partial Q_{ii}}{\partial p^w_{ii}} \frac{\partial p^w_{ii}}{\partial z_{ii}} + \frac{\partial \pi_{ii}}{\partial p^B_{ii}} \frac{\partial p^B_{ii}}{\partial p^w_{ii}} \right).
\]
Regarding \(\frac{\partial p^B_{ii}(p^w_{ii}, z_{ii})}{\partial z_{ii}}\), I depart from expression (2), so that
\[
\frac{\partial p^B_{ii}(s_{ii}^w, \varphi_{ii})}{\partial s_{ii}^w} = \frac{\partial p^B_{ii}(\cdot)}{\partial s_{ii}^w} \frac{\partial s_{ii}^w}{\partial z_{ii}} + \frac{\partial p^B_{ii}(\cdot)}{\partial z_{ii}} \frac{\partial s_{ii}^w}{\partial z_{ii}} = \frac{1}{1 - \frac{\partial p^B_{ii}(\cdot)}{\partial s_{ii}^w}}.
\]
Given \(\frac{\partial p^B_{ii}(\cdot)}{\partial s_{ii}^w} = \frac{1}{\varepsilon(s_{ii}^w)} s_{ii}^w\) and working out the expression with some of the calculations determined above,
\[
\frac{\partial \ln p^B_{ii}(s_{ii}^w, \varphi_{ii})}{\partial \ln z_{ii}} = \frac{s_{ii}^w}{\varepsilon(s_{ii}^w)} \varepsilon^{(s_{ii}^w)}(1 - s_{ii}^w)\varepsilon^{(s_{ii}^w)}\varepsilon^{(s_{ii}^w)}.
\]
By making use of all the results,
\[
\frac{d\pi_{ii}}{dz_{ii}} = \frac{s_{ii}^w}{\varepsilon(s_{ii}^w)} \varepsilon^{(s_{ii}^w)}(1 - s_{ii}^w)\varepsilon^{(s_{ii}^w)}\varepsilon^{(s_{ii}^w)} - f_z = 0.
\]
Thus, the optimal domestic investments are,
\[
f_z z_{ii}^{seq}(s_{ii}^w) = \frac{s_{ii}^w}{\varepsilon(s_{ii}^w)} \varepsilon^{(s_{ii}^w)}(1 - s_{ii}^w)\varepsilon^{(s_{ii}^w)}\varepsilon^{(s_{ii}^w)}.
\]
Likewise, optimal domestic profits are,

\[ \pi_{ii}^{seq}(s_{ii}^w) := \frac{s_{ii}^w}{\epsilon(s_{ii}^w)} \left[ 1 - \delta \left(1 - s_{ii}^w\right) \left(\frac{\sigma}{\sigma - s_{ii}^w \epsilon(s_{ii}^w)}\right)\right]. \]

### 4.3 Calculation of the Counterfactual

Given values for the parameters, the structural model determines that all the results can be determined by knowledge of the firms’ market shares. While the market share in the sequential case obtained from the data, I proceed to recover the market shares under the simultaneous scenario. I exploit the expression of the market share given by equation (5), and the fact that \( \epsilon \)’s domestic aggregate \( A_i \) is the same in both the sequential and simultaneous situation.

Given a value of \((\sigma, \delta)\), the quotient of firm’s market shares in each case is,

\[ \frac{s_{ii}^{seq}(\omega)}{s_{ii}^{sim}(\omega)} = \frac{\left[p_{ii} \left(s_{ii}^{seq}(\omega), \varphi_\omega\right)\right]^{1-\sigma} \left[z_{ii}^{seq}(s_{ii}^{seq}(\omega))\right]^\delta}{\left[p_{ii} \left(s_{ii}^{sim}(\omega), \varphi_\omega\right)\right]^{1-\sigma} \left[z_{ii}^{sim}(s_{ii}^{sim}(\omega))\right]^\delta}. \]

The expression (6) does not have a closed form solution, so \( s_{ii}^{sim}(\omega) \) has to be determined numerically. Remarkably, in that expression, the terms \( \varphi_\omega \) and \( f_z \) cancel out, so there is no need to know their values. I only need to have estimations of \( \sigma \) and \( \delta \).

Intuitively, the market shares of the simultaneous case are recovered based on how market shares are determined in the model. This means that I exploit the variations of prices and investments choices predicted by the model and their impact on the market shares.

### 5 Empirical Analysis

For the empirical study, I draw on information from Denmark provided by Statistics Denmark. The information is part of the country’s sources for official statistics. Several features make the data appropriate to conduct the analysis. First, the information at disposal is at the firm-product level. Since the equations are in terms of firms’ market shares, it allows me to avoid the use of other imperfect proxies measured at the
plant- or product-level. Moreover, since the information on imports and domestic firms’ sales are disaggregated at the 8-digit product level, I am able to allocate each product to a properly defined market. Finally, the information of imports encompasses both manufacturing and nonmanufacturing firms, thus providing an accurate measure of the import competition for each industry.

I start by describing the information included in the datasets. After this, I proceed to construct the data analogs of the model concepts. Finally, I perform the quantitative analysis. Several alternative approaches and robustness checks are included in Appendix C.

5.1 Data Description

I make use of two datasets at an annual frequency. One provides information about production of manufacturing firms while the other contains international transactions by both manufacturing and nonmanufacturing firms. Both datasets have information reported at the year-firm-product level and they can be easily merged through a unique identifier that each Danish firm has. I take 2005 as the baseline year. In Appendix C.1, I recalculate the results for all years between 2000 and 2007.

The dataset that contains information about physical production in manufacturing industries constitutes the source for Danish Prodcom statistics. The information is gathered through a compulsory survey to all the production units belonging to a same firm. Any unit with main activity in manufacturing and having at least ten employees is included. Overall, at least 90% of the total production value in each NACE (revision 1.1) 4-digit sector is covered. It provides information on the values and quantities of the production at the firm-product level. Products are defined in terms of the Combined Nomenclature at the 8-digit level (hereafter, CN8).

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9The Prodcom database records data on the physical production of manufactured products of EU countries. All EU members produce Prodcom statistics.

10NACE is the standard industry classification used in the EU. It is similar to the NAICS system for North American countries, or the older SIC used in USA.

11It is worthy of remark that the coverage is not defined as production on the physical territory of Denmark. Instead it is by the economic ownership of goods sold and produced by Danish firms, in case they are produced under subcontracting for a Danish firm.

12The Combined Nomenclature is the nomenclature applied by all the EU countries to report trade data. Their first six digits coincide with the Harmonized System (HS) nomenclature.
The total value reported includes sales to the domestic market and exports, without a break down of its final use. For this reason, in order to get a measure of domestic sales, I make use of a dataset that reports imports and exports by firms. This dataset is collected by Danish customs. It contains information regarding exports (FOB values) and imports (CIF values) of all the firms, covering those belonging to the production dataset but also others whose main activity is services (for instance, retailers). Like the production dataset, products are also defined at the CN8.\footnote{The trade flows of countries belonging to the European Union represent around 95\% and 97\% of the total imports and exports are recorded, respectively. Regarding, countries not belonging to the EU, the universe of transactions is covered.}

### 5.2 Definitions and Final Dataset

With the aim of constructing a measure of market shares, it is necessary to define the bounds of the market and some criteria to identify domestic firms as well as the imports that compete with domestic products in the industry.

