Labor Market Frictions, Firm Growth and International Trade*

Pablo D. Fajgelbaum
Princeton University

January 2011†

Abstract

Hiring new workers takes time. Yet firms must employ a sufficient number of workers to justify paying the fixed costs of entry into export markets. This paper studies how characteristics of the labor market impact income and trade via the time it takes for firms to grow large enough to justify investing in exporting. In the theory, firms make random contacts with potential employees slowly and there are endogenous job-to-job transitions. Firms choose an optimal time to enter into export markets in the light of their anticipated labor-market experience. The model predictions are consistent with observed correlations between firm size, age and export activity, and also with observed correlations between export activity and the share of new hires attracted from other jobs and from other exporting firms. I use the model to examine the impact of labor market frictions on aggregate outcomes in general equilibrium. Then I use an extended version of the model with ex-ante differences in firm productivity to match some aggregate moments in the data, and to simulate the effect of changes in labor-market conditions and the trading environment.

JEL Classification: F16

*I am greatly thankful to Esteban Rossi-Hansberg and Gene Grossman for priceless guidance and continuous encouragement. I specially thank Oleg Itskhoki, Nobuhiro Kiyotaki and Stephen Redding. I am also grateful to Francisco Buera, Juan Carlos Hallak, Frederic Robert-Nicoud, Jon Vogel, Joaquin Blaum, Leandro Gorno, Juan Ortner, Maria Jose Prados, Edouard Schaal and Mathieu Tschereau-Dumouchel for useful comments and discussions. Special thanks to Ana Sofia Rojo-Brizuela and Lucía Tumini at the Argentine Ministry of Labor for their support.

†First version: November 2010.
1 Introduction

Hiring new workers is a costly and time consuming activity. Labor market frictions determine the magnitude of these costs, influencing the growth of firms. At the same time, many forms of investment have a fixed-cost component, and can be profitably undertaken only by larger producers. Participation in international trade is a paradigmatic example. Obtaining the increase in revenues associated with access to foreign markets requires spending considerable amount of resources in, among other things, setting up distribution networks or developing products. Firms need to be large to cover these costs. The dependence of investment on firm size, and of firm growth on labor market frictions, naturally forges a link between the labor market and aggregate outcomes. This paper studies how the labor market environment determines income, trade and welfare through its impact on the time it takes for firms to reach the size that justifies investing.

These forces have a clear manifestation in the data. Figure 1 is based on data for the formal manufacturing sector in Argentina for the period from 1999 to 2007. It shows average log-employment, demeaned by industry-year, of non exporters, exporters, and exporters to more than five countries, plotted against age quantiles within industry-year-export status.\textsuperscript{1} There are three salient patterns in this figure. First, as it is well known in the industrial organization literature, older firms are larger.\textsuperscript{2} Second, exporters are larger than non-exporters conditioning for age, as are firms that export to many countries relative to firms that export to few countries. Furthermore, the gap between types widens over time.\textsuperscript{3} Third, the age quantiles of non-exporters are more concentrated in low ages relative to exporters, as are those of exporters to any number of countries relative to exporters to many countries. This reflects that exporters are relatively older. The rise in export participation over age is depicted in Figure 2, which shows the average fraction of exporters to any number of countries, and of exporters to at least five countries, by quantiles of the distribution of ages within industry-year. About 30% of firms in the oldest 5% are exporters.\textsuperscript{4} Taken together, these correlations naturally underlie the well known fact that larger firms are more likely to export, as shown in Figure 3. Only 1% of the smallest 5% of firms (in number of workers) export, in contrast with 60% in the largest 5%, and the share of firms exporting to more than five countries rises sharply towards the highest percentiles of the size distribution.\textsuperscript{5}

\textsuperscript{1}The figure only includes continuing firms between consecutive years. It presents averages for 25 groups of age plus the top 1%; entrants appear at age zero. For a description of the data see Appendix B.

\textsuperscript{2}See for example Dunne et.al. (1989).

\textsuperscript{3}See Bernard and Jensen (1999) for evidence of higher employment growth rates among U.S. exporters relative to non-exporters.

\textsuperscript{4}The figure presents averages for 25 groups of age plus the top 1%; entrants appear at age zero. On average across cohorts born between 1998 and 2003, 2% of firms are born as exporters and 10% export during the first five years of age. See Eaton et. al. (2008a) and Albornoz et. al. (2010) for evidence about the probability of switching into exporting over the life of firms.

\textsuperscript{5}The figure presents averages for 25 groups of size plus the top 1% within industry-year. Bernard and Jensen (1995) report that exporters are larger in the U.S. Similar observations about export participation across the size distribution are reported in Hallak and Sivadasan (2009) for India, U.S., Chile and Colombia.
Figure 1: Firm size by age and export status.

Figure 2: Export participation by age.

Figure 3: Export participation by firm size.
I present a theory consistent with these outcomes based on the slow hiring process of firms in a frictional labor market with job-to-job transitions. Since the activity of finding and hiring workers is not immediate, it operates as an adjustment cost that drives the evolution in the stock of workers. The correlation between age and export status arises from the waiting time of firms until they have enough workers to justify paying the fixed costs to export. On the other hand, differences in the rates at which firms of different export status accumulate workers are a reflection of random assignment of workers to firms and search on the job. These elements imply that not every contact between a worker and a firm results in a new hire, because firms might find workers who are already employed by competitors that offer better jobs, and who are, as such, too costly to be attracted. Thus, the return on the search activity, in terms of number of workers hired per worker contacted, is increasing in the value of jobs offered by a specific firm relative to the value of jobs offered by competitors. By exporting, firms not only increase their revenues, but they also become stronger competitors in the labor market, which allows them to grow faster. As firms grow and export to progressively more countries, they boost the value of their jobs even further, strengthening their advantage vis-a-vis smaller rivals.

The core of this mechanism is constituted by specific patterns in the composition of new hires. By offering jobs of higher value than non-exporters, exporters are more likely to hire workers away from other firms rather than from the unemployment pool, and from other exporters rather than from non-exporters. These patterns are indeed observed in the data. Consider, first, the share of new hires entering firms from other jobs. Figure 4, constructed with the same population of firms as the previous figures, presents for each year between 1999 and 2007 the average share of new hires in manufacturing firms attracted from another formal job, split in the three groups by export status.\(^6\) The complement of this fraction corresponds to workers attracted from either unemployment or from the informal employment sector. On average in the entire sample period, 37% of all new hires in firms that export to more than five countries enter from jobs in the formal employment sector, in contrast to 25% in firms that export to no more than five countries and to 15% in non-exporters. Similarly, workers employed by manufacturing exporters are harder to attract than workers in manufacturing non-exporters. Figure 5 shows that firms with greater export intensity are more likely to lure workers from exporters, as are exporting firms relative to non-exporters.\(^7\)

The ranking present in figures 4 and 5 holds markedly throughout all the years in the sample, although it covers two very distinct phases of the macroeconomic cycle.\(^8\) In Appendix B, I show that it is statistically significant when controlling for industry-year effects as well as for firm age, size, wage and net job creation.

\(^6\) These measures are computed from linked employer-employee data representative of the formal employment sector. Transitions are registered between consecutive two-month periods. See Appendix B for details.

\(^7\) See also Muendler and Molina (2009) and Mion and Oppromolla (2010) for evidence consistent with this pattern in Brazil and Portugal, respectively.

\(^8\) The Argentine economy was in recession between 1999 and 2001, hit a trough in 2002, and boomed between 2003 and 2006, with a slight reduction in economic activity in 2007. The pace of the downturn and the recovery, in terms of number of firms and total employment, was similar for exporting and non-exporting firms. See Table B.1 in Appendix B for sample averages in the periods of downturn and expansion.
This paper studies the relation between labor-market frictions, trade and income in the light of these micro-level patterns. First, I present a baseline theory where all the heterogeneity in size and productivity across firms is due to firms’ slow growth and fixed-cost investments. I use this model to prove a number of analytic results about the impact of labor market fundamentals on aggregate outcomes in general equilibrium. Then, I extend the model to match various features of the data and I use it for a quantitative assessment of the effects highlighted by the theory.

The baseline theory builds upon a standard model of a labor market with search frictions where firm size is determined by efficient job-to-job transitions, as in Burdett and Mortensen (1998). Ex-ante symmetric firms with linear technologies contact the same number of workers per period and there is random matching. Workers learn about job opportunities both when unemployed and on-the-job, and aggregate contact rates are exogenous. Rent sharing takes the same form as in
Postel-Vinay and Robin (2002), where firms make take-it-or-leave-it offers and current employers can counter offer, resulting in Bertrand competition for workers between firms.

I make three departures from this standard setup in order to generate a firm life cycle with an endogenous timing of entry into export markets. First, I introduce a simple form of industry dynamics. Firms are born and die continuously due to exogenous shocks. Second, firms are allowed to make a once-and-for-all investment to export and obtain a permanent increase in revenue per worker. The revenue advantage of exporters derives from product differentiation and monopolistic competition, as in Krugman (1980) and Melitz (2003). Third, firms contact potential employees slowly, and take into account the transition towards their long-run size to decide when to invest. The distinctive feature of the theory, generated by these elements, is an endogenous timing of investment based on firms’ projected labor market experience. This outcome depends on a key trade-off: firms have the natural incentives to delay the investment to save on the interest value of sunk costs, and to invest earlier to obtain greater revenues on their current workforce; in addition, due to the endogenous job-to-job transitions, investing earlier generates a higher yield on firms’ search for workers along their growth path until investing. Labor market fundamentals determine aggregate outcomes through their impact on this trade-off.

This model isolates the effect of the labor market environment on aggregate outcomes through the impact on the time it takes for firms to grow large enough to justify investing. In general equilibrium, it predicts that job-to-job transitions, unlike transitions from unemployment into jobs, have a central role in the determination of income per capita. In a single country, lower frictions in job-to-job transitions strengthen firms’ incentives to invest earlier, raising aggregate output. In contrast, frictions in transitions out of unemployment have no effects on the timing of investment or output per worker, because their impact is absorbed by firm entry or exit. I also find that higher unemployment compensation raises aggregate investment because it reduces competition in the labor market, therefore promoting faster growth of individual firms towards the size that justifies the investment.

In a two-country setup, these results have a natural correspondence with the volume of trade and the income gains from trade. When countries are symmetric, policies that encourage more frequent transitions between jobs or larger unemployment benefits generate an increase in income and exports in both countries. When countries are asymmetric, labor market policies that favour export participation in the foreign country generate an increase in income and exports in the home country. Thus, the theory highlights a complementarity between the policies of trading economies; an individual economy gains from a labor market environment that encourages exporting in the trading partner.

I extend the baseline model in several dimensions to allow it the flexibility to capture some of the main characteristics in the data. The baseline model yields dispersion in export participation by firm size and age, albeit starkly: only firms above a threshold are exporters. To match the observed facts, I include innate heterogeneity across firms in productivity and fixed costs, so that firms with higher productivity or lower costs in each cohort choose to become exporters earlier and grow faster.
In this case, export participation increases smoothly over the age and size distributions. Since the main facts are about the intensity in export activity -measured by the number of destinations- I also enrich the theory to allow for multiple destinations. Finally, I also allow for endogenous search effort by firms, that gives the model more flexibility in the response to changes in parameters.

I choose the parameters in the extended model to match aggregate moments in the Argentine data. Then, I use the calibrated model to reproduce the cross-sectional patterns over age, size and export status presented above, and to simulate changes in the labor market and trading environments. I find that the calibrated model provides a good description of the increase in export participation by firm age and size, although it fails to explain the growth rate of old exporters. From the simulated changes in parameters, I find sizeable welfare effects from an increase in unemployment transfers, and lower welfare gains from trade in more flexible labor market environments.

The paper is structured as follows. The next section lays out the basic setup and characterizes the partial equilibrium problem of an individual firm. Section 3 studies the general equilibrium in a single country, where the revenue advantage of exporters is taken as given. At that stage, the model equivalently describes a closed economy where firms make a choice between technologies with different productivity. Section 4 studies international trade with two countries, where the exporter revenue premium is endogenous. In section 5 I present the extended version of the model and the quantitative exercises. Section 6 concludes. Proofs and tables are gathered in the appendix.

**Connection with the Literature**

In the theory, firms choose their productivity and firm size reflects labor market outcomes as in models of job search in the tradition of Burdett and Mortensen (1998). Postel-Vinay and Robin (2003) introduce endogenous productivity differences in their variant of that model; more recently, Meghir et. el. (2010) extend that model to allow for sorting of heterogeneous firms into two sectors to study informality. Mortensen (2009) studies a framework with search on the job, exogenous differences in firm productivity, decreasing returns to scale and Stole-Zwiebel bargaining. The main difference with my approach is that all of these authors analyze the static decisions of firms operating in their long-run scale; here, in contrast, the nature of the fixed-cost investment problem that I study leads me to focus on the dynamic aspect in firms’ decisions and on frictions as a driver of firm size over time.

The process determining the evolution of firm size shares some features with Klette and Kortum (2004). As in that framework, firms have linear revenue functions and expand by poaching workers (in their case, products) from other firms. Some recent working papers, such as Garibaldi and Moen (2009) and Acemoglu and Hawkins (2010), incorporate the slow hiring as a source of firm dynamics, but they do not study firms’ choice of technology.

The impact of labor-market characteristics on aggregate outcomes through firms’ investment

---

9Two main differences are that I focus on deterministic firm growth while they allow for randomness in firm-level outcomes, and that in my case worker flows have some specific direction (from smaller to larger firms) while in their model a product lost by a firm is randomly allocated among competitors.
decisions is explored by Acemoglu and Shimer (1999, 2000) in a directed search framework with single-worker firms. I do not analyze risk aversion or wage inequality as drivers of technology dispersion, as they do. The relation between frictions and innovation is present in a recent working paper by Mortensen and Lentz (2010), who combine search frictions with the Klette-Kortum framework. None of these models incorporate the fixed-cost investment problem that is the focus of my research. More broadly, the paper is also related to a growing literature that studies the impact of misallocation on income, as in Restuccia and Rogerson (2008) and Hsieh and Klenow (2009). They do not study search frictions or fixed-cost investment decisions.

The fixed-cost nature of the exporting decision has been central in the international trade literature that springs from the Krugman (1980)-Melitz (2003) model and the facts in Bernard and Jensen (1995). Recently, there has been an interest in other decisions of firms that respond to the presence of fixed costs: number of export destinations (Chaney, 2008; Eaton et. al., 2008b), foreign direct investment (Helpman et. al., 2004), technology choice (Bustos, forthcoming), access to imported inputs (Halpern et. al., 2009) and multi-product firms (Bernard et. al., forthcoming). In all these cases, and in tune with empirical observations, the result is that larger firms select themselves into activities that enhance productivity or revenues per worker. In this paper I study the impact of labor market frictions as determinant of trade and income in an economy where firms have the option of making investments of this type. In contrast with this literature, where selection is based exclusively on ex-ante differences in productivity across firms in a static setting, the present framework shows how heterogeneity in outcomes can emerge among firms with same productivity based on differences in firm age and frictions in the accumulation of resources.

Recent studies, such as Davis and Harrigan (2007), Felbermayr et.al. (2008), Eckel and Kreickemeier (2009), Ritter (2009), Helpman and Itskhoki (2010), Helpman et. al. (2010) and Cosar et. al. (2010), also introduce labor market imperfections in an open-economy setting with differences in export status within industries. They all have in common that imperfect labor markets are embedded in a context of heterogeneous-productivity firms as in Melitz (2003). In these setups the driving force for export participation is selection based on productivity dispersion, and job-to-job transitions are not an equilibrium outcome. Here, in contrast, differences in export status across firms with identical productivity arise because of the labor-market experience, while the sluggishness in the hiring technology underlying this dispersion depends on the extent of search on the job. Also related is the work of Davidson et. al. (2008), who study matching frictions between single-worker firms and heterogeneous workers as the mechanism underlying dispersion in export status. None of these papers incorporates the slow accumulation of workers or the job-to-job transitions that constitute central elements of my analysis.

