Globalization and the Jobs Ladder

Carl Davidson\textsuperscript{a}, Fredrik Heyman\textsuperscript{b}, Steven Matusz\textsuperscript{a}, Fredrik Sjoholm\textsuperscript{c,b} and Susan Zhu\textsuperscript{a}

March 2018

\textbf{Abstract}: We develop a model in which firms differ in terms of productivity ala Melitz (2003) and workers differ in terms of the skills that they possess. There are two types of skills that determine a worker's productivity – the ability to work with the appropriate technology, which we call “basic experience,” and the ability to facilitate international commerce, which we refer to as “international experience.” Workers imperfectly acquire these skills on the job. Firms cannot observe the skills embodied in a worker, but can observe each potential recruit's employment history. In equilibrium, firm self-select into groups that use different networks to fill vacancies. Some firms hire young, inexperienced workers and pay a low wage; while other firms poach workers with either basic experience or international experience from other firms by offering a higher wage. The heterogeneity in firm productivity implies that firms will also differ in their level of international engagement. We use the model to examine how globalization affects the career path of workers as they climb the jobs ladder.

\textsuperscript{a} Department of Economics; Michigan State University; East Lansing, MI 48824
\textsuperscript{b} Research Institute of Industrial Economics; Stockholm, Sweden
\textsuperscript{c} Department of Economics; Lund University; Lund Sweden
Introduction

The impact of globalization on labor market outcomes is one of the most heavily researched and hotly debated topics in all of economics. In the academic arena, there are two questions that have garnered almost all of the attention. First, can we identify those that benefit and those that are harmed by the falling trade costs that are the hallmark of globalization? And, second, how does globalization affect overall wage inequality? These two questions are related, of course, since we most often look at changes in wages to determine those that gain or lose as trade patterns change. A narrow focus on wages may be misleading, however, in that jobs carry with them more than just a wage. Workers gain different skills while carrying out their duties and the skills that they acquire often open up new paths for them as they move from job to job. An engineer employed by Ford gains valuable experience in the auto industry that may result in a new, higher paying job with GM or Chrysler. Alternatively, a manager at a company that exports some of its products to China may be a prime target for another firm that is hoping to break into the Chinese market. Thus, the rate at which a worker gains skills, the types of skills that they acquire and the rate at which they move up the jobs ladder can play a large role in determining lifetime earnings. By impacting the types of jobs available in the economy and the level of international engagement by firms, globalization can have a significant impact of the skill sets that workers acquire and thus, their career paths. And, while the literature on the impact of globalization on wage inequality is vast and rapidly growing (see Harrison, McLaren and McMillan 2011 and Helpman 2017 for recent surveys), not much attention has been paid to the manner in which globalization affects these dynamic properties of the labor market. The

---

1 A typical worker holds a large number of jobs while young, before transitioning to a more stable employment pattern with maturity. However, even prime-age adults transition from job to job as their careers progress -- the average duration of a job in the US is only about 8 years, with a median duration that is slightly lower than that. Moreover, job stability has been on the decline in recent years. For example, average job tenure for males at age 50 has declined from 13.6 years in the 1970s to 11.8 years in the early 2000s (the classic references on job stability are Hall 1982 and Farber 1994, 1998 – Farber 2010 provides a survey of the literature).

2 For an excellent discussion the importance of economic mobility in determining lifetime earnings see Bernhardt, Morris, Handcock and Scott (2001).
purpose of this paper is to provide a framework in which to examine such issues, with particular attention focused on the link between globalization and the economic mobility of workers.

To do so, we introduce a dynamic overlapping generations model of trade in which workers gain skills on the job and transition from job to job as their careers progress. There are two types of skills that matter for productivity – the ability to work with the appropriate technology, which we call “basic experience,” and the ability to facilitate international commerce, which we call “international experience.” We assume that firms cannot directly observe the skills embodied in a worker, but they can observe each potential recruit’s employment history. Firms differ in the technologies that they use and self-select into different recruiting networks based on their own productivity measures and the signals embedded in each recruit’s job application. Some firms hire young inexperienced workers and pay a low wage while others poach workers with either basic experience or international experience from other firms by offering a higher wage. The heterogeneity in firm productivity implies that firms will differ in their level of international engagement, making international experience more valuable for some firms relative to others. Our goal is to examine how globalization affects the distribution of wages offered by firms and the rates at which workers move up the jobs ladder as they gain experience and skills. This provides us with a more complete picture of how globalization affects the labor market experience of workers.

The framework for our model is based on recent empirical findings of Haltiwanger, Hyatt, Kahn and McEntarfer (2018) that firms with different levels of productivity tend to use different methods to fill their vacancies. This study focuses on job flows across firms that offer different wages along the jobs ladder. It reveals that firms that are low on the jobs ladder tend to hire new workers from the pool of unemployed, while firms at the top tend to poach workers from lower paying firms. We posit that one of the main reasons for this is that high-productivity, high-wage firms are concerned about the skills that workers carry with them. By recruiting workers that have been able to hold steady jobs, high-wage firms can be confident that they are adding workers that have proven
to be reliable and effective. If these workers are poached from firms within the same industry, they are also likely to be more productive, since they have experience with the technology that the firm is using. Knowledge of and experience with the production process is only one aspect of productivity that may matter for firms. As is well known, high-productivity firms are more likely to be engaged in international commerce (Bernard and Jensen 1995). By poaching workers from multinationals or exporters, a firm may be able to build a workforce that includes skills that may lower trade costs.

The notion that internationally engaged firms hire workers with international experience to lower trade costs is consistent with recent empirical findings. For example, Labanca, Molina and Muendler (2014) find that as firms prepare to start exporting, they tend to poach workers from other exporters. This poaching leads to deeper market penetration by the hiring firm and reduced market penetration by the firm that loses the worker. See also, Mion, Opromolla and Sforza (2017) who show that export experience gained by a manager at a previous firm leads to better export performance by the worker’s current employer and a large wage premium for the manager.

To formalize our ideas, in section 2 we develop a model of a jobs ladder in which firms differ in productivity and workers differ in the skills that they have acquired. The firm side is modeled as in Melitz (2003) in that each firm draws a productivity parameter after paying a sunk cost of entry. Worker productivity is determined by the worker’s experiences on the job and unobservable factors. All workers begin life inexperienced and start their climb up the jobs ladder with an entry level job that pays a low wage. They gain “basic skill” via a Poisson process at rate $\tau_e$. The acquisition of basic skill increases their sector-specific productivity, preparing them to move to the next rung on the ladder. The idea that we are trying to capture by modelling skill acquisition as a Poisson process is that some workers pick up the production process quickly while others never seem to grasp the essential details. Thus, some workers see their productivity rise right away, while others remain at their initial low-productivity rate for a very long time. However, without additional information, firms cannot distinguish employed workers with basic experience from their counterparts that are
still inexperienced. To obtain this information, firms can screen workers at a cost. This means that firms face a trade-off. They can offer a low wage and hire workers without screening them, making it likely that their workforce will largely consist of inexperienced workers. Alternatively, firms can offer a higher wage, poach workers from low-wage firms and screen them for basic experience. These firms will face higher costs in filling out their workforce, but their employees will be more productive.

Workers go through a similar process to gain international experience. If they are employed by an exporter, they gain international experience through a Poisson process at rate $\tau_i$. The firm’s iceberg trade costs are assumed to be a decreasing function of the fraction of its workforce that has international experience. As with basic experience, international experience cannot be observed, but firms can use a costly screening process to identify those workers that have acquired it.

In equilibrium, active firms self-select into four categories, defined by the wage that they pay, the workers that they hire and their level of international engagement. Low-productivity active firms hire inexperienced workers, pay a low wage and serve only their domestic market. While employed at these firms, some workers gain basic experience, which makes them eligible to apply for higher paying jobs. Medium-productivity firms pay a higher wage and poach workers from low-wage firms. To ensure that these workers have acquired basic experience, these firms screen all potential employees before hiring them. Among this group of medium-wage firms, those with relatively low-productivity do not earn enough revenue to cover the costs associated with exporting, so they sell all of their output domestically. In contrast, high-productivity medium-wage firms export a portion of their output and this enables some of their workers to gain international experience. Finally, firms with the highest productivity pay the highest wage, poach employees from medium-wage exporters, screen for international experience and export a portion of their output.

As explained above, as workers gain experience, they become eligible for higher paying jobs. We assume that opportunities to move up the job ladder arrive randomly via a Poisson process and that changing jobs is costly for workers. The latter assumption captures the notion that a new job
might require the worker to move to a new location, disrupt family or social networks, and/or require
the adaptation to a new routine. We aggregate all of these costs into a single worker-specific measure
that is randomly drawn at the time that the job opportunity becomes available. If the increase in
expected lifetime income exceeds the cost of moving, the worker takes the job; otherwise, they stay
put. Thus, workers gain skills on the job and move up the jobs ladder as their careers progress.

