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Abstract: Globalization might affect the mix of jobs available in an economy and the rate at which workers gain skills. We develop a model in which firms differ in terms of productivity and skills and use the model to examine how globalization affects the wage distribution and the career path of workers as they move up the jobs ladder. There are two types of skills that determine a worker's productivity in the model: the ability to work with the appropriate technology and the ability to facilitate international commerce. Workers imperfectly acquire these skills on the job. Firms cannot costlessly observe the skills embodied in a worker but can observe each potential recruit's employment history. In equilibrium, firms self-select into groups that use different networks to fill vacancies. Our results indicate that 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 ladders and less time spent in entry level jobs. The key assumptions and predictions are confirmed in data on recruitments and job mobility in Sweden.

JEL: F10, F20, J30

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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.¹ 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.² 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 move 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 with only high productivity firms able to cover the costs of exporting. As a result, international experience is 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. 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. In addition, Mion, Opromolla and Sforza (2017) 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 τ_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 τ_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, when workers gain experience, they become eligible for higher paying jobs. We assume that opportunities to move up the jobs ladder arrive randomly via a Poisson process and that changing jobs is costly. 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 the medium-wage firms, those with relatively high productivity expand their exports and see their revenues rise enough to enable them to 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.³ 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 considerably more than their low-wage and medium-wage counterparts.

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).⁴ 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 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.

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

⁵ There is an additional reason that economic mobility might rise with globalization that is tied 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 wage inequality increases as trade costs fall, 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 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.⁶

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 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 only move up 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 that skill 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 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

⁶ Guner, Ruggieri and Tybout (2018) present an alternative model of the jobs ladder that has some overlap with ours (job poaching and on the job training) as well as significant differences (e.g., the way in which experience alters firm productivity and trade costs, unemployment and search frictions in the labor market). Most importantly, the main mechanism that links globalization to economic mobility differs. Their focus is on offshoring (which is not present in our model) and the way in which it alters the outside option of workers. They find that offshoring slows down labor market turnover by limiting the outside options of workers and that this results in reduced economic mobility and slower wage growth. The main mechanism in our model is the way in which workers gain international experience and how that international experience lowers trade costs for exporting firms. Globalization increases the number of firms that export, making it easier for workers to gain international experience and this can, in turn, lead to greater economic mobility.

shirking. This extension yields a new insight – since globalization increases wage inequality, 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.

Our highly stylized model yields several testable hypotheses about the manner in which globalization affects the career paths of workers. In Section 5 we present some descriptive statistics based on matched worker-firm data from Sweden that provide support both for our model’s key assumptions and our more novel predictions. Concluding remarks are offered in Section 6.

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 \mathcal{M}_d firms in the process of developing plans to enter the industry. Each developing firm draws a productivity measure (ϕ) as in Melitz (2003) and becomes active if it can at least break-even. We use \mathcal{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 (or skill) 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 skill. The life-cycle of a worker is based on the model of perpetual youth (Blanchard 1985), with workers dying at rate δ_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 τ_e to represent the rate at which workers gain this experience. In a similar way, worker acquire international experience via a Poisson process with τ_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.

The transition rates τ_e and τ_i are the key parameters of our model. They are intended to capture the complexity of the production process, the difficulty of the tasks involved in carrying out international commerce and the intricacies of the trading process. A high value for τ_e indicates that workers gain basic experience quickly, suggesting that the production process is easy to grasp. Thus, more sophisticated and complicated production processes should be associated with lower values for τ_e . There are two issues that are likely to influence the value of τ_i . First, there is the difficulty of mastering the tasks needed to export a product. If these task are straightforward, workers should catch on quickly and τ_i should be relatively large. So, for example, if the task is managing the supply chain, we would expect a high value of τ_i if the supply chain is relatively short and easy to manage and a low value of τ_i if the supply chain is more complex. Second, there is the nature of the trading relationship itself – that is, how difficult is it to export to a particular market? For example, one could imagine that the supply chain would be more difficult to manage if the firm faced significant language barriers and/or geographical and cultural hurdles in order to do business in a particular country. In

such a situation, we would expect τ_i to be low, indicating that trade costs are particularly sensitive to the amount of international experience embodied in the firm's workforce. Thus, as we present our results, we pay particular attention to the manner in which they are affected by these transition rates.

In our base model, experience does not depreciate – 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).⁷

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.⁸ 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

⁷ 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.

⁸ 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 fixed costs, due to screening and exporting, to lower their marginal costs (by hiring more productive workers).

B. Labor Market Dynamics

We illustrate worker flows in Figure 2. Since δ_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 cost κ from a distribution $g(\kappa)$ and moves if the expected benefit from doing so exceeds this cost. Thus, moving costs are a random variable (κ) 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 λ_n to denote the fraction of medium-wage offers that come from non-exporters.

The steady-state equations related to the flows 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 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 ($\delta_w L$) has to be offset with an equal number of births, with each newborn taking a job at a low-wage firm. Thus, $\delta_w L$ 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 τ_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).

$$(1.a) \quad \delta_w L = (\delta_w + \tau_e)L_{0l}$$

$$(1.b) \quad \tau_e L_{0l} = (\delta_w + a_m[\lambda_n G(\kappa_n) + (1 - \lambda_n)G(\kappa_x)])L_{el}$$

$$(1.c) \quad a_m \lambda_n G(\kappa_n)L_{el} = \delta_w L_{en}$$

$$(1.d) \quad a_m (1 - \lambda_n)G(\kappa_x)L_{el} = (\delta_w + \tau_i)L_{ex}$$

$$(1.e) \quad \tau_i L_{ex} = (\delta_w + a_h G(\kappa_i))L_{ix}$$

$$(1.f) \quad a_h G(\kappa_i)L_{ix} = (\delta_w + a_d G(\kappa_d))L_{ih}$$

$$(1.g) \quad a_d G(\kappa_d)L_{ih} = \delta_w L_{id}$$

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 τ_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 a_m , with a fraction (λ_n) of the opportunities coming from non-exporters. We define κ_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. 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 ρ to represent the discount rate and \tilde{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.

$$(2.a) \quad \rho V_{ol}(w_l) = \frac{w_l}{\tilde{p}} + \tau_e \{V_{el}(w_l) - V_{ol}(w_l)\} - \delta_w V_{ol}(w_l)$$

$$(2.b) \quad \rho V_{el}(w_l) = \frac{w_l}{\tilde{p}} + a_m \lambda_n G(\kappa_n) \left(V_{en}(w_m) - V_{el}(w_l) - \frac{1}{G(\kappa_n)} \int_0^{\kappa_n} \kappa g(\kappa) d\kappa \right) + \\ a_m (1 - \lambda_n) G(\kappa_x) \left(V_{ex}(w_m) - V_{el}(w_l) - \frac{1}{G(\kappa_x)} \int_0^{\kappa_x} \kappa g(\kappa) d\kappa \right) - \delta_w V_{el}(w_l)$$

$$(2.c) \quad \rho V_{en}(w_m) = \frac{w_m}{\tilde{p}} - \delta_w V_{en}(w_m)$$

$$(2.d) \quad \rho V_{ex}(w_m) = \frac{w_m}{\tilde{p}} + \tau_i (V_{ix}(w_m) - V_{ex}(w_m)) - \delta_w V_{ex}(w_m)$$

$$(2.e) \quad \rho V_{ix}(w_m) = \frac{w_m}{\tilde{p}} + a_h G(\kappa_i) \left(V_{ih}(w_h) - V_{ix}(w_m) - \frac{1}{G(\kappa_i)} \int_0^{\kappa_i} \kappa g(\kappa) d\kappa \right) - \delta_w V_{ix}(w_m)$$

$$(2.f) \quad \rho V_{ih}(w_h) = \frac{w_h}{\tilde{p}} + a_d G(\kappa_d) (V_{id}(w_d) - V_{ih}(w_h)) - \delta_w V_{ih}(w_h)$$

$$(2.g) \quad \rho V_{id}(w_d) = \frac{w_d}{\tilde{p}} - \delta_w V_{id}(w_d)$$

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 τ_e and δ_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 $V_{en}(w_m) - V_{el}(w_l) - \frac{1}{G(\kappa_n)} \int_0^{\kappa_n} \kappa g(\kappa) d\kappa$, or move to a medium-wage exporter, in which case the capital gain would be $V_{ex}(w_m) - V_{el}(w_l) - \frac{1}{G(\kappa_x)} \int_0^{\kappa_x} \kappa g(\kappa) d\kappa$. 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 δ_w , respectively. Derivation of the remaining asset-value equations follows the same logic.