The definition of a market requires a break in the chain of substitute goods. Given that the information is at the 8-digit product level, I assemble it such that a market is defined as the group of goods that belong to the same 4-digit NACE industry.

I define domestic firms as those that report positive production in Denmark for that industry. It is worthy of remark that this classification is applied in a market-by-market basis and so is the classification of a firm as domestic. As a consequence, some firms could be considered domestic in one industry but not in other.
The imports which are considered competition in the industry comprise two cases. On the one hand, it includes imports by firms that do not engage in any production activity in the country. These gather all the retailers whose imports are competing directly with the sales by domestic firms. On the other hand, it also includes imports by domestic firms which do not produce in that that industry. They are mainly inputs which the firm could have bought to a domestic firm. Figure 6 illustrates the classification.

Figure 6: Domestic Firms Classification and Import Competition

Note: The classification of firms is conducted in an industry-by-industry basis. Firm 1 and 2 are considered domestic in industries 1 and 2, respectively, since they produced goods belonging to each industry. Regarding industry 1, the import competition encompasses imports of goods belonging to industry 1 by nonmanufacturing firms (e.g. retailers) and manufacturing firms which do not produce any good belonging to industry 1 (e.g. Firm 2).

Regarding the sales of the domestic firms, several definitions might be used. For the baseline calculations, I use the total turnover reported in the dataset of physical production. It includes sales of own goods, either produced, processed or assembled by the firm, goods produced by a subcontractor established abroad if the firm owns the inputs of the subcontracted firm, and resales of goods bought to other domestic firms and sold with any processing.\footnote{In Appendix C.2, I recalculate the results of the analysis for the case where some of the own firm’s imports are part of the firm’s total supply. Two alternatives are considered and the main results for the average of the economy are essentially the same.}

In terms of classifications between large and small firms, I consider a firm as big if it has a domestic market share greater than 5%. Any firm with a lower market share
belongs to the competitive fringe.

In order to use the model for the empirical study, it is necessary to ensure that the market-structure features of the data are consistent with the theoretical setup. In my model, this implies that the industries under consideration should have a subset of firms which are negligible to the market.\textsuperscript{15} I do this following the procedure described in the Appendix B. After the cleaning of the industries, I end up with 119 industries out of 203 industries. This covers 83\% of the total value of the manufacturing.

5.3 Determination of the Parameters

The empirical implementation requires information values of the parameters $\sigma$ and $\delta$. In this part, I deal with the determination of $\sigma$ and $\delta$.

The elasticity of substitution for each industry is taken directly from Broda and Weinstein (2006).\textsuperscript{16} As far as $\delta$ goes, I choose a value so that the market shares differences within each industry fit the model as close as possible. In the following, I provide some intuition of the procedure, relegating its formal treatment to Appendix A.3.

I depart from the domestic demand faced by a BF and keep notation simple by skipping any country or firm type index. The quantities demanded in equation (1) define that the domestic market share of a BF producing variety $\omega$ in the industry $n$ satisfies,

$$\ln s(\omega) = (1 - \sigma_n) \ln p(\omega) + \delta \ln z(\omega) - \ln A_n.$$  

The intuition to calibrate $\delta$ is using the investments chosen by BFs to fit the variation of market shares within an industry. With this aim, I first obtain a measure of the portion of market shares that is not explained by prices or the aggregate conditions of the industry, where the latter is treated as a fixed effect.\textsuperscript{17} Then I fit those residuals to

\textsuperscript{15}It is worth remarking that it is not necessary to verify that these SFs coexist with a group of BFs since, in terms of the structural model, BFs with negligible market shares behave as monopolistic competitive firms. Thus, the model predicts each of these firms has a zero impact on the market.

\textsuperscript{16}Given that the calculations are in terms of the 4-digit industry, I take an average of the elasticities, with weights given by the importance of the products in terms of expenditure in the sector.

\textsuperscript{17}This is an intuition similar to models of quality where, conditional on prices, a higher quality is assigned to products with a higher market share. Since quality is a residual of a regression of market shares on prices, some authors have referred to it as perceived quality (Sutton, 2012) and appealing
\[ \delta \ln z(\omega) \]. The procedure gives a value of \( \delta = 0.915 \). Details of the calculations are in Appendix B.

### 5.4 Results

I present the results relative to the pool of industries that have a mixed market structure. Figure 7 and Table 2 provide a comparison between the sequential and simultaneous scenarios in terms of industry averages for each sector.

#### Table 2: Strategic Gains - Averages per Sector

<table>
<thead>
<tr>
<th>Industry</th>
<th>Avg. Ind.</th>
<th>Avg. Per Firm</th>
<th>Total Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass &amp; Cement</td>
<td>21.2</td>
<td>6.2</td>
<td>7.4</td>
</tr>
<tr>
<td>Other Transports</td>
<td>18.2</td>
<td>9.1</td>
<td>13.9</td>
</tr>
<tr>
<td>Printing</td>
<td>17.8</td>
<td>4.7</td>
<td>6.6</td>
</tr>
<tr>
<td>Other Manufactures</td>
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<td>6.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Apparel</td>
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<tr>
<td>Chemicals</td>
<td>15.2</td>
<td>5.2</td>
<td>7.6</td>
</tr>
<tr>
<td>Food &amp; Beverages</td>
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<td>5.7</td>
<td>7.2</td>
</tr>
<tr>
<td>Electrical Machinery</td>
<td>11.7</td>
<td>5.8</td>
<td>7.1</td>
</tr>
<tr>
<td>Paper</td>
<td>10.2</td>
<td>3.7</td>
<td>5.6</td>
</tr>
<tr>
<td>Motor Vehicles</td>
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<td>5.0</td>
<td>.</td>
</tr>
<tr>
<td>Metal Products</td>
<td>9.7</td>
<td>4.0</td>
<td>6.4</td>
</tr>
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<td>7.0</td>
</tr>
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<td>Textiles</td>
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<td>5.8</td>
</tr>
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<td>Rubber &amp; Plastic</td>
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<td>3.2</td>
<td>8.2</td>
</tr>
<tr>
<td>Machinery</td>
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<td>10.8</td>
</tr>
<tr>
<td>Media Equipment</td>
<td>1.6</td>
<td>1.6</td>
<td>.</td>
</tr>
<tr>
<td>Average of Sectors</td>
<td>10.8</td>
<td>4.7</td>
<td>8.3</td>
</tr>
</tbody>
</table>

**Note:** Gains are differences between the sequential and simultaneous case. Only industries with a mixed market structure considered. Results in terms of points are percentage-points differences. Results in terms of increases are percentage variations relative to the simultaneous case. Market shares account for for import competition. Domestic intensity defined as firm’s domestic sales relative to its own total sales and it excludes firms that exclusively sell to the domestic market. Those cases with "." reported are because all firms sell exclusively to the domestic market.