In section 3, we analyze a symmetric trade model in which globalization reduces trade costs.
As trade costs fall, firms reconsider their decisions with the most important changes coming from
medium-wage firms. Amongst these firms, those with relatively high productivity expand their
exports and see their revenues rise enough to enable them to switch and become high-wage firms.
Lower-productivity non-exporters are harmed by an inflow of imports, forcing them to become low-
wage firms. As a result, employment by low-wage firms increases. Finally, higher-productivity non-
exporters take advantage of the lower trade costs and begin to export. As a result, employment
shares for both high-wage and low-wage firms rise, while the share of medium-wage non-exporters
falls. As for wages, the reduction in trade costs triggers an increase in wage inequality, with high-
wage workers gaining the most and low-wage workers either gaining the least or actually seeing their
real wages fall.

On the surface, the shifts in employment shares and the changes in wage inequality do not
seem to offer any new insights. The shift in jobs from non-exporters towards exporters, and from
medium-wage firms towards the extremes, and the link between globalization and wage inequality
are largely in line with what we would expect from a trade model with heterogeneous firms (e.g.,
Egger and Kreickemeier 2012; Helpman, Itskhoki and Redding 2010a,b or Sampson 2014). The

---

3 As we explain in Section 3, globalization can lead to more or less entry by low productivity firms. However, even in the case in which lower trade costs lead to exit by low productivity low-wage firms, we find that the net impact of low-wage employment is positive.

4 Although our results are consistent with these other papers, the mechanism behind our results is different. This follows from the fact that our model assumes competitive labor markets, while Egger and Kreickemeier use a “fair wage” model and Helpman, Itskhoki and Redding (2010a,b) and Sampson (2014) assume labor market frictions and wage bargaining. In both of those settings, the increase in inequality comes from an
wage effects are also consistent with the recent empirical findings of Helpman, Itskhoki, Muendler and Redding (2017). However, in the context of our model, taken together these results have important implications for the manner in which workers move up the jobs ladder. To see this, note first that while the total number of medium wage jobs fall as trade becomes less costly, there is a significant shift in the make-up of those jobs. On the one hand, the number of medium-wage non-exporters drops dramatically, as the least productive of these firms switch and begin to offer the low-wage, and the most productive firms within this class start exporting. On the other hand, the number of medium-wage exporters can increase or decrease. To see this, note that while high-productivity non-exporters switch and start to export (resulting in more medium-wage exporters), the high-productivity medium-wage exporters see a significant increase in their revenues, allowing them to switch and start to offer the high wage (reducing the number of medium-wage exporters).

A change in the number of medium-wage exporters is significant, since these are the jobs that provide workers with the skills needed to make it to the top of the jobs ladder. In contrast, jobs at medium-wage non-exporters are dead ends in that they offer no hope of further advancement. Thus, the change in the composition of the medium-wage jobs can alter the path that allows workers to cap off their careers by landing the highest paying jobs in the economy. Our numeric results indicate that when trade costs are initially high, globalization tends to increase economic mobility by widening the path up the jobs ladder for low-wage workers. In such a case, the increase in economic mobility moderates the rise in inequality experienced by low wage workers by allowing them to climb up the jobs ladder at a faster pace.\(^5\) In contrast, we find that as trade costs vanish, further increase in the export wage premium. In addition, in those settings workers do not transition from low-wage to high-wage jobs, so that low-wage workers always remain low-wage workers.

\(^5\) There is an additional reason that economic mobility might rise with globalization that arises due to the increase in wage inequality. When a worker receives an opportunity to move, he/she accepts the wage offer if the expected benefit from moving exceeds the cost of doing so. Since the gap between real wages increases as trade costs fall, this means that the expected benefit from taking a wage offer from a higher-paying firm grows with globalization. Thus, an increase in wage inequality should reduce the expected duration of low-wage and medium-wage jobs, implying that workers reach the top of the jobs ladder quicker. We discuss this mechanism in greater detail in Section 3.
Globalization tends to narrow the path up the jobs ladder for low-wage workers by increasing the average duration of low-wage jobs. In this latter case, in addition to eroding the relative wages of low-wage workers, globalization makes it harder for such workers to acquire the skills needed to secure the economy’s highest paying jobs.

The implication of our main result is that by focusing simply on the impact of globalization on wage inequality, either across or within industries, one can miss potentially important changes in labor market dynamics that impact expected lifetime earnings. Although falling trade costs may result in greater wage inequality, if trade costs are initially high, it can also lead to a wider path up the jobs ladder as firms increase their level of international engagement and it can also lead to greater economic mobility, implying that workers spend less time in entry level jobs.

In section 4 we discuss an important extension of the model. In our base model, workers can only move up the rungs of the jobs ladder – they are never forced to move back down and take a job at a lower wage. However, in reality workers are sometimes fired or demoted and forced to take a new job at lower pay. To capture this notion, we assume that once a worker gains a new skill, they must exert effort to keep those skills from deteriorating. Workers that put forth such effort remain highly productive, while those that choose not to put forth the effort see their skills and productivity erode. Firms cannot observe effort and thus must monitor their workers, with those caught shirking being subsequently dismissed. And, since the dismissed workers have lost their skills, they must move back down the jobs ladder one rung and seek reemployment at a lower wage. In this setting, workers make the choice between effort and shirking by comparing the cost of effort with the expected loss from shirking. This extension yields a new insight – since globalization widens the gap between wages, it increases the expected loss in lifetime earning associated with shirking. As a result, in equilibrium fewer workers shirk as trade costs fall and there are fewer demotions. The implications for expected job duration follow. Since fewer medium-wage workers are demoted, the fraction of a worker’s lifetime spent in low-wage, entry level jobs decreases. And, since fewer high-
wage workers shirk, the fraction of a worker’s lifetime spent at the top of the jobs ladder increases. As for medium-wage workers, the overall impact of globalization on expected job duration becomes uncertain. On the one hand, the forces uncovered in section 3 imply that as trade costs fall, a worker at a medium-wage firm will move up and accept a higher paying job more rapidly. On the other hand, since globalization reduces the number of medium-wage workers that shirk, these workers are less likely to be fired and forced to take lower paying jobs. The former effect reduces the expected duration of a low-wage job while the latter effect increases it.

2. The Jobs Ladder

A. Types of Workers and Firms

We begin by providing an overview of the structure of the economy. Our model consists of a single industry with heterogeneous firms and ex ante identical workers. At each point in time, there are $M_d$ firms in the process of developing plans to enter the industry. Each developing firm draws a productivity measure ($\phi$) as in Melitz (2003) and becomes active if it can at least break-even. We use $M$ to denote the mass of active firms in steady-state. Active firms produce output with labor as the only input.

All workers begin life inexperienced. They potentially gain two kinds of experience as they age. Basic experience lowers the cost of production, while international experience reduces the cost of exporting. Neither basic experience nor international experience is directly observable, but firms can pay a fixed cost to screen for either type of experience. The life-cycle of a worker is based on the model of perpetual youth (Blanchard 1985), with workers dying at rate $\delta_w$, regardless of age.

Labor markets are competitive, with wages adjusting to equate supply and demand in each sub-market. There are four market-clearing wages in equilibrium (low, medium, high, and development) which we label $w_l, w_m, w_h, w_d$. Firms can choose to hire only new workers (all of whom are inexperienced), pay the low wage, and save the fixed cost of screening. The cost of this is that inexperienced workers are relatively less productive. Nevertheless, this is the profit-maximizing
strategy for firms that cannot earn enough operating profit to cover the cost of screening. Using similar reasoning, it follows that firms can choose to screen for only basic experience and pay the medium wage, or they can screen for international experience as well and pay the high wage. The development wage is paid to fully experienced workers who are hired to develop the business plans for potential entrants. These workers can be thought of as the job creators in the model. The costs of employing these workers correspond to the sunk entry cost in Melitz (2003). In addition to choosing their screening strategy, firms choose whether to export. Again following Melitz (2003), we assume a fixed cost of exporting so that only the most productive firms can afford to do so.

The firm's decision tree is illustrated in Figure 1. Firms are characterized either by the wage that they pay or by whether they choose to export. In equilibrium, no low-wage firm exports and all high-wage firms export, so that wage and export status are interchangeable identifiers for these two types of firms. As such, we use the subscript $l$ to represent all variables associated with low-wage, non-exporting firms; while we use the subscript $h$ to represent variables associated with high-wage, exporting firms. In contrast, some medium-wage firms export while others do not. Moreover, some decisions (e.g., profit-maximizing prices) depend only on the wage that a firm pays, while others (e.g., whether to screen for international experience) depend on its export status. Because of this heterogeneity, we identify medium-wage firms with the subscript $m$ when export status is not relevant, while identifying medium wage firms with subscripts $n$ (non-exporter) or $x$ (exporter) when export status is important.