As stated earlier $\kappa_n, \kappa_x, \kappa_i$ and κ_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 is 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:

$$(3.a) \quad \kappa_n = V_{en}(w_m) - V_{el}(w_l)$$

$$(3.b) \quad \kappa_x = V_{ex}(w_m) - V_{el}(w_l)$$

$$(3.c) \quad \kappa_i = V_{ih}(w_h) - V_{ix}(w_m)$$

$$(3.d) \quad \kappa_d = V_{id}(w_d) - V_{ih}(w_h)$$

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, $\kappa_n < \kappa_x$.

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.⁹ As in Melitz (2003), prospective entrants incur a cost to draw a productivity parameter ϕ , 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 ϕ . 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

$$(4) \quad q(v) = \frac{Y}{\tilde{p}^{1-\sigma}} p(v)^{-\sigma}$$

where Y is total expenditure, $p(v)$ is the price of variety v and $\tilde{p} \equiv [\int p(v)^{1-\sigma} dv]^{\frac{1}{1-\sigma}}$ 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 ϕ_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 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.

⁹ Since the Foreign market is symmetric with Home, we focus on the Home country.

The prices that maximize steady-state profit are given in (5) below. All employees of medium-wage and high-wage firms have marginal product of ϕ , meaning that the marginal costs for both these firms are w_m/ϕ and w_h/ϕ . Things are more complicated for low-wage firms, where 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 ϕ . Therefore, the average product of labor for a low-wage firm is $(\lambda_{ol}\beta + \lambda_{el})\phi$, where λ_{ol} is the fraction of the low-wage workforce that is inexperienced. We then have:¹⁰

$$(5.a) \quad p_l(\phi) = \frac{\sigma}{\sigma-1} \frac{w_l}{(\lambda_{ol}\beta + \lambda_{el})\phi}, \quad \phi \in [\phi_0, \phi_l]$$

$$(5.b) \quad p_m(\phi) = \frac{\sigma}{\sigma-1} \frac{w_m}{\phi}, \quad \phi \in [\phi_l, \phi_x]$$

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

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 λ_{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 λ_{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 η to measure the degree of openness, with $\eta = 1$ denoting free trade, and θ to measure the sensitivity of iceberg transportation to changes in λ_{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-

¹⁰ In the Melitz (2003) model prices are a constant mark-up over marginal cost. In addition, in that model all workers are the same so that there is no difference between marginal and average productivity. In our model, since the marginal worker hired by a low-wage firm is inexperienced, that worker has a marginal product of $\beta\phi$. This differs from average product, which is given by $(\lambda_{ol}\beta + \lambda_{el})\phi$. We have a dynamic model in which the firm's goal is to maximize its aggregate discounted stream of profits. With zero discounting (an assumption that we borrow from Melitz), this amounts to maximizing steady-state profits. For low-wage firms, this occurs when price is set as a mark-up over average product, as given in (5.a).

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

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

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

E. Labor Demand

Firms cannot identify experience among existing workers since experience acquisition is a Poisson process and identification requires costly screening. However, firms do know the average product of labor since they know the share of their workforce with experience and they know how productivity varies with experience. As described above, the average product of labor for a low-wage firm is $(\lambda_{ol}\beta + \lambda_{el})\phi$, while the average product of labor for medium-wage and high-wage firms is ϕ . Therefore, the demand for labor needed to produce output for domestic sales is:

$$(6.a) \quad \ell_l(\phi) = f + \frac{q_l}{(\lambda_{ol}\beta + \lambda_{el})\phi}$$

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

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

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_i follows from (4) in the obvious manner.¹¹

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

$$(7.a) \quad \ell_x^*(\phi) = f_x + \frac{q_x^*}{\phi} \frac{1}{\eta (\lambda_{ix})^\theta}$$

¹¹ 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.

$$(7.b) \quad \ell_h^*(\phi) = f_x + f_i + \frac{q_h^*}{\phi} \frac{1}{\eta}$$

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 λ_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.

$$(8.a) \quad L_{ol} + L_{el} = \mathcal{M} \int_{\phi_0}^{\phi_l} \ell_l(\phi) \tilde{z}(\phi) d\phi$$

$$(8.b) \quad L_{en} = \mathcal{M} \int_{\phi_l}^{\phi_n} \ell_m(\phi) \tilde{z}(\phi) d\phi$$

$$(8.c) \quad L_{ex} + L_{ix} = \mathcal{M} \int_{\phi_n}^{\phi_x} [\ell_m(\phi) + \ell_x^*(\phi)] \tilde{z}(\phi) d\phi$$

$$(8.d) \quad L_{ih} = \mathcal{M} \int_{\phi_x}^{\infty} [\ell_h(\phi) + \ell_h^*(\phi)] \tilde{z}(\phi) d\phi$$

$$(8.e) \quad L_{id} = \mathcal{M}_d f_d$$

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

$$(9.a) \quad \Pi_l(\phi) = \frac{r_l(\phi)}{\sigma} - w_l f \quad \text{for } \phi \in [\phi_0, \phi_l]$$

$$(9.b) \quad \Pi_n(\phi) = \frac{r_m(\phi)}{\sigma} - w_m (f + f_e) \quad \text{for } \phi \in [\phi_l, \phi_n]$$

$$(9.c) \quad \Pi_x(\phi) = \frac{r_m(\phi) + r_x^*(\phi)}{\sigma} - w_m[f + f_e + f_x] \quad \text{for } \phi \in [\phi_n, \phi_x]$$

$$(9.d) \quad \Pi_h(\phi) = \frac{r_h(\phi) + r_h^*(\phi)}{\sigma} - w_h[f + f_i + f_x] \quad \text{for } \phi \geq \phi_x$$

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 δ_f . For tractability, we assume that each new entrant hires all the workers employed by the firm that it replaces. Sunk cost is $w_d f_d$ and the probability of successful entry is $1 - Z(\phi_0)$. We can then write the free entry condition as

$$(11) \quad \frac{1 - Z(\phi_0)}{\rho + \delta_f} \int_{\phi_0}^{\infty} \Pi_F(\phi) \tilde{z}(\phi) d\phi = w_d f_d$$

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

$$(12) \quad Y = w_l(L_{ol} + L_{el}) + w_m(L_{en} + L_{ex} + L_{ix}) + w_h L_{ih} + w_d L_{id}$$

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 (λ_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).¹²

3. Globalization

We model globalization as a reduction in trade costs (an increase in η 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 $\phi_0, \phi_l, \phi_n,$ and ϕ_x represent the initial values of the critical productivity cutoffs and let $\hat{\phi}_0, \hat{\phi}_l, \hat{\phi}_n,$ 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), $\Pi_x(\phi_x) = \Pi_h(\phi_x)$. Workers at both types of firms are equally productive in domestic sales. The higher wage means higher marginal cost, higher price, and lower 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 ϕ_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

¹² The L_{EF} terms that appear in (1) are endogenous as well and appear in (8) and (12). However, there are seven such terms ($L_{0l}, L_{el}, L_{en}, L_{ex}, L_{ix}, L_{ih}, L_{id}$) and seven equations in (1). These equations can be solved to find the L_{EF} terms as functions of the parameters of the model and the critical cost cut-offs ($\kappa_n, \kappa_x, \kappa_i, \kappa_d$). In a similar vein, the seven equations in (2) can be solved for the seven V_{EF} terms defined in those equations. This allows us to write the V_{EF} terms as functions of the wages and the cost cut-offs. The resulting functions can then be substituted into (3), (8) and (12) to solve for equilibrium.

effect is larger for the high-wage firm, so that $\Pi_h(\phi_x) > \Pi_m(\phi_x)$.¹³ 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 $\Pi_l(\phi_l) > \Pi_n(\phi_l)$. 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 Melitz model, sunk cost are parametrically determined, therefore the only margin of adjustment is that the likelihood of successful entry has to fall (ϕ_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.

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.

¹³ 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.

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 3.¹⁴ In the example depicted in Figure 3, real wages increase for all workers as trade costs fall, but the sharpest increase occurs for high-wage workers. The real wage for this group of workers increases by 102% as the ad-valorem equivalent tariff falls from 400% to zero. By comparison, the real value of the low wage increases by 55%. 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.

The magnitude of the increase in wage inequality depends on our key parameters, τ_e and τ_i , with globalization generating a larger increase in wage inequality when τ_e is high or τ_i is low. The intuition behind these results is straightforward. As in most models with heterogeneous firms, globalization increases inequality by increasing the returns to skill. When τ_e is high, basic skills are easy to acquire, so experienced and inexperienced low-wage workers are not all that different from each other (inexperienced workers just need a little more time on the job to catch up in terms of productivity). Thus, globalization does not result in large gains for workers with only basic skills – their skills are not all that valuable in relative terms. Similar logic applies to international experience.

¹⁴ 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 η approaches zero (and the ad-valorem equivalent becomes infinite).