(Hottman, Redding, and Weinstein, 2016).
Figure 7: Sequential vs. Simultaneous Cases - Averages per Sector

(a) All Domestic Leaders’ Market Share

(b) All Domestic Leaders’ Domestic Intensity

(c) Firm’s Market Share

(d) Firm’s Domestic Intensity

Note: Gains are percentage-points differences between the sequential and simultaneous case. Domestic intensity excludes those firms that sell exclusively in the domestic market. Market shares are relative to total sales and account for import competition.

Considering all the sectors, a typical firm has 12% and 7% of domestic market share and a domestic intensity of 70% and 62% in the sequential and simultaneous scenario, respectively. In addition, considering all domestic leaders as a group, they would have in a typical industry 27% and 16% of domestic market shares and domestic intensity of 76% and 67% in the sequential and simultaneous scenario, respectively.

Nonetheless, conclusions derived from an average may represent a partial picture regarding the strategic effects. By an inspection of the sectors, it is noticed that the results display a pronounced heterogeneity. To interpret the results at the sector level, notice that they reflect averages of the industries that composed them with a different
number of them within sectors. For instance, while the results in terms of market shares are significant for the case of Other Transports, they only reflect the behavior of one industry. In contrast, Food & Beverages capture an average of 19 industries.

In Figure 8, I present the results at the industry and firm level where the heterogeneity shows itself even more starkly. To understand how the gains are determined, variation of firm’s market share depends not only on the market share that the firm has in the sequential equilibrium but also the elasticity of substitution of the industry. The less substitute the products within an industry, the greater the first-mover advantages. Regarding the domestic intensity, firms that devote the bulk of sales to exports or local sales are less influenced by the strategic move.

Figure 8: Industry’s and Firm’s Gains

(a) All Domestic Leaders’ Market Share

(b) All Domestic Leaders’ Domestic Intensity

(c) Domestic Leader’s Market Share

(d) Domestic Leader’s Domestic Intensity

Note: Gains are percentage-points differences between the sequential and simultaneous case. Figures 8a and 8b consider all domestic leaders of the industry as a group. Market shares are relative to total sales and account for for import competition. Domestic intensity defined as domestic sales relative to own total sales.
5.5 Gains by Rauch’s Classification of Goods

The possibility of affecting demand through sunk investments does not exclude industries with physically homogeneous product. While those goods are roughly equivalent in terms of the physical unit, which is the dimension that output is measured, they could be differentiated along other dimension. These dimensions could be either real or perceived, observable or not.\textsuperscript{18} The insight is present in Foster, Haltiwanger, and Syverson (2016). They find that demand differences are central to explain firm’s size since small firms are in fact slightly more efficient than large firms. To assess the outcomes in terms of homogeneous and differentiated goods, I resort to the classification of goods by Rauch (1999). The original classification can be concorded with products at the 6-digit level according to the Harmonized System. Rauch works with three categories of goods: traded on organized exchanges, having a reference price, and the rest of commodities. I refer to the former two categories as homogeneous goods, while I classify the rest as differentiated products. Given that the analysis is at the industry level, I assign each industry to one of the three categories, according to the median number of products’ type.\textsuperscript{19} The results are presented in Tables 9 and 9b.

\textsuperscript{18}Bronnenberg, Dhar, and Dubé (2009, 2011) show that for the food industry in the US, and even for products that consumers cannot distinguish among in blind tests, intangible aspects of the demand play an important role in the emergence of leaders in the market.

\textsuperscript{19}I use the liberal classification in Rauch (1999). The results are robust to use a conservative classification, and assigning the industries according to other measures different from the median number of products’ types.
Figure 9: Total Market Share Gains per Type of Industry

(a) All Domestic Leaders’ Market Share Gains

(b) Domestic Leader’s Market Share Gains

Note: Industries classified according to the median number of goods that correspond to each category of Rauch’s classification. H refers to goods traded on organized exchanges, R to goods with a reference price, and D to the rest of goods. Liberal classification used.
The results indicate that first-mover advantages are acquired predominantly by firms in differentiated industries. One notable exception is the case of Food & Beverages and Chemicals. In that case, the gains are acquired by both homogeneous and differentiated industries.

6 Conclusion

In this paper I have built a structural model to quantify first-mover advantages that create outcomes consistent with a home bias. I have provided evidence on the magnitude of the phenomenon by making use of rich disaggregated data for the Danish manufacturing.

I have built up a framework that keeps tractable a scenario with an endogenous number of heterogeneous firms, strategic interactions and firms making multiple choices.

The conclusions I derive are that first-mover advantages are important determinants in shaping the structure of the economy and home-bias patterns, with great heterogeneity at the sector-, industry- and firm-level. Moreover, the gains are acquired by firms belonging to differentiated industries.

References


References


A Derivations of Section 4

A.1 On the Choice of an Augmented CES

The demand of a consumer from country \( i \) of a variety \( \omega \) produced by a BF from \( j \) is,

\[
Q_{ji}^B(\omega) := (\bar{P}_i)^{\sigma-1} [z_{ji}(\omega)]^\delta \left[ p_{ji}^B(\omega) \right]^{-\sigma}
\]  

(4)

where \((\bar{P}_i)^{1-\sigma} := \sum_{j=1}^C \int_{\omega \in \Omega_j^S} \left[ p_{ji}^S(\omega) \right]^{1-\sigma} d\omega + \sum_{\omega \in \Omega_j^B} \left[ p_{ji}^B(\omega) \right]^{1-\sigma} \left[ z_{ji}^B(\omega) \right]^\delta \). In terms of the general demand system, the aggregator is defined as,

\[
A_i := \sum_{j=1}^C \int_{\omega \in \Omega_j^S} h^S \left[ p_{ji}^S(\omega) \right] d\omega + \sum_{\omega \in \Omega_j^B} h^B \left[ p_{ji}^B(\omega), z_{ji}(\omega) \right]
\]

so that the demand (4) is consistent with defining \( A_i := (\bar{P}_i)^{1-\sigma} \) with \( h^S \left[ p_{ji}^S(\omega) \right] := \left[ p_{ji}^S(\omega) \right]^{1-\sigma} \) and \( h^B \left[ p_{ji}^B(\omega), z_{ji}(\omega) \right] := \left[ p_{ji}^B(\omega) \right]^{1-\sigma} \left[ z_{ji}^B(\omega) \right]^\delta \). Broadly speaking, the CES has been numerous times applied given its tractability, prominence and empirical feasibility (Broda and Weinstein, 2006; Hottman, Redding, and Weinstein, 2016). However, other options, for instance the Multinomial Logit, satisfy these features too. I have opted for the CES as it meets the following additional properties.