Since workers begin life inexperienced, they enter the jobs ladder by taking an entry-level low-wage job with the prospect of gaining experience. We model the acquisition of basic experience as a Poisson process (some workers catch on faster than others do; some never catch on), using $\tau_e$ to represent the rate at which workers gain this experience. In a similar way, worker acquire international experience via a Poisson process with $\tau_i$ representing the rate at which workers employed by exporters gain international experience. Since international experience can only be
gained by working for an exporter, $\tau_i = 0$ for all workers employed at low-wage firms and for all workers employed at medium-wage non-exporters.

In our initial model, neither type of experience depreciates – that is, once a worker acquires either form of experience, it remains with them throughout their life. Experience is not observable. With the exception of high-wage workers (who have already been screened for basic and international experience), employment status does not perfectly signal experience. To really know if a worker is experienced, the firm must screen (this is why medium wage exporters and non-exporters must pay the same wage – if non-exporters paid a lower wage, exporters could poach workers from the non-exporters, knowing that all of their workers have basic experience, and avoid the screening process).\footnote{By construction, all workers with international experience also have basic experience, therefore firms that screen for international experience need not also screen for basic experience.}

Profit-maximizing firms self-select into one of the four types. First, active firms with the lowest productivity measures offer the low wage ($w_l$) and serve only their home market. These firms do not earn enough revenue to cover the cost of screening nor the cost of exporting. The new hires for these firms come entirely from new labor market entrants. As these workers age, some gain basic experience, which makes them eligible to move on to higher paying jobs. Opportunities to move arrive randomly (as described below) and workers move on if the cost of doing so is sufficiently low. However, some workers that have gained basic experience face high moving costs, and thus, choose to remain in a low-paying job.\footnote{This method of modelling worker movement across jobs follows Artuc, Chaudhuri and McLaren (2010).} As a result, low-wage firms employ a mixture of inexperienced workers and workers with basic experience.

Active firms with somewhat higher productivity offer the medium wage ($w_m$) and serve only their home market. These firms poach workers from low-wage firms and screen for basic experience, so that all of their employees have it. They do not earn enough revenue to cover the cost of exporting. The next group consists of medium-wage exporters. As with medium-wage non-exporters, these

---

6 By construction, all workers with international experience also have basic experience, therefore firms that screen for international experience need not also screen for basic experience.

7 This method of modelling worker movement across jobs follows Artuc, Chaudhuri and McLaren (2010).
firms poach workers from low-wage firms and screen for basic experience. Some of these workers eventually acquire international experience and move on to higher paying jobs when the opportunity to do so arises if their moving costs are sufficiently low. Thus, these firms employ a mixture of workers with basic experience and workers with international experience.

Obviously, high-productivity firms offer the high-wage ($w_h$), poaching their workers from medium-wage exporters. Since only a fraction of those employed by medium-wage exporters have international experience, high-wage firms screen to ensure that they hire only those with international experience. Finally, potential entrants pay $w_d$ and poach workers from high-wage firms. As noted above, these workers develop the business plans for potential entrants.

Note that as we move across firm types, higher productivity firms take on more and more fixed costs, due to screening and exporting, in order to lower their marginal costs (by hiring more productive workers).

B. Labor Market Dynamics

We illustrate worker flows in Figure 2. Since $\delta_w$ is the death rate for workers, it is also the transition rate for workers into the labor force. In addition to the notation already described, $L_{EF}$ represents the number of workers with experience $E$ employed at a type-$F$ firm and $L$ represents the size of the labor force. Workers earning a particular wage get the opportunity to move to a higher paying job if they have the appropriate experience and do so if the cost of moving is sufficiently low. To be precise, when given an opportunity to move, each worker draws a moving cost $\kappa$ from a distribution $g(\kappa)$ and moves if the expected benefit from doing so exceeds this cost. Thus, moving costs are a random variable ($\kappa$) with cumulative distribution $G(\kappa)$ and density $g(\kappa)$.

We use $a_m$, $a_h$ and $a_d$ to denote the arrival rate of opportunities to move to a medium-wage firm, a high-wage firm and a developing firm, respectively. Since there are two types of medium-wage firms, we use $\lambda_n$ to denote the fraction of medium-wage offers that come from non-exporters.
The steady-state equations related to the flows depicted in Figure 2 are given in (1) below. In each case, the flow into the labor market state is on the left-hand-side while the flow out of that labor market state is on the right-hand-side. We start with (1.a), which applies to labor market state \( L_{0l} \) (inexperienced workers employed at low-wage firms). Since we only consider steady-state equilibria, we hold constant the total size of the labor force (L). The number of deaths (\( \delta_wL \)) has to be offset with an equal number of births, with each newborn taking a job at a low-wage firm. Thus, \( \delta_wL \) is the flow into labor market state \( L_{0l} \). As for the outflow, we know that every new entrant is inexperienced. Some inexperienced workers eventually obtain basic experience (at rate \( \tau_e \)), while others die without ever having done so. Thus, the outflow of inexperienced workers is \( (\delta_w + \tau_e)L_{0l} \). This explains (1.a).

\[
\begin{align*}
(1.a) \quad \delta_wL &= (\delta_w + \tau_e)L_{0l} \\
(1.b) \quad \tau_eL_{0l} &= (\delta_w + \alpha_m[\lambda_n + \lambda_n G(\kappa_n) + (1 - \lambda_n)G(\kappa_x)])L_{el} \\
(1.c) \quad \alpha_m \lambda_n G(\kappa_n)L_{el} &= \delta_wL_{en} \\
(1.d) \quad \alpha_m(1 - \lambda_n)G(\kappa_x)L_{el} &= (\delta_w + \tau_i)L_{ex} \\
(1.e) \quad \tau_iL_{ex} &= (\delta_w + \alpha_h G(\kappa_i))L_{ix} \\
(1.f) \quad \alpha_h G(\kappa_i)L_{ix} &= (\delta_w + \alpha_d G(\kappa_d))L_{ih} \\
(1.g) \quad \alpha_d G(\kappa_d)L_{ih} &= \delta_wL_{id}
\end{align*}
\]

Turn next to (1.b), which equates the inflow and outflow from state \( L_{el} \) (workers with basic experience employed by low wage firms). The rate at which inexperienced workers gain basic experience is \( \tau_e \), therefore the left-hand side of (1.b), which is the flow into state \( L_{el} \), is the number of workers employed by low-wage firms that gain basic experience. Opportunities for low-wage experienced workers to move to medium-wage jobs arrive at rate \( \alpha_m \), with a fraction \( \lambda_n \) of the opportunities coming from non-exporters. We define \( \kappa_F \) as a critical moving cost such that workers drawing \( \kappa \leq \kappa_F \) accept an offer from a type-\( F \) firm and move up the ladder. Therefore, \( G(\kappa_F) \)
represents the fraction of workers who accept an offer from a type-$F$ firm. The right-hand side of (1.b) then represents the number of experienced low-wage workers who transition out of that state due to death ($\delta_w L_{el}$), acceptance of jobs at medium-wage non-exporting firms ($a_m \lambda_n G(\kappa_n) L_{el}$), or acceptance of jobs at medium-wage exporting firms ($a_m (1 - \lambda_n) G(\kappa_x) L_{el}$). All of the remaining conditions are derived similarly.