Some recent frameworks featuring firm dynamics and exporting could be consistent with aspects of the patterns over age, size and export status depicted in Figures 1 to 3. Recent theories include technology diffusion as in Ederington and McCalman (2008), accumulation of firm-specific knowledge as in Atkeson and Burstein (2010), learning about exporting as in Eaton et. al. (2009) and a combination of selection based on productivity shocks and exogenous trends in demand or
productivity as in Ruhl and Willis (2008) or Arkolakis (2009). My approach, based on firms’ slow
growth in a frictional labor market, is complementary to these studies and deals with a different
range of policy questions. From an empirical standpoint it is distinguished by the predictions re-
garding the composition of new hires by export status, consistent with the observations in Figures
4 and 5; it also gives rise to specific implications about the impact of labor-market characteristics
on firm dynamics and trade. The theories enumerated above are silent in these dimensions.

2 The Model

I develop a stylized model of the labor market in which the accumulation of employees takes
time. Firms decide whether and when to expand revenues by bearing the fixed costs of entry into
an export market or a more productive technology. I use this model to assess how characteristics
of the labor market impact aggregate outcomes.

2.1 Preferences and Technology

There is mass of identical workers of measure one. Workers have dynastic preferences with
linear utility for consumption of the final good and they discount the future at rate $\rho$:

$$U (c_t) = \int_0^\infty e^{-\rho t} c_t dt.$$  

I focus on a steady state in which aggregate variables are constant, so that the flow value of
aggregate utility equals consumption of the final good, $c$.

Firms produce output using a constant-returns-to-scale technology with labor as the only factor
of production. At any moment of time a firm employs a stock of workers of measure $n$ that evolves
according to its experience in the labor market, as I describe below. Firm productivity can take
one of two values according to a firm decision that I also describe below. They can produce $y_D$
units of output per worker with a simple technology or $y_X = \Gamma y_D$ units of output per worker using
a superior technology, where $\Gamma > 1$. At first, I will speak of this as a literal choice of technology,
but later I will link it to export status. A firm in an open economy that sinks the fixed cost of entry
into a foreign market can earn more revenue per worker than one that sells only at home. When I
focus on the role of trade, the revenue premium of exporters, $\Gamma$, will be determined endogenously.

As will become clear in the next section, the assumption of constant returns to scale is used
to facilitate the introduction of job-to-job transitions. By making the marginal valuation of new
workers independent of firm size, the total value of a match in a given firm will depend only on how
long a firm with productivity $y_D$ plans to wait until switching to $y_X$, or if it has already done so.
This will imply a simple pattern of transitions between jobs, with workers moving from younger to
older firms.
2.2 Labor-Market Environment

Labor markets are subject to a standard search friction whereby workers learn of jobs when unemployed or employed according to a random process. The Poisson rate at which a worker makes contact with some firm is $\lambda_u$ for unemployed workers and $\lambda_e$ for employed workers. In addition to the transitions between jobs to be described below, jobs are terminated at an exogenous rate $\gamma$ and firms suffer a shock that forces them to exit at rate $\mu$. This means that every employee moves into the pool of unemployed workers at rate $\delta = \gamma + \mu$. The steady-state rate of unemployment is $u = \delta / (\lambda_u + \delta)$. To save notation later, I define the normalized contact rate on the job $\kappa_e = \lambda_e / \delta$.

2.3 Value of Jobs

Production technologies are not constant throughout the life of firms. In equilibrium, firms with technology $y_X$ do not switch back into $y_D$, but firms with technology $y_D$ may intend to upgrade at some point in the future if they survive long enough. The decision of when to invest is examined in the next section, but, for the moment, it implies that the relevant dimension of heterogeneity across firms, in terms of the value of the jobs that they can offer to prospective workers, is how far removed they are in time from switching into the better productivity—or if they have already done so. Let $x$ indicate this "time until switch" for a given firm. Across the economy there are (potentially) three classes of firms: $x = 0$ denotes firms that have already invested; $x \in (0, \infty)$ denotes firms that will upgrade in $x$ periods from now; and $x = \infty$ denotes firms that will never upgrade no matter how long they survive.\(^\text{11}\)

Let $v(x)$ represent the total value of a job held by a firm whose time until switch, if they do not suffer an exit-inducing shock before then, is $x$. This value reflects the joint surplus of a match shared by the firm and the worker. When a new relationship is formed, the partners divide the surplus according to the game posited by Postel-Vinay and Robin (2003): firms observe the current status of contacted workers, tender take-it-or-leave-it offers, and commit to the value promised to the worker. As a consequence, when an unemployed worker meets a firm, the offer leaves the worker indifferent between the job and the value of unemployment, $w_u$, and is accepted. The present discounted sum of future expected profits generated in firm $x$ by a worker who enters the firm from unemployment is the total value of a job held by this firm, net of the amount necessary to lure the worker, namely

$$J_u (x) = v(x) - w_u. \tag{1}$$

In contrast, when an employed worker meets a new firm, the current employer hears the job offer and makes a counter-offer. The outcome is similar to Bertrand competition: the firm offering the job of greater total value obtains the worker, offering in exchange a value equal to what the

\(^{10}\)Firm exit is necessary to induce an invariant distribution of ages. Exogenous separations serve to bound the size of surviving firms.

\(^{11}\)Since firms are homogenous and will all choose the same outcome, the equilibrium will either feature firms who never invest ($x = \infty$) or firms who invest at some point ($0 \leq x < \infty$), but not both. In the extension with heterogeneity of Section 5 these types can coexist.
worker could obtain in the alternative employment. Transitions in this model are efficient, hence we can conjecture that workers flow from firms with higher \( x \) into firms with lower \( x \). Therefore, when a worker moves from a firm \( x_0 \) to a firm \( x \) that is closer (in expectation) to the switching date, the firm in state \( x \) captures a present discounted value of profits

\[
J(x_0, x) = v(x) - v(x_0).
\]

Note that both \( J_u(x) \) and \( J(x_0, x) \) denote present discounted sums of expected profits captured by a firm from one particular worker at the instant when the worker enters the firm. After that moment, the worker might leave due to an exogenous shock or make contact with another firm, triggering a renegotiation or a quit. These possible events are reflected in the computation of \( J(x_0, x) \).

As shown in section A.1 of the appendix, the assumptions of the bargaining game and equation (2) can be used to derive the total value of a match as a function of \( x \):

\[
(\rho + \delta) v(x) = y_D + (y_X - y_D) e^{-(\rho+\delta)x} + \delta w_u.
\]

In flow-equivalent terms, the value of a job offered by a firm that is \( x \) periods away from switching consists of the sum of the average revenue generated by the worker throughout the expected duration of the match and the value of unemployment obtained by the worker when the match is dissolved, which occurs at rate \( \delta \). This job value increases as the firm approaches the time of switching (i.e., it decreases with \( x \)), confirming our conjecture that workers move from high-\( x \) to low-\( x \) firms, but not vice-versa.\(^{12}\)

### 2.4 Value of Firms, Stock Effect and Timing of Investment

As anticipated, firms can choose between the alternative technologies \( y_D \) and \( y_X \). Firms enter the marketplace with no workers and grow subject to their contacts in the labor market while facing the risk of death. At birth, they are endowed with productivity \( y_D \), but they can choose at any time to make a once-and-for-all investment to upgrade to productivity \( y_X \). This investment entails a sunk cost with flow-equivalent value of \( f_X \) units of the final good per period.\(^{13}\) This "switching into a better technology" will be the same as "starting to export" for a firm in an open economy.

A firm has perfect foresight about the evolution of its stock of employees, facing no uncertainty beyond the exit probability.\(^{14}\) As a result, firms choose an age \( h \) at which to introduce the high-productivity technology. This decision is made on the basis of the flow of workers obtained in each period and the valuation attached to each. At any moment, a firm makes contact with

\(^{12}\)In the data, workers also move in the opposite direction; for example, there are transitions from exporters (\( x = 0 \) in the model) into non-exporters (\( x > 0 \)). The model can be reconciled with these flows adding heterogeneity in firm productivity or in fixed costs, as in the extension of Section 5.

\(^{13}\)Since growth is deterministic, it is equivalent to cast the firm problem in terms of fixed costs \( f_X \) per period.

\(^{14}\)I.e., I treat the stock of workers in the firm as a continuous set, hence the individual contact and exit rates equal the fraction of workers who experience these shocks.
workers, where $s/\pi$ is the search effort exerted by the firm to find workers relative to average search activity in the economy, and $M$ is the total number of firms. Until Section 5, $s$ is assumed to be common to all firms. As a result, a worker who hears of an opening has the same probability of being matched with any firm, and differences in the rate at which firms accumulate workers arise solely from the ability to attract workers away from other firms.

Because of our assumption of linear revenue functions, firms wish to grow as large as possible; therefore, every match with an unemployed worker results in a hire. In contrast, out of all contacts made with employed workers, a firm with time until switch of $x$ only attracts those workers employed in firms offering jobs of lesser value, i.e. in firms at $x_0 > x$ periods from switching. Let $G(x)$ be the share of employment in firms whose time until switch is less than $x$; this distribution has mass points at 0 or at $\infty$ that measure employment in firms that have already implemented $y_X$ or that will never do so, respectively. The fraction of new hires out of all workers contacted by a firm with time until switch of $x$ is then

$$
\frac{1 + \kappa_e [1 - G(x)]}{1 + \kappa_e}
$$

(5)

The number of firms $M$ in (4) and the distribution of employment across firms with different time until switch $G(x)$ in (5) capture competition in the labor market and will be determined in general equilibrium.

The linear technology implies that the present discounted value of profits generated by all workers who enter a firm in state $x$, expressed in terms of the final good, is the sum of the values generated by each of these workers individually:

$$
\pi(x) = \frac{\lambda_u u}{M} J_u(x) + \frac{\lambda_e (1 - u)}{M} \int_x^{\pi} J(x_0, x) dG(x_0).
$$

(6)

The first term in this sum is the present value of profits generated by workers attracted from the pool of unemployment and the second term corresponds to profits from workers attracted from other firms, drawn from the employment distribution $G$.\footnote{The upper limit of integration $\pi$ denotes firms who are furthest away from investing than any other firm.} Using this expression, we can write the value at entry of a firm that switches into the high-productivity technology at age $h$ as

$$
\Pi(h) = \int_0^h e^{-(\rho+\mu)a} \pi(h - a) \ da + e^{-(\rho+\mu)h} \left[ \frac{\pi(0) - f_X}{\rho + \mu} \right].
$$

(7)

A new firm starts with no workers. When it has age $a = h - x < h$, the switch lies $h - a$ periods ahead and incoming workers generate average expected profits with a present discounted value of $\pi(h - a)$; after $h$ the firm obtains $\pi(0)$ from new workers, which is the value of incoming workers in a high-productivity firm for the rest of its expected life. To switch, it must pay the sunk cost $f_X/ (\rho + \mu)$. The effective rate of time discount, $\rho + \mu$, takes into account the probability of
firm exit. Note that this expression is written as the discounted sum of the stock value of profits generated by the flow of workers who enter at each age; as such, information about the worker flows is already incorporated in \( \pi (\cdot) \), which computes worker exit and on-the-job contact probabilities as part of the discounting in the expected stream of profits generated by new hires.

Firms choose the age at which to implement the better technology. In the case with international trade, this will be the age at which they begin to export. Consider a firm that invests at \( h \). If that firm delays the investment at that age, it incurs two types of opportunity costs. First, it has the opportunity cost of not implementing the better technology, which reduces output per worker on the stock of workers available at \( h \). Second, it reduces the inflow of workers at each age below \( h \), because a higher switching age \( h \) increases the time until investment, \( x = h - a \), for all \( a < h \). As a consequence of these two effects, \( \pi (h - a) \) in (7) shifts down for all \( a \). On the other hand, by delaying the time of investment at \( h \), the firm has marginal savings on its costs for an amount of \( f_X \).

These marginal costs and benefits from delaying the investment are reflected in the first-order condition of the firm’s problem. In any positive solution for the switching age, it satisfies:

\[
S(h) = f_X \text{ if } h < \infty, \\
S(h) \leq f_X \text{ if } h = \infty,
\]

where

\[
S(h) = \int_0^h e^{(\rho + \mu)x} [-\pi'(x)] \, dx.
\]

I will refer to the function \( S(h) \) as the stock effect of a delay in \( h \). It captures the marginal opportunity costs of delaying the age of switching. As shown in (8), the firm chooses the \( h \) where these marginal costs are equal to the marginal savings in fixed costs, \( f_X \). It is possible that the stock effect is never large enough, relative to the fixed cost, to justify the investment. This could occur, for example, if the firm never grows too large. In this case, as shown in (9), the firm chooses not to invest.

The value of a firm in (7) can equivalently be expressed in dynamic form as \( (\rho + \mu) \Pi(h) = \pi(h) - \Pi'(h) \). Letting \( \Pi^e \equiv \max_h \Pi(h) \) be the value of the firm at entry when it chooses the switching age optimally, in an interior solution (i.e. where \( \Pi'(h) = 0 \)) it must be that

\[
\Pi^e = \frac{\pi(h)}{\rho + \mu}.
\]

Hence, when \( h \) is chosen optimally, the value of the firm at entry is the same as if the firm obtained the value of all workers who are hired at the moment of entry (i.e., when \( x = h \)) in every period. This expression will be useful in the characterization of the general equilibrium.

Figure 6 illustrates the basic trade-off faced by the firm. It depicts the evolution, as the firm ages, of the value generated by new workers (net of fixed costs), in a firm that switches at \( h \).

\[16\]I write \( h = \infty \) to denote that the firm’s optimal choice is to never invest.
The value of the firm at entry, $\Pi(h)$, is the discounted sum of this schedule. In present value, total profits obtained from workers accumulated before investment corresponds to the area below $\pi(h-a)$, above $\pi(0) - fx$ and to the left of $h$. When a firm delays the investment from a generic age $\hat{h}$ up to the optimal age $h$, it reduces the value generated by all workers attracted before $\hat{h}$. This loss, represented by the shadowed area A, constitutes the stock effect. But it gains in terms of the value generated by all workers attracted after $\hat{h}$ and before $h$, represented by the shadowed area B. The firm’s decision balances these marginal losses and gains. When the switching age is chosen optimally, (11) holds. In this case the flow value of the firm at entry is equal to the intercept of the figure, which must be above $\pi(0) - fx$, the flow value of investing at birth, which always constitutes a feasible choice for the firm.

![Figure 6: Value of new workers and stock effect](image)

Since the firm grows over time, the longer it waits, the larger is the opportunity cost of not exercising the investment; this is reflected in that $S'(h) > 0$, which implies that the profit function is strictly concave. Furthermore, $S(0) = 0$, there is no cost from waiting at entry because there is no initial labor force; so it must be that $h > 0$ unless the fixed costs of upgrading technology are zero, in which case investment occurs right away. On the other hand, $S(h)$ is bounded, which implies that the firm actually intends to invest, i.e. $h$ is a finite number, if and only if the fixed cost of investing is not too large.\footnote{This follows from firm size being bounded; if $\gamma \to 0$ (no exogenous separations) then $h < \infty$ necessarily.}

The switching age of a firm is affected by various parameters and aggregate variables. We can infer from Figure 6 that the stock effect is stronger, and therefore investment takes place earlier, the steeper is the rise in $\pi$ with firm age. This increment reflects two margins: the rise in the number of new hires and the rise in the discounted revenues generated by the average worker as the firm ages. The latter occurs because, as the firm ages, it approaches the time of switching into the high-productivity technology. Substituting the expressions for the value of each match from (1) to (3) into the present value of profits generated by all workers who enter at $x$, $\pi(x)$ in (6), the
The integrand in the stock effect takes the form

\[
e^{(\rho+\mu)x} \left[ -\pi'(x) \right] = (\Gamma - 1) y_D e^{-\gamma x} \times \left( \frac{\lambda_u t}{M} \right) \{1 + \kappa_e [1 - G(x)] \}. \tag{12}
\]

Forces that generate an increase in this expression reduce the switching age, while an increase in \(f_X\) delays it. In the "revenue" margin, larger values of \(y_D\) or \(\Gamma\) accelerate the investment. More frequent separations, captured by a larger \(\gamma\), produce the opposite effect by making it less likely that a new worker will remain in the firm until the time of investing, diminishing the value of the current stock. In the "new hires" margin, either a higher contact rate with unemployed or with employed workers leads to an increase in the number of new hires and to earlier investment.