In first place, given a normalized expenditure equal to unity, the revenue of a firm corresponds to its market share. Formally, define the market share in terms of sales of a BF from \( j \) selling a variety \( \omega \) in \( i \) by \( s_{ji}^B(\omega) := p_{ji}^B(\omega) Q_{ji}^B(\omega) \). Then, by making use of the equation (4), the market share can be expressed as,

\[
s_{ji}^B(\omega) = \frac{\left[ z_{ji}(\omega) \right]^\delta \left[ p_{ji}^B(\omega) \right]^{1-\sigma}}{(\bar{P}_i)^{1-\sigma}} = \frac{h^B \left[ p_{ji}^B(\omega), z_{ji}(\omega) \right]}{A_i}.
\]  

(5)

This implies that a CES demand defines the market share of a firm by the weight of its \( h^B \) in the aggregate \( A_i \). In other terms, \( h^B \) could be seen as the bundle of variety \( \omega \)'s characteristics (including the price) that determines the appealing of \( \omega \) and so its position in the market. Through the lens of this interpretation, the functional form of
$h^B$ gives a specific role to the parameters $1 - \sigma$ and $\delta$. They are the elasticities of $h^B$ with respect to prices and the investments, respectively. As a corollary, for a given value $A$, these parameters indicate, in percentage terms, how each firm’s decision impacts on the market share. By the same token, they also represent how each variable impacts the aggregator. Once that market shares are expressed in a general form as in equation (5), it is also possible to see the flexibility that the expression entails. Depending how $h^B$ is defined, different relations between the investments and the prices are able to be incorporated. In second place, the functional forms of $h^S$ and $h^B$ are homothetic with respect to the strategies. Joint with an aggregator linear in those functions, they determine that the optimal choices and profits can be expressed in terms of the market shares. Hence, all the solutions can be characterized by firm’s market shares, creating a direct link of the model to the data. Remarkably, it can be shown that the Multinomial Logit has similar properties to the ones described but for a situation where market shares are defined in terms of quantities instead of sales. Nonetheless, in a setup with SFs coexisting with BFs, this feature of the Logit could represent a distorted picture of the presence, and hence the market power, of a BF in the market. Intuitively, while two firms could be selling the same amount of quantities, a firm with more market power might be able to charge higher prices. This explains my inclination for the use of a CES demand.

20 In all the papers mentioned in the previous footnote that incorporate quality through an augmented CES, they define the functional form in a way that $\delta$ is in fact equal to $1 - \sigma$. Implicitly, this means that the prices and perceived quality have the same effect on the demand. Other papers, e.g. Arkolakis (2010), work with the proportion of consumers reached in a market. In that case, $\delta$ would be equal to one.

21 Notice that this also rationalizes the assumption of the strategic variable as a composite good. Specifically, the variable can be interpreted as a bundle of non-price variables which are perfect complements with an effect of $\delta$ on the market share. Formally, let $\left(z^k(\omega)\right)_{k=1}^K$ non-price variables that a firm producing a variety $\omega$ has at their disposal. Then, assuming that $K$ is finite, define $z(\omega) := \min \{\alpha^1 z^1(\omega), ..., \alpha^K z^K(\omega)\}$ where $\left(\alpha^k\right)_{k=1}^K$ are parameters.

22 Notice that here I am assuming that all the varieties enter the CES in a symmetric way. Nonetheless, it is easy to see that it could also be defined $h^B_\omega$, that is, the function depends on the variety $\omega$ considered. For instance, I could have allowed for firm-specific elasticities by defining $h^B_\omega [p^B(\omega), z(\omega)] := \left[p^B(\omega)\right]^{1-\sigma_\omega} [z(\omega)]^{\delta_\omega}$. 

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A.2 Calculation of the Counterfactual

With values of $\sigma$ and $\delta$, I proceed to recover the market shares for the simultaneous scenario. I exploit the expression of the market share given by equation (5), and the fact that $i$’s domestic aggregate $A_i$ is the same in both the sequential and simultaneous situation. Given a value of $(\sigma, \delta)$, the quotient of firm’s market shares in each case is,

$$\frac{s_{ii}^{\text{seq}} (\omega)}{s_{ii}^{\text{sim}} (\omega)} = \frac{[p_{ii} (s_{ii}^{\text{seq}} (\omega), \varphi_\omega)]^{1-\sigma} [z_{ii}^{\text{seq}} (s_{ii}^{\text{seq}} (\omega))]^\delta}{[p_{ii} (s_{ii}^{\text{sim}} (\omega), \varphi_\omega)]^{1-\sigma} [z_{ii}^{\text{sim}} (s_{ii}^{\text{sim}} (\omega))]^\delta}.$$  

By using the optimal solutions for the prices and the investments in each scenario, the following equation is determined,

$$\left[ s_{ii}^{\text{sim}} (\omega) \right]^{\delta-1} \left( \frac{1 - s_{ii}^{\text{sim}} (\omega)}{\epsilon (s_{ii}^{\text{sim}} (\omega))} \right)^\delta \left( \frac{\epsilon (s_{ii}^{\text{sim}} (\omega))}{\epsilon (s_{ii}^{\text{sim}} (\omega)) - 1} \right)^{1-\sigma} = \xi_{ii}^{\text{seq}} (s_{ii}^{\text{seq}} (\omega)) \quad (6)$$

where $\xi_{ii}^{\text{seq}} (s_{ii}^{\text{seq}} (\omega)) := \left[ s_{ii}^{\text{seq}} (\omega) \right]^{\delta-1} \left[ \frac{\epsilon (s_{ii}^{\text{seq}} (\omega))}{\epsilon (s_{ii}^{\text{seq}} (\omega)) - 1} \right]^{1-\sigma} \left[ \frac{(1-s_{ii}^{\text{seq}} (\omega))}{\epsilon (s_{ii}^{\text{seq}} (\omega))} \right]^{\sigma} \epsilon (s_{ii}^{\text{seq}} (\omega))$. The expression (6) does not have a closed form solution, so $s_{ii}^{\text{sim}} (\omega)$ has to be determined numerically. Intuitively, the market shares of the simultaneous case are recovered based on how market shares are determined in the model. Given a value of aggregate, market shares depend on the prices and the investments. BF’s invest more heavily in the sequential case relative to the simultaneous scenario. Likewise, the variation of prices is explained by changes in the marginal costs and the markup. While the former remains the same, markups are affected by the increase of investment. Hence, I obtain the market share of the simultaneous case through the variations of each choice predicted by the model and their impact on the market shares.