C. Lifetime Labor Real Income

Workers make career decisions in order to maximize expected lifetime real income. With this in mind, let $V_{EF}(w_j)$ denote the expected lifetime real income for a worker with experience level $E$ employed by a type-$F$ firm earning wage $w_j$. In addition, we use $\rho$ to represent the discount rate and $\bar{p}$ to denote the price index (to be defined below). The right-hand side for each of the following value functions represents instantaneous income plus the expected capital gain (or minus the expected capital loss) from transitioning to another labor-market state.

\begin{align}
(2.a) \quad \rho V_{ol}(w_l) &= \frac{w_l}{\bar{p}} + \tau_e \{V_{el}(w_l) - V_{ol}(w_l)\} - \delta_w V_{ol}(w_l) \\
(2.b) \quad \rho V_{el}(w_l) &= \frac{w_l}{\bar{p}} + a_m \lambda_n G(\kappa_n) \left( V_{en}(w_m) - V_{el}(w_l) - \frac{1}{G(\kappa_n)} \int_0^{\kappa_n} \kappa g(\kappa) d\kappa \right) + a_m (1 - \lambda_n) G(\kappa_x) \left( V_{ex}(w_m) - V_{el}(w_l) - \frac{1}{G(\kappa_x)} \int_0^{\kappa_x} \kappa g(\kappa) d\kappa \right) - \delta_w V_{el}(w_l) \\
(2.c) \quad \rho V_{en}(w_m) &= \frac{w_m}{\bar{p}} - \delta_w V_{en}(w_m) \\
(2.d) \quad \rho V_{ex}(w_m) &= \frac{w_m}{\bar{p}} + \tau_i \{V_{ix}(w_m) - V_{ex}(w_m)\} - \delta_w V_{ex}(w_m) \\
(2.e) \quad \rho V_{ix}(w_m) &= \frac{w_m}{\bar{p}} + a_h G(\kappa_i) \left( V_{ih}(w_h) - V_{ix}(w_m) - \frac{1}{G(\kappa_i)} \int_0^{\kappa_i} \kappa g(\kappa) d\kappa \right) - \delta_w V_{ix}(w_m) \\
(2.f) \quad \rho V_{ih}(w_h) &= \frac{w_h}{\bar{p}} + a_d G(\kappa_d) \left( V_{id}(w_d) - V_{ih}(w_h) \right) - \delta_w V_{ih}(w_h) \\
(2.g) \quad \rho V_{id}(w_d) &= \frac{w_d}{\bar{p}} - \delta_w V_{id}(w_d)
\end{align}
Starting with the first equation, the only possible transitions for an inexperienced worker are to either gain experience with a resulting capital gain $V_{el}(w_l) - V_{ol}(w_l)$, or to exit the labor force and suffer a capital loss of $V_{ol}(w_l)$. These occur at rates $\tau_e$ and $\delta_w$. This explains (2.a).

A low-wage worker with basic experience has more possibilities. The worker might move to a medium-wage non-exporting firm, earning a capital gain of $V_{en}(w_m) - V_{el}(w_l) - \frac{1}{\phi(\kappa_n)} \int_0^{\kappa_n} \kappa g(\kappa) d\kappa$, or move to a medium-wage exporter, in which case the capital gain would be $V_{ex}(w_m) - V_{el}(w_l) - \frac{1}{\phi(\kappa_x)} \int_0^{\kappa_x} \kappa g(\kappa) d\kappa$. In both cases, the capital gains must take into account expected moving costs. Of course, the worker could also exit the labor force and suffer a capital loss of $V_{el}(w_l)$. These transitions occur at rates $a_m \lambda_n G(\kappa_n), a_m (1 - \lambda_n) G(\kappa_x)$, and $\delta_w$, respectively. Derivation of the remaining asset-value equations follows the same logic.

As stated earlier $\kappa_n, \kappa_x, \kappa_i$ and $\kappa_d$ are defined such that a low-wage worker would accept an offer from a medium-wage non-exporter if $\kappa \leq \kappa_n$; a low-wage worker would accept an offer from a medium-wage exporter if $\kappa \leq \kappa_x$; a medium-wage worker would accept an offer from a high-wage firm if $\kappa \leq \kappa_i$; and a high-wage worker would accept an offer to develop new firms if $\kappa \leq \kappa_d$. Formally, these critical values equal the difference between the value of climbing up one rung on the jobs ladder or remaining on the lower rung:

\begin{align*}
(3.a) \quad \kappa_n &= V_{en}(w_m) - V_{el}(w_l) \\
(3.b) \quad \kappa_x &= V_{ex}(w_m) - V_{el}(w_l) \\
(3.c) \quad \kappa_i &= V_{ih}(w_h) - V_{ix}(w_m) \\
(3.d) \quad \kappa_d &= V_{id}(w_d) - V_{ih}(w_h)
\end{align*}

Even though medium-wage exporters and non-exporters pay the same wage for workers with only basic skills, workers would be willing to incur a higher moving cost to accept a job at an exporting firm compared with a non-exporter since this would be a stepping-stone to an even higher paying job. In contrast, middle-wage jobs at non-exporters are dead ends. Thus, $\kappa_n < \kappa_x$. 

14
Conceptually, the systems in (2) and (3) provide the critical cutoff values for moving costs. These depend on endogenously determined wages along with the parameters of the model. Substituting these cutoffs into equations (1.a)-(1.g) then generates the supplies of labor for all combinations of experience and firm-types. The next step is to derive the demands by each type of firm for each level of experience.

D. Prices and Output

We assume two identical countries populated by heterogeneous firms. As in Melitz (2003), prospective entrants incur a cost to draw a productivity parameter \( \phi \), a random variable with density \( z(\phi) \) and cumulative distribution \( Z(\phi) \). The firm’s productivity combines with the experience of new hires to determine the marginal product of labor. Specifically, we assume that the marginal product of an inexperienced worker is \( \beta \phi \) with \( \beta < 1 \), while the marginal productivity of a worker with basic experience is \( \phi \). While basic experience reduces the cost of production, international experience lowers the cost of exporting. In particular, we assume iceberg transportation costs that are diminishing in the share of the firm’s workforce with international experience.

We make the standard assumption that goods are horizontally differentiated and that all consumers have identical, constant elasticity preferences. We use \( \sigma > 1 \) to represent the constant elasticity of demand. Demand for a variety \( v \) is given by

\[
q(v) = \frac{Y}{\bar{p}^{1-\sigma}} p(v)^{-\sigma}
\]

where \( Y \) is total expenditure, \( p(v) \) is the price of variety \( v \) and \( \bar{p} \equiv \left[ \int p(v)^{1-\sigma} dv \right]^{1/1-\sigma} \) is the price index.

Firms select into wage and export status according to productivity. Define \( \phi_0 < \phi_l < \phi_n < \phi_x \) as a set of critical cutoff productivities. Firms with productivity below \( \phi_0 \) cannot earn non-negative profit and therefore do not produce. Firms with \( \phi \in [\phi_0, \phi_l] \) are those that choose to forego any screening and pay the low wage. Firms with \( \phi \in [\phi_l, \phi_n] \) screen for basic experience and pay a

---

8 Since the Foreign market is symmetric with Home, we focus on the Home country.
medium wage, but they do not export. Firms with \( \phi \in [\phi_n, \phi_x] \) screen for basic experience, pay a medium wage, and export. The highest productivity firms \( \phi \geq \phi_x \) screen for international experience, pay a high wage, and export.

The profit-maximizing price is a constant markup over marginal cost. Since all newly employed low-wage workers have marginal product of \( \beta \phi \), the marginal cost for a low-wage firm is \( w_l / \beta \phi \). Similarly, all new employees of medium-wage and high-wage firms have marginal product of \( \phi \), meaning that the marginal costs for both these firms are \( w_m / \phi \) and \( w_h / \phi \). We can now express the profit-maximizing prices for the domestic market as functions of productivity:

\[
\begin{align*}
(5.a) \quad p_l(\phi) &= \frac{\sigma}{\sigma-1} \frac{w_l}{\beta \phi}, \quad \phi \in [\phi_0, \phi_l] \\
(5.b) \quad p_m(\phi) &= \frac{\sigma}{\sigma-1} \frac{w_m}{\phi}, \quad \phi \in [\phi_l, \phi_x] \\
(5.c) \quad p_h(\phi) &= \frac{\sigma}{\sigma-1} \frac{w_h}{\phi}, \quad \phi \in [\phi_x, \infty]
\end{align*}
\]

For the export market, things are a bit more complicated because we want to assume that a firm’s iceberg transportation costs depend on the fraction of its workforce with international experience. With this in mind, let \( \lambda_{EF} \) denote the fraction of workers with experience \( E = o,e,i \) employed by a firm of type \( F = l,n,x,h \). A type-F firm’s cost of exporting is tied to \( \lambda_{iF} \); in particular, we assume that a type-F firm must produce and ship \( \frac{q^*}{\eta(\lambda_{iF})^\theta} \) units of the product if it wishes to deliver \( q^* \) units to the foreign country. Note that we use \( \eta \) to measure the degree of openness, with \( \eta = 1 \) denoting free trade, and \( \theta \) to measure the sensitivity of iceberg transportation to changes in \( \lambda_{iF} \). In equilibrium, all high-wage firms are exporters and these firms only hire workers with international experience, so \( \lambda_{ih} = 1 \). Similarly, no low-wage firm exports, therefore none of their workers have international experience, implying that \( \lambda_{il} = 0 \). Some medium-wage firms are non-exporters. For these firms \( \lambda_{in} = 0 \). Finally, some medium-wage firms do export. A fraction of the
workforce for these firms do have international experience, so \( 0 < \lambda_{ix} \equiv \frac{L_{ix}}{L_{ix} + L_{ex}} < 1 \). Therefore, profit-maximizing prices for goods produced by Home firms for sale in Foreign are

\[
(5.d) \quad p_x^*(\phi) = \sigma \frac{w_m}{\sigma - 1} \frac{1}{\phi (\lambda_{ix})^\alpha}, \quad \phi \in [\phi_m, \phi_x]
\]

\[
(5.e) \quad p_h^*(\phi) = \sigma \frac{w_h}{\sigma - 1} \frac{1}{\phi}, \quad \phi \in [\phi_x, \infty]
\]