When τ_i is low, the skills required to lower trade costs are complex and take a long time to acquire. In such a case, international experience becomes relatively rare, increasing its value. As a result, globalization leads to large gains for workers that have acquired such experience.

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 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) 61% to 66% 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 4% of production employment when the ad valorem equivalent tariff is 400% to over 6% 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 17% of all production jobs to 5% over the range of trade costs that we consider. In the example depicted in Figure 4, employment at medium-wage exporters grows from 17% to nearly 23%. However, this is not a general result – this share can actually fall if a significant fraction of medium-wage exporters move into the high-wage category. The fall in employment at medium-wage non-exporters triggered by falling trade costs is more dramatic for the same combinations of parameters that lead to a larger increase in wage inequality – high values of τ_e or low values of τ_i .

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.¹⁵

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.

¹⁵ It is worth noting that in Helpman, Itskhoki 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.

$$(13.a) \quad D_l = \frac{1}{a_m[\lambda_n G(\kappa_n) + (1 - \lambda_n)G(\kappa_x)] + \delta_w}$$

$$(13.b) \quad D_x = \frac{1}{a_h G(\kappa_i) + \delta_w}$$

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 δ_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 δ_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 (κ_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 (λ_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 dead end 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 5A, 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 λ_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.

An alternative measure of the economic mobility of low-wage workers would be the rate at which they move up to medium-wage exporters. This measure, which is given by $a_m(1 - \lambda_n)G(\kappa_x)$, is depicted in Figure 5B. As the figure clearly indicates, this measure is non-monotonic as well, rising when trade costs fall from an initially high level, but then falling as trade costs vanish. The forces driving this result are the same as those behind Figure 5A.

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 worker is to examine its impact on that worker's expected lifetime real income. That measure considers both the change in real wages and the degree of economic mobility faced by that worker. Thus, we can get a 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 production workers to those earning the lowest wage; that is, $\frac{w_h}{w_l}$. In our main example, this value is 5.34 for the highest level of trade costs that we consider. It rises to 6.79 as trade costs vanish; an overall increase of 27%.

Turn next to expected lifetime real income. Our measure on inequality in this dimension is the $\frac{V_{ih}}{V_{ol}}$. 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 4.15 for the highest level of trade costs that we consider. The fact that this measure it is 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.¹⁶

The second thing in Figure 6 worth noting is that, in our example, $\frac{V_{ih}}{V_{ol}}$ actually *falls* to 3.55 as trade costs vanish (a 15% 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 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. The third point to make about Figure 6 is that the negative relationship between $\frac{V_{ih}}{V_{ol}}$ and trade costs depicted in Figure 6 is *not* a general result – in many examples, this value rises as η approaches one. However, even when this ratio does rise, the increase is always smaller than the increase in the wage ratio, $\frac{w_h}{w_l}$.

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

¹⁶ 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).

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.¹⁷ 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 Appendix A.

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 worker 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

¹⁷ 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).

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 (λ_n) are matched with medium-wage non-exporters, with the remainder 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

$$(14.a) \quad V_{ex}(w_m, c) = \frac{w_m}{\bar{p}} - c + \tau_i[V_{ix}(w_m) - V_{ex}(w_m, c)] - \delta_w V_{ex}(w_m, c)$$

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)

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

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 with 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 7. 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 straight-forward. 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 economic 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_l 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.

5. Empirical Evidence

Our model makes use of two key assumptions to derive a variety of testable predictions about the impact of globalization on the career- paths of workers. The two assumptions are that heterogeneous firms use different recruiting networks to fill their vacancies and that the international experience of a firm's workforce can lower its trade costs. The second assumption has strong support from the recent empirical studies cited in the introduction (e.g., see the discussion of Labanca et al. 2014 and Mion et al. 2017). However, with respect to our first assumption, we know of no study of the role that international engagement plays in determining firms' recruitment strategies. While a detailed empirical analysis is beyond the scope of this paper, we provide below some descriptive statistics that are largely in line with our premise.

Our empirical analysis uses matched worker-firm data from Sweden for 1997-2013.¹⁸ Since our data does not include information on service trade, the evidence presented below is for manufacturing only. We separate firms into three groups based on exports as a share of total sales: (i) firms that do not export (non-exporters), (ii) firms that have export shares below the sample median of exporting firms across all industries (low export firms), and (iii) firms that have export shares above the sample median of exporting firms across all industries (high export firms). We examine recruitment by these firms. A recruitment is defined as a worker who is employed in a firm in year t (November) but not in that firm in year $t-1$ (November). A worker who is recruited in year t is linked to the character of the previous employer in year $t-1$. In Figure 8 we start by examining the recruitment from non-exporters by different firm groups. As seen from panel (a), compared to other firm groups, non-exporters are more likely to hire workers from firms that also do not export. In contrast, panel (c) shows that out of the total recruitment by high export firms, substantially more recruits come from other high export firms (about 60-80% over the sample period).

¹⁸ See Appendix B for more details about the data

Figure 8 also reveals that there is substantial amount of worker mobility across firm groups. For example, in 2005, 24 percent of new hires by high export firms came from firms that either did not export or had an export share below the median in 2005, while 61 percent of new hires by non-exporters came from firms that exported in 2005. Below we will examine worker mobility in more detail. In particular, we are interested in the possible link between worker mobility and globalization as implied by our model above. Before presenting the results, we first provide an interpretation of our model designed to lay the foundation for an empirical assessment.

In our model, firms employ workers to perform just two tasks – production of output and, if the firm is an exporter, shipment of goods abroad. The firm’s ability to produce output depends on how much basic experience is embedded in its workforce; while its trade costs depend on the fraction of its workforce with international experience. In addition, the economy-wide wage distribution applies to all workers, regardless of experience. In reality, firms are far more complex than this, requiring a large number of tasks to be carried out both for production and distribution. Firms employ workers in a wide variety of occupations to carry out these tasks and the wage distributions for different occupations are largely distinct. Thus, the most appropriate way to view our model is that it describes a jobs ladder for workers in a particular occupation. Further, it is easy to imagine that international experience plays a larger role in lowering trade costs in some occupations (e.g., supply chain or business development managers, business tax or global trade lawyers, experts in international finance) relative to others (e.g., clerical support). That is, we expect that our predictions are more likely to find support in occupations that play a major role in international commerce, such as professionals and managers.

Table 1 presents some suggestive evidence at the industry level for the link between trade openness and worker mobility. In panel A we focus on upward mobility – worker movement from firms that do not export (or export less) to the firms that export (or export more). To capture this type of upward mobility, for each industry we first divide firms into three groups as above. Let i (and

$j) = 1, 2, 3$ indicate the group of non-exporters, low export firms, and high export firms, respectively. Let S_{ijt} be the number of workers who move from a firm in the i group to another firm in the j group as a share of all movers between $t - 1$ and t .¹⁹ We define the upward mobility index as $\sum_{ij} S_{ijt} \cdot (j - i)/(k - 1)$ for $i < j$ where k is the number of firm groups and $j - i$ can be interpreted as the number of “steps” by which workers move upward (this is a variant of the measure proposed by Bartholomew 1982). This measure is bounded by 0 and 1. If no workers moved upward during the period, the index equals zero. If all workers started at non-exporting firms in $t - 1$ and moved to high export firms in t , the index equals one. Thus, the index is larger when there is more upward mobility. For each industry we compute the upward mobility index separately for professionals and managers, and for clerks.²⁰ We focus on these two broad occupational categories because we expect them to differ in their impacts on reducing the costs associated with international businesses.

To investigate the link between upward mobility and trade openness, we regress our mobility index on industry export shares and control for both industry and year fixed effects. Export shares are computed as an industry’s total exports as a share of total sales and used to capture the extent of trade openness for that industry.²¹ The coefficient on export shares is identified by within-industry over-time variation in export shares. The estimate in column 1 (based on three firm groups) suggests a statistically significant positive correlation between increased industry export shares and upward mobility for professionals and managers. In contrast, the results in column 6 do not suggest any significant link between increased openness and upward mobility for clerks. Columns 2 and 7 in panel A display a similar pattern when firms are divided into five groups in which the first group still

¹⁹ For workers who moved across industries, industry affiliation is based on the industry where the workers ended up.

²⁰ Based on the *Swedish Standard Classification of Occupations (SSYK96)*, professionals and managers include occupations with SSYK96 = 1, 2, and 3, and clerks are occupations with SSYK96 = 4.