A.3 Determination of $\delta$

The equation (5) expressed in logarithms determines that the market share of a domestic BF producing variety $\omega$ in the industry $n$ is,

$$\ln s (\omega) = (1-\sigma_n) \ln p (\omega) + \delta \ln z (\omega) - \ln A_n. \quad (7)$$
The procedure requires information on market shares and prices, while \( \ln A_n \) can be treated as a fixed effect of the industry. Regarding \( \ln z(\omega) \), I use the solution under the sequential scenario. Adding an error term, this implies that \( \delta \) is obtained from regressing the following equation,

\[
\ln \tilde{s}(\omega) = \delta \ln z(\omega) - \ln A_n + \varepsilon(\omega)
\]

where \( \ln \tilde{s}(\omega) := \ln s(\omega) - (1 - \sigma_n) \ln p(\omega) \). The intuition behind the approach is obtaining a value of \( \delta \) that fits the model in terms of the market shares’ variation within industries not explained by prices. Since some of the variables determining the strategic investments are industry specific, equation (7) can be equivalently expressed in the following way,

\[
\ln \tilde{s}(\omega) = \Lambda_n + \delta \ln \xi(\omega) + \varepsilon(\omega).
\]

where \( \xi(\omega) := \frac{s(\omega)(1-s(\omega))}{\varepsilon(s(\omega))} \) and \( \Lambda_n := \delta \ln \left[ \frac{\delta \sigma_n}{f_z} \right] - \ln A_n \). I use this equation to conduct the calibration.

**B  Cleaning of the Datasets**

Table 3 shows descriptive statistics of the economy. The total information at disposal comprises 203 industries with 3,518 firms.
Table 3: Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>% value</th>
<th># industries</th>
<th># firms</th>
<th># exporters</th>
<th>% exporters</th>
<th>import share</th>
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<tbody>
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<td>Food-Beverages</td>
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<td>95</td>
</tr>
<tr>
<td>Wood</td>
<td>3.3</td>
<td>6</td>
<td>230</td>
<td>72</td>
<td>31</td>
<td>46</td>
</tr>
<tr>
<td>Glass &amp; Cement</td>
<td>3.4</td>
<td>23</td>
<td>192</td>
<td>78</td>
<td>41</td>
<td>31</td>
</tr>
<tr>
<td>Apparel</td>
<td>2.9</td>
<td>6</td>
<td>68</td>
<td>57</td>
<td>84</td>
<td>92</td>
</tr>
<tr>
<td>Other Transports</td>
<td>2.8</td>
<td>8</td>
<td>45</td>
<td>28</td>
<td>62</td>
<td>72</td>
</tr>
<tr>
<td>Medical Equipment</td>
<td>2.8</td>
<td>4</td>
<td>189</td>
<td>125</td>
<td>66</td>
<td>54</td>
</tr>
<tr>
<td>Paper</td>
<td>2.8</td>
<td>6</td>
<td>200</td>
<td>82</td>
<td>41</td>
<td>58</td>
</tr>
<tr>
<td>Textiles</td>
<td>2.0</td>
<td>10</td>
<td>158</td>
<td>106</td>
<td>67</td>
<td>79</td>
</tr>
<tr>
<td>Leather</td>
<td>0.9</td>
<td>2</td>
<td>24</td>
<td>15</td>
<td>63</td>
<td>97</td>
</tr>
<tr>
<td>Average of Sectors</td>
<td>.</td>
<td>10</td>
<td>233</td>
<td>120</td>
<td>56</td>
<td>61</td>
</tr>
<tr>
<td>All Sectors</td>
<td>.</td>
<td>203</td>
<td>3518</td>
<td>1916</td>
<td>54</td>
<td>55</td>
</tr>
</tbody>
</table>

Note: % value of each sector measured relative to total sales. % exporters relative to its own sector. Import shares relative to total sales.

For the classification of firms, I consider a firm as a domestic leader if it has 5% or more of market share. To be able to have a dataset that it consistent with the theoretical model, I drop industries according to the following criteria. First, I remove those that have a low number of firms, where the cutoff is set as 10 firms. To ensure that industries have a competitive fringe, I exclude those where either the subset of five firms or the 20% of firms with lowest market share accumulate more than 5% of the domestic market share. Besides, I only keep industries where importing is an option, adopting a 3% of market share for the importers as the cutoff. After the cleaning of the industries, in absolute terms, I end up with 119 industries. As regards of the percentage of total industries covered relative to the whole manufacturing, I present the results in the Tables 4a and 4b. They indicate the number of industries covered per sector as well the value that each sector represents. In terms of calculations, market shares are calculated as described in Section (5.2). Also, the parameter $\sigma_n$ for each industry is taken from Broda and Weinstein (2006). For the estimation of $\delta$, I need
Table 4: Final Dataset

(a) Industries with a Fringe

<table>
<thead>
<tr>
<th>Industry</th>
<th>% industries</th>
<th>% value</th>
<th>Industry</th>
<th>% industries</th>
<th>% value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media Equipment</td>
<td>100</td>
<td>100</td>
<td>Media Equipment</td>
<td>33</td>
<td>18</td>
</tr>
<tr>
<td>Leather</td>
<td>100</td>
<td>100</td>
<td>Leather</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wood</td>
<td>83</td>
<td>99</td>
<td>Wood</td>
<td>80</td>
<td>74</td>
</tr>
<tr>
<td>Medical Equipment</td>
<td>75</td>
<td>97</td>
<td>Medical Equipment</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Apparel</td>
<td>67</td>
<td>97</td>
<td>Apparel</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Chemicals</td>
<td>76</td>
<td>95</td>
<td>Chemicals</td>
<td>76</td>
<td>83</td>
</tr>
<tr>
<td>Electrical Machinery</td>
<td>71</td>
<td>95</td>
<td>Electrical Machinery</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>Computers</td>
<td>50</td>
<td>94</td>
<td>Computers</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other Manufactures</td>
<td>67</td>
<td>93</td>
<td>Other Manufactures</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>Machinery</td>
<td>68</td>
<td>92</td>
<td>Machinery</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td>Rubber &amp; Plastic</td>
<td>71</td>
<td>91</td>
<td>Rubber &amp; Plastic</td>
<td>80</td>
<td>72</td>
</tr>
<tr>
<td>Paper</td>
<td>67</td>
<td>89</td>
<td>Paper</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Metal Products</td>
<td>61</td>
<td>87</td>
<td>Metal Products</td>
<td>87</td>
<td>95</td>
</tr>
<tr>
<td>Basic Metals</td>
<td>33</td>
<td>87</td>
<td>Basic Metals</td>
<td>75</td>
<td>84</td>
</tr>
<tr>
<td>Food-Beverages</td>
<td>58</td>
<td>86</td>
<td>Food-Beverages</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Textiles</td>
<td>70</td>
<td>82</td>
<td>Textiles</td>
<td>43</td>
<td>19</td>
</tr>
<tr>
<td>Printing</td>
<td>71</td>
<td>68</td>
<td>Printing</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Glass &amp; Cement</td>
<td>22</td>
<td>45</td>
<td>Glass &amp; Cement</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Transport Equip.</td>
<td>67</td>
<td>29</td>
<td>Transport Equip.</td>
<td>50</td>
<td>49</td>
</tr>
<tr>
<td>Other Transports</td>
<td>12</td>
<td>2</td>
<td>Other Transports</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