E. Labor Demand

Firms always know the experience of newly-hired workers, but cannot individually identify experience among existing workers since experience acquisition is a Poisson process and identification requires costly screening. However, firms can know the average product of labor since they know the share of their workforce with experience and know the productivity of experienced and inexperienced workers. For example, low-wage firms know that a fraction of their workers are inexperienced and have marginal (and average) productivity \( \beta \phi \) and the remaining workers are experienced with marginal (and average) productivity \( \phi \). In equilibrium \( \lambda_{ii} = 0 \). Therefore, the average product of labor for a low-wage firm is \( (\lambda_{oi} \beta + \lambda_{el}) \phi \). Similarly, the average product of labor for medium-wage and high-wage firms is just \( \phi \). Therefore, the demand for labor needed to produce output for domestic sales is:

\[
(6.a) \quad \ell_l(\phi) = f + \frac{q_l}{(\lambda_{oi} \beta + \lambda_{el}) \phi}
\]

\[
(6.b) \quad \ell_m(\phi) = f + f_e + \frac{q_m}{\phi}
\]

\[
(6.c) \quad \ell_h(\phi) = f + \frac{q_h}{\phi}
\]

where \( f \) is a fixed amount of labor needed for production, \( f_e \) is a fixed amount of labor needed to screen for basic experience and \( q_l \) follows from (4) in the obvious manner.\(^9\)

\(^9\) High-wage firms only hire workers with international experience. We attribute the additional cost of screening for international (above the cost of screening for basic experience) to the cost of exporting. All workers with international experience also have basic experience.
Similarly, we can write the amount of labor needed to produce output for export. Low-wage firms do not export, so \( \ell_l^* = 0 \). For medium-wage firms that export, and for high-wage firms, we have

\[
\begin{align*}
(7.a) \quad & \ell_x^*(\phi) = f_x + \frac{q_x}{\phi} \frac{1}{\eta(\lambda_i, d)\eta} \\
(7.b) \quad & \ell_h^*(\phi) = f_x + f_i + \frac{q_h}{\phi} \frac{1}{\eta}
\end{align*}
\]

The fixed cost of exporting is \( f_x \), while the cost of screening for international experience is \( f_i \) in (7.b).

Let \( \tilde{z}(\phi) \) represent the productivity distribution of firms conditional on successful entry. For now, take as given the critical productivity cutoffs that determine the distribution of low-wage, medium-wage non-exporters, medium-wage exporters, and high-wage firms. Then the wage vector and \( \lambda_n \) (the share of medium-wage job offers originating from non-exporters) must adjust to equate the total demand for each experience type with the supply of that type. The demands by each firm \( F \) for workers with experience \( E \) are represented by (6.a)-(6.c) and (7.a)-(7.b). The supplies of each level of experience available to each type of firm are given by the solutions to (1.a)-(1.g). Equating supply and demand for each type of labor gives us the equilibrium conditions in (8.a)-(8.e). Note that the proportion of medium-wage job offers coming from non-exporters adjusts to ensure that \( w_m \) clears both segments of the medium-wage labor market.

\[
\begin{align*}
(8.a) \quad & L_{ol} + L_{el} = M \int_{\phi_0}^{\phi_1} \ell_l^1(\phi) \tilde{z}(\phi) d\phi \\
(8.b) \quad & L_{en} = M \int_{\phi_1}^{\phi_2} \ell_m(\phi) \tilde{z}(\phi) d\phi \\
(8.c) \quad & L_{ex} + L_{ix} = M \int_{\phi_2}^{\phi_3} [\ell_m(\phi) + \ell_x^*(\phi)] \tilde{z}(\phi) d\phi \\
(8.d) \quad & L_{ih} = M \int_{\phi_3}^{\phi_4} [\ell_h(\phi) + \ell_h^*(\phi)] \tilde{z}(\phi) d\phi \\
(8.e) \quad & L_{id} = M d f_d
\end{align*}
\]

F. Firm Selection and Dynamics

Firms select their hiring and export strategies to maximize profit conditional on their randomly-drawn productivity. Using \( r_F(\phi) \) and \( r_F^*(\phi) \) to represent revenue from domestic and
export sales for a type-$F$ firm, profits for the four types of firms are

\[(9.a) \quad \Pi_l(\phi) = r_l(\phi) - w_l \ell_l(\phi) \]

\[(9.b) \quad \Pi_n(\phi) = r_m(\phi) - w_m \ell_m(\phi) \]

\[(9.c) \quad \Pi_x(\phi) = r_m(\phi) + r_x^*(\phi) - w_m[\ell_m(\phi) + \ell_x^*(\phi)] \]

\[(9.d) \quad \Pi_h(\phi) = r_h(\phi) + r_h^*(\phi) - w_h[\ell_h(\phi) + \ell_h^*(\phi)] \]

where the revenue functions are defined as $r_l(\phi) = p_l(\phi)q_l(\phi)$ for $\phi \in [\phi_0, \phi_l]$; $r_m(\phi) = p_m(\phi)q_m(\phi)$ for $\phi \in [\phi_l, \phi_x]$; $r_x^*(\phi) = p_x(\phi)q_x^*(\phi)$ for $\phi \in [\phi_n, \phi_x]$; $r_h(\phi) = p_h(\phi)q_h(\phi)$ for $\phi \geq \phi_x$; and $r_h^*(\phi) = p_h^*(\phi)q_h^*(\phi)$ for $\phi \geq \phi_x$.

The critical productivity cutoffs satisfy the following equal profit conditions:

\[(10.a) \quad \Pi_l(\phi_0) = 0 \]

\[(10.b) \quad \Pi_l(\phi_l) = \Pi_n(\phi_l) \]

\[(10.c) \quad \Pi_n(\phi_n) = \Pi_x(\phi_n) \]

\[(10.d) \quad \Pi_x(\phi_x) = \Pi_h(\phi_x) \]

Finally, we have the free entry condition stating that the sunk cost of developing a business plan must equal expected discounted profit. We assume that firms die (and are therefore replaced) at rate $\delta_f$. For tractability, we assume that each new entrant hires all the workers employed by the firm that it replaces. Sunk cost is $w_df_d$ and the probability of successful entry is $1 - Z(\phi_0)$. We can then write the free entry condition as

\[ (11) \quad \frac{1 - Z(\phi_0)}{\rho + \delta_f} \int_{\phi_0}^{\phi_x} \Pi_F(\phi)Z(\phi) d\phi = w_df_d \]

If the discount rate is zero, all profit earned by the firm during its existence is paid to development labor (see Melitz 2003, footnote 16 for details). Combining this with wage income earned by production workers, we arrive at the final equation of the model, which equates aggregate labor income with aggregate expenditure, $Y$. Thus, in equilibrium we have
Equilibrium is characterized by four wages \((w_l, w_m, w_h, w_d)\), the share of medium-wage jobs offered by non-exporting firms \((\lambda_n)\), four critical productivities \((\phi_0, \phi_l, \phi_n, \phi_x)\), four critical moving costs \((\kappa_n, \kappa_x, \kappa_i, \kappa_d)\), the mass of prospective firms \((M_d)\), and national income \((Y)\). These fifteen variables are determined by five labor-market clearing conditions \((8.a)-(8.e)\), four equal-profit conditions \((10.a)-(10.d)\), four worker-indifference conditions \((3.a)-(3.d)\), the free-entry condition \((11)\), and the national income identity \((12)\).

### 3. Globalization

We model globalization as a reduction in trade costs (an increase in \(\eta\) towards one). Unfortunately, our model is too complex to yield analytic results. However, our numeric analysis of the model yields remarkably robust predictions about the manner in which a reduction in trade costs affects the distribution of workers, firms, and income.

We know that a reduction in trade costs will affect both the intensive and extensive margins of trade. Let \(\phi_0, \phi_l, \phi_n, \text{ and } \phi_x\) represent the initial values of the critical productivity cutoffs and let \(\hat{\phi}_0, \hat{\phi}_l, \hat{\phi}_n, \text{ and } \hat{\phi}_x\) represent those values subsequent to a reduction in trade costs. We know that a reduction in trade costs results in higher profit for firms that already export. However, the additional competition from abroad reduces profits for any firm that does not export. Therefore, given a fall in trade costs, (i) \(\Pi_h(\phi)\) increases for all \(\phi \geq \phi_x\); (ii) \(\Pi_x(\phi)\) increase for all \(\phi \geq \phi_n\); (iii) \(\Pi_n(\phi)\) falls for all \(\phi \leq \phi_n\); and (iv) \(\Pi_l(\phi)\) falls for all \(\phi \leq \phi_l\).