²¹ We have also used industry tariffs on Swedish exports to capture trade openness. The results are qualitatively similar to those reported in Table 1. However, since around 70 percent of Swedish exports are to other EU countries and the variation in industry tariffs is relatively small, the estimates are less precise. These results are available upon request.

consists of non-exporters, and the other four groups are based on quartiles of the distribution for firm export shares. Finally, allowing for ten firm groups does not alter our results (columns 3 and 8).²²

An alternative way to capture upward mobility is to use the share of workers who move up to firms that have a larger export share compared to the worker's previous employee. As shown in panel A columns 4-5, for professionals and managers a 10 percentage point increase in industry export shares is associated with a 8.5 percentage point increase in the share of workers who move up to firms that have a higher export share, and most of upward mobility is to firms that have a larger export share by more than 10 percentage points compared to the worker's previous employee. In contrast, in columns 9-10 we again find no evidence for a link between industry export expansion and upward mobility for clerks.

In panel B, we turn to downward mobility. All measures of downward mobility are defined in a way similar to those of upward mobility. We find some evidence for a negative relationship between industry export shares and downward mobility. In particular, the estimates in columns 4-5 for professionals and managers suggest that a 10 percentage point increase in industry export shares is associated with a 10.5 percentage point decrease in the share of workers who move downward to firms that export less compared to the worker's previous employee, and a 12.9 percentage point decrease in the share of workers who move down to firms that export less by 10 percentage points than the worker's previous employee did.

Overall, the results in Table 1 provide some preliminary and suggestive evidence for the link between trade openness and worker mobility for professionals and managers. On the other hand, we

²² The classification by export shares in Table 1 is based on the entire sample of exporting firms across all industries. We have also grouped firms based on the distribution of export shares within each industry. For example, in the case of three firm groups, high export firms are defined as those with export shares above the industry median of exporting firms, and low export firms are those with export shares below the industry median of exporting firms. The regression results based on this alternative firm grouping are very similar to those reported in Table 1. These results are shown in the appendix.

find little evidence for such a link for clerks. These different patterns of worker mobility for different occupations (e.g., professionals and managers versus clerks) could have further implications for wage mobility between occupations.

6. 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 to 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 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 disproportionately 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 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 section 5, we presented some initial empirical findings based on data on recruitments and job mobility in Sweden that provide support the key assumptions of our model and some of its predictions concerning the link between globalization and economic mobility for certain occupations. One question that we did not address empirically is whether or not the impact of globalization on inequality in lifetime earnings is 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.

Appendix A

Our goal is to show how our model can be extended to allow for downward economic mobility. The basic idea is as described in the text. Once a worker gains a new skill and secures a new job, they must exert effort to maintain that skill. If effort is exerted, the worker's productivity remains at its new, higher level. If the worker does not put forth effort, their new skill erodes, their productivity reverts to its old level and they risk detection and termination. Terminated workers must go back down the jobs ladder one rung, take a new job at a lower wage, and try and reacquire their skills. The cost of effort is drawn from a distribution once the skill is acquired and thus, varies across workers. Workers make the effort/shirk decision based on cost benefit analysis.

We introduce the following new notation:

d_j = the detection rate at firms that pay wage w_j (for $j = m, h$)

s_{gj} = the shirking rate for workers with experience level g (for $g = e, i$) employed by type j firms (for $j = n, x, h$)

c_j = the critical cost of maintaining your most recently acquired skill if you work for a type j firm (for $j = n, x, h$)

Workers employed by a type j firm that draw a cost of effort below c_j exert effort and maintain their skill. Workers that draw a cost above c_j shirk and risk detection.

Given the new notation, we can now explain how the labor market dynamics, as described in (1), are altered by downward economic mobility. Equations (1.b) and (1.g) are not altered, while the remaining equations become

$$(1.a) \quad \delta_w L_j + d_m (s_{en} L_{en} + s_{ex} L_{ex} + s_{ix} L_{ix}) = (\delta_w + \tau_e) L_{0i}$$

$$(1.c) \quad a_m \lambda_n G(\kappa_n) L_{ei} + d_h \lambda_n s_{ih} L_{ih} = (\delta_w + d_m s_{en}) L_{en}$$

$$(1.d) \quad a_m (1 - \lambda_n) G(\kappa_x) L_{ei} + d_h (1 - \lambda_n) s_{ih} L_{ih} = [\delta_w + (1 - s_{ex}) \tau_i + d_m s_{ex}] L_{ex}$$

$$(1.e) \quad (1 - s_{ex})\tau_i L_{ex} = [\delta_w + a_n G(\kappa_i) + d_m s_{ix}] L_{ix}$$

$$(1.f) \quad a_h G(\kappa_i) L_{ix} = [\delta_w + a_d G(\kappa_d) + d_h s_{ih}] L_{ih}$$

As before, the left-hand-side gives the flow into a labor market state. Equation (1.a) now reflects the fact that some workers earning the medium wage are caught shirking and are fired, forcing them back to the bottom rung of the jobs ladder. To be fired, a worker must shirk and must be detected shirking by the firm. Thus, the measure of workers entering labor market state L_{ol} is now made up of the newborns (the first term on the left-hand-side of 1.a) and those medium-wage workers that shirk and are then fired by their firms (the second term on the left-hand-side of 1.a). Similar logic explains the remaining equations. For (1.c), which refers to flows into and out of state L_{en} , there is now a new flow into that state made up of high-wage workers that were fired for shirking ($d_h \lambda_n s_{ih} L_{ih}$) and a new flow out of that state made up of current employees that were fired ($d_m s_{ed} L_{en}$). Note that flows into and out of states L_{el} and L_d are not affected by the extension, since medium-wage workers that are fired are equivalent to inexperience workers and development workers cannot be demoted.²³

Turn next to expected lifetime incomes, described in our base model in (2). We define the following new terms: Nothing changes in (2.a) or (2.g), since we assume that you do not have to put in effort to maintain your basic skills until you take a medium-wage job (this simplification is made to capture the idea that you do not lose skills right away, rather that they erode over time – they begin eroding when you move and take a medium-wage job). For the remaining terms, define

$V_{gj}^S(w_t)$ = expected lifetime real income for a shirking worker with experience level g (for $g = e, i$) that is earning a wage of w_t (for $t = m, h$) while employed by a type j firm (for $j = n, x, h$)

$V_{gj}(w_t, c)$ = expected lifetime real income for a worker with experience level g (for $g = e, i$) that is earning a wage of w_t (for $t = m, h$) while employed by a type j firm (for $j = n, x, h$) that is exerting effort at a cost of c to keep their skills from eroding

Then, if we use $h(c)$ to denote the distribution of the cost of effort, (2) becomes:

$$(2.b) \quad \rho V_{el}(w_l) = \frac{w_l}{\bar{p}} + a_m \lambda_n G(\kappa_n) \left(EV_n(w_m) - V_{el}(w_l) - \frac{1}{G(\kappa_n)} \int_0^{\kappa_n} \kappa g(\kappa) d\kappa \right) + a_m (1 - \lambda_n) G(\kappa_x) \left(EV_x(w_m) - V_{el}(w_l) - \frac{1}{G(\kappa_x)} \int_0^{\kappa_x} \kappa g(\kappa) d\kappa \right) - \delta_w V_{el}(w_l)$$

$$\text{where } EV_n(w_m) = \int_0^{c_n} V_{en}(w_m, c) h(c) dc + [1 - H(c_n)] V_{en}^S(w_m)$$

$$EV_x(w_m) = \int_0^{c_x} V_{ex}(w_m, c) h(c) dc + [1 - H(c_x)] V_{ex}^S(w_m)$$

$$(2.c) \quad \rho V_{en}(w_m, c) = \frac{w_m}{\bar{p}} - c - \delta_w V_{en}(w_m, c)$$

$$(2.c') \quad \rho V_{en}^S(w_m) = \frac{w_m}{\bar{p}} - \delta_w V_{en}^S(w_m) + d_m [V_{ol}(w_l) - V_{en}^S(w_m) - \bar{\kappa}]$$

$$(2.d) \quad \rho V_{ex}(w_m, c) = \frac{w_m}{\bar{p}} - c + \tau_i [V_{ix}(w_m) - V_{ex}(w_m, c)] - \delta_w V_{ex}(w_m, c)$$

²³ We assume that medium-wage workers employed by exporters must be maintaining those skills in order to gain international experience. With this assumption in place (1.a) and (1.e) can be simplified because in equilibrium we will have $s_{ix} = 0$. The logic is as follows. While working for a medium-wage exporter a worker exerts effort is the cost of effort is lower than the expected loss from being caught shirking. The expected cost of being caught shirking *rises* once this worker gains international experience. Thus, if the workers was exerting effort *before* gaining international experience, it will be optimal to continue to exert effort *after* gaining international experience.