(b) Industries with a Mixed Market Structure

<table>
<thead>
<tr>
<th>Industry</th>
<th>% industries</th>
<th>% value</th>
<th>Industry</th>
<th>% industries</th>
<th>% value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media Equipment</td>
<td>33</td>
<td>18</td>
<td>Media Equipment</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Leather</td>
<td>0</td>
<td>0</td>
<td>Leather</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wood</td>
<td>80</td>
<td>74</td>
<td>Wood</td>
<td>80</td>
<td>74</td>
</tr>
<tr>
<td>Medical Equipment</td>
<td>100</td>
<td>100</td>
<td>Medical Equipment</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Apparel</td>
<td>25</td>
<td>3</td>
<td>Apparel</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Chemicals</td>
<td>76</td>
<td>83</td>
<td>Chemicals</td>
<td>76</td>
<td>83</td>
</tr>
<tr>
<td>Electrical Machinery</td>
<td>80</td>
<td>90</td>
<td>Electrical Machinery</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>Computers</td>
<td>0</td>
<td>0</td>
<td>Computers</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other Manufactures</td>
<td>50</td>
<td>55</td>
<td>Other Manufactures</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>Machinery</td>
<td>93</td>
<td>93</td>
<td>Machinery</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td>Rubber &amp; Plastic</td>
<td>80</td>
<td>72</td>
<td>Rubber &amp; Plastic</td>
<td>80</td>
<td>72</td>
</tr>
<tr>
<td>Paper</td>
<td>100</td>
<td>100</td>
<td>Paper</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Metal Products</td>
<td>87</td>
<td>95</td>
<td>Metal Products</td>
<td>87</td>
<td>95</td>
</tr>
<tr>
<td>Basic Metals</td>
<td>75</td>
<td>84</td>
<td>Basic Metals</td>
<td>75</td>
<td>84</td>
</tr>
<tr>
<td>Food-Beverages</td>
<td>100</td>
<td>100</td>
<td>Food-Beverages</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Textiles</td>
<td>43</td>
<td>19</td>
<td>Textiles</td>
<td>43</td>
<td>19</td>
</tr>
<tr>
<td>Printing</td>
<td>100</td>
<td>100</td>
<td>Printing</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Glass &amp; Cement</td>
<td>100</td>
<td>100</td>
<td>Glass &amp; Cement</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Transport Equip.</td>
<td>50</td>
<td>49</td>
<td>Transport Equip.</td>
<td>50</td>
<td>49</td>
</tr>
<tr>
<td>Other Transports</td>
<td>100</td>
<td>100</td>
<td>Other Transports</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: Table 4a: Existence of a fringe in an industry defined such that the 5 firms or 20 percent of firms with lowest market share accumulates less than 5 percent of the market share. Market shares are relative to total sales and account for import competition. Value defined as the total sales of the sector. Percentages are relative to all the manufacturing industries. Table 4b: Industry with a mixed market structure defined by the coexistence of a fringe with at least one domestic firm that has 5 percent or more of market. Market shares defined relative to total sales, including imports. Value defined as the total sales of the sector. Percentages are relative to the industries with a fringe.

information on prices. I resort to unit values as a proxy. As is well known, unit values constitute an extremely noisy measure of prices. As I rely on a small group of firms, as it is the one composed of domestic leaders in each industry, the measurement error of particular observations makes the problem even more severe. To reduce the noise of the calculations to estimate \( \delta \), I depart from the information on quantities and values at the 8-digit Combined Nomenclature product level (hereafter CN8). I define unit values as the ratio between total sales and quantities. Equation (9) is at

\[ \delta = \frac{\text{Unit Values}}{\text{Quantities}} \]

In the dataset at disposal, the reported quantities are also subject to different problems. Some of these issues are also present in other European datasets. On the one hand, firms are not obliged to report quantities and so missing values are pervasive. In addition, some of the quantities reported are imputations based on reports of the same good from other production units in the same quarter. On the other hand, firms report quantities in not necessarily common, or at least comparable, units of measure.
the firm-industry level, while the information on prices is at the CN8 which represents a more disaggregated level. Thus, I calculate firm’s prices as a weighted average with weights defined by the contribution of each CN8 to firm’s revenue. For the cleaning of the data, I work with the logarithm of unit values as prices. The basic procedure consists of the following steps:

[i] By CN8, I drop those prices within the category that fall below the 5 or above the 95 percentile as in Khandelwal (2010) and Amiti and Khandelwal (2013).

[ii] By firm and CN8, I remove prices which are greater than 150% or lower than 66% of the previous and subsequent year to 2005, which is our reference year.

[iii] I remove industries where at least one of the BF do not report quantities.

In addition, within industries, and even for a same product, some of the quantities reported are in different units of measure. I drop industries where within industries at least one CN8 is expressed in noncomparable units. Then, I express all the products belonging to an industry in a common unit. For instance, if a CN8 is expressed in kilograms and other CN8 in tons, I express both in kilograms.\(^{24}\) After the cleaning, I end up with 85 industries out of the 119 industries which I use to regress equation (9). This provides a value of \(\delta = 0.915\).

<table>
<thead>
<tr>
<th>(\ln \tilde{s}(\omega))</th>
<th>(\ln \xi(\omega))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>-9.068***</td>
<td>0.915**</td>
</tr>
<tr>
<td>(2.166)</td>
<td>(0.394)</td>
</tr>
</tbody>
</table>

Observations 146 146
R-squared 0.109 0.991
Industry FE No Yes

Note: Standard errors in parentheses. *** \(p < 0.01\), ** \(p < 0.05\), * \(p < 0.1\).

\(^{24}\)Note that this methodology introduces noise to unit values. The reason is that, following with the example, the report in tons do not keep track of the decimal numbers, and so when it is converted to kilograms, it is actually an approximation of the real weight.
C Additional Quantitative Results

In this section, I provide some robustness check of the results. First, I show the calculations for several years. After this, I recalculate the strategic gains presented in the main text but using the elasticities of substitution of Soderbery (2015). Finally, I consider some alternative calculations of domestic sales, where I consider imports of goods that are either produced or exported by the firm as part of its total supply. The main conclusion that can be derived is that, concerning the average of the economy, the strategic gains are similar to the ones I presented in the main text.

C.1 Years 2000-2007

Let’s recalculate the strategic gains for the years 2000-2007. For each year, I follow the same methodology as in the main part of the paper. In particular, this includes the same cleaning procedure of industries for each year so that all industries have a fringe. The average strategic gains are quite similar. Nonetheless, at a more disaggregated level, the gains vary in some of the sectors, although without a particular pattern,
meaning that in some cases the gains are greater and in others lower.