Interactions among firms in the labor market occur through the number of firms and the employment distribution. A larger number of firms \(M\) delays investment because it increases competition for workers, shrinking the number of meetings experienced by the firm. Similarly, a first-order shift in the employment distribution \(G(x)\) towards low-\(x\) firms delays the investment because it makes it more likely that a worker contacted from another job is employed in a firm that is close to investing, reducing the share of meetings that translate into new hires.

Summarizing the results from this section:\(^{18}\)

**Proposition 1** In an interior equilibrium, a firm chooses the unique \(h\) where (8) holds. The firm never invests at entry unless \(f_X = 0\), but eventually invests if and only if \(f_X\) is below some finite threshold. At an interior solution, \(h\) is decreasing in \(y_D\), \(\Gamma\), \(\lambda_u\) and \(\lambda_e\), and increasing in \(f_X\), \(\gamma\), \(M\), and a first-order shift in \(G(x)\).

For what follows, the main implication of this proposition is that a more flexible labor market leads to earlier investment, while more competition, through either the measure of rival firms or the distribution of employment across them, delays the investment of an individual firm. To assess the full impact of labor market conditions on investment and income we need to move on to the general equilibrium, where these measures of competition are determined endogenously, as I do next.

### 3 Single-Country Equilibrium

I now consider a general equilibrium in which many firms interact based on the decisions of competitors. I analyze the steady state, where aggregate variables are constant over time. Since all firms face the same problem for which, as shown in the previous section, there is a unique solution, in equilibrium they must all invest at the same time after birth, \(H\). This common switching age induces a number of new endogenous objects: the distribution across firms of the time until switch \(P(x)\), the share of high-productivity firms \(m_X\), the share of employment in these firms \(e_X\) and aggregate productivity \(y\). In equilibrium, these variables must be such that a number of conditions

\(^{18}\)Formal proofs are relegated to the appendix.
hold. First, each individual firm, taking these variables as given, solves the problem in the previous section and optimizes over its choice of $h$. Second, firms must not have incentives to deviate from the common decision $H$. Third, the number of firms, $M$, must be such that the free entry condition is satisfied.

I proceed to define these aggregate variables, then I move to the definition and characterization of the equilibrium, and finally I show the comparative statics. Throughout this section the productivity gap $\Gamma$ is still exogenous, so that the model describes a closed economy where firms make a choice between technologies with different productivity. Using the results from the single-country equilibrium, in the next section we will be able to characterize the impact of labor market policies on trade and income in an open economy setup.

The growth of a firm depends on where it is located relative to other firms in terms of time to invest; across the economy, the share of firms that are less than $x$ periods away from investing equals the fraction of firms that have survived beyond age $H - x$. The constant death rate $\mu$ generates an exponential distribution of ages, implying a share of firms that are less than $x$ periods from switching as given by

$$P(x; H) = e^{-\mu(H-x)}, \text{ for } x \in [0, H].$$

(13)

Due to random matching and the common search effort for workers across firms, workers in either unemployment or employment who make contact with a potential new employer have a probability $P(x; H)$ of sampling one that is less than $x$ periods away from switching. The pattern of transitions from high-$x$ firms into low-$x$ firms gives the steady-state distribution across employees of the time until switch of their employer:

$$G(x; H) = \frac{(1 + \kappa_e)P(x; H)}{1 + \kappa_eP(x; H)}.$$  

(14)

The shape of this distribution responds monotonically to first-order shifts in $P(\cdot)$; a change in the firm distribution towards stronger competitors (i.e., an increase in $P(\cdot)$ for each $x$) naturally translates into a rise in $G(\cdot)$.

From the firm and employment distributions evaluated at $x = 0$ we find, respectively, the share of high-productivity firms and the share of employment allocated to these firms:

$$m_X(H) \equiv P(0; H) = e^{-\mu H},$$

$$e_X(H) \equiv G(0; H) = \frac{(1 + \kappa_e)m_X(H)}{1 + \kappa_em_X(H)}.$$  

(15)  

(16)

The share of firms with productivity $y_X$ (i.e., exporters in the open-economy setting of the next section) is simply given by the fraction of firms that has survived beyond age $H$. The assumption of a common search effort across firms implies that $m_X$ represents also the probability that a worker

---

$^{19}$This is obtained by setting equal to zero the expression describing the evolution of $G(x)$: $(1-u)dG(x) = \{\lambda_u + \lambda_e (1-u)[1-G(x)]\} P(x) - \delta (1-u) G(x)$. 

15
who learns about a job does so about one in a high-productivity firm. The fact that workers flow from type $D$ firms into type $X$ firms then yields the expression for $e_X$.

In the aggregate economy, output per employed worker is endogenous. It results from an average of the productivity in the two types of firms, weighted by their employment shares:

$$y = \left[ 1 + (1 - \Gamma) e_X (H) \right] y_D.$$  
(17)

The term in squared brackets represents the endogenous part of TFP. Hence, in the end, this theory is about the determination of $e_X$, the share of employment in high-productivity jobs, as a way of explaining aggregate income. The common switching age $H$ is a sufficient statistic for these aggregate variables.

The value of unemployment $w_u$ is linked to aggregate income. The take-it-or-leave structure implies that $\rho w_u$ is equal to the income flow of unemployed workers. I assume that this value is chosen by the government, which levies a lump-sum tax to compensate each unemployed worker on a basis relative to income per worker in the economy:

$$\rho w_u = bg.$$  
(18)

By increasing $b$ the government raises the transfer received by each unemployed worker as a share of income, irrespective of the unemployment rate. Below, I consider how changes in this policy variable affect the endogenous variables.

The distributions that we have just introduced, as well as income per employee, are all functions of $H$. Through its effect on these variables, $H$ impacts the decision of firms characterized in the previous section. To denote this dependency, I write now the stock effect defined in (10) as $S (h; H)$. In an interior equilibrium, the first-order condition is

$$S (h; H) = f_X.$$  
(19)

This condition gives the age for investment $h$ chosen by an individual firm, taking the group of aggregate variables affected by $H$ as given. In equilibrium this decision must be consistent across firms; i.e.,

$$h = H.$$  
(20)

Regardless of their current level of technology, firms must pay a cost to enter the market with flow-equivalent value of $f_D$ units of the final good. Using $\Pi^e$, the flow value of a new firm from (11), the free-entry condition implies that a potential entrant must be indifferent about entering,

$$(\rho + \mu) \Pi^e = \pi (h; H) = f_D.$$  
(21)

Since firms are continually exiting, a constant number of firms in steady state requires actual entry, so that the free entry condition holds with equality.
where the value of firms at entry, $\pi(h;H)$, is expressed as a function of $H$, too.

### 3.1 Existence and Uniqueness of a Single-Country Equilibrium

We are now in position to define an equilibrium.

**Definition 1** A single-country equilibrium consists of labor market outcomes $\{h, H, M\}$, distributions $\{P(\cdot), G(\cdot)\}$, shares of firms and employment $\{m_X, e_X\}$, output per worker $y$, consumption $c$ and unemployment value $w_u$ such that:

a) the first-order condition (19) from the firms’ optimization problem holds;

b) the individual and the common age for switching are consistent, (20);

c) the number of firms adjusts to satisfy free entry, (21);

d) the firm and employment distributions are given, respectively, by (13) and (14);

e) the shares of high-productivity firms and of employment in these firms are given, respectively, by (15) and (16);

f) output per worker is given by (17);

$g$) the value of unemployment is given by (18); and

h) goods market clear.$^{21}$

My next step is to establish conditions for uniqueness and existence of the equilibrium. To do so, it is useful to define the function $\Omega(h, H)$ as the ratio of the stock effect of an individual firm at its optimal choice to the common value of firms at entry. Using (19) and (21) we have that, in equilibrium, this (free entry adjusted) stock effect equals the cost of upgrading technology relative to the cost of entry,

$$\Omega(h, H) = \frac{S(h; H)}{\pi(h; H)} = \frac{f_X}{\bar{D}}. \tag{22}$$

Implicit in this equation is the reaction of each firm, $h$, to the common switching age $H$. This response is depicted in Figure 7, that shows condition (22) in the space of $h$ and $H$ for two levels of exporting costs.

---

$^{21}$Total output and investment are determined by the firms’ entry and investment decisions. Consumption is obtained residually from market clearing in the final good.
An equilibrium consists of an $H$ that satisfies $\Omega(H, H) = f_X/f_D$, i.e. when $\Omega(h, H)$ intersects the 45° line. Since the adjusted stock effect increases with $h$, uniqueness can be examined based on whether the incentive to invest for each firm at the equilibrium increases when other firms delay investment, i.e. whether $\partial\Omega/\partial H > 0$ whenever $h = H$. This would imply that $\Omega(h, H)$ intersects the 45° line once, if ever. To verify this, we must take into account that $\Omega(h, H)$ simultaneously accounts for two margins, the stock effect and the value of firms at entry. Forces that increase the former lead to an increase in $\Omega(h, H)$ and are reflected in equilibrium in a lower $h$, while forces that increase the latter lead to more entry, increasing competition and reducing $\Omega(h, H)$. We must ask, then, how these two forces respond to changes in $H$. On the one hand, a larger $H$ shifts the distribution of employment $G(x; H)$ towards firms that are further from investing; as we know from the previous section, this strengthens the stock effect. On the other hand, if firms take longer to invest, productivity $y$ in (17) shrinks. The value of unemployment $w_u$ in (18) goes down as a consequence, increasing the value of a potential entrant. This induces entry and weakens the stock effect.\footnote{Later investment by competitors also implies that firms can attract more workers in every period, which is reflected in a larger upper limit of integration $\pi = H$ in (6). However, the consistency condition (20) determines that this second effect disappears at the equilibrium. See the proof of Lemma 1 in the appendix.}

Summing up, a larger $H$ affects $h$ through one negative-feedback channel (distribution of competitors) and one positive-feedback channel (worker value of unemployment), hence we cannot generically sign $\partial\Omega/\partial H$. But in order to make progress, we can impose a sufficient condition on the parameters to ensure that the positive-feedback effect is weaker, namely:

$$\Gamma < \frac{1 + \kappa_e/b}{1 + \kappa_e}. \quad (23)$$

This condition implies the following.

**Lemma 1** If (23) holds then $\partial\Omega/\partial H > 0$ when $h = H$.

I assume henceforth that condition (23) is met.\footnote{This condition depends on three parameters: $\{\kappa_e, b, \Gamma\}$. In the case of the exporting decision, we can impose natural restrictions on their values from readily available data to assess its validity. The share of GDP used to finance unemployment benefits is $bu/(1-u)$, and from the OECD Social Expenditure Database, public spending on unemployment compensation as a fraction of GDP among OECD member countries has been on average 1% between 1980 and 2000. Jolivet et. al. (2006) estimate the rate of contact on the job to be strictly lower than that from unemployment among ten OECD countries since the mid-90’s, implying $\lambda_u/\lambda_e < 1$. Average unemployment in the OECD since 1980 has been of 7.5%. From these values, (23) determines an upper threshold for $\Gamma$ of 1.8 when $\lambda_e/\lambda_u = 0.01$, and increasing in this ratio. For example, for $\lambda_e/\lambda_u = 0.1$, approximately the value found in Jolivet et.al. (2006) for France and for the UK, $\Gamma$ must be smaller than 5. Mayer and Ottaviano (2010) find a value added premium of exporters of 2.7 in France and 1.3. This raw evidence indicates that (23) is likely to be met in the data.} This condition requires that transfers to unemployed workers and the productivity differential $\Gamma$ (i.e., the revenue-differential of exporters in a trade environment) are not too large relative to contacts made by employed workers.\footnote{Broadly speaking, the larger are $\Gamma$ and $b$ and the lower is $\kappa_e$, the greater is the increase in the value of unemployment that results from a reduction in $H$, in a context where firms rely relatively more on workers from unemployment to grow. This results in a larger reduction in the value of new firms and, therefore, in the number of firms, when there is a reduction in $H$. Therefore, when (23) fails, we cannot ensure that the favorable effect from the reduced productivity is sufficient to offset the negative effect on the stock effect.}
Lemma 1 implies that \( h = H \) can only hold at one point in the \((h, H)\) space, so that the equilibrium \( H \) is unique. As for existence, we have, as in the partial equilibrium case, that there are no stock effects at entry, \( \Omega(0, H) = 0 \) for any \( H \). Therefore, immediate investment of every firm cannot be an outcome if \( f_X > 0 \). An alternative candidate for an equilibrium is that firms never invest in the high-productivity technology. As in the partial equilibrium, the (free entry adjusted) stock effect \( \Omega(h, H) \) is bounded, and firms invest if and only if

\[
\frac{f_X}{f_D} < \lim_{H \to \infty} \frac{\rho + \delta (1 - \kappa_e) (1 + \kappa_e)}{\gamma} \frac{f_X}{f_D} = \frac{f_X}{f_D},
\]

i.e., whenever the fixed costs of upgrading technology are not too large relative to the cost of entry into the market.\(^{25}\)

Summarizing the results from this section, we have

**Proposition 2** The equilibrium is unique. Firms never invest at entry if \( f_X > 0 \), but eventually invests if and only if \( f_X / f_D < f_X / f_D \).

### 3.2 Comparative statics: Labor Market Environment and Productivity

I proceed to show comparative statics about the impact of the labor market environment on productivity. In an interior equilibrium we have that \( \Omega(H, H) = f_X / f_D \), and the discussion from the previous section implies that the adjusted stock effect is increasing in \( H \) at the margin, i.e. \( d\Omega(H, H) / dH > 0 \). Therefore, changes in parameters that shift \( \Omega(H, H) \) upwards for every \( H \) also result in a lower age for switching, biasing the distribution of employment towards more productive firms and raising aggregate productivity. Since \( H \) is sufficient statistic for income per worker and for the size of the high-productivity sector, we have the following results.

**Proposition 3** The switching age \( H \) and output per worker \( y \) are independent from the contact rate from unemployment \( \lambda_u \). \( H \) is decreasing, and \( y, e_X \) and \( m_X \) are increasing, in contact rates on the job \( \lambda_e \), transfers to unemployed workers as a fraction of income per worker \( b \), the productivity differential \( \Gamma \), and the fixed costs of entry relative to the fixed cost of productivity upgrading \( f_D / f_X \).

The irrelevance of \( \lambda_u \) for the time of investment is a reflection of free entry. A higher contact rate with unemployed workers increases firms’ rate of new hires from unemployment, but it also reduces the unemployment pool. From the perspective of an individual firm, this results in a proportional impact on the stock effect and on firm value. But the number of firms adjusts through free entry and leads to more competition, offsetting this partial-equilibrium effect. In contrast, the frequency of contacts on the job \( \lambda_e \) has a non-proportional impact on the stock effect. It only strengthens the new hires margin in (12) through the higher entry rate of workers from other jobs. Variation measure of competitors \( M \) on the investment decision \( h \) of each firm derived from a reduction in \( H \) is weaker than the effect derived from a more competitive environment captured by \( G(x, H) \).