$$(2.d') \quad \rho V_{ex}^s(w_m) = \frac{w_m}{\bar{p}} - \delta_w V_{ex}^s(w_m) + d_m [V_{ol}(w_l) - V_{ex}^s(w_m) - \bar{\kappa}]$$

$$(2.e) \quad \rho V_{ix}(w_m) = \frac{w_m}{\bar{p}} + a_h G(\kappa_i) \left(EV_h(w_h) - V_{ix}(w_m) - \frac{1}{G(\kappa_i)} \int_0^{\kappa_i} \kappa g(\kappa) d\kappa \right) - \delta_w V_{ix}(w_m)$$

$$\text{where } EV_h(w_h) = \int_0^{c_i} V_{ih}(w_h, c) h(c) dc + [1 - H(c_i)] V_{ih}^s(w_h)$$

$$(2.f) \quad \rho V_{ih}(w_h, c) = \frac{w_h}{\bar{p}} - c + a_d G(\kappa_d) (V_{id}(w_d) - V_{ih}(w_h, c)) - \delta_w V_{ih}(w_h, c)$$

$$(2.f') \quad \rho V_{ih}^s(w_h) = \frac{w_h}{\bar{p}} - \delta_w V_{ih}^s(w_h) + d_h [\lambda_n EV_n(w_m) + (1 - \lambda_n) EV_x(w_m) - V_{ih}^s(w_h) - \bar{\kappa}]$$

Note that (2.a) and (2.g) are unaffected by the extension since you cannot be demoted when you are inexperienced or working in the development sector. Equation (2.b) changes only slightly in that when the worker receives an offer to move they are not sure of their cost of effort and therefore the capital gain from accepting the offer is based on a convex combination of what they will earn if they draw a low cost of effort (and exert effort) and what they will earn if they draw a high cost of effort (and shirk). This convex combination is denoted by $EV_n(w_m)$ if the offer comes from a medium wage non-exporter and $EV_x(w_m)$ if the offer comes from a medium-wage exporter. Similar logic explains the change to (2.e).

Equations (2.c), (2.d) and (2.f) apply to workers that are exerting effort and therefore do not need to worry about being fired. The only change to these equations is that we now must account for the cost of effort, c . The remaining equations apply to those workers that draw a high cost of effort and shirk. These equations account for the expected capital loss from shirking. Note that fired workers incur a cost of moving, which, in expected value terms is $\bar{\kappa}$, the mean of the cost of moving distribution.

Since the marginal worker is just indifferent between shirking and exerting effort, the new critical cost cut-offs are determined as follows

$$(3.e) \quad V_{en}(w_m, c_n) = V_{en}^s(w_m)$$

$$(3.f) \quad V_{ex}(w_m, c_x) = V_{ex}^s(w_m)$$

$$(3.g) \quad V_{ih}(w_h, c_i) = V_{ih}^s(w_h)$$

Since we know that workers with costs below these critical cut-off rates exert effort, we can now define the shirking rates as

$$(15.a) \quad s_{en} = 1 - H(c_n)$$

$$(15.b) \quad s_{ex} = 1 - H(c_x)$$

$$(15.c) \quad s_{ih} = 1 - H(c_i)$$

The pricing equation for domestic market for medium-wage firms is different under this extension, because prices depend on worker productivity and productivity in domestic production for these firms depends on the shirking rate. In particular, (5.b) becomes

$$(5.b) \quad p_n(\phi) = \frac{\sigma}{\sigma-1} \frac{w_m}{[\beta s_{en} + 1 - s_{en}] \phi}, \quad \phi \in [\phi_l, \phi_n]$$

$$(5.b') \quad p_x(\phi) = \frac{\sigma}{\sigma-1} \frac{w_m}{[\beta s_{ex} + 1 - s_{ex}] \phi}, \quad \phi \in [\phi_n, \phi_x]$$

Workers that exert effort keep their basic skills and have a productivity of ϕ , while workers that shirk lose their basic skills and have their productivity revert to $\beta\phi$. Since the shirking rate is different for medium-wage non-exporters and exporters, their domestic prices now differ. Note that (5.a) and (5.c) do not change. This follows from two assumptions. First, we assume that workers do not need to exert effort to maintain their basic skills until securing a medium-wage job, implying that productivity at low-wage firms is still described by $(\lambda_{ol}\beta + \lambda_{el})$. Second, we assume that high-wage workers need to exert effort to maintain their *international* experience, implying that all such workers have basic experience and thus, productivity in production of ϕ .

The pricing equation for foreign markets changes only for high-wage firms. For medium-wage exporters, trade costs do not change since all workers gaining international experience keep it until moving to high-wage firms – thus, (5.d) still applies. However, for high-wage firms, some workers shirk and see their international experience disappear. The fraction of workers that shirk is s_{ih} , so that (5.e) becomes

$$(5.e) \quad p_h^*(\phi) = \frac{\sigma}{\sigma-1} \frac{w_h}{\phi} \frac{1}{\eta[1-s_{ih}]^\theta}$$

Since shirking affects that average product of the workforce at medium-wage firms, the labor demand functions also change. Start with the demand for workers used to satisfy domestic demand. We now have (note that labor demand by exporters and non-exporters now demand now differ)

$$(6.b) \quad \ell_n(\phi) = f + f_e + \frac{q_n}{[\beta s_{en} + 1 - s_{en}]\phi}$$

$$(6.b') \quad \ell_x(\phi) = f + f_e + \frac{q_x}{[\beta s_{ex} + 1 - s_{ex}]\phi}$$

All workers at high-wage firms have basic experience, so (6.c) does not change.

Finally, consider the labor used to satisfy foreign demand. Workers do not shirk at medium-wage exporters and their workers that gain international experience keep it until they get to high-wage firms. Thus, (7.a) does not change. However, (7.b) becomes

$$(7.b) \quad \ell_h^*(\phi) = f_x + f_i + \frac{q_h^*}{\phi} \frac{1}{\eta[1-s_{ih}]^\theta}$$

No other equations in the model change. Note that, in essence, this extension adds 3 new endogenous variables (the cut-offs that define the shirking rates) and 3 new equilibrium conditions, given in (3).

Appendix B

Our data originate from several register-based data sets from Statistics Sweden. Our empirical analysis uses two main datasets. The first one is the Swedish firm data base containing detailed information on all Swedish private sector firms. Firm level information on export for these firms originate from the Swedish Foreign Trade Statistics, collected by Statistics Sweden. Based on compulsory registration at Swedish Customs, the data cover all trade transactions outside the EU. Trade data for EU countries are available for all firms with a yearly import or export of around 1.5 million SEK and above. According to figures from Statistics Sweden, the data cover around 92% of total goods trade within the EU. The trade data cover export of goods but not on export of services.

The second data set includes detailed information all Swedish individuals at the age 16 or above. For our purpose, a crucial feature of the data is that we know if the person is in the labor force or not. Persons in the labor force can be linked to the firm level data set. The information on the individuals comes in two forms. Firstly, the main part of the information concerns the status in the month of November. Secondly, there are some additional information on the status in the rest of the year, such as the number of days being unemployed.

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Figure 1: The Firm's Decision Tree