Table 6: Strategic Gains - Gains per Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Avg. Ind.</th>
<th>Avg. Per Firm</th>
<th>Avg. Per Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>10.6</td>
<td>4.7</td>
<td>7.4</td>
</tr>
<tr>
<td>2001</td>
<td>11.2</td>
<td>5.3</td>
<td>6.7</td>
</tr>
<tr>
<td>2002</td>
<td>11.3</td>
<td>4.7</td>
<td>7.4</td>
</tr>
<tr>
<td>2003</td>
<td>11.4</td>
<td>4.8</td>
<td>7.3</td>
</tr>
<tr>
<td>2004</td>
<td>10.5</td>
<td>4.4</td>
<td>7.6</td>
</tr>
<tr>
<td>2005</td>
<td>10.8</td>
<td>4.7</td>
<td>8.3</td>
</tr>
<tr>
<td>2006</td>
<td>10.1</td>
<td>4.3</td>
<td>7.9</td>
</tr>
<tr>
<td>2007</td>
<td>10.2</td>
<td>4.2</td>
<td>7.7</td>
</tr>
<tr>
<td>Average</td>
<td>10.8</td>
<td>4.6</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Note: Gains are differences between the sequential and simultaneous case. Only industries with a mixed market structure considered. Results in terms of points are percentage-points differences. Results in terms of increases are percentage variations relative to the simultaneous case. Market shares account for import competition. Domestic intensity defined as firm’s domestic sales relative to its own total sales and it excludes firms that exclusively sell to the domestic market.

Figure 11: Sequential vs. Simultaneous Cases - Averages of Years 2000 -2007

(a) All Domestic Leaders’ Market Share

(b) All Domestic Leaders’ Domestic Intensity
Note: Gains are percentage-points differences between the sequential and simultaneous cases. Domestic intensity excludes those firms that sell exclusively in the domestic market. Market shares are relative to total sales and account for import competition.

Figure 12: Industry’s and Firm’s Gains - Years 2000 -2007
C.2 Alternative Definitions of Domestic Sales

Several definitions of domestic sales might be used. Ideally, the goal is to obtain a measure of the firm’s total supply in the domestic market. This includes goods produced by itself, locally or abroad, and also goods which are produced by other firms (domestically or through imports) and bought with the aim of reselling. For the baseline calculations, I use the total turnover reported in the dataset of physical production. It includes sales of own goods, either produced, processed or assembled by the firm, goods produced by a subcontractor established abroad if the firm owns the inputs of the subcontracted firm, and resales of goods bought to other domestic firms and sold with any processing. The only portion that is not encompassed is the imports to other firms. Although I have information on the imports by each firm, they are not split into different categories, i.e. inputs and final goods. As a consequence, a take on this matter is needed. While firms’ imports that do not belong to the firm’s industry are considered inputs, several options exist regarding the imports of an industry in which the firm reports positive production. In the baseline scenario considered in the main text, I adopt a conservative position and assume that all these imports are inputs of the firm.25 Since the information at disposal is at 8-digit product level, the assump-

\[\text{(Note: Gains are percentage-points differences between the sequential and simultaneous case. Figures 12a and 12b consider all domestic leaders of the industry as a group. Market shares are relative to total sales and account for for import competition. Domestic intensity defined as domestic sales relative to own total sales.)}\]

---

25This also avoids the problem of overestimating the market power of firms which report a small portion of positive production and are mainly retailers. On the other hand, domestic sales are defined...
tion means that if a firm imports an 8-digit product that also produces, the same has been assembled or reprocessed by it, and, so, included in the value of production that it reports. I consider a scenario in which I include in the firm’s total supply those imports of the 8-digit products that the firm produces or exports. Then, I determine firm’s domestic supply by subtracting the exports of each good. For an easier comparison, I present the results following the order of industries of the table in the main text.

Table 7: Strategic Gains - Averages per Sector Including Imports for Total Supply

<table>
<thead>
<tr>
<th>Avg. Ind.</th>
<th>Avg. Per Firm</th>
<th>Total Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass &amp; Cement</td>
<td>22.4</td>
<td>5.8</td>
</tr>
<tr>
<td>Other Transports</td>
<td>18.7</td>
<td>9.3</td>
</tr>
<tr>
<td>Printing</td>
<td>18.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Other Manufactures</td>
<td>11.7</td>
<td>5.9</td>
</tr>
<tr>
<td>Apparel</td>
<td>24.6</td>
<td>8.2</td>
</tr>
<tr>
<td>Chemicals</td>
<td>14.8</td>
<td>4.9</td>
</tr>
<tr>
<td>Food &amp; Beverages</td>
<td>14.6</td>
<td>5.5</td>
</tr>
<tr>
<td>Electrical Machinery</td>
<td>11.3</td>
<td>5.1</td>
</tr>
<tr>
<td>Paper</td>
<td>11.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Motor Vehicles</td>
<td>9.6</td>
<td>4.8</td>
</tr>
<tr>
<td>Metal Products</td>
<td>11.7</td>
<td>3.9</td>
</tr>
<tr>
<td>Wood</td>
<td>7.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Textiles</td>
<td>5.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Rubber &amp; Plastic</td>
<td>5.5</td>
<td>3.1</td>
</tr>
<tr>
<td>Machinery</td>
<td>6.6</td>
<td>3.7</td>
</tr>
<tr>
<td>Basic Metals</td>
<td>4.3</td>
<td>3.4</td>
</tr>
<tr>
<td>Medical Equipment</td>
<td>5.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Media Equipment</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Average</td>
<td>11.4</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Note: Gains are differences between the sequential and simultaneous case. Only industries with a mixed market structure considered. Results in terms of points are percentage-points differences. Results in terms of increases are percentage variations relative to the simultaneous case. Market shares account for for import competition. Domestic intensity defined as firm’s domestic sales relative to its own total sales and it excludes firms that exclusively sell to the domestic market. Those cases with “.” reported are because all firms sell exclusively to the domestic market.

by the difference between total production and exports. Thus, it could understate the domestic sales since the firm could import goods to reexport.

26I have also considered the case in which I only consider those imports of goods that the firm also produces. The results are similar.
Figure 13: Sequential vs. Simultaneous Cases - Averages per Sector - Including Imports for Total Supply

(a) All Domestic Leaders’ Market Share

(b) All Domestic Leaders’ Domestic Intensity

(c) Firm’s Market Share

(d) Firm’s Domestic Intensity

Note: Gains are percentage-points differences between the sequential and simultaneous cases. Domestic intensity excludes those firms that sell exclusively in the domestic market. Market shares are relative to total sales and account for import competition.
C.3 Alternative Elasticities of Substitutions

Soderbery (2015) shows that the elasticities of substitutions estimated by Broda and Weinstein (2006) are biased since their methodology overweights outliers. Based on this, he proposes an estimator that addresses small sample bias and constrained search inefficiencies. I recalculate the strategic gains by making use of Soderbery’s (2015) estimations. Consistent with the fact that the elasticity of substitutions calculated by Soderbery (2015) are lower than the ones by Broda and Weinstein (2006), the strategic gains obtained are greater. Notwithstanding, on average, the results are
quite similar relative to the baseline case. For an easier comparison, I present the results following the order of industries of the table in the main text.