\(^{25}\)Note that whenever (23) holds there are values for the parameters such that (24) is not violated; e.g., if \( f_X / f_D \) is small enough.
in the number of firms cannot absorb this effect completely as with $\lambda_u$, and the adjustment occurs both through the number of firms and the common age for switching.

Unemployment compensation $b$ has an inverse effect relative to $\lambda_u$, in that it is irrelevant in partial equilibrium but it affects $H$ in general equilibrium. In partial equilibrium, a higher value of unemployment reduces the value of firms by a constant amount at every age, thereby leaving the trade-off between the stock effect and the fixed cost of investing unchanged. But in general equilibrium, this reduction in firm value compresses the number of firms via free entry. This alleviates competition for workers in the labor market, allowing each firm to grow faster.

Qualitatively, the comparative statics on the impact of $\lambda_e$ and $b$ on productivity are similar to those in Acemoglu and Shimer (1999) and Acemoglu and Shimer (2000). Acemoglu and Shimer (1999) show that higher unemployment insurance makes risk-averse workers search for high-wage jobs, inducing firms to invest more in their own productivity. Acemoglu and Shimer (2000) show that worker search might be efficiency-enhancing when heterogeneous technologies are chosen by ex-ante identical firms. The current model has similar outcomes, but they are generated by a different mechanism; namely the impact of search on the job and unemployment compensation on the stock effect.

### 3.3 Size distribution

In this economy, workers transit from small and young firms into old and large firms. Firms are continually exiting and being replaced by small entrants. This process originates a distribution of firm sizes. What does the model imply for its shape? We can show that job to job transitions are necessary for the density of the distribution not to be increasing in its entire domain, which would contradict the empirical evidence. The next lemma shows a condition for a decreasing density in a particular point of the distribution, from which I infer the role of job to job transitions in shaping the distribution.

**Lemma 2** Let $N(h)$ be the size of firms of age $h$ in an equilibrium where firms switch at age $H$, and $f(n)$ be the density of the distribution of firm sizes. Then, if $N(h) = n$, $f'(n) < 0$ if and only if

$$\mu + \frac{N''(h)}{N'(h)} > 0.$$  \hspace{1cm} (25)

**Corollary 1** If $\mu < \gamma$ then: (i) If $\lambda_e = 0$, $f'(n) > 0$ for all $n$; (ii) $f'(0) > 0$; (iii) If $h < H$, then $\lim_{h \to H} f'(N(h)) < 0$; (iv) If $h > H$, $f'(N(h)) > 0$.

In the data, the size distribution of firms has a decreasing density in the upper tail. Lemma 2 states that there are two forces competing to determine the slope of $f(n)$, the proportional change in net flows $N'(h)$ over age and the firm exit rate $\mu$. Broadly speaking, if firm growth decelerates too fast and firms do not exit often, there is a tendency for firms to cluster at some point in the size distribution, which results in an increasing density.\footnote{Consider an hypothetic extreme case with no firm exit where firms grow until a certain age and stop growing afterwards. The size distribution would collapse to a point at the size attained by firms at that age.} With no transitions between jobs ($\lambda_e = 0$),
net flows slow down at the rate of job separations, \( N''(h)/N'(h) = -\gamma \). Therefore, as stated in (i), if the rate of firm exit \( \mu \) is below that of job separation \( \gamma \) then (25) is violated. Indeed, \( \mu < \gamma \) is what we see in the data. This means that, absent job-to-job transitions, there are no hopes in this model to generate a realistic distribution of firm sizes.

On the other hand, when \( \lambda_e > 0 \), there are two opposing forces that determine condition (25): a constant number of workers is attracted in each period from unemployment at any firm size, but as firms age they attract progressively more worker from other firms. Points (ii) and (iii) in the corollary state that the first effect dominates at firm entry and the second dominates when firms are large enough but still do not invest. Therefore, if firms invest at a sufficiently old age, there is a region in the distribution of firm sizes where the density is decreasing.

Since firms that have invested do not become relatively more attractive to workers as they grow, for \( N(h) > N(H) \) the density of the size distribution is again increasing, as established in (iv). But note that this property is an artifact of allowing for just one investment opportunity. If firms chose to sequentially implement multiple investments—a case that I consider in Section 5—this region would only exist above the largest size at which firms implement an upgrading. Hence the interval with an increasing density in the upper tail shrinks as more expensive investment options are allowed into the model.

It is worth contrasting these properties with the outcome in Acemoglu and Hawkins (2010), where the slow hiring of firms in a frictional labor market also induces a distribution of firm sizes, but there are no transitions between jobs or investment in productivity. As they note, the size distribution originating in their case has an increasing density; here, transitions from young and small firms who are far from investing into old and large firms are necessary for the distribution of firm sizes to exhibit a decreasing density in some part of its domain, as it is typically observed in the data.

4 International Trade

We can proceed now to the interaction between labor market frictions, trade, and income. Here, I show analytic results on the impact of frictions, unemployment transfers and trade barriers on exports and income. In the next section, I will use numerical examples to illustrate the impact of changes in the labor market and trading environments on welfare.

Suppose that there are two economies like the one described in the previous section, home and foreign. They differ, potentially, in labor market fundamentals \( \{\lambda_u, \lambda_e, b\} \) and relative fixed costs \( f_X/fD \). Foreign country variables are denoted with an asterisk. From now on, I refer to the two types of firms that I have analyzed so far as exporting and domestic (i.e., selling only in the domestic market). The productivity advantage of type-X firms, \( \Gamma \), is now a revenue advantage. All firms have the same physical productivity, but exporters generate more value for the same quantity of output. The main difference with the previous sections is going to be that \( \Gamma \) is now endogenous.
4.1 Trade Environment

The trade environment shares the central features of Krugman (1980). Monopolistically competitive firms sell varieties of a differentiated good. These varieties are aggregated in each economy in the production of a final non-tradable good using a technology with constant elasticity of substitution (CES) \( \sigma > 1 \) across varieties. Exporters face iceberg trade costs \( \tau \), that potentially differ across economies.

A known feature of this framework is that product differentiation leads to downward sloping demand and concave revenue-functions. As firms expand their supply, consumers derive a progressively lower marginal utility from a particular variety. In order to incorporate the linear revenue functions that I have used in the analysis so far into a trade setting, I extend this basic CES framework with a quality choice by firms. Thanks to investing in quality, firms can shift their demand curves outwards instead of necessarily sliding them down as they offer more output. In section A.3 of the Appendix, I show that when workers are perfectly substitutable inside the firm between the production of quality and quantity, both effects exactly compensate as the firm expands. As a result, the willingness of consumers to pay for a variety remains constant as the firm grows, and so do prices. I adopt this specification for analytical convenience.

In this setup, the revenue premium of exporters takes the form:

\[
\Gamma = \left[ 1 + \tau^{-(\sigma-1)} \left( \frac{p^*}{p} \right)^\sigma \right]^{\frac{1}{\sigma}},
\]

where

\[
p = P \left( (1 - u) y \right)^{\frac{1}{\sigma}}
\]

reflects the size of the home economy in terms of its price index for the final good and income per capita. Therefore, \( \Gamma \) depends on

\[
\frac{p^*}{p} = \frac{P^*}{P} \left[ \frac{(1 - u^*)}{(1 - u)} y^* \right]^{\frac{1}{\sigma}}.
\]

From the perspective of an individual firm, the relative size of the foreign economy increases due to less competition (higher \( P^*/P \)) or more demand (higher \( y^*/y \)), resulting in a larger \( \Gamma \).\(^{27}\) The revenue premium reflects that, by exporting, firms can sell to consumers who have on average a higher willingness to pay for its products. Revenues of each type of firm are measured in terms of the domestic non-tradable good.\(^{28}\)

\(^{27}\) In the terminology of Redding and Venables (2004), \( \Gamma \) is the "market access" and \( p \) is the "market capacity" of the home country. McGrattan and Prescott (2008) derive a similar expression in an open economy setting with perfectly competitive product markets and decreasing returns in production, where the increase in output is associated with diversification of resources across destinations by firms doing FDI.

\(^{28}\) Revenues per worker in domestic firms \( y_D \) will also react to changes in the trading environment. Due to monopolistic competition, the value of sales depends on market size, which is affected via trade. As derived in the appendix, we have now that \( y_D = [(1 - u) y]^{1/\sigma} \). This introduces one minor practical difference with our previous analysis of the single-country equilibrium. Replacing the value for \( y_D \) in our expression for aggregate productivity, \( y \), defined in
In the previous sections, we have treated $\Gamma$ as a parameter. Proposition 3 shows how the fraction of high-productivity firms—now, exporters—and the share of employment in these firms react to this premium. I denote these reduced-form responses from the previous section as $m_X(\Gamma)$ and $e_X(\Gamma)$. Now, we are interested in examining how trade determines $\Gamma$, and, through this "price", the response of these variables and of aggregate income.

4.2 Equilibrium definition and uniqueness

The solution for the aggregate variables in the home and foreign countries can be divided into two interdependent blocks of equations. A first block yields exports in each country given $\Gamma$. As shown in the Appendix, exporters in the home country sell abroad at price $\tau \Gamma p$, and ship abroad a fraction of their output equal to

$$s_X(\Gamma) = 1 - \Gamma^{-\sigma}. \quad (27)$$

The total value of exports from the home country is thus

$$X(\Gamma) = (\tau \Gamma p) Q_X(\Gamma), \quad (28)$$

where

$$Q_X(\Gamma) = (1 - u) e_X(\Gamma) s_X(\Gamma)$$

are the exported units of output.

The second block of equations concerns the relation between the two economies through the balance of payments. The relation between $\Gamma$ and $\Gamma^*$ must be such that trade is balanced: $X(\Gamma) = X^*(\Gamma^*)$. Using (28) and rearranging terms, we can write this balanced trade condition as

$$\frac{p^*}{p} = \left(\frac{\tau \Gamma}{\tau \Gamma^*}\right) \frac{Q_X(\Gamma)}{Q_X^*(\Gamma^*)}. \quad (29)$$

Note also that, from the definition of the exporter revenue premium in (26), an increase in the exporter premium in one country is mechanically related to a reduction in the premium in the other country,

$$\frac{p^*}{p} = (\Gamma^\sigma - 1) \frac{\frac{1}{\sigma} - \frac{1}{\delta}}{\Gamma^\sigma} = \frac{1}{(\Gamma^\sigma - 1) \frac{\frac{1}{\sigma} - \frac{1}{\delta}}{\gamma^\sigma - 1}}. \quad (30)$$

Using these two sets of equations, we can define an equilibrium with two countries:

**Definition 2** An international trade equilibrium consists of revenue premia \{\(\Gamma, \Gamma^*\)\}, a relative size of the foreign market \(p^*/p\), and outcomes in each country \(eq \equiv \{h, H, M, P(\cdot), G(\cdot), m_X, e_X, y, c, w_u\}\) and \(eq^* \equiv \{h^*, H^*, M^*, P^*(\cdot), G^*(\cdot), m_X^*, e_X^*, y^*, c^*, w_u^*\}\) such that

a) \(eq, eq^*\) are single-country equilibria given \(\{\Gamma, \Gamma^*\}\); and

b) \(\{\Gamma, \Gamma^*, p^*/p\}\) satisfy (29) and (30).
Given the response for the exported quantity, $Q_X (\Gamma)$, (29) and the two equalities in (30) give a system of three equations in an equal number of unknowns. Substituting for $p^*/p$ from (29) into the first equality of (30) gives the schedule denoted as TB (for "trade balance") in Figure 8. As shown in the Appendix, this relation is strictly increasing, reflecting that a larger exporter premium in the foreign economy must be met with a larger exporter premium in the trading partner for trade balance to hold. The second equality in (30) is described by curve XP (for "exporter premia"). To ensure that exporters emerge in both countries I work henceforth under the assumption that the relative fixed cost of exporting $f_X/f_D$ is sufficiently small, but positive, or that the upper bound $f_X/f_D$ for these costs such that firms choose to invest in exporting is sufficiently large. In that way, I ensure existence and uniqueness of the equilibrium.

**Proposition 4** If $(\rho + \delta)(1 + \kappa_e)/[\gamma (1 - b)]$ is sufficiently large or if $f_X/f_D$ is sufficiently small, there exists a unique trade equilibrium.

![Figure 8: International trade equilibrium](image)

### 4.3 Comparative Statics: Labor Market, Trade, and Income

I ask, next, how income and export participation are affected in each country by changes in labor market parameters and trade costs. The simplest case to analyze is an environment with symmetric countries. Since the equilibrium is unique, it must also be symmetric, implying that $p^*/p = 1$; the revenue-premium is then readily given from (26):

$$\Gamma = \Gamma^* = \left(1 + \tau^{-(\sigma - 1)}\right)^{\frac{1}{\sigma}}.$$

Firms respond in the same way to $\Gamma$ in both countries, hence trade balances by construction. Lower trade costs have naturally the effect of making exports more profitable through a larger $\Gamma$. The same occurs in the comparison between pairs of countries trading in industries with different degrees of product differentiation $\sigma$. The more differentiated the industry (the lower is $\sigma$), the larger the revenue advantage of exporters; comparative statics within country follow as in the single-country
response to a larger $\Gamma$. 29 Meanwhile, taking $\tau$ and $\sigma$ as given, changes in labor market variables or in fixed costs do not affect the revenue premium. Therefore, when we start from a symmetric configuration and changes in parameters occur simultaneously in both economies, the results in Proposition 3 imply the following.

**Corollary 2** In a trade equilibrium with symmetric countries, higher contact rates on the job $\lambda_e$ or unemployment transfers $b$, and lower trade barriers $\tau$, demand elasticity $\sigma$ or lower relative fixed costs of exporting $f_X/f_D$, lead to a reduction in the age for entry into exporting $H$ and to an increase in income per worker $y$, in export participation $m_X$, and in the share of employment in exporting firms $e_X$ in both countries.

The central implication of this result is that the income gains from trade are larger when trading partners jointly implement policies that allow for more flexible labor markets in terms of the frequency of the transitions between jobs, or more generous compensation to unemployed workers. 30 It is worth comparing these implications with the results Helpman and Itskhoki (2010), who address similar questions in an environment with ex-ante differences in productivity across firms and frictional labor markets. In their analysis, job-to-job transitions are not an equilibrium outcome. Here, in contrast, they are a central aspect of the firms’ decision about entry into export markets, and as such their intensity impacts aggregate outcomes. On the other hand, in their framework, unemployment compensation has a detrimental impact on trade when it raises labor costs enough. 31 Here, in contrast, that effect – the reduction in firm value derived from higher costs – leads to lower aggregate competition. Each firm accumulates workers faster and switches into exporting earlier as a consequence, resulting in more exports and income.

I ask next how policies in the foreign country affect the domestic economy through trade. We can show that labor market policies that, from the known single-country responses, favor export participation in the foreign economy, have a positive impact on income in the home country and in exports in both countries.

Suppose that countries are potentially asymmetric, and consider an increase in unemployment compensation $b^*$, or in the rate of job-to-job transitions $\lambda^*_e$ abroad. From Proposition 3, these changes imply a reduction in the common age for switching $H^*$. Therefore, the quantity exported by the foreign country increases for each value of $\Gamma^*$. This shift is illustrated in curve TB’ of Figure 8; for each value of $\Gamma^*$, the trade balance condition (29) requires that the larger quantity now imported by the home country is met with a higher $H$. In the new steady state there is a higher exporter premium in the domestic economy and a lower one in the foreign country, an outcome that resembles the standard adverse response in the terms of trade faced by specialized countries that experience a productivity shock. To see the final outcome in each country, we must feed back

29 Note that trade costs $\tau$ do not affect any variable other than $\Gamma$. Product differentiation $\sigma$ also affects revenues of domestic firms, but in general equilibrium this has no effects on $H$.