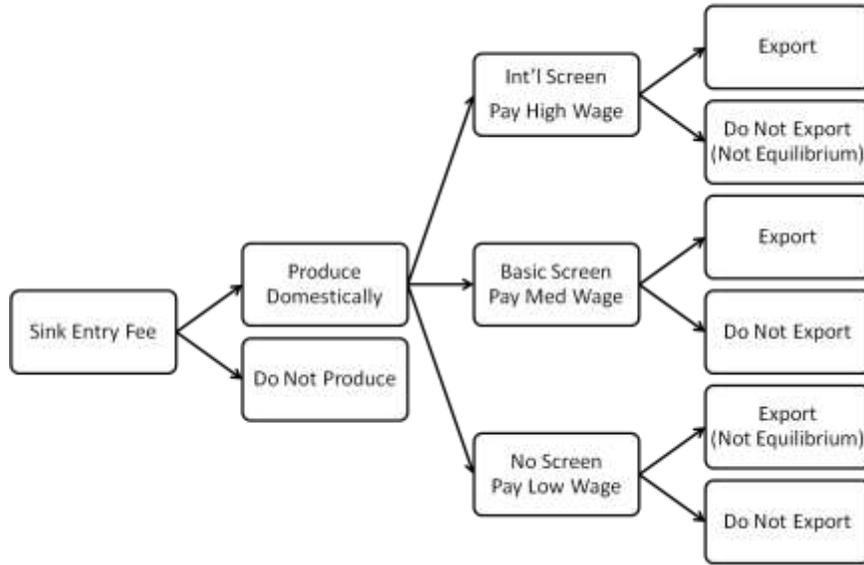


Figure 2: Worker Flows

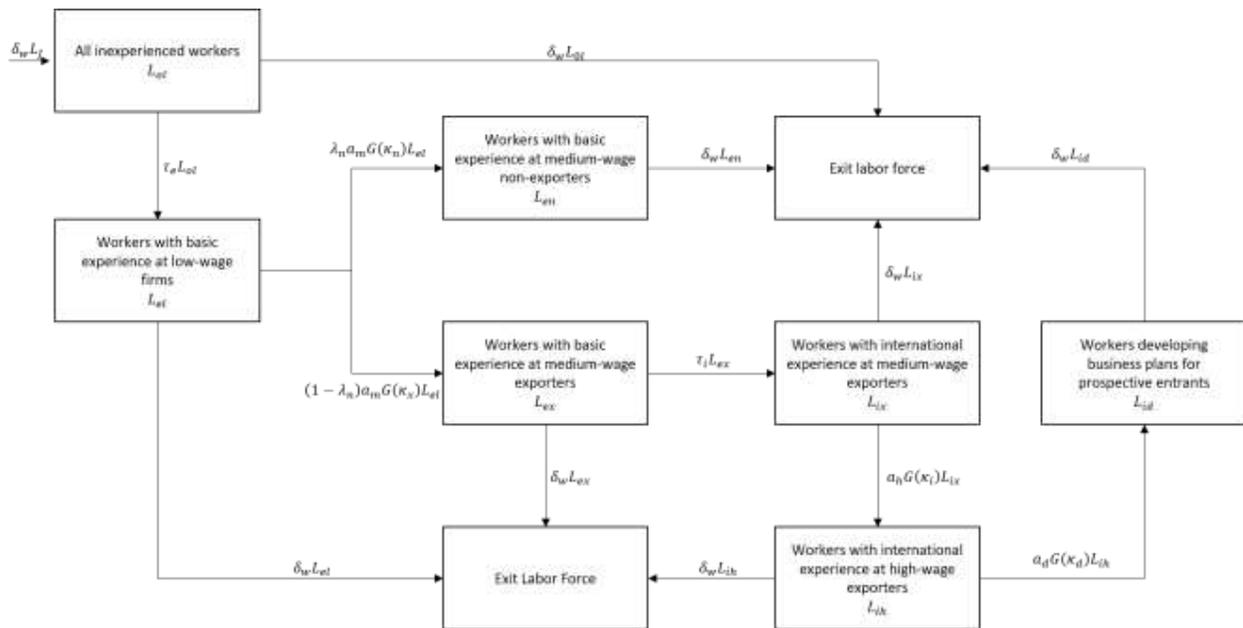


Figure 3: Real Wage Effects

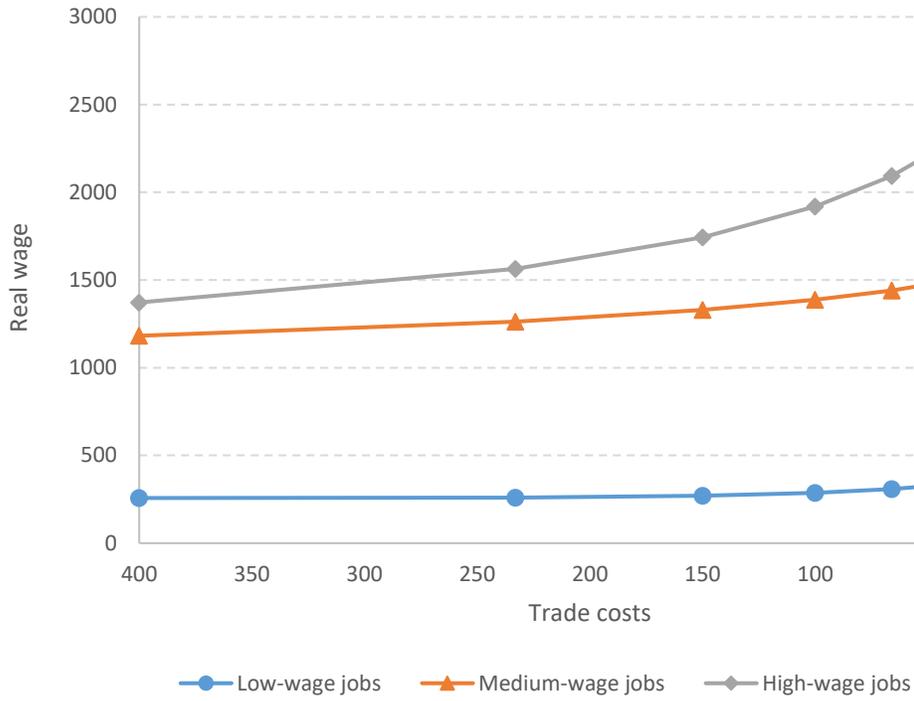


Figure 4: Employment Shares

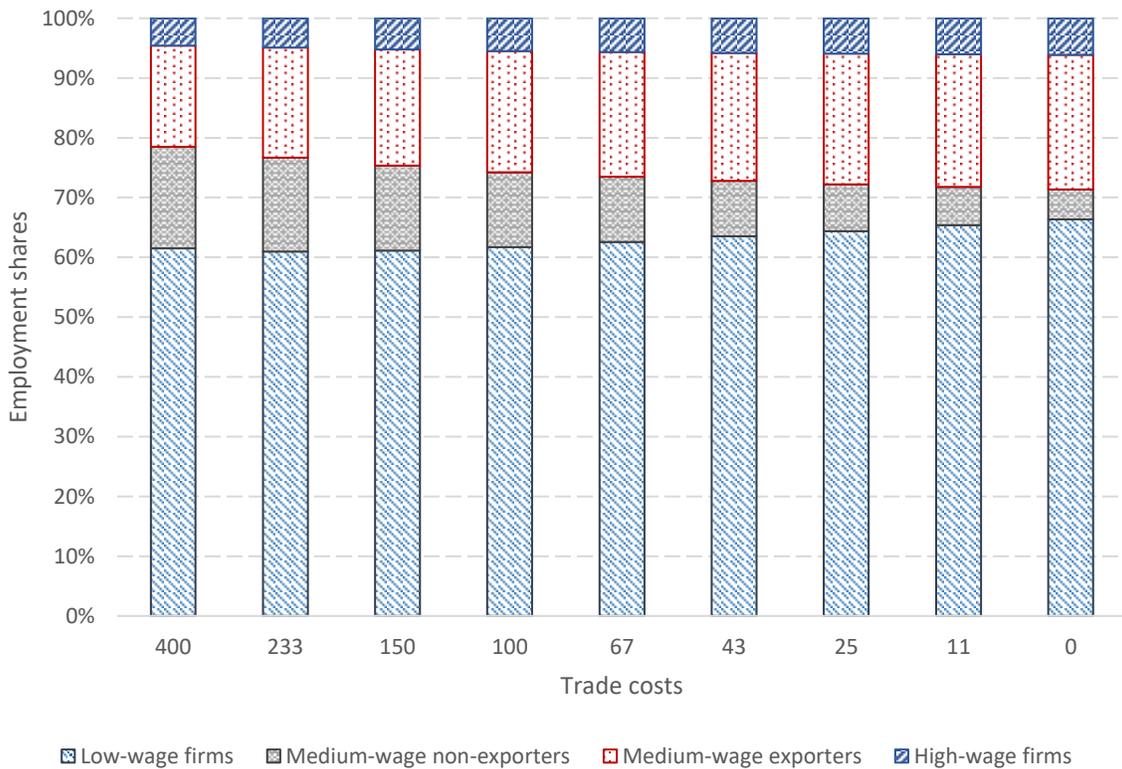


Figure 5A: Average Duration of Low-Wage Jobs

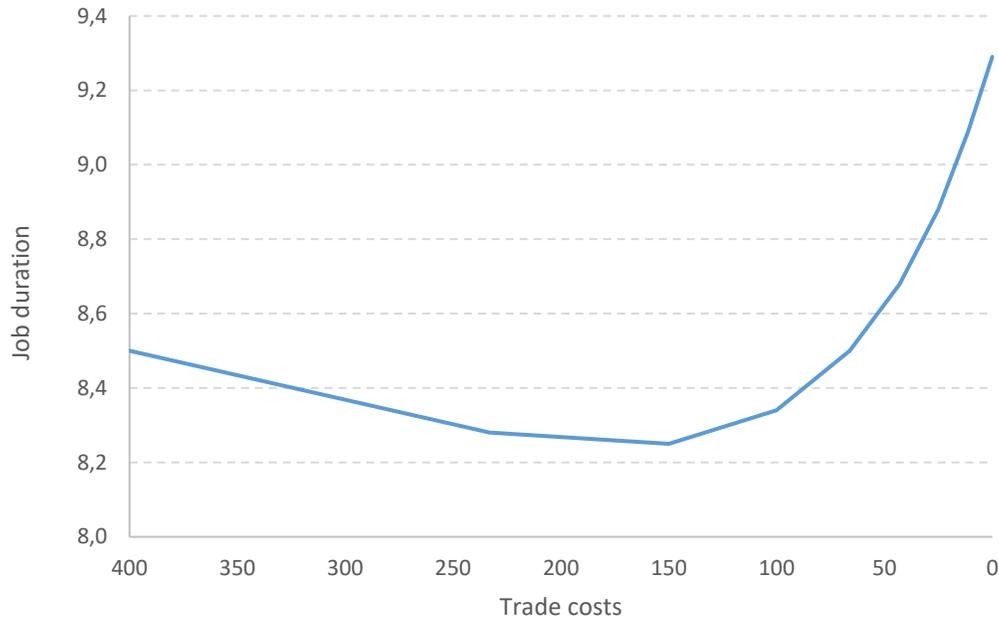