Now consider the equal profit condition \((10.d)\). Workers at both types of firms are equally productive in domestic sales. The higher wage means higher marginal cost, higher price, and lower

\[ Y = w_l(L_{ol} + L_{el}) + w_m(L_{en} + L_{ex} + L_{ix}) + w_hL_{ih} + w_dL_{id} \]
domestic output for high-wage exporters versus medium-wage exporters. It also means lower profit on domestic sales for the high-wage firm. However, total profits for high-wage firms and medium-wage exporters are, by definition, the same at $\phi_x$. It follows that the extra reduction in trade costs leads to more exports for the high-wage firm compared with the medium-wage exporter. Therefore, comparing $\Pi_h(\phi_x)$ with $\Pi_x(\phi_x)$, it is evident that the profit-enhancing effect is larger for the high-wage firm, so that $\Pi_h(\hat{\phi}_x) > \Pi_m(\hat{\phi}_x)$. The implication is that $\hat{\phi}_x < \phi_x$, so that a larger fraction of firms are high-wage exporters.

Using a similar argument, medium-wage non-exporters have lower marginal costs (but higher fixed costs) than low-wage firms. The increased competition due to lower trade costs is therefore more significant for the medium-wage non-exporter, so $\Pi_n(\phi_l)$ falls by more than $\Pi_l(\phi_l)$, allowing us to conclude that $\Pi_l(\hat{\phi}_l) > \Pi_n(\hat{\phi}_l)$. The implication is that $\hat{\phi}_l > \phi_l$. Parts (ii) and (iii) of our statement above imply that $\hat{\phi}_n < \phi_n$. The end result is that medium-wage non-exporters are squeezed from both ends. The more productive firms in this range become medium-wage exporters, while the least productive become low-wage firms.

Finally, we know that, conditional on a firm being active, a reduction in trade costs results in an increase in expected profit (the term excluding $1 - Z(\phi_0)$ on the left-hand side of eq. 11). The free entry condition requires that unconditional expected profit equals sunk costs. In the Meltiz model, sunk cost are parametrically determined, therefore the only margin of adjustment is that the likelihood of successful entry has to fall ($\phi_0$ has to increase). But in our framework, sunk costs depend on the wage paid to development workers. This wage changes as trade costs fall, thereby changing sunk costs. If the development wage rises, the increase in sunk costs could outpace the increase in ex-post expected profit, making entry easier. Otherwise, entry becomes more difficult as trade costs fall, resulting in exit by low-productivity, low-wage firms, as in the Melitz framework.

---

11 This result is reinforced by the fact that both firms lose profit on domestic sales as the domestic market becomes more competitive. But marginal cost for domestic sales is lower for the medium wage firm, therefore it has larger market share and is therefore harder hit by the increased competition.
To solve the model numerically, we assume that productivity and moving costs are drawn from independent Pareto distributions. In addition, for ease of exposition, we translate iceberg transportation cost into its ad-valorem equivalent, which is calculated as $\frac{1-\eta}{\eta}$. We illustrate our results with respect to wages and employment in Figures 3 and 4.

The model determines three production wages as well as the wage for workers who develop business plans. The real wages earned by production workers are plotted against ad-valorem equivalent tariffs in Figure 3.\(^\text{12}\) In the example depicted in Figure 3, real wages increase for all workers, but the sharpest increase occurs for high-wage workers. The real wage for this group of workers increases by 93% as the ad-valorem equivalent tariff falls from 400% to zero. By comparison, the medium real wage increases by 35%, while the real value of the low wage increases by 31%. Thus, globalization increases wage inequality among production workers.

The increase in wage inequality is a general result, but the increase in real wages for all worker groups is not. It is possible for the real wages earned by low-wage workers to fall as trade costs approach zero. That is, there are cases in which the real wage earned by this group is non-monotonic in trade costs – rising as the ad valorem equivalent tariff falls from an initially high level and then falling as it vanishes. This is not due to a fall in nominal wages, but, rather a possible increase in the price index. As more firms become exporters, many of the medium-wage exporters start to pay the high-wage and this pushes up prices in the domestic market. Although variety is increasing, the price increases may be large enough to depress the real wages of low-wage workers.

Turn next to Figure 4, where we report the share of each worker type relative to all production workers. Increased globalization has a small impact on low-wage jobs as a share of all production jobs. While the lowest productivity firms usually exit the market as trade costs fall, the

\(^{12}\) The highest ad-valorem equivalent reported is 400%, corresponding to $\eta = 0.20$. The Pareto distribution has no upper-limit on productivity, so that there will always be some exporters even as $\eta$ approaches zero (and the ad-valorem equivalent becomes infinite).
lowest productivity non-exporting firms replace them. The former are smaller than the latter. The increased demand for entry-level labor from formerly medium-wage firms outweighs the lower demand due to firm exit. As a result, low-wage employment as a share of production employment rises from (roughly) 50% to 54% as the ad valorem equivalent tariff declines from 400% to zero.

The reduction in trade costs results in more exports (intensive margin) and more exporters (extensive margin). The combined effect is to increase the share of high-wage jobs; rising from about 8% of production employment when the ad valorem equivalent tariff is 400% to 12% when there are no trade costs at all. Combined with the increase in the share of low-wage jobs, the share of medium-wage jobs must fall.

Figure 4 also shows the breakdown of the two types of middle wage jobs. As is evident, the reduction in the share of these jobs results from a precipitous fall in workers employed by non-exporting firms. Specifically, employment at medium-wage non-exporters falls from about 16.4% of all production jobs to 1.4% over the range of trade costs that we consider. In the example depicted in Figure 4, employment at medium-wage exporters grows from nearly 24% to 33.1%. However, this is not a general result – this share can actually fall if a significant fraction of medium-wage exporters change and start to offer the high-wage.

To summarize, we find that lower trade costs are associated with increased wage inequality among production workers and that the share of production workers in medium-wage jobs shrinks as employment moves towards the extremes with employment at high-wage and low-wage firms rising modestly. As emphasized in the introduction, these predictions are broadly consistent with what we would see in most heterogeneous-firm trade models in which firms hire from the same pool of workers (e.g., Egger and Kreickemeir 2012, Helpman, Itskhoki and Redding 2010a,b or Sampson 2014). They are also consistent with recent empirical findings of Helpman, Itskhoki, Muendler and Redding (2017). However, as we stressed in the introduction, for workers that have careers in which
they change jobs overtime, information about wage inequality and employment shares is not sufficient to fully address the link between globalization and inequality.\footnote{In is worth noting that in Helpman, Itskoki and Redding (2010a) inequality is non-monotonic in trade costs. As the economy moves away from autarky, inequality rises as the most productive firms start to export – in that case, the reduction in trade costs magnifies firm heterogeneity as only the most productive firms are able to access world markets. As trade costs continue to fall, a greater fraction of firms are able to export; and, eventually trade costs fall to the level of which all firms export. At that point, inequality is decreasing in trade costs. This is due to the fact that as the weakest firms begin to export, firm heterogeneity falls. This non-monotonicity does not arise in our setting since we only consider equilibria in which some firms do not export.}

We now turn to the issue of economic mobility. In our model, low-wage workers see their relative wages fall with globalization. However, workers only take low-wage jobs in order to acquire skills and hope to move on to higher paying jobs as quickly as possible. Thus, their welfare depends on all of the wages they will earn over their lifetimes and the rates at which they move from job to job. If globalization reduces the average time spent in low-wage and medium-wage jobs, current low-wage workers might not care that much even if the reduction in trade costs lowers their real wage, since they know that better prospects lie ahead and that they will get to these better prospects more quickly. To investigate this issue, we now calculate the expected duration in low-wage jobs and the expected duration of a job with a medium-wage exporter. These measures, denoted by $D_l$ and $D_x$, respectively, are given in (13) below.

\begin{align}
(13.a) \quad D_l &= \frac{1}{a_m \lambda_n G(\kappa_n) + (1-\lambda_n) G(\kappa_x) + \delta_w} \\
(13.b) \quad D_x &= \frac{1}{a_h G(\kappa_i) + \delta_w}
\end{align}

In each case, expected duration is the inverse of the overall transition rate out of the particular labor market state. A low-wage worker accepts a job at a medium-wage non-exporter if they get an offer (which happens at rate $a_m \lambda_n$) and the cost of moving is sufficiently low (which occurs with probability $G(\kappa_n)$); and, they take a job at a medium-wage exporter if they get an offer (which happens at rate $a_m (1 - \lambda_n)$) and the cost of moving is sufficiently low (which occurs with probability $G(\kappa_x)$). In addition, low-wage workers die at rate $\delta_w$. These are the only three ways to leave low-
wage employment, which gives us the explanation for (13.a). Workers employed by medium-wage exporters leave and take a high-wage job if they get an offer (which happens at rate \(a_h\)) and the cost of moving is sufficiently low (which happens with probability \(G(\kappa_i)\)). The only other way to leave such a job is through death, which occurs at rate \(\delta_w\). This explains (13.b).