30 In the quantitative exercises below, I also consider the implications on welfare.

31 In their two-sector model, unemployment compensation can also have a positive impact when it induces a sufficient number of workers to search for jobs in the high-unemployment differentiated sector.
these changes in $\Gamma$ and $\Gamma^*$ into the single-country responses. In the foreign economy, the reduction in $\Gamma^*$ partially offsets the initial rise in exports, but the overall effect is that the size of the export sector grows. At the same time, since the domestic country experienced no change in policy, it has the standard response across steady states to a larger $\Gamma$. Following similar steps we can find the impact of a reduction in the trade barriers $\tau$ faced by exporters in the home country. The results are summarized as follows.

**Proposition 5** In a trade equilibrium with asymmetric countries, an increase in the rate of contacts on the job $\lambda_e^*$ or in compensation to unemployed workers in the foreign country $b^*$ leads to an increase in the share of exporting firms and in the share of employment in these firms in both countries, and to an increase in income $y$ in the home country. A reduction in trade barriers faced by home exporters $\tau$ leads to an increase in the share of exporting firms, in the share of employment in these firms and in income $y$ in the home country.

The main aspect in the results of Corollary 2 and Proposition 5 is that they reflect a positive feedback between income per worker of trading partners. Exporting firms are high-income firms, because they generate more value than non-exporters for the same amount of output by selling in two destinations. The prevalence of these firms, and their share of employment, depends on $\Gamma$, that captures the relative size of the foreign country. When the foreign country increases transfers to unemployed workers, or the frequency of transitions between jobs, it promotes caeteris paribus an increase in export participation. If this were the overall response, trade would not be balanced. However, at impact, this raises income per worker in the foreign market, and, therefore, the revenue premium in the home country. As a result, firms in the home country also reduce the age for switching into exporting, and output exported by domestic firms adjusts up to the point that trade is balanced again. In the new equilibrium, both countries have a larger share of employment in the export sector.32

The fact that it takes time for firms to export is ultimately what generates these effects.33 As in Krugman (1980), there are no exogenous differences in productivity; but as in Melitz (2003), there is selection based on firm size. Older firms are larger and select into exporting. In Krugman (1980), in order for trade to balance, an increase in the size of the domestic economy is met by an increase in the incentives to export to this country. While in that model this occurs through a domestic appreciation in the real wage (i.e., the home market effect) to induce entry or exit of firms (all of whom are exporters) here the adjustment to a change in conditions occurs through the relation between the revenue premia of both countries, to induce an earlier or later age to switch

---

32 The positive correlation between transfers to unemployed workers and openness echoes the empirical results of Rodrik (1998), who finds a positive link between government spending and openness. This result is interpreted as a reflection that governments increase spending to compensate workers for the risk associated with globalization. The present model suggests the reversed causality: countries that compensate unemployed workers to a greater extent turn out to be more open.

33 For example, as $fx \to 0$, so that all firms are born as exporters, changes in the rate of search on the job or in unemployment compensation naturally have no effect on the equilibrium allocation of employment in exporting firms.
into exporting. The resulting changes in income per worker share the spirit of Melitz (2003), in that they derive from reallocations towards high-productivity firms (in our case, high-revenue firms).

Proposition 5 establishes results about the effect of independent changes in trade barriers, and in the labor market environment, on income per employed worker and trade. I have not yet inquired about the impact of changes in these variables on welfare, or about the interaction between both changes in policy. I address these issues next using a numerical analysis.

5 Extensions and Numeric Analysis

The previous sections have traced the theoretical link between labor market frictions, trade and income. Here I extend the basic model in several directions. The ultimate goal is to develop a framework that can match aggregate moments of the data and that can be used to evaluate changes in labor market conditions and in trade barriers on income and welfare. I also want to assess how good a theory of the firm life cycle this is, based on the extended model's ability to match the cross-sectional patterns presented in the Introduction. To these ends, it is necessary to include some additional ingredients to make the model more flexible to capture some dimensions in the data. I introduce three extensions: two export destinations, endogenous search effort by firms, and ex-ante differences in productivity and fixed costs. Using the extended model, I parametrize the model to match aggregate moments of the Argentine data and simulate changes in the labor market environment and trade barriers.

5.1 Extensions to the basic model

I motivate each of the extensions in contrast to properties of the model developed so far, referred to as the "basic model".

Two export destinations

I assume that there are two export markets, \( k = 1, 2 \). As Figures 1 to 5 show, the patterns found in the data are not only about exporting, but also about the intensity of exporting activity as measured by the number of destinations.\(^{34}\) Also, the inclusion of more than one destination helps to generate a size distribution of firms with a realistic shape. As implied by Lemma 2 and its corollary, if firms become exporters very early in life the basic model necessarily implies a size distribution with increasing density in a large interval of the domain; with more than one export destination this restriction can be relaxed.

Endogenous search effort

Up to now, the effort \( s \) in (4) that firms exert to recruit workers has been set exogenously and common to all firms. As a consequence, in the basic model firms are not able to choose the number

\(^{34}\)See regressions in Appendix B.
of workers that they sample in each period. This assumption imposes strong constraints on the
relations between the main outcomes of the theory. First, in the basic model, the ratio between
the average size of exporters and non-exporters is fixed at $1 + \kappa_c$.$^{35}$ This restricts the share of
exporting firms and the share of employment in these firms to move in the same proportion. In
addition, fixing the recruiting effort $s$ imposes the constraint that, after an increase in $H$, the shape
of the size distribution of non-exporters is, caeteris paribus, unaffected. This needs not be the case
if firms can choose $s$, since in that case firms with higher valuation for meeting a new worker would
recruit more aggressively. Following Bertola and Caballero (1994) and, more recently, Mortensen
and Lentz (2010), I assume a convex cost of search, $c(s) = s^\zeta$ with $\zeta > 1$.\textsuperscript{36}

**Heterogeneity**

In the spirit of Melitz (2003), I allow for ex-ante differences across firms in productivity, $\psi$, and
fixed costs, $\phi$. There are two reasons to introduce heterogeneity. First, the quantitative exercise
will aim at matching the empirical share of workers in exporting firms, which constitutes one of
the central endogenous objects of the theory. As shown in the introduction, the patterns over age
and size that underlie this aggregate allocation are continuous in the data, but the basic model
replicates them starkly; only firms above a threshold of age or size actually export. Second, a
quick calculation reveals that heterogeneity is necessary to match both the share of exporters in
the economy and the average ages of exporters and non-exporters. The exit rate that provides the
better match for the age distribution in the data is 7.5%, and the average share of exporters in the
manufacturing sector over the sample period is 11%. Therefore, in the basic model, to match this
share exactly we need $H = 29$ years. But the average age of exporters to less than five countries
in the economy is 12 years, necessarily implying a much earlier age of investment. These facts can
readily be reconciled once we add heterogeneity.

### 5.2 Firm problem

This section proceeds in parallel with Section 2. I formulate and solve the partial equilibrium
problem of a firm in the extended model. Various objects are referred to with the same notation
as in Section 2, but with different arguments. Firms are now distinguished by their draws of
productivity $\psi$ and fixed cost $\phi$, denoted by

$$\varepsilon \equiv \{\psi, \phi\}.$$  

Firms also differ in their time to investing in each of the two market. I write all the expressions
under the assumption that firms enter first in market $k = 1$. I show below a sufficient condition for

\textsuperscript{35}This follows from (16).

\textsuperscript{36}The cost of search is measured in units of the final good. Since revenues are linear, convexity is needed to bound
the number of new hires. This cost of search plays a similar role to the labor adjustment costs for which evidence
is provided in Yashiv and Merz (2007) and Cooper et. al. (2007). The latter study also includes a fixed cost of
adjustment; in the present setup, where all firms want to expand and there is no firm-level uncertainty, a fixed cost
of adjusting the size of the labor force would be captured in the per period operative cost.
this to be true in any firm. The time until entry into each of the two export markets is denoted by
\[ x \equiv \{x_1, x_2\}, \]
where \( x_k \in [0, \infty] \). As shown in section A.1 in the appendix, the expression describing the flow
value of a new job is now
\[
(\rho + \delta) v(x; \psi) = \left[ y_0 + e^{-(\rho+\delta)x_1} (y_1 - y_0) + e^{-(\rho+\delta)x_2} (y_2 - y_1) \right] \psi + \delta w_u. \tag{31}
\]
With respect to the value of a job in the basic model presented in (3), this expression adds produc-
tivity as a shifter of revenues and an additional export destination. Using (57) in the appendix
and normalizing the domestic price index to 1, revenues per unit of output of domestic firms and
each exporter type are
\[
y_0 = Y_0^\frac{1}{\sigma}, \tag{32}
\]
\[
y_1 = \Gamma_1 Y_0^\frac{1}{\sigma} = (Y_0 + A_1)^\frac{1}{\sigma}, \tag{33}
\]
\[
y_2 = \Gamma_1 Y_0^\frac{1}{\sigma} = (Y_0 + A_1 + A_2)^\frac{1}{\sigma}, \tag{34}
\]
where \( A_k \equiv \tau_k^{-(\sigma-1)} P_k^\sigma Y_k \) is the size of foreign market \( k \).

In order to characterize the problem of the firm, we must consider some new aggregate variables.
The basic model was structured around the observation that, in equilibrium, the time to switch into
exporting was a sufficient statistic for the value of a new job. Given the employment distribution
across times until switch, \( G(x) \), we knew the share of workers that a firm at \( x \) could hire among
all contacted workers. In the current scenario, where \( x \) is no longer a sufficient statistic for the
value of the firm, we can instead determine the return on search by considering the distribution of
employment across firms offering jobs with different values, \( G_v(v) \). Given this distribution, firms
know the yield on their search effort, and subsequently decide how much to search. In the appendix,
I show that from the search decision of firms we can obtain an expression, equivalent to (6), for the
value of all workers who enter a firm with productivity \( \psi \) at \( x \), now denoted as \( \pi(x; \psi) \).

Using \( \pi(x; \psi) \) from (62) in the appendix, we can rewrite the firm’s problem (7). Firms are
born as domestic producers, and they can access two markets \( k = 1, 2 \) by paying entry costs with
flow equivalent values of \( \phi f_k \). Now, \( f_k \) is a component of entry costs in market \( k \) that is common
across firms and \( \phi \) is firm specific. Let \( h_1 \) be the age at which the firm enters in market 1 and \( h_2 \)
be the lapse before the firm enters market 2 after it has entered market 1. Additionally, define
\( \Pi_0(h_1, h_2; \varepsilon) \) in parallel to \( \Pi(h) \) in (7) as the value at entry of a firm that exports to markets
\( k = 1, 2 \) beginning at ages \( h_1 \) and \( h_1 + h_2 \), respectively, and define \( \Pi_1(h_2; \varepsilon) \) as the value of this
firm at the moment of entry into market 1. These functions are given by:
\[
\Pi_0(h_1, h_2; \varepsilon) = \int_0^{h_1} e^{-(\rho+\mu)\alpha} \pi(h_1 - a, h_1 + h_2 - a; \psi) da + e^{-(\rho+\mu)h_1} \left( \Pi_1(h_2; \varepsilon) - \frac{\phi f_1}{\rho + \mu} \right), \tag{35}
\]
and
\[ \Pi_1 (h_2; \varepsilon) = \int_0^{h_2} e^{-(\rho + \mu)h_2} \pi (0, h_2 - a; \psi) \, da_2 + e^{-(\rho + \mu)h_2} \pi (0, 0; \psi) - \phi f_2, \]
respectively.

The firm chooses \( h_1 \) and \( h_2 \). As shown in the proof of Lemma 3 in the appendix, the solution to the extended firm problem has a simple structure based on the stock effect. As in (10), we can define now the stock effect in each market for a firm with productivity \( \psi \):\(^{37}\)

\[
S_1 (h_1, h_2; \psi) = \int_0^{h_1} e^{(\rho + \mu)x_1} [-\pi_1 (x_1, x_1 + h_2; \psi)] \, dx_1, \\
S_2 (h_2; \psi) = \int_0^{h_2} e^{(\rho + \mu)x_2} [-\pi_2 (0, x_2; \psi)] \, dx_2.
\]

The first expression gives the change, after a delay in the time of entry into market 1, in the present discounted value of all workers attracted between ages 0 and \( h_1 \). The second gives the change in the present discounted value, at age \( h_2 \), of all workers attracted between ages \( h_1 \) and \( h_1 + h_2 \), due to a delay in the age of entry into market 2. In an interior solution the firm chooses \( h_1 \) and \( h_2 \) that satisfy

\[
S_1 (h_1, h_2; \psi) = \phi f_1, \\
S_2 (h_2; \psi) = \left( \frac{f_2}{f_1} - \frac{\Gamma_2 - \Gamma_1}{\Gamma_1 - 1} \right) \phi f_1.
\]

There are some novel features in these first order conditions compared to the basic model. First, stock effects depend now on firm-specific productivity and fixed costs. Firms with higher productivity or lower costs naturally enter earlier in both markets. We also have that \( h_2 \) affects the incentives to enter in market 1 through the value of a worker attracted before \( h_1 \). Finally, we see that \( S_2 (h_2) \) depends on a combination of the relative fixed costs and revenue differentials in each market. The lower is \( f_2/f_1 \) or \((\Gamma_1 - \Gamma_2) / (\Gamma_1 - 1)\), the earlier the firm enters in export market 2 conditional on having entered in market 1.

This solution to the firm’s problem was derived under the assumption that the firm enters first in market 1. Lemma 3 summarizes the comparative statics on the firm’s decision and presents a sufficient condition such that this is indeed the outcome.

**Lemma 3** At an interior solution for the firm problem, entry ages \( h_1 \) into market 1 and \( h_1 + h_2 \) into market 2 are decreasing in firm productivity \( \psi \) and increasing in the fixed-cost component \( \phi \). If \( f_2/f_1 > \max \left[ (\Gamma_1 - \Gamma_2) / (\Gamma_1 - 1), (\Gamma_2 - 1) / (\Gamma_2 - 1) \right] \) and the firm enters in both markets, it enters first in market 1.

\(^{37}\)I use the notation \( \pi_1 (a, b; \psi) = \partial \pi (x, y; \psi) / \partial x \) and \( \pi_2 (a, b; \psi) = \partial \pi (x, y; \psi) / \partial y \) evaluated at \((x, y) = (a, b)\).
5.3 Calibration

In the appendix, I define a general equilibrium of the extended model. Using the equilibrium conditions from Definition 3 in section A.4, I solve the model numerically and choose parameters to match aggregate moments for the manufacturing sector in Argentina for the period 2003 – 2007. The calibration strategy is as follows. First, some parameters are set to match their empirical counterparts. The exit rate of firms is set at $\mu = 0.075$ to fit the density of the age distribution. The exogenous job separation rate is set to $\gamma = 0.15$, to match the probability that workers employed in non-exiting firms move into the unemployment pool within the year. The unemployment rate is set at the average rate over the period of $u = 10\%$ according to the Argentine institute of statistics. The rate of time discount $\rho$ matches an average interest rate of 6\% on deposits at the fourth quarter of each year according to the Argentine Central Bank. The elasticity of demand equals $3$, as in the estimate of Eaton et. al. (2008b).

I normalize the operative fixed cost to $f_0 = 10$, and I set the firm specific shifter of exporting costs $\phi$ to be uniformly distributed between 0 and 2.