Table 8: Strategic Gains - Soderbery’s (2015) Sigmas

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass &amp; Cement</td>
<td>26.9</td>
<td>7.9</td>
<td>8.9</td>
<td>82.3</td>
<td>21.7</td>
<td>14.7</td>
</tr>
<tr>
<td>Other Transports</td>
<td>20.7</td>
<td>10.4</td>
<td>16.3</td>
<td>97.3</td>
<td>28.6</td>
<td>17.4</td>
</tr>
<tr>
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<td>59.5</td>
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<td>11.8</td>
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<td>59.9</td>
<td>11.1</td>
<td>5.4</td>
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<td>44.2</td>
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</table>

Average: 11.7 5.1 8.8 68.2 15.6 9.2 67.7

Note: Gains are differences between the sequential and simultaneous case. Only industries with a mixed market structure considered. Results in terms of points are percentage-points differences. Results in terms of increases are percentage variations relative to the simultaneous case. Market shares account for for import competition. Domestic intensity defined as firm’s domestic sales relative to its own total sales and it excludes firms that exclusively sell to the domestic market. Those cases with “.” reported are because all firms sell exclusively to the domestic market.
Figure 15: Sequential vs. Simultaneous Cases - Averages per Sector - Soderbery’s (2015) Sigmas

(a) All Domestic Leaders’ Market Share

(b) All Domestic Leaders’ Domestic Intensity

(c) Firm’s Market Share

(d) Firm’s Domestic Intensity

Note: Gains are percentage-points differences between the sequential and simultaneous cases. Domestic intensity excludes those firms that sell exclusively in the domestic market. Market shares are relative to total sales and account for import competition.
C Additional Quantitative Results

Figure 16: Industry’s and Firm’s Gains - Soderbery’s (2015) Sigmas

(a) All Domestic Leaders’ Market Share

(b) All Domestic Leaders’ Domestic Intensity

(c) Domestic Leader’s Market Share

(d) Domestic Leader’s Domestic Intensity

Note: Gains are percentage-points differences between the sequential and simultaneous case. Figures 16a and 16b consider all domestic leaders of the industry as a group. Market shares are relative to total sales and account for import competition. Domestic intensity defined as domestic sales relative to own total sales.

C.4 Alternative Calibration of $\delta$

Resorting to unit values as a proxy of prices determine that several caveats are in order. Since unit values constitute a noisy measure and, depending on how the data is cleaned or the year taken as reference, the values of $\delta$ vary. Due to this, I proceed by assuming that prices are not observed by the econometrician and regress equation (9) under that assumption. By making use of the 119 industries suitable for the analysis, the results provide a value of $\delta$ equal to 0.95. This value is a useful baseline as it can be interpreted as a lower bound of the impact of investments on market shares in those
Table 9: Calibration

<table>
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<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln ( \bar{s}(\omega) )</td>
<td>0.787***</td>
<td>0.866***</td>
<td>0.952***</td>
</tr>
<tr>
<td></td>
<td>(0.0305)</td>
<td>(0.0252)</td>
<td>(0.00243)</td>
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<tr>
<td>Observations</td>
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<td>216</td>
<td>216</td>
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<tr>
<td>R-squared</td>
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<td>0.872</td>
<td>0.999</td>
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<td>Sector FE</td>
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<td></td>
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<tr>
<td>Industry FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
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</table>

Note: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

situations where greater market shares are associated with higher prices. To formalize this argument, consider the market share of a firm \( \omega \) in industry \( n \),

\[
\ln s(\omega) = (1 - \sigma_n) \ln p(\omega) + \delta \ln z(\omega) - \ln \Lambda_n + \varepsilon(\omega) .
\]  
with prices given by,

\[
\ln p(\omega) = \ln c(\omega) + \ln \mu(\omega) ,
\]

where \( c(\omega) \) and \( \mu(\omega) \) represents the marginal cost and the markup of firm \( \omega \), respectively. In the model, the more productive the firm is, the greater its market share and its expenditures on the strategic investments. Considering the scenario where the investments increase the consumers’ willingness to pay for the product, a more productive firm has two opposite forces acting on prices: lower marginal costs decrease prices while the greater investments increase the markups and so the prices. Assuming that an increase of productivity affect prices predominantly due to the variations in markups, prices can be expressed as,

\[
\ln p(\omega) = \ln c_n + \ln \mu(\omega) .
\]

Gathering the terms that are absorbed by an industry fixed effect, let’s define \( \lambda_n := - \ln \Lambda_n + (1 - \sigma_n) \ln c_n \). Also, let the error term be \( \nu(\omega) := \varepsilon(\omega) + (1 - \sigma_n) \ln \mu(\omega) . \)
Hence,

\[ \ln s(\omega) = \lambda_n + \delta \ln z(\omega) + \nu(\omega). \]

By ignoring that firms with greater market shares charge higher markups, the effect of investments on market shares does not have to take into account that consumers buy the product even when prices are higher. Therefore, the calibration would constitute a lower bound of \( \delta \) under the scenario considered.

### Table 10: Strategic Gains - Averages

<table>
<thead>
<tr>
<th>Industry</th>
<th>Avg. Ind. Market Share Points</th>
<th>Avg. Per Firm</th>
<th>Total Sector</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avg. Ind. Market Share Points</td>
<td>Avg. Per Firm</td>
<td>Total Sector</td>
</tr>
<tr>
<td></td>
<td>Dom. Intensity Points Increase</td>
<td>Dom. Sales Increase</td>
<td>Dom. Profits Increase</td>
</tr>
<tr>
<td></td>
<td>Dom. Intensity Points Increase</td>
<td>Dom. Sales Increase</td>
<td></td>
</tr>
<tr>
<td>Glass &amp; Cement</td>
<td>24.9</td>
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<td>Other Transports</td>
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<td>9.1</td>
<td>15.4</td>
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<td>18.2</td>
<td>6.3</td>
<td>10.6</td>
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<tr>
<td>Food &amp; Beverages</td>
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<td>6.7</td>
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<td>Textiles</td>
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<td>Rubber &amp; Plastic</td>
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<td>Medical Equipment</td>
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</tr>
<tr>
<td>Media Equipment</td>
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<td>2.1</td>
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</tr>
<tr>
<td>Average</td>
<td>13</td>
<td>5.7</td>
<td>11.5</td>
</tr>
</tbody>
</table>

**Note:** Gains are differences between the sequential and simultaneous case. Only industries with a mixed market structure considered. Results in terms of points are percentage-points differences. Results in terms of increases are percentage variations relative to the simultaneous case. Market shares account for import competition. Domestic intensity defined as firm’s domestic sales relative to its own total sales and it excludes firms that exclusively sell to the domestic market. Those cases with “.” reported are because all firms sell exclusively to the domestic market.
Figure 17: Sequential vs. Simultaneous Cases - Averages per Sector

(a) All Domestic Leaders’ Market Share
(b) All Domestic Leaders’ Domestic Intensity

(c) Firm’s Market Share
(d) Firm’s Domestic Intensity

Note: Gains are percentage-points differences between the sequential and simultaneous cases. Domestic intensity excludes those firms that sell exclusively in the domestic market. Market shares are relative to total sales and account for import competition.

Figure 18: Industry’s and Firm’s Gains - Alternative $\delta$
Note: Gains are percentage-points differences between the sequential and simultaneous case. Figures 18a and 18b consider all domestic leaders of the industry as a group. Market shares are relative to total sales and account for import competition. Domestic intensity defined as domestic sales relative to own total sales.