The impact of globalization of the duration of medium-wage jobs with exporters is rather straightforward. Since globalization increases the gap between \(w_m\) and \(w_h\), workers are more anxious to accept high wage offers. Thus, globalization increases the critical cost cut-off for workers employed in medium-wage exporting jobs \((\kappa_i)\), thereby increasing \(G(\kappa_i)\) and reducing \(D_x\).

The impact of globalization on the duration of low-wage jobs is more complicated. There are three effects. The first two are tied to the increase in wage inequality. With high-wage jobs becoming more valuable, low-wage workers become more willing to accept jobs from medium-wage exporters, but less willing to accept the dead-end jobs offered by medium-wage non-exporters. Thus, \(G(\kappa_x)\) rises while \(G(\kappa_n)\) falls. These two effects work in opposite directions, making the overall impact on \(D_l\) ambiguous. The third effect comes from the change in the composition of medium-wage jobs. As trade costs fall, fewer and fewer firms that offer the medium-wage are non-exporters. Thus, one might expect that as trade costs fall the fraction of job offers coming from non-exporters \((\lambda_n)\) would fall, thereby reducing the average duration of a low-wage job. But, this need not be the case. As trade costs fall, workers become much less willing to accept such jobs and since all openings must be filled (labor markets are competitive), medium-wage non-exporters must increase the number of offers they make in order to attract enough workers. Thus, globalization leads to fewer medium-wage non-exporters with such firm making more offers than before, implying that the fraction of medium-wage offers coming from non-exporters can rise or fall.

In our example, the impact of globalization on the expected duration of a low-wage job is non-monotonic. As shown in Figure 5, when trade costs are initially high, globalization leads to fewer offers from non-exports and this, combined with the increased willingness of workers to accept offers
from medium-wage exporters, leads to a reduction in \( D_l \). But, as trade costs fall, it becomes more and more difficult for the remaining medium-wage non-exporters to fill their vacancies, prompting an increase in \( \lambda_n \). This, combined with the decreased willingness of low-wage workers to accept dead end jobs leads to an increase in \( D_l \). This u-shaped pattern appears to be quite general, with the only difference in the examples that we have examined being the point at which \( D_l \) is minimized.

Our results indicate that when trade costs are initially high, globalization produces two countervailing forces that affect the welfare of low-wage workers. On the one hand, their relative standing in the labor market is eroded somewhat, as there is an increase in overall wage inequality. On the other hand, globalization allows them to move up the jobs ladder more quickly and, as they reach higher and higher rungs, they enjoy the enhanced benefits of the higher real wages generated by freer trade. In this case, a focus on wage inequality can be misleading in that low-wage workers do not lose as much relative to others in the labor market as would be indicated by standard analysis.

The situation is quite different when trade costs are initially quite low. In that case, a further reduction in trade costs generates two reinforcing effects that reduce the standing of low-wage workers relative to their counterparts. Wage inequality rises and the rate at which workers move out of their entry level jobs slows.

In this framework, the proper way to measure the effect of globalization on a particular worker is to examine its impact on that worker's expected lifetime real income. That measure takes into account both the change in real wages and the degree of economic mobility faced by that worker. Thus, we can get a much better view of how globalization affects inequality by examining the changes in expected lifetime real incomes for workers in different labor market states. There are many ways to measure inequality, especially in a framework such as this one which includes a large number of labor markets states. For simplicity, we focus on the impact of globalization on the relative standing of the production workers at the bottom and the top of the jobs ladder. For our measure of wage inequality, we investigate how globalization impacts the ratio of the wages paid to highest-paid

26
production workers to those earning the lowest wage; that is, \( \frac{w_h}{w_l} \). In our main example, this value is 4.89 for the highest level of trade costs that we consider. It rises to 7.24 as trade costs vanish; an overall increase of 48%.

Turn next to expected lifetime real income. Our measure on inequality in this dimension is the \( \frac{V_{lh}}{V_{ol}} \). The numerator is the expected lifetime real income for a worker that has international experience and has managed to secure a job at a high-wage exporter. The denominator is the expected lifetime real income of a newborn worker—a worker with no experience employed by a low-wage firm. This ratio, as a function of trade costs, is shown in Figure 6 for our main example, along with the ratio of wages. There are several features of Figure 6 that are worth emphasizing. First, this ratio is 2.26 for the highest level of trade costs that we consider. The fact that this measure is so much lower than the ratio of wages shows how misleading it can be to focus on wages and ignore economic mobility. Inexperienced workers only hold low-wage jobs for a portion of their lifetime, moving on to much better jobs as they gain skills. As they mature, they benefit from the higher real wages paid to medium-wage and high-wage production workers if they can gain the proper skills and land better jobs. The fact that using current wages as a proxy for lifetime earnings can lead to misleading conclusions is not a new insight. This issue is well understood and heavily researched in many sub-fields of economics; but, as far as we know, it has not received much attention from those investigating the link between globalization and inequality.\(^\text{14}\)

The second thing in Figure 6 worth noting is that, in our example, \( \frac{V_{lh}}{V_{ol}} \) actually falls to 1.96 as trade costs vanish (a 13% reduction); indicating that this measure of inequality is reduced by globalization. When trade costs are initially high, this is due to the increase in wages that current

\(^{14}\) In labor economics, a classic reference is Lillard (1977). See Haider and Solon (2006) for a discussion of the determinants that make current earnings either a good or bad proxy for lifetime earnings. For an example of the importance of this distinction in public economics (or, in particular, in calculating tax incidence), see Davies, St-Hilaire and Whalley (1984) or Fullerton and Rogers (1993).
low-wage workers will earn later in life combined with an increase in economic mobility. Note, however, that even when trade costs are initially low, globalization leads to a (slight) decrease in this ratio. This is because the increase in the medium and high wages, coupled with greater economic mobility for medium-wage workers, is sufficient to counterbalance the increase in the average duration of low-wage jobs.

Finally, we should note that the negative relationship between $\frac{V_{th}}{V_{ol}}$ and trade costs depicted in Figure 6 is not a general result – in many examples, this value rises as $\eta$ approaches one. However, even when this ratio does rise, the increase is always smaller than the increase in the wage ratio, $\frac{w_H}{w_I}$.

4. Downward Mobility and Globalization

As constructed, each worker in this economy follows a similar path up to the top of the jobs ladder. They take an entry level job to gain basic skills, move to a medium wage exporter to gain international skills and then move to an internationally engaged high-wage firm. There are never any moves back down the jobs ladder. However, in reality, some workers are demoted by their employer and others are let go and forced to accept a new, lower wage to gain reemployment. Using US data covering 1994 to 2016 Forsythe (2017) finds that “approximately 7% of employed individuals move down the occupational ladder each year.” Using Danish data, Groes, Kirchner and Manovskii (2013) and Frederiksen, Halliday and Koch (2016) find substantial rates of downward economic mobility. Such movements back down the jobs ladder can be devastating for individual workers, resulting in large losses in lifetime earnings.\cite{footnote15} These downward movements can also obviously retard the development of an effective career. Our goal in this section is to extend our model to allow for downward economic mobility and to examine the impact of globalization on rates of displacement. For brevity, we provide a description of the extension in this section, but we relegate the details of how the basic equations of our model are altered to the Appendix.

\footnote{The classic references on the losses from job displacement are Jacobson, LaLonde and Sullivan (1993) and Kletzer (1998). For more recent discussion, see Davis and von Wachter (2011) or Krolikowski (2017).}
To allow for downward economic mobility, we assume that once a worker gains a certain type of experience and uses it to secure a better job, they must then exert effort to keep those skills from deteriorating. This effort is costly, with the cost varying across workers. The cost of effort is modeled in the same manner as moving costs – once a skill is gained and a better job is secured, the worker gets a random draw that determines the cost of effort. As long as the worker exerts effort, the skill does not deteriorate. However, if the workers does not exert effort, the skills disappear and the worker’s productivity reverts to its previous level. To prevent shirking, firms monitor workers and fire those that have lost their skills. Thus, workers that shirk risk detection; and, workers that are caught shirking are forced to fall back one level on the jobs ladder where they must then re-acquire those skills if they want to move back up and earn a higher wage.