There are 8 remaining parameters: revenue premia $\{\Gamma_1, \Gamma_2\}$, exporting costs $\{f_1, f_2\}$, labor market fundamentals $\{b, \lambda_e\}$, the convexity in the hiring cost $\zeta$ and the shape parameter $\sigma_\psi$ in the distribution of productivity $\psi$, which I assume to be Pareto. I choose their values to minimize the sum of squared residuals between the prediction of the model for ten aggregate moments and their empirical values. The two markets $k = 1, 2$ of the model correspond, in the data, to firms exporting to up to five countries and to more than five countries.\footnote{I.e., I assume that firms bear a single cost of entry for the first five markets and an additional cost for the rest. Since, in the data, most Argentine firms that export to less than five countries export to Mercosur, the two markets in the model very broadly correspond to exports to this block of countries and to exports to the rest of the world.}

I choose to match moments from the data that correspond to the central outcomes studied in the theory: the shares of each type of firm in the total number of firms, the shares of employment in each type of firm, the average age of the three types of firms, and the share of job-to-job transitions in new hires.\footnote{Quantitatively, the levels of job-to-job transitions in the model are particularly sensitive to the probability of a contact on the job, $\lambda_e$.}

As a result of the calibration I find $\{\Gamma_1, \Gamma_2, f_1/f_0, f_2/f_0, \lambda_e/\lambda_u, b, \zeta, \sigma_\psi\} = \{1.2, 1.3, 1.8, 6.1, 0.1, 0.04, 1.9, 3\}$.\footnote{The relative value for $\lambda_e$ is line with results in Jolivet et. al. (2006) in various OECD countries. The value for $b$ implies a share of GDP spent in unemployment compensation of 0.5\%; this is similar to the value in many relatively low-income OECD countries in recent years according to the OECD Social Expenditure Database, e.g. 0.1\% in Turkey, 0.3\% in Slovak Republic, 0.4\% in Greece, and 0.5\% in Hungary. The average exporting cost to at least five country appears particularly large. However, the presence of the firm-level shifter of the exporting costs $\phi$ implies the presence of firms with small costs of exporting.}

<table>
<thead>
<tr>
<th>Calibrated Moments</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm Distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exporters to up to 5 countries</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Exporters to more than 5 countries</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Employment Distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exporters to up to 5 countries</td>
<td>21%</td>
<td>20%</td>
</tr>
<tr>
<td>Exporters to more than 5 countries</td>
<td>32%</td>
<td>33%</td>
</tr>
<tr>
<td>Average age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Exporters</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Exporters to up to 5 countries</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Exporters to more than 5 countries</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>Fraction of new hires job-to-job</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exporters to up to 5 countries</td>
<td>13%</td>
<td>16%</td>
</tr>
<tr>
<td>Exporters to more than 5 countries</td>
<td>31%</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>39%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Table 1: Matched moments, model and data
The moments generated by the model as well as the targets are reported in Table 1. These moments capture the averages in Figures 1 to 4 for the period after 2003. The model matches closely all target moments except the average age of exporters to more than five countries.

5.4 Cross-Sectional Predictions

The central prediction of the theory is the timing of firm entry into different export markets and the allocation of workers across firms with different export status. Given the (exogenous) age and productivity distributions, these outcomes give the fraction of exporting firms and their employment allocation. Since in the calibration I match these aggregate moments, a natural question is whether the model does a good job in replicating the profile of export participation over the firm age and size distributions that we see in the data. Figure 9 shows the parametrized model’s predictions for Figures 2 and 3 in the Introduction. It depicts, in solid lines, the share of exporters and the share of exporters to up to five countries by firm age (left panel) and by firm size (right panel) generated by the model, as well as their actual empirical values (dotted lines). The model captures the increase in export participation for firms younger than 30 years and the share of exporters to more than five countries across the size distribution, although it overpredicts the share of exporters among the largest firms.

A separate question is whether the model can account for the dispersion in firm size by export status that appears in the data. Figure 10 shows the calibrated model’s prediction for Figure 1. It depicts the average (demeaned) log size of firms with different export status within groups of age. There are two forces generating the increase in size by export status in this figure: growth of continuing firms within each export group and selection of firms between exports groups over time. More efficient and lower cost firms in the group of non-exporters select themselves into exporting as they age. Within exporters, more efficient and lower cost firms select themselves into the group of firms exporting to more destinations.
The model captures the increase in size over age within non-exporters that we see in the data, as well as the constant gap in size between exporters to different number of destinations. However, it fails to predict the steady growth among exporters. This constant increase in log-size suggests that firms are in a balanced growth path due to forces not taken into account in the model. Natural candidates for this trend are accumulation of another resource, learning or size-dependency in the search technology.

Figure 10: Firm size by age and export status, data (dotted lines) and model (solid lines)

5.5 Simulated Policies

I use the parametrized model to measure the magnitude of the welfare effects induced by the changes in policy studied in the baseline theory, and to ask about the differential impact of a reduction in trade barriers in labor market environments with different flexibility.\footnote{This question has recently been the focus of quantitative explorations in Kambourov (2009) and Cosar (2010), who study two-sector models where the labor market friction slows down reallocations to the comparative advantage sectors after a trade reform. In the current model, in contrast, all the reallocations are within industries.}

The overall methodology is as follows. From the calibrated values of $\Gamma_1$ and $\Gamma_2$ and the value for aggregate income $Y_0$ that results from the calibration, I use equations (33) and (34) to infer the value of the foreign market sizes $A_1$ and $A_2$. Then, I simulate changes on these foreign market sizes and on the calibrated labor market fundamentals $b$ and $\lambda$. For each new set of parameters I recompute the equilibrium, including new values for $\Gamma_1$ and $\Gamma_2$ that result from the change in income $Y_0$. I make the small-country assumption that foreign market sizes $A_1$ and $A_2$ do not change in response to changes in outcomes in the home economy. Welfare equals aggregate consumption of the final good, and is found residually given the equilibrium at home from the difference between output of the final good and firms’ spending in search for workers, entry, and investment in exporting.

First, I simulate a 10% increase in the rate of transfers to unemployed workers $b$. The percent changes in total employment in exporters and in aggregate income and consumption appear in the first column of Table 2. From the baseline model, we know that this shock results in an increase...
in income given the revenue differential of exporters. At the calibrated parameters of the extended model, it results in a 2% increase in income and in a 1.5% increase in aggregate consumption or welfare. These gains occur through a 1.2% increase in the size of the workforce allocated to exporting firms.

Second, I simulate a 10% increase in trade costs to any destination under the calibrated value for $\lambda_c$, and also under a more flexible labor market regime, where $\lambda_c$ is 10% larger.\footnote{Assuming that trade barriers are the same in both markets, the elasticity of demand implies that the reduction in trade costs is equivalent to a 20% increase in foreign market sizes $A_1$ and $A_2$.} In reduced form, the increase in $\lambda_c$ can be interpreted as deriving from policies that encourage on-the-job search, such as lower firing costs. It can also be associated with a shift towards more decentralized bargaining schemes between firms and workers, which would encourage the type of transitions and individual bargaining highlighted in the model. The second column in Table 2 reports the percent difference between the change on aggregate outcomes due to the reduction in trade barriers under the more and the less flexible labor market.

The impact of lower trade barriers is smaller in a more flexible environment. The increase in employment in exporting firms resulting from 10% lower trade barriers is 10% smaller in the more flexible environment, and the increase in welfare is 15% smaller. Therefore, at the calibrated values for the parameters, this economy exhibits no complementarities between more labor market flexibility and lower trade barriers. Under a more flexible labor market, a greater share of employment is allocated in exporting firms and the revenue premium of exporters is smaller, resulting in a smaller marginal impact of lower trade barriers.

<table>
<thead>
<tr>
<th>Moments</th>
<th>Transfers Barriers (dif in dif)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment in Exporters</td>
<td>1.2%</td>
</tr>
<tr>
<td>Employment in Exporters, more than 5 countries</td>
<td>-9.6%</td>
</tr>
<tr>
<td>Consumption (welfare)</td>
<td>2.0%</td>
</tr>
<tr>
<td>Income</td>
<td>1.5%</td>
</tr>
<tr>
<td></td>
<td>-13.0%</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
</tr>
<tr>
<td></td>
<td>-14.9%</td>
</tr>
<tr>
<td></td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td>-14.7%</td>
</tr>
</tbody>
</table>

Table 2: Simulated policies

6 Conclusion

I have studied the impact of labor market frictions on trade and income in an economy where productivity upgrading and export participation require fixed-cost investments. The central aspect of the analysis has been that the growth of firms takes time depending on frictions in the labor market. As a result, there is a period after firm birth during which firms choose to use low-productivity technologies or to sell only at home, and aggregate income is determined by the duration of this transition. The friction generates dispersion in size and export activity among ex-ante identical firms in a dynamic environment. The model predicts that older and larger firms are more likely to export, and that exporters hire relatively more workers from other jobs and from other exporters, as observed in a matched employer-employee dataset from Argentina. At the aggregate level, it implies that policies encouraging job-to-job transitions and more generous
unemployment compensation raise trade and income. It also implies that individual countries gain when these policies are implemented by trading partners.

The basic theory was extended to allow for endogenous search effort of firms, two export destinations and ex-ante differences in productivity. When I choose parameters to match aggregate moments in the Argentine data, I find that the model generates a close description of the increase in export participation by firm age and size, although it fails to explain the systematic increase in firm size among old exporters. This suggests that there is room for a theory combining frictions and accumulation of another resource at the firm level to explain firm-level outcomes. When I simulate changes in the environment, I find that a 10% increase in unemployment transfers results in a 1.5% increase in welfare, and that welfare gains due to an increase in foreign market size are lower in a more flexible labor market environment.

The quantitative setup lends itself to many extensions to answer a range of questions not addressed in the paper. I have not included various features of reality that are important for a full account of the role of frictions or unemployment benefits, such as an endogenous aggregate rate of matching between workers and firms, or a search decision of workers. The analysis was also limited to comparisons between steady states, but it would be interesting to use the model to study aggregate transitions after a change in the environment. These questions are left for future research.
References


[41] Meghir, Costas, Renata Narita, and Jean-Marc Robin (2010), "Wages and Informality in Developing Countries," manuscript.

[42] Mion, Giordano and Opromolla, Luca (2010), "Managers Mobility, Trade Status, and Wages," manuscript.


Derivations and Proofs

A.1 Appendix to Section 2

Derivation of (3) and (31)

The value of a job equals the sum of values obtained by the worker and the firm, \( v = W + J \). At the moment in which a worker moves from firm \( i \) to firm \( j \), the values obtained by the worker and by the firm are, respectively, \( W_{i,j} \) and \( J_{i,j} \). The reduced-form implication of the bargaining process in Postel-Vinay and Robin (2003) is that the splitting of the total surplus in \( j \), \( v_j \), only depends on the total surplus in \( i \). In particular, it occurs as if the worker used the total value in the previous employment, \( v_i \), as outside option in a bilateral bargaining with \( j \) in which the new firm has monopsony power:

\[
W_{i,j} = W(v_i, v_j) = v_i, \quad (41)
\]

\[
J_{i,j} = J(v_i, v_j) = v_j - v_i. \quad (42)
\]

By construction, \( W_{i,j} \) satisfies

\[
(\rho + \delta + \lambda e P_{k:v_i \leq v_k}) W_{i,j} = \omega_{i,j} + \delta w_u + \lambda e \left( \int_{v_i \leq v_k \leq v_j} W_{k,j} dP_k + \int_{v_k < v_j} W_{j,k} dP_k \right) + dW_{i,j},
\]

where \( \omega_{i,j} \) is the income flow obtained by the worker at the moment of the transition from \( i \) to \( j \) and \( \delta w_u \) is the value for the worker if the match is dissolved. The term in brackets is the value obtained in the case of a contact with firms offering jobs with value higher than \( i \), where \( dP_k \) measures the probability of sampling firm \( k \) and \( P_{k:v_i \leq v_k} \) is the measure of all firms whose value is above \( v_i \). The last term, \( dW_{i,j} \), is the change in the value obtained by the worker at the point in time where the transition from \( j \) to \( i \) occurs. Using (41) and (42), changing the variable of integration to the distribution of values \( v_0 \) with associated sampling function \( dP_v(v) \) and integrating by parts yields:

\[
(\rho + \delta) W_{i,j} = \omega_{i,j} + \delta w_u + \lambda e \int_{v_i}^{v_j} [1 - P_v(v_0)] dv_0 + dW_{i,j}. \quad (43)
\]

On the other hand, \( J_{i,j} \) is given by:

\[
(\rho + \delta + \lambda e P_{k:v_i \leq v_k}) J_{i,j} = \tilde{y}_j - \omega_{i,j} + \lambda e \int_{v_i \leq v_k \leq v_j} J_{k,j} dP_k + dJ_{i,j}, \quad (44)
\]

where \( \tilde{y}_j \) is the current revenue per worker generated in firm \( j \).

Suppose that a worker employed in \( j \) meets a firm \( j' \) whose total value is the same as in \( j \), \( v_j = v_{j'} \). In this instance, (41) and (42) lead to \( J_{j',j} = 0 \) and \( W_{j',j} = v_j \). On the other hand, \( dW + dJ = dv \), the sum in the change in value obtained by the firm and the worker in any event add up to the total change in the value of the job. In particular, this holds when a worker from \( i \) enters \( j \), i.e. \( dW_{i,j} + dJ_{i,j} = dv_j \). The specific way in which the change in the value of the match is split between the parts at this point pins down the evolution of the transfer flow between firm and worker, but for our purposes it needs not be specified.
In Postel-Vinay and Robin (2003), this division results from the assumption that firms commit to a fixed wage until a renegotiation occurs. Therefore, evaluating (43) and (44) at $i = j'$ and summing over these equations gives

$$\left(\rho + \delta\right) v_j = \tilde{y}_j + \delta w_u + dv_j.$$  \hfill (45)

Thus, the total value of a job in firm $j$ is characterized by this differential equation that depends on the process for the revenues generated by each employed worker in firm $j$, $\tilde{y}_j$.

Suppose next that firms are heterogeneous in their (constant) productivity per worker $\psi$ and that they enter sequentially in different markets at ages $H_k$. Letting $y_k$ be the revenues per unit of output generated by a firm who has entered in $k$ markets, $\tilde{y}_j$ depends on the age of the firm, $a$, as given by $\tilde{y}(a; \{H_k\}) = \psi \sum_k 1_{(H_k \leq a < H_{k+1})} y_k$. Using this in (45), we have the differential equation over age

$$\left(\rho + \delta\right) v (a; \{H_k\}) = \psi \tilde{y}(a; \{H_k\}) + \delta w_u + v' (a; \{H_k\}).$$

Expressing the solution to this equation in terms of the time until the firm enters each market $k$, $x_k \geq 0$, gives

$$\left(\rho + \delta\right) v \{x_k\} = \psi \left[ y_0 + \sum_{k=0}^{K} e^{-(\rho+\delta)x_k} (y_{k+1} - y_k) \right] + \delta w_u.$$

In the case of $K = 1$ and $\psi = 1$ this constitutes the expression in (3) used in sections 2 to 4; for $K = 2$ this is the expression (31) used in Section 5.

**Proof of Proposition 1**

The first order condition in the firm problem is:

$$\Pi' (h) = e^{-(\rho+\mu)h} (f_X - S (h)) \leq 0 \text{ if } h = 0,$$

$$= e^{-(\rho+\mu)h} (f_X - S (h)) = 0 \text{ if } h > 0.$$

where, replacing the expression in (12) into (10),

$$S (h) = (\Gamma - 1) y_D (\lambda u/M) \int_0^h e^{-\gamma x} \{1 + \kappa_\epsilon [1 - G (x)]\} \, dx.$$  \hfill (46)

We have: i) $S (0) = 0$; ii) $S' (h) > 0$; and iii) if $G (x) = 0$, $\lim_{h \to \infty} S (h) = (\Gamma - 1) y_D (\lambda u/M) (1 + \kappa_\epsilon) / \gamma$. From i) and the first order condition, $f_X > 0$ implies that $h > 0$. From ii), there is a unique interior solution to the firm problem. From iii), if $f_X > (\Gamma - 1) y_D (\lambda u/M) (1 + \kappa_\epsilon) / \gamma$ then $S (h) < f_X$ for all $h$, and the first order condition implies that $h = \infty$. This proves the first part of the proposition. Comparative statics follow from the interior solution $S (h) = f_X$, inspection of the change in $S (h)$ with respect to each parameter and ii).
A.2 Appendix to Section 3

Proof of Lemma 1

I use the notation $\Omega_1 (h, H) \equiv \partial \Omega (h, H) / \partial H$ and $\Omega_2 (h, H) \equiv \partial \Omega (h, H) / \partial H$. First, write the function $\Omega (h, H)$ explicitly. Replacing for $G (x)$ from (14) in (46), and replacing for $\pi (x; H)$ from (6) evaluated at $\pi = H$ we have:

$$\Omega (h, H) \equiv \frac{S (h; H)}{\pi (h; H)} = \frac{(\Gamma - 1) (1 + \kappa_e) \int_0^h \frac{e^{-\gamma x}}{1 + \kappa_e e^{-\mu (H - x)}} - dx}{J_u (h; H) + \kappa_e \int_h^H \tilde{J} (x, h) dG (x)}, \tag{47}$$

where $\tilde{J}_u (h, H) \equiv J_u (h, H) / y_D$ and $\tilde{J} (x, h) \equiv J (x, h) / y_D$. Using the definitions of $J_u (x, J (x_0, x)$ and $v (x)$, we can write $\Omega (h, H) = A (h, H) / [B (h, H) + C (h, H)]$, where

$$A (h, H) = (\Gamma - 1) (1 + \kappa_e) \int_0^h \frac{e^{-\gamma x}}{1 + \kappa_e e^{-\mu (H - x)}} - dx,$$

$$B (h, H) = [1 - \rho w_u / y_D + (\Gamma - 1) e^{-(\rho + \delta) h}] / (\rho + \delta),$$

$$C (h, H) = [\kappa_e (\Gamma - 1) / (\rho + \delta)] \int_h^H \frac{e^{-(\rho + \delta) x} - e^{-(\rho + \delta) x}}{x^H} dG (x),$$

where, in $B (h, H)$:

$$\rho w_u / y_D = b y / y_D = b [1 + e x (H) (\Gamma - 1)] = b \{1 + [\Gamma (1 + \kappa_e) - 1] e^{-\mu H} \} / (1 + \kappa_e e^{-\mu H}). \tag{48}$$

The first equality in (48) follows from (18), the second from (17) and the third from (16).

We want to prove that $\Omega_2 (H, H) > 0$. Note, first, that $C (H, H) = C_2 (H, H) = 0$, implying that $\Omega_2 (H, H) = \Omega_2 (H, H)$, where $\Omega (h, H) \equiv A (h, H) / B (h, H)$. Hence, $\Omega_2 (H, H) > 0$ if and only if $\Omega_2 (H, H) > 0$. Using $A (h, H)$, $B (h, H)$, multiplying numerator and denominator of $\Omega (h, H)$ by $(1 + \kappa_e e^{-\mu H}) (\rho + \delta)$, and changing the variable of integration in $A (h, H)$ to $h_0 = H - x$ gives:

$$\tilde{\Omega} (h, H) \equiv (\rho + \delta) (\Gamma - 1) (1 + \kappa_e) \int_{H-h}^H \frac{e^{-\gamma H} + \kappa e^{-H \delta} H (e^{-\gamma h_0} + \kappa e^{-\delta h_0}) - 1 dh_0}{1 - b + \{\kappa_e - b [\Gamma (1 + \kappa_e) - 1] e^{-\mu H} + (\Gamma - 1) (1 + \kappa e e^{-\mu H}) e^{-\(\rho + \delta) H \}}. \tag{49}$$

From (23), the denominator is decreasing in $H$. To prove that $\tilde{\Omega}_2 (H, H) > 0$ it suffices to show that the numerator increases in $H$. This occurs if

$$\frac{\partial}{\partial H} \int_{H-h}^H \frac{e^{-\gamma H} + \kappa e^{-H \delta} e^{-\gamma h_0} + \kappa e^{-\delta h_0} dh_0 > 0 \iff \int_{H-h}^H \frac{\gamma e^{-\gamma H} + \delta \kappa_1 e^{-\delta h_0}}{\gamma e^{-\gamma h_0} + \kappa e^{-\delta h_0} dh_0 < 1 - \gamma e^{-\gamma H} + \kappa e^{-\delta H} \gamma e^{-\gamma (H-h)} + \kappa e^{-\delta (H-h)}}.$$ At $h = H$, the second inequality is equivalent to

$$LHS (H) \equiv \int_0^H \frac{1}{e^{-\gamma h_0} + \kappa e^{-\delta h_0} dh_0} < \frac{1}{\gamma e^{-\gamma H} + \delta \kappa_1 e^{-\delta h_0}} \left(1 - \frac{\gamma e^{-\gamma H} + \kappa e^{-\delta H}}{1 + \kappa e} \right) \equiv RHS (H).$$

Since $LHS (0) = RHS (0) = 0$, to prove that this inequality holds it is sufficient to show that $LHS' (H) <
Testing these expressions and some manipulation implies that this holds if and only if \((e^{-\gamma H} + \kappa_e e^{-\delta H}) / (1 + \kappa_e) < 1\), that holds given \(H > 0\).

**Proof of Proposition 2**

Let \(\Omega_0 (H) \equiv \Omega (H, H)\). In an interior equilibrium, \(\Omega_0 (H) = f_X / f_D\). We have that \(\Omega_1 (h, H) > 0\) for all \(H\) by inspection of \(\Omega (h, H), J_u (h, H)\) and \(J (x, h)\), and that \(\Omega_2 (H, H) > 0\) from Lemma 1. Therefore, \(\Omega_0' (H) > 0\), implying that an interior equilibrium is unique. For existence of the interior equilibrium, \(\Omega_0 (0) = 0\) implies that \(H > 0\). On the other hand, if \(\lim_{H \to \infty} \Omega_0 (H) \equiv \frac{f_X}{f_D} \leq \frac{f_X}{f_D}\), where \(f_X / f_D\) is defined in (24) in the text, then no interior equilibrium exists. In the other direction, if \(H = \infty\) is an equilibrium, then it must be that no firm invests when no firm invests, i.e. \(\lim_{h \to \infty} \lim_{H \to \infty} \Omega (h, H) \equiv \frac{f_X}{f_D} \leq \frac{f_X}{f_D} \). Therefore, \(H = \infty \iff \frac{f_X}{f_D} \leq \frac{f_X}{f_D}\).

**Proof of Proposition 3**

Note that in an interior equilibrium,

\[
\Omega (H, H) = \frac{(\rho + \delta) (\Gamma - 1) (1 + \kappa_e) \int_0^H e^{-\gamma x} [1 + \kappa_e e^{-\mu (H-x)}]^{-1} dx}{1 - b \{1 + [\Gamma (1 + \kappa_e) - 1] e^{-\mu H} \} (1 + \kappa_e e^{-\mu H})^{-1} + (\Gamma - 1) e^{-\mu (\rho + \delta) H}} = \frac{f_X}{f_D}
\]

Changes in parameters that raise \(\Omega (H, H)\) given \(H\) lead to lower equilibrium \(H\). By inspection, we have \(\partial \Omega (H, H) / \partial \lambda_u = 0\) and \(\partial \Omega (H, H) / \partial b > 0\). Multiplying numerator and denominator of \(\Omega (H, H)\) by \((1 + \kappa_e e^{-\mu H}) \) \((\Gamma - 1)\) we see that \(\partial \Omega (H, H) / \partial \Gamma > 0\) if (23) holds. Finally, the numerator of \(\Omega (H, H)\) is increasing in \(\kappa_e\) by inspection, while the denominator is decreasing since \(1 - e^{-\mu H} > 0\), implying \(\partial \Omega (H, H) / \partial \kappa_e > 0\). By inspection of (15) to (17), each of the parameter changes leading to a lower \(H\) also lead to an increase in \(m_X, e_X\) and \(y\).

**Proof of Lemma 2**

Consider an equilibrium where every firm switches at age \(H\), and let \(N (h)\) be the size of a firm of age \(h\). The net flow of workers in a firm of age \(h\) is

\[
N' (h) = \begin{cases} \frac{(M \mu \gamma)}{\alpha} [1 + \kappa_e G_H (h)] - \{\gamma + \lambda \omega [1 - P_H (h)]\} N (h) & \text{if } h < H \\ \frac{(M \mu \gamma)}{\alpha} [1 + \kappa_e G_H (H)] - \{\gamma + \omega \lambda_e [1 - P_H (H)]\} N (h) & \text{if } H \leq h \end{cases}
\]

where \(P_H (h) = 1 - e^{-\mu h}\) and \(G_H (h) = P_H (h) / \{1 + \kappa_e [1 - P_H (h)]\}\) are the firm and employment distributions defined over age, instead of over time until investment as in (13) and (14), respectively. Workers in firms older than \(H\) who contact another firm older than \(H\) are indifferent about making a transition, in which case they move with exogenous probability \(\omega\).

Note first that the rate at which workers leave the firm is weakly decreasing and the number of new hires is weakly increasing in \(h\), so \(N (h)\) is increasing. Letting \(F (n)\) be the share of firms of size less than \(n\), we
have, from the exponential distribution of ages, that $F(n) = 1 - e^{-\mu N^{-1}(n)}$. This implies

$$f'(n) / f(n) = - \left[ \mu + N''(N^{-1}(n)) / N'(N^{-1}(n)) \right] / N'(N^{-1}(n)),$$

which gives Lemma 2. If $h < H$ and $\lambda_e = 0$ then $N''(h) / N'(h) = -\gamma$, and if $h > H$ then $N''(h) / N'(h) = -\{\gamma + \omega \lambda_e [1 - P_H(H)]\}$, implying (i) and (iv) in Corollary 1. If $h < H$, from (50),

$$\frac{N''(h)}{N'(h)} = \frac{\lambda u}{M} \cdot \frac{1 + \kappa e^{-\mu h}}{1 + \kappa e^{-\mu h}} \left( \frac{\mu - \gamma - \frac{\gamma + \lambda e^{-\mu h} \lambda e^{-\mu h}}{\gamma + \mu + \lambda e^{-\mu h}} + \left[ (\lambda e^{-\mu h} + \gamma)^2 - \mu \gamma \right] N(h)}{1 + \kappa e^{-\mu h}} - (\lambda e^{-\mu h} + \gamma) N(h) \right)^{\frac{1}{\gamma + \mu + \lambda e^{-\mu h}}}. \quad (51)$$

At $h = 0$, (51) yields $N''(h) / N'(h) + \mu = \mu - \gamma - \lambda e (\gamma + \lambda e) / (\gamma + \mu + \lambda e) < 0$, implying (ii). Since the denominator in the right hand side of (51) is positive, we have that $\lim_{h \to \infty} N''(h) / N'(h) + \mu > 0$ if and only if $\lim_{h \to \infty} N(h) > (\lambda u / \gamma M)$. But from (50) we have $\lim_{h \to \infty} N(h) = (1 + \kappa e) (\lambda u / \gamma M)$, implying (iii) in the corollary.

### A.3 Appendix to Section 4

#### Derivation of (26) and (27)

I derive the linear revenue function used in the international trade section from a monopolistic competition setting. Output of the final good in each country is

$$Y = \left( \int I z_i^{1/\sigma} q_i^{(\sigma - 1)/\sigma} d_i \right)^{\sigma/(\sigma - 1)},$$

where $I$ is the set of available varieties from any country, while $q_i$ and $z_i$ denote the quantity and the quality of each variety. This good is produced in a competitive sector that uses the differentiated varieties as inputs, resulting in a demand for $i$ of

$$q_i = z_i Y (\tilde{p}_i / P)^{-\sigma},$$

where $\tilde{p}_i$ is the price of variety $i$ and $P = \left( \int z_i\tilde{p}_i^{1-\sigma} d_i \right)^{1/\sigma}$ is the domestic price index.

Consider firms in the home market, indexed by 0, in a world with many countries. Given levels of quantity and quality $q_i$ and $z_i$, a firm selling in a set $J$ of markets (including the domestic market) chooses the fraction $s_j$ of total output to ship to market $j$. Of each unit shipped to country $j \neq 0$ only a fraction of $1/\tau_j > 1$ arrives. Letting

$$p_j \equiv P_j Y_j^{1/\sigma},$$

revenues of an exporter to a set $J$ of markets are

$$\tilde{r}_j = \max_{s_j} \left\{ z^{1/\sigma} q^{1-1/\sigma} \sum_{j \in J} p_j (s_j / \tau_j)^{1-1/\sigma} \text{ s.t. } \sum_{j \in J} s_j = 1 \right\} = \left( \sum_{j \in J} p_j^{z^1/\tau_j^{1-\sigma}} \right)^{1/\sigma} \left( z^{1/\sigma} q^{1-1/\sigma} \right), \quad (52)$$

44
where the second line follows from evaluating the revenue function at the optimal shares:

\[ s_j = \frac{p_j \tau_j^{1-\sigma}}{\sum_{j \in J} p_j \tau_j^{1-\sigma}}. \]  

(53)

In each moment firms have a stock of \( n \) workers evolving over time as described in the text. This workforce can be allocated to produce final goods, either for domestic or foreign shipment, or quality. The production frontier within firms is linear in these variables: a firm with \( n \) workers and productivity \( \psi \) faces the constraint \( (1/\sigma) z + (1 - 1/\sigma) q = \psi n \) (the introduction of \( \sigma \) in this constraint serves to save notation). As a result, the optimal allocation of workers dictates that firm quantity and quality increase proportionally with the stock of workers no matter the export status:

\[ z = q = \psi n. \]  

(54)

Using (54) in the revenue function (52) and normalizing by the domestic price index, real revenues (i.e., in terms of the final good) in a firm with \( n \) workers exporting to the set of markets \( J \) are

\[ r_J = y_J \psi n, \]

where revenues per unit of output are

\[ y_0 = Y_0^{1/\sigma}, \]

\[ yJ = \Gamma_J y_0, \]

and where the revenue premium of a firm exporting to a set \( J \) of markets is:

\[ \Gamma_J = \left[ 1 + \sum_{j \in J} (p_j/p_0)^{\sigma} \tau_j^{-(\sigma-1)} \right]^{1/\sigma}. \]  

(57)

Evaluating (53) and (57) in the case of two countries and \( \psi = 1 \) gives (26) and (27) in Section 4, while setting the number of markets to be at most 3 gives the revenue premia in (32) to (34) in Section 5.

**Proof of Proposition 4**

Using (27) for both countries and the first equality of (30) in (29) yields

\[ \Gamma^* e_X^* (\Gamma^*) s_X^* (\Gamma^*) = \left[ \tau^{1/\sigma} (1 - w) \right] / \left[ \tau^* (1 - u^*) \right] e_X (\Gamma) s_X (\Gamma)^{(\sigma-1)/\sigma}. \]  

(58)

Since \( de_X / d\Gamma \geq 0 \) and \( ds_X / d\Gamma > 0 \), if \( e_X > 0 \) and \( e_X^* > 0 \) this gives an increasing relation between \( \Gamma \) and \( \Gamma^* \), corresponding to TB. If \( (\rho + \delta) (1 + \kappa_v) / [\gamma (1 - b)] \to \infty \) or \( f_X / f_D \to 0 \), we have from Proposition 2 that \( e_X (1) = s_X (1) = 0 \) and that \( de_X / d\Gamma > 0 \) if \( e_X < 1 \). The same applies in the foreign country. Therefore, (58) is satisfied with both sides equal to zero at \( \Gamma = \Gamma^* = 1 \) and each side is strictly increasing.
in its respective argument if $\Gamma > 1$ and $\Gamma^* > 1$. On the other hand, XP is an hyperbole in the region given by $\Gamma > 1$ and $\Gamma^* > 1$, with the property that $\Gamma^* \to \infty$ as $\Gamma \to 1$, and vice versa. This implies that XP necessarily intersects TB in one and only one point in the region defined by $\Gamma > 1$ and $\Gamma^* > 1$.

**Proof of Proposition 5**

Under the conditions from Proposition 4, from (58) we can implicitly write $\Gamma$ as an increasing function of $\Gamma^*$. The equilibrium values for $\Gamma$ and $\Gamma^*$ correspond to the intersection between this function and (30). From Proposition 3, $e_X^* (\Gamma^*)$ in (58) increases for each value of $\Gamma^*$ with a rise in $b^*$ or in $\lambda_1^*$, hence the new equilibrium must have a larger $\Gamma$ and a lower $\Gamma^*$. The increase in export participation in the home country follows from Proposition 3. For the increase in export participation in the foreign economy, we have that with a rise in $b^*$ or in $\lambda_1^*$, the increase in $\Gamma$ leads to an increase in the right hand side of (58). Since $\Gamma^*$ decreases in the left hand side, so does $s_X (\Gamma^*)$, meaning that $e_X^* (\Gamma^*)$ and therefore $m_X^* (\Gamma^*)$ must increase. On the other hand, consider a reduction in $\Gamma$ and suppose that $s$ shrinks. Then, $e_X^* (\Gamma^*)$ must increase in (30), the right hand side of (58) decreases and, from Proposition 3, the left hand side increases, which can’t be an equilibrium. Therefore, $\Gamma$ must increase.

**A.4 Appendix to Section 5**

**Derivation of $\pi (x; \psi)$**

The present discounted value of all workers attracted by a firm with productivity $\psi$ in state $x$ -the equivalent to (6)- is

$$\pi (x; \psi) = \max_{s \geq 0} \left( \lambda_u u / M \bar{s} \right) \pi_0 (v (x; \psi)) s - c (s).$$

(59)

where

$$\pi_0 (v) = v - w + \kappa \int_{v_0 \leq v} G_v (v_0) \, dv_0.$$

(60)

In each period the firm solves a static problem about how many workers to attract. Higher search $s$ entails a cost, but, in expectation, yields a return proportional to $\pi_0$. A firm offering jobs with value $v$ chooses

$$s (v) = \left[ (\lambda_u u / M \bar{s}) \, \pi_0 (v) / \zeta \right]^{1 / \kappa - 1}.$$

(61)

Replacing in (59) this yields an expression equivalent to (6):

$$\pi (x; \psi) = (\zeta - 1) \left[ (\lambda_u u / M \bar{s}) \, \pi_0 (v (x; \psi)) / \zeta \right]^{1 - 1 / \kappa}.$$

(62)

**Proof of Lemma 3**

In an interior solution, the first order condition of the firm problem with respect to $h_1$ and $h_2$ can be
written as

\[ h_1 : \int_0^{h_1} e^{(\rho + \mu)x_1} \pi_1 (x_1, x_1 + h_2; \psi) \, dx_1 + \phi f_1 = 0, \]

\[ h_2 : \int_0^{h_1} e^{(\rho + \mu)x_1} \pi_2 (x_1, x_1 + h_2; \psi) \, dx_1 + e^{-(\rho + \mu)h_2} \left[ \int_0^{h_2} e^{(\rho + \mu)x_2} \pi_2 (0, x_2; \psi) \, dx_2 + \phi f_2 \right] = 0, \]

Taking derivatives of (62) and using the resulting expression for \( \pi_2 (x_1, x_1 + h_2; \psi) \) in these conditions gives (37) and (38) in the text. Using the expressions for \( \pi_1 (x_1, x_1 + h_2; \psi) \) and \( \pi_2 (0, x_2; \psi) \) that result from (62) and the expression for \( G_v \) from (66) gives

\[ h_1 : \zeta^{-\frac{1}{\zeta-1}} \left( \frac{\lambda_v u}{M_\beta} \right)^{-\frac{1}{\zeta-1}} \psi \int_0^{h_1} \frac{(1 + \kappa_v) \pi_0 (x_1, x_1 + h_2; \psi)}{1 + \kappa_v [1 - P (v (x_1, x_1 + h_2; \psi))]} e^{-\gamma x_1} \, dx_1 = \phi \frac{f_1}{y_1 - y_0}, \]

\[ h_2 : \zeta^{-\frac{1}{\zeta-1}} \left( \frac{\lambda_v u}{M_\beta} \right)^{-\frac{1}{\zeta-1}} \psi \int_0^{h_2} \frac{(1 + \kappa_v) \pi_0 (0, x_2; \psi)}{1 + \kappa_v [1 - P (v (0, x_2; \psi))]} e^{-\gamma x_2} \, dx_2 = \phi \left( \frac{f_2}{y_2 - y_1} - \frac{f_1}{y_1 - y_0} \right). \]

The left hand side of the second function is strictly increasing in \( h_2 \) and independent from \( h_1 \), while the first one is strictly increasing in both \( h_1 \) and \( h_2 \), implying a unique interior solution to the firm problem. Since \( \pi_0 (x; \psi) \) and \( v (x; \psi) \) are increasing in \( \psi \), the left hand side of both functions is increasing in \( \psi \), while the firm specific fixed cost \( \phi \) only appears on the right hand side, implying that \( h_1 \) and \( h_1 + h_2 \) are decreasing in \( \psi \) and increasing in \( \phi \). For the second part of the lemma, note that the firm entering in both markets and entering first in market 1 can only be an outcome if the right hand side of (40) is positive, i.e. if \( f_2 / f_1 > (\Gamma_{12} - \Gamma_1) / (\Gamma_1 - 1) \). Following the same logic, if we conjecture that the firm enters first in 2 and then in 1, we have a contradiction if the right hand side of the equivalent version of (40) is negative, i.e. if \( f_1 / f_2 < (\Gamma_{12} - \Gamma_2) / (\Gamma_2 - 1) \). Both inequalities together are equivalent to the condition in the lemma and they imply that if the firm enters in both export markets, it must enter first in market 1.

**Definition of the Equilibrium**

To proceed with the definition of the equilibrium, let \( h_k (\varepsilon) \) denote the choice of firm \( \varepsilon \). Then, from the first order condition of the firm problem we have, as in (11), the value of the firm at entry, now indexed by the firm type:

\[ \Pi^\varepsilon (\varepsilon) \equiv \pi (h_1 (\varepsilon), h_1 (\varepsilon) + h_2 (\varepsilon); \psi) / (\rho + \mu). \quad (63) \]

Defining the equilibrium requires, first, that we identify the function \( P_v (v) \) that indicates the probability that a worker who samples a firm finds job with value below \( v \); this is equivalent to \( P (x) \) in the basic model. To find that function define first the equilibrium value of a job offered by firm \( \varepsilon \) over age:

\[ v^* (a; \varepsilon) \equiv v (\max [h_1 (\varepsilon) - a, 0], \max [h_1 (\varepsilon) + h_2 (\varepsilon) - a, 0]; \psi). \]

Notice that \( v^* (h; \varepsilon) \) is strictly increasing in \( a \), as such having a well defined inverse denoted by \( a^* (v; \varepsilon) \).
Using (61), define also the level of search chosen by firms of type $\varepsilon$ and age $a$ as:

$$s^*(a; \varepsilon) \equiv s(v^*(a; \varepsilon)). \quad (64)$$

The effective measure that a firm of age $a$ and type $\varepsilon$ has in the labor market is $s^*(a; \varepsilon) / \bar{s}$. Therefore, the sampling function is:

$$P_v(v) = \mathbb{E}_\varepsilon \int_0^{a^*(v; \varepsilon)} \left[ s^*(a; \varepsilon) / \bar{s} \right] \mu e^{-\mu a} da, \quad (65)$$

where $\mathbb{E}_\varepsilon$ denotes the expectation over the distribution of firm types $\varepsilon$. This function yields in turn the share of employment in firms with value of jobs below $v$:

$$G_v(v) = P_v(v) / \{1 + \kappa_\varepsilon [1 - P_v(v)]\}. \quad (66)$$

The measure of firms in the economy is determined by zero profits. Entry requires flow equivalent fixed costs of $f_0$ in each period, so that the free entry condition is:

$$\mathbb{E}_\varepsilon [\Pi^* (\varepsilon)] = f_0. \quad (67)$$

Aggregate income in the economy depends now on both productivity and the distribution of switching ages. Let

$$y^*(a; \varepsilon) = 1_{a<h_1(\varepsilon)} y_0 + 1_{(h_1(\varepsilon) \leq a < h_1(\varepsilon) + h_2(\varepsilon))} y_1 + 1_{(h_1(\varepsilon) + h_2(\varepsilon) \leq a)} y_2$$

be the revenue per worker generated in firm $\varepsilon$ when it has age $a$. Aggregate income is $Y_0 = (1 - u) y$, where output per employed worker equals

$$y = (1 - u) \mathbb{E} [y^*(a; \varepsilon)], \quad (68)$$

where the expectation is taken with respect to the equilibrium distribution of employment over states $(a, \varepsilon)$ induced by $P_v(v)$. As before, the value of unemployment is

$$\rho w_u = by \quad (69)$$

Summarizing:

**Definition 3** A general equilibrium consists of individual rules \{h_k(\varepsilon), s^*(a; \varepsilon)\}, distributions \{G_v(v), P_v(y)\}, a number of firms $M$, output per worker $y$, consumption $c$ and value of unemployment $w_u$ such that:

a) the first-order conditions from the firm problem, (39), (40) and (64), hold;
b) there is consistency between the individual decision rules and the aggregate distributions, (65) and (66);
c) the number of firms adjusts to satisfy free entry, (67);
d) output per worker is given by (68);
e) the value of unemployment is given by (69); and
f) goods market clear.
B Data appendix

Construction of Variables

The dataset used in the construction of the figures and in the regressions below is a match of two sources. Exports data is standard customs data at the firm-year level. This is linked with firm employment data from administrative records. The data is from the Employment and Business Dynamics Observatory of the Ministry of Labor and Social Security of Argentina (OEDE). All firms are required to report their formal employees on a monthly basis. Workers who are not reported are either informally employed or unemployed. In each of six two-month periods within each year between 1998 and 2008, every formal worker of age 18 to 64 is linked to the firm where he/she is reported as earning the highest wage. Workers earning below the minimum wage are excluded. Thus, the data includes the universe of firms that report employment above the minimum wage in any period in these years.

Each firm-year observation is marked as an exporter if the firm exports at least USD 10000. The age of the firm is the difference between the current year and the year of birth of the firm for tax purposes. The number of workers per firm-year is computed as the average employment over periods within year in which the firm reports positive employment. Industries are defined at the two-digit level. A worker employed in a firm is considered as a new hire if he/she is not employed in the firm in the previous period. To compute the fraction of new hires coming from other formal jobs in any sector of the economy for each firm-year, the shares are first computed for each pair of consecutive periods within year, and then averaged across periods within year for each firm. Similar steps are followed to compute the fraction of new hires from the manufacturing sector entering firms from jobs in exporting firms. The resulting dataset is at the firm-year level.

All figures are based on firms from the manufacturing sector. Exiting firms of any export status (i.e., firms present in a given year who do not report employment in the next) are excluded. Firms who do not report formal employment but who report exports are excluded, as well as industries with less than one-hundred firms in any year. The resulting sample represents on average 97% of the formal employment and 82% of all firms who either export or formally report the wages of their employees in the manufacturing sector between 1999 and 2007, with a total of 429934 firm-year observations.
Sample Averages and Regressions

Table B.1 shows sample means for the main variables discussed in the text. Exporters are larger and pay higher wages, as it is well known since the evidence in Bernard and Jensen (1995) for the US. Exporters are also older and hire relatively more from other firms and from other exporters. Only 11% of firms export, but these firms represent more than half of the employment in the manufacturing sector. In particular, 3% of firms that export to more than five countries represent one-third of employment in manufacturing.

Table B.2 shows that the rankings in the share of new hires from other jobs and from exporting firms in Figures 4 and 5 and in Table B.1 are not completely absorbed by various controls. For the regressions the sample is restricted to the period 2003-2007, but same coefficients are significant for 1999-2002. The first column in each set of regressions includes only industry-year fixed effects. The difference in the share of new hires from other jobs between non-exporters and exporters to no more than five countries is of 9 percent points, and between non-exporters and exporters to more than five countries is of 21 percent points. These differences are similar to the differences in sample means in Table B.1, reflecting that they hold within two-digit industries in each year. The same for shares of new hires from exporters among new hires from manufacturing.

Columns 2 to 4 control for either a second order polynomial in size and in age, wage, or net job creation. As we should expect from the theory, controlling for age and size shrinks the magnitude of the coefficients on the indicator for export status. To the extent that the current wage is a reflection of the higher average value of jobs offered by exporting firms, it should be expected to have a similar qualitative effect than firm size, as we observe in the regression. The number of hires and separations controls for the possibility that expanding and contracting firms exhibit different patterns in the composition of new hires. When all the controls are included, in Column 5, the differences in the composition of new hires by export status are still significant.

Table B.1: Sample Averages

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Workers per firm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Exp</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Exp, 1&lt;=#dest&lt;=5</td>
<td>53</td>
<td>51</td>
</tr>
<tr>
<td>Exp, 5&gt;#dest</td>
<td>255</td>
<td>225</td>
</tr>
<tr>
<td>Firm Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Exp</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Exp, 1&lt;=#dest&lt;=5</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Exp, 5&gt;#dest</td>
<td>22</td>
<td>28</td>
</tr>
<tr>
<td>Transitions from other jobs as a share of new hires</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Exp</td>
<td>15%</td>
<td>16%</td>
</tr>
<tr>
<td>Exp, 1&lt;=#dest&lt;=5</td>
<td>23%</td>
<td>27%</td>
</tr>
<tr>
<td>Exp, 5&gt;#dest</td>
<td>33%</td>
<td>40%</td>
</tr>
<tr>
<td>Transitions from exporters in manufacturing as a share of new hires from manufacturing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Exp</td>
<td>30%</td>
<td>29%</td>
</tr>
<tr>
<td>Exp, 1&lt;=#dest&lt;=5</td>
<td>51%</td>
<td>50%</td>
</tr>
<tr>
<td>Exp, 5&gt;#dest</td>
<td>66%</td>
<td>63%</td>
</tr>
<tr>
<td>Wage (Argentine Pesos)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Exp</td>
<td>528</td>
<td>1335</td>
</tr>
<tr>
<td>Exp, 1&lt;=#dest&lt;=5</td>
<td>947</td>
<td>1713</td>
</tr>
<tr>
<td>Exp, 5&gt;#dest</td>
<td>1558</td>
<td>2510</td>
</tr>
<tr>
<td>Share of employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Exp</td>
<td>47%</td>
<td>47%</td>
</tr>
<tr>
<td>Exp, 1&lt;=#dest&lt;=5</td>
<td>23%</td>
<td>20%</td>
</tr>
<tr>
<td>Exp, 5&gt;#dest</td>
<td>30%</td>
<td>33%</td>
</tr>
<tr>
<td>Share of firms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Exp</td>
<td>90%</td>
<td>89%</td>
</tr>
<tr>
<td>Exp, 1&lt;=#dest&lt;=5</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Exp, 5&gt;#dest</td>
<td>2%</td>
<td>3%</td>
</tr>
</tbody>
</table>
Values marked with a star are significant at 1% and standard errors clustered by firm are reported below each coefficient. The explained variables are in percent terms, the first two rows correspond to an indicator of the export status of the firm, and the remaining explanatory variables are in logs. The number of observations in the first set of regressions corresponds to the number of observations with positive number of new hires, and the number of observations in the second set is the number of observations with positive number of new hires from the manufacturing sector.