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Monopsonistic Labor Markets and International Trade

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Abstract

We study the impact of trade on wage inequality and welfare when the labor market is monopsonistic. Firm heterogeneity in productivity along with workers' idiosyncratic preferences for different firms generate between-firm wage inequality for workers with identical skills. The model features a novel welfare channel of workers' "love of firm variety." Trade liberalization provides additional welfare gains through the firm-variety channel when monopsony power is high but detracts from welfare gains when monopsony power is low.

JEL Classification: F12, F13, F16

Keywords: monopsonistic labor market, wage inequality, trade liberalization, love of firm variety

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1 Introduction

Employers have monopsony power in the labor market, which means that individual firms face an upward-sloping—rather than a perfectly elastic—labor supply and thus have wage-setting power.[1] In spite of its first order importance, the vast literature on trade and labor markets has largely ignored the implications of employers' monopsony power on trade-related economic outcomes. The objective of this paper is to fill this gap by providing a theoretical framework to study the effects of trade on the allocation of economic activity, wage inequality, and welfare when the labor market is monopsonistic. In this process, we uncover a novel *love-of-firm-variety* mechanism through which trade affects welfare: workers value having a variety of firms to choose from, and with trade liberalization affecting the number of domestic firms, workers' welfare is then also affected through the firm-variety channel.

Toward our goal, we incorporate a static monopsonistic competition model of the labor market in a standard Melitz-type model with heterogeneous firms. Therefore, in our model there is monopolistic competition in the product market and monopsonistic competition in the labor market. Monopsony power arises because workers have idiosyncratic preferences for jobs across different employers; this could happen either because a worker likes the amenities offered by a particular firm or prefers the location of the firm. As a consequence, each firm ends up facing an upward-sloping labor supply curve with a constant wage elasticity. By capturing monopsony power in a single parameter, our CELS (constant elasticity of labor supply) model provides straightforward intuition for the effects of firms' wage-setting power within a Melitz structure.

The mechanism is simple: facing an upward-sloping labor supply curve, if a firm wants to attract more workers, it will have to offer higher wages. Hence, firm heterogeneity in productivity translates into heterogeneity in wages, with more productive firms not only hiring more workers but paying higher wages too. In a closed-economy version of the model, we show that an increase in monopsony power relaxes the competitive environment. Intuitively, monopsony power acts as a check on high-productivity firms because it makes hiring more expensive for them as they have to be further up the upward-sloping labor-supply schedule. This has implications for the allocation of resources across firms: more productive firms are smaller, and less productive firms are larger in comparison to their sizes in the competitive labor market benchmark. Moreover, given that low productivity firms

[1] Naidu, Posner, and Weyl (2018) document extensive usage of anti-competitive practices in the labor market (such as non-compete covenants and no-poaching agreements) that reduce the mobility of workers between jobs and increase the monopsony power of employers. For example, Krueger and Posner (2018) find that 24.5 percent of U.S. workers said that they are, or have been, bound by non-compete agreements. Relatedly, Starr, Prescott, and Bishara (2019) find that 12.5 percent of U.S. workers without college education and earning less than $40,000 a year were bound by non-compete clauses in 2014.

also pay lower wages, an increase in monopsony power raises inequality in the closed economy; *i.e.*, inequality increases due to the expansion of the lower tail of the wage distribution.

A consequence of the idiosyncratic preferences of workers for employers is that their welfare, measured by expected maximized utility, depends not only their real income but also on the number of domestic firms that they can choose to work for. An increase in the number of domestic firms increases the welfare of workers because they are more likely to find a better match; *i.e.*, workers have love of firm variety. We refer to this welfare effect as the *firm-variety channel*, which is distinct from the conventional love-of-variety channel on the consumption side.

In an open economy, and similar to Melitz (2003), only high-productivity firms export due to the existence of fixed and iceberg trading costs. A key difference from the standard Melitz model, however, is that the act of exporting has a feedback effect on wages because exporting firms need to hire more workers, and therefore, they are further up the labor-supply schedule. Hence, when a firm is deciding whether to export, it not only has to consider trading costs and the profits in the export market, but also the impact of exporting on wages, which will affect its profits from domestic sales. More monopsony power increases a firm's exporting wage premium, reducing the firm's incentives to export and leading to a smaller fraction of exporting firms. As a consequence, for high degrees of monopsony power, trade liberalization always increases wage inequality.

Trade liberalization always increases the real income or the average wage of workers. However