Figure 5B: Transition Rate to Jobs at Medium-Wage Exporters

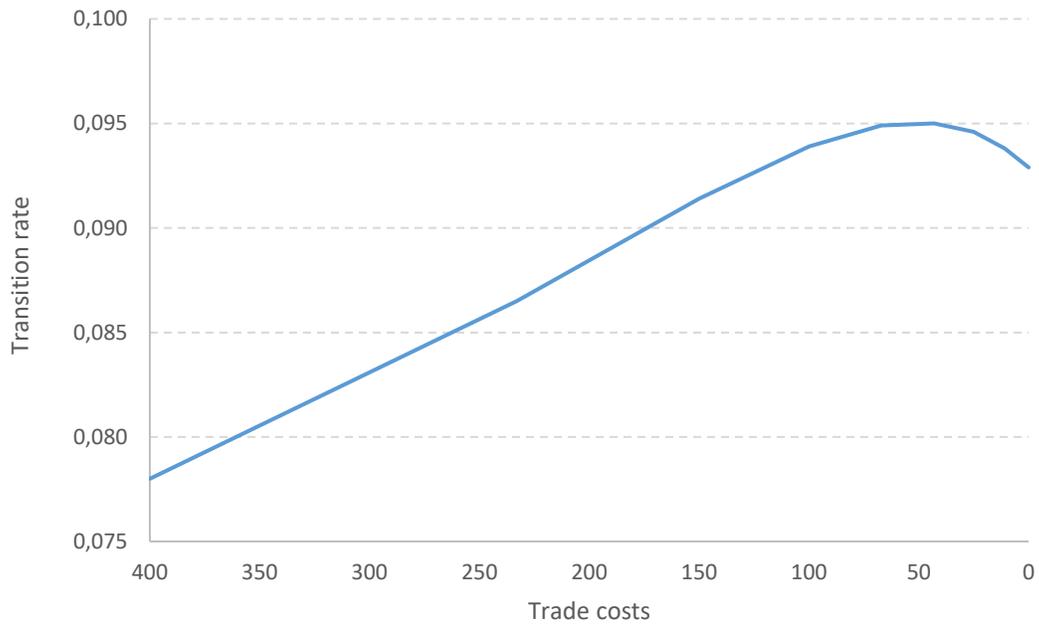


Figure 6: Measures of Inequality

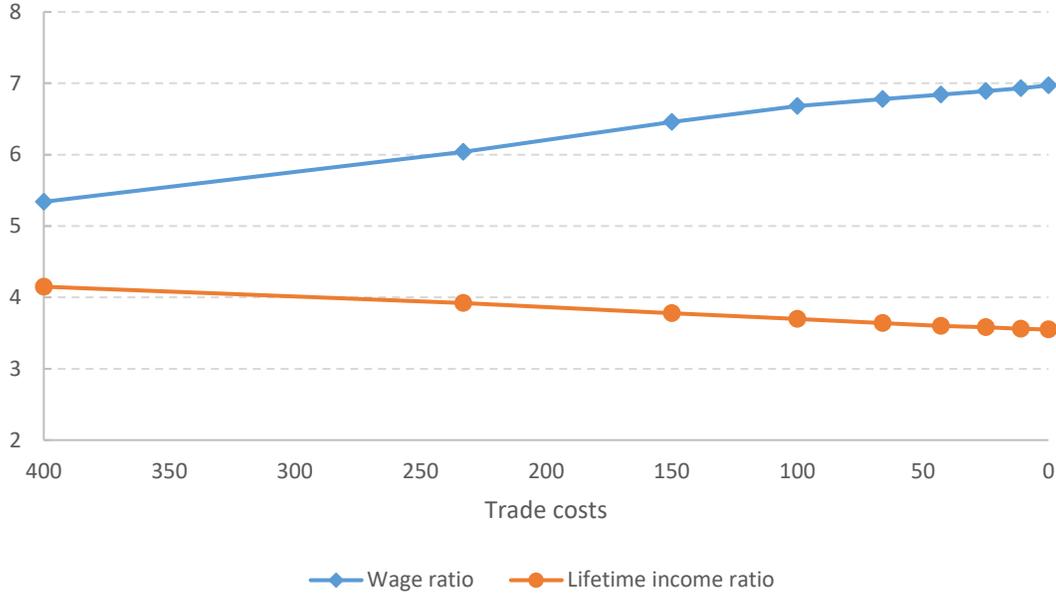


Figure 7: Worker Flows with Downward Economic Mobility

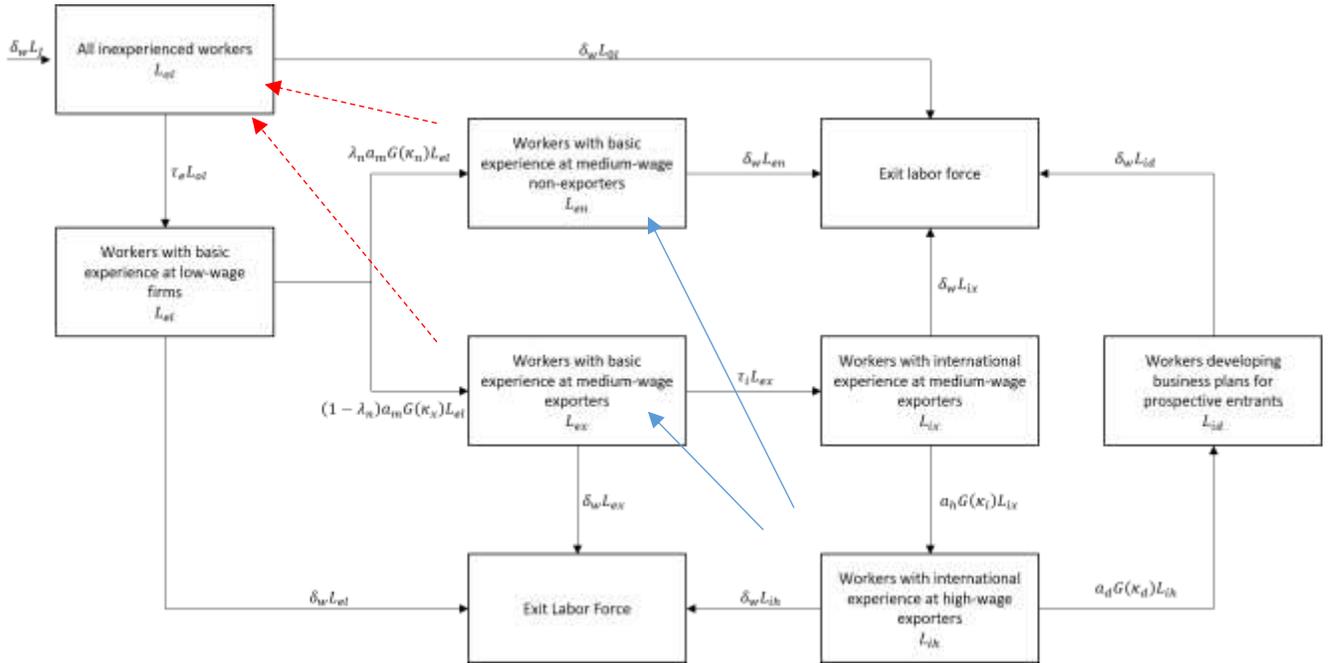
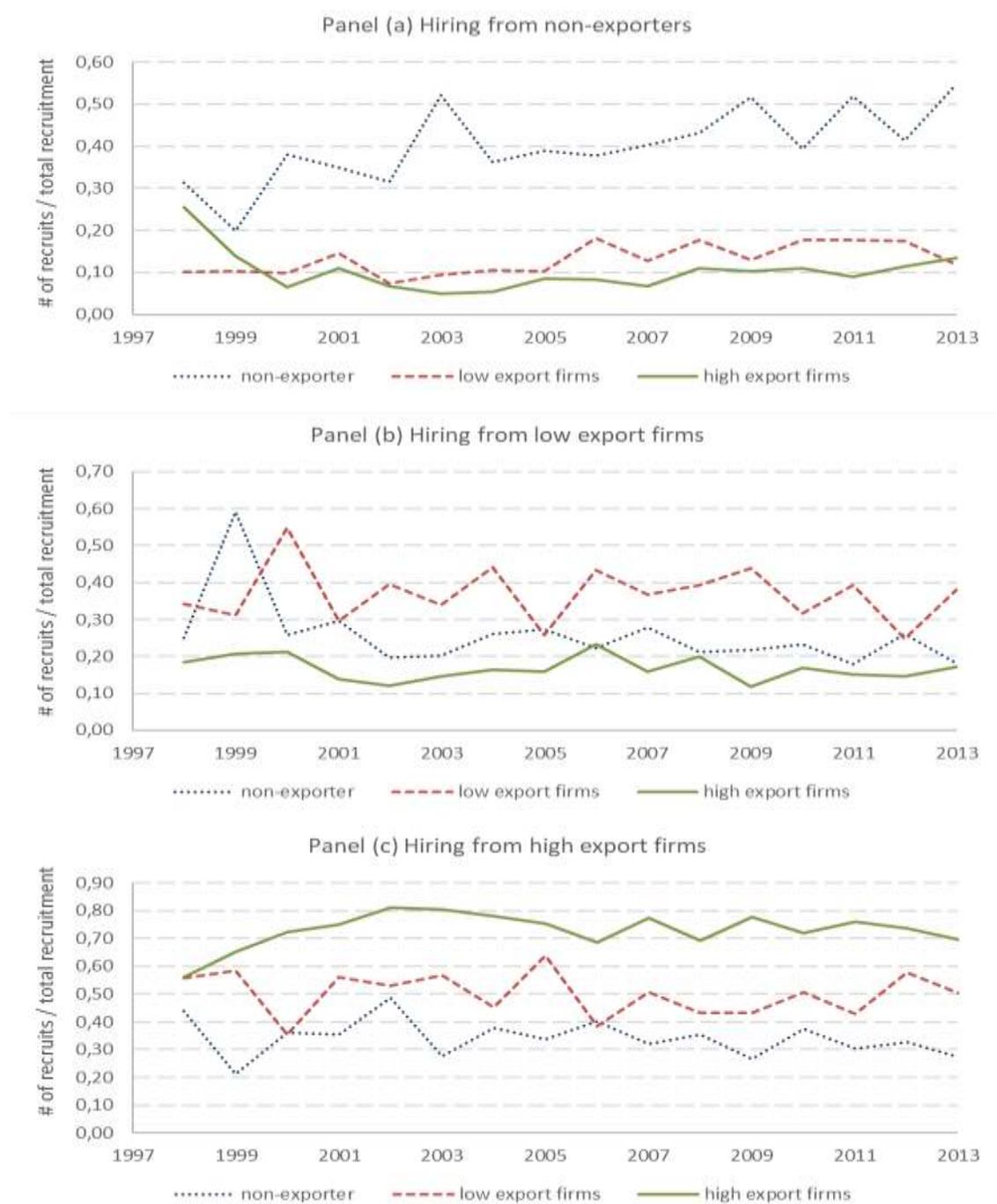