Worker flows in the extended model are illustrated in Figure 7. The dashed red arrows indicate that medium-wage workers caught shirking are fired and forced to take low-wage jobs. These workers no longer have basic experience and therefore are indistinguishable from inexperienced workers. The solid blue arrows indicate that high-wage workers caught shirking are fired and forced to take medium-wage jobs. A fraction of these workers ($\lambda_n$) are matched with medium-wage non-exporters, while the remainder are matched with medium-wage exporters. These workers have lost their international skills and can only re-acquire those skills if they are fortunate enough to land a job at an exporter.

Workers use standard cost-benefit analysis to decide whether to shirk. Consider, for example, a medium-wage worker with basic experience employed by an exporter. This worker has an expected lifetime income of $V_{ex}(w_m, c)$ if the cost of effort is $c$ and they do not shirk, where

$\begin{align*}
V_{ex}(w_m, c) &= \frac{w_m}{\bar{p}} - c + \tau_i[V_{ix}(w_m) - V_{ex}(w_m, c)] - \delta_w V_{ex}(w_m, c) \\
\end{align*}$
The explanation for (14.a) is the same as for (2.d), it just now includes the cost of effort. If we use $d_m$ to denote the probability of detection when shirking at a medium-wage firm, then this worker expects to earn $V_{ex}^s(w_m)$ over their lifetime if they shirk, (where $\bar{\kappa}$ is mean of the distribution of moving costs)

\[ (14.b) \quad \rho V_{ex}^s(w_m) = \frac{w_m}{\bar{\kappa}} - \delta_w V_{ex}^s(w_m) + d_m[V_{ol}(w_l) - V_{ex}^s(w_m) - \bar{\kappa}] \]

Note that because this worker is shirking, they do not pay the cost of effort. However, shirking risks detection and, if caught, the worker sees their expected lifetime income drop to $V_{ol}(w_l)$. Moreover, because this worker is forced to move, they expect to incur moving costs of $\bar{\kappa}$. A worker will be indifferent between shirking and putting forth effort if $c = c_x$ where $V_{ex}(w_m, c_x) = \rho V_{ex}^s(w_m)$. All workers with $c \leq c_x$ put forth effort, while the remainder shirk.

Similar analysis can be used to solve for the critical cost of effort for medium-wage workers employed by non-exporters ($c_n$) and for high-wage workers ($c_h$). In both cases, these are the costs that make workers indifferent between shirking and putting forth the effort required to maintain their skills. Workers higher costs shirk and a fraction of those workers are caught and fired, forcing them to move back down the jobs ladder. These critical cut-offs can be used to solve for the rate of shirking, which allows us to determine the flows associated with the red and blue arrows in Figure 6. Any increase in $c_x$, $c_n$ or $c_h$ means that fewer workers are shirking, implying less downward economic mobility in the economy.

In the framework of this model, the impact of globalization on downward economic mobility is rather straightforward. As we saw in Section 3, as trade costs fall, wage inequality increases. The direct implication is that the expected cost of shirking rises with globalization. As a result, all three critical cost cut-offs rise, leading to less shirking and less downward economic mobility.

We can combine this result, with those derived in Section 3 to summarize the link between globalization and economics mobility. There are two cases to consider. Suppose first, that trade costs are initially high. Then globalization reduces the average duration of both low-wage and medium-wage jobs. It also leads to less shirking, so that there is less downward mobility. The overall effect
of this is to increase the rate at which workers move up the jobs ladder and an increase in the fraction of their lives that they spend in high-wage jobs.

Things are more complicated when trade costs are already low. In that case, globalization makes it harder for workers to find jobs with medium-wage exporters – that is, the average duration of a low-wage job rises. On the other hand, once workers leave their entry level jobs, globalization makes it less likely that they will be fired and forced to work for low-wages again. As a result, the average time that a worker spends earning \( w_1 \) can rise or fall, depending on which effect dominates.

For those workers that secure jobs with medium-wage exporters, globalization speeds up the rate at which they move on to high-wage jobs. But, that is not the only impact on these workers. Globalization makes it (a) less likely that they will be fired and forced back down the jobs ladder and (b) less likely that once they secure a high-wage job they will lose it. The overall impact on the expected duration of a medium-wage job with an exporter therefore becomes ambiguous.

4. Conclusion

Most workers land their first full-time job in their 20s and then spend 40 to 50 years in the labor market trying to earn a living. Over their careers, workers acquire new skills, which enables them change jobs and (sometimes) occupations in order to increase job satisfaction and career earnings. It follows that a complete picture of the impact of globalization on a typical worker should take into account its impact on skill acquisition and the rate at which workers are able to secure better jobs (that is, economic mobility).

In this paper, we have provided a framework to investigate such issues. In particular, we have developed a model of a jobs ladder in which workers gain skills on the job that qualify them for higher-paying jobs at more productive firms. Productivity is not directly observable, requiring firms to expend resources to screen workers during the recruiting process. Firms then self-select into different groups based on the wages that they pay, their level of international engagement, the type of screening that they use and the manner in which they recruit workers. Low-productivity firms
pay low wages and recruit only new and inexperienced workers. These firms do not earn enough revenue to cover the fixed cost of accessing world markets, and thus, sell all of their output domestically. Medium-productivity firms pay higher wages, recruit workers away from low-wage firms and screen them to ensure that they have acquired skills that reduce the firm’s marginal cost of production. High-productivity medium-wage firms export a portion of their output, while low-productivity medium-wage firms do not engage in international markets. Finally, high-productivity firms pay high-wages, export a fraction of their output, and poach workers from medium-wage exporters. These firms screen for the type of skills that reduce the cost of exporting. Globalization alters the mix of jobs available and thus, changes the rate at which workers gain skills and move up the jobs ladder.

Our main finding is that when trade costs are initially high, globalization increases economic mobility through two channels. First, the reduction in trade costs leads to more international engagement by firms. As the number of exporting firms grows, the ability of workers to gain skills that reduce trade costs is enhanced. This makes it easier for workers to qualify for jobs at the top of the jobs ladder. Second, since high-productivity firms gain disproportionally from falling trade costs, globalization increases wage inequality. And, as the gaps between the wages paid by different groups of firms increase, workers become more willing to (a) incur the moving costs associated with changing jobs and (b) expend effort to keep their skills from deteriorating. As a result, upward economic mobility rises and downward economic mobility (due to demotions or terminations) falls. These changes in economic mobility reduce the differences in expected lifetime incomes forecast by workers in high-wage and low-wage jobs, resulting in the possibility that inequality in lifetime incomes might actually fall with globalization (even though wage inequality is rising). Even the case in which globalization increases inequality in terms of lifetime incomes, the impact is smaller than its impact on wage inequality. Thus, our model yields several potentially important predictions that deserve detailed empirical scrutiny. In particular, is there empirical support for our prediction that
falling trade costs increase economic mobility? And, is the impact of globalization on inequality in lifetime earnings more muted than its impact on wage inequality?

We also find that globalization alters the wage distribution for a given occupation in a particular manner. Employment is reallocated from firms that pay medium wage towards the extremes, with high-wage and low-wage employment both increasing. While it is tempting to interpret this reallocation of employment as an explanation of “job polarization” as described in recent empirical work (see Goos and Manning 2007; Goos, Manning, and Salomons 2009; Autor, Katz and Kearney 2006, 2008 and Autor and Dorn 2013), we believe that would be a mistake. That work has a different focus than ours, in that it examines recent changes in the occupational structure of the labor market. In particular, these authors argue that the type of jobs that pay middle class wages have been disappearing, with an increase in low-wage service sector jobs (that cannot be outsourced) and high-wage jobs that require complex skills. Outsourcing has been highlighted as one of the major causes of this phenomenon. Our results indicate that globalization can result in a shrinking middle-class within a given occupation, with increased export opportunities resulting in more firms willing to recruit the most experienced workers by paying the highest wage; while others react to increased competition from imports by re-orienting their hiring toward inexperienced low-wage workers. These results are not driven by outsourcing. Instead, they are completely driven by the manner in which globalization alters the networks that firms use to fill their vacancies.

References


Figure 1: The Firm’s Decision Tree

Figure 2: Worker Flows
Figure 3: Real Wage Effects

Figure 4: Employment Shares

Ad Valorem Equivalent Tariff

Low  Non-Exporters  Exporters  High
Figure 5: Average Duration of Low-Wage Jobs

Figure 6: Measures of Inequality
Figure 7: Worker Flows with Downward Economic Mobility