Figure 8: Hiring Practice by Firm Types



Notes: This figure displays the pattern of recruitment by three firm groups: (i) firms that do not export ("non-exporters"); (ii) firms that have export-to-sales ratios below the sample median of exporting firms across all industries ("low export firms"); and (iii) firms that have export-to-sales ratios above the sample median of exporting firms across all industries ("high export firms"). Panels (a)-(c) show the number of recruits from non-exporters, low export firms and high export firms, respectively, as a share of total recruitment by each firm group. For example, in 2005, out of the total recruitment by high export firms, about 8% came from non-exporters (see panel a), 16% from low export firms (see panel b), and 76% from other high export firms (see panel c).

Table 1: Mobility regressions

	Professionals and managers					Clerks				
	3 firm groups	5 firm groups	10 firm groups	> 0%	> 10%	3 firm groups	5 firm groups	10 firm groups	> 0%	> 10%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>Panel A: Upward mobility</i>										
Industry export share	0.0173** (2.20)	0.0203** (2.61)	0.0158** (2.34)	0.853* (2.07)	0.837* (1.90)	0.00785 (0.75)	0.00898 (0.79)	-0.00323 (-0.45)	0.626 (1.22)	0.626 (1.16)
Observations	192	192	192	192	192	192	192	192	192	192
Adjusted R2	0.089	0.121	0.117	0.188	0.120	0.006	-0.005	0.036	0.121	0.074
<i>Panel B: Downward mobility</i>										
Industry export share	-0.0487 (-1.33)	-0.103 (-1.49)	-0.0820 (-1.32)	-1.047** (-2.87)	-1.288*** (-3.21)	-0.0202 (-1.40)	-0.0484 (-1.46)	-0.0364 (-1.19)	-0.754 (-1.57)	-1.034* (-1.85)
Observations	192	192	192	192	192	192	192	192	192	192
Adjusted R2	0.065	0.109	0.099	0.169	0.229	0.108	0.087	0.078	0.081	0.099

Notes: This table examines the link between worker mobility and trade openness at the industry level. Industry export share is computed as an industry's total exports as a share of total sales. In panel A columns 1 and 6, upward mobility is defined as $\sum_{ij} S_{ijt}(j-i)/(k-1)$ for $i < j$ where i (and j) = 1, 2, 3 indicate, respectively, the group of non-exporters, low export firms (those with export-to-sales ratios below the sample median of exporting firms across all industries), and high export firms (those with export-to-sales ratios above the sample median of exporting firms across all industries); S_{ijt} is the number of workers who move from a firm in the i group to another firm in the j group as a share of all movers between year $t-1$ to year t ; and k is the number of firm groups. In panel A columns 2 and 7, firms are divided into 5 groups in which the first group consists of non-exporters, and the other four groups are based on quartiles of the distribution for export-to-sales ratios of exporting firms across all industries. In columns 3 and 8, firms are separated into 10 groups. In panel A columns 4 and 9, upward mobility is computed as the share of workers who move up to firms that have a larger export-to-sales ratio compared to the worker's previous employee. In panel A columns 5 and 10, upward mobility is computed as the share of workers who move up to firms that have a larger export-to-sales ratio by more than 10 percentage points compared to the worker's previous employee. In panel B all measures of downward mobility are constructed in a way similar to those of upward mobility in panel A. In all regressions, both industry and year fixed effects are included. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Table A1: Mobility regressions: robustness to alternative firm grouping

	Professionals and managers			Clerks		
	3 firm groups	5 firm groups	10 firm groups	3 firm groups	5 firm groups	10 firm groups
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Upward mobility</i>						
Industry export share	0.0154** (2.36)	0.0191** (2.91)	0.0151* (1.89)	-0.0132 (-0.80)	-0.00223 (-0.29)	-0.00367 (-0.55)
Observations	192	192	192	192	192	192
Adjusted R2	0.146	0.092	0.087	0.066	0.077	0.070
<i>Panel B: Downward mobility</i>						
Industry export share	-0.000104 (-0.01)	-0.0885 (-1.24)	-0.0812 (-1.28)	-0.00584 (-0.49)	-0.0464 (-1.39)	-0.0465 (-1.53)
Observations	192	192	192	192	192	192
Adjusted R2	0.108	0.081	0.088	0.021	0.041	0.064

Notes: This table examines the link between worker mobility and trade openness at the industry level. Industry export share is computed as an industry's total exports as a share of total sales. Differing from Table 1, in this table firms are grouped based on the distribution of export-to-sales ratios of exporting firms within each industry. In panel A columns 1 and 4, upward mobility is defined as $\sum_{ij} S_{ijt}(j-i)/(k-1)$ for $i < j$ where i (and j) = 1, 2, 3 indicate, respectively, the group of non-exporters, low export firms (those with export-to-sales ratios below the industry median of exporting firms), and high export firms (those with export-to-sales ratios above the industry median of exporting firms); S_{ijt} is the number of workers who move from a firm in the i group to another firm in the j group as a share of all movers between year $t-1$ to year t ; and k is the number of firm groups. In panel A columns 2 and 5, firms are divided into 5 groups in which the first group consists of non-exporters, and the other four groups are based on quartiles of the distribution for export-to-sales ratios of exporting firms within an industry. In columns 3 and 6, firms are separated into 10 groups. In panel B all measures of downward mobility are constructed in a way similar to those of upward mobility in panel A. In all regressions, both industry and year fixed effects are included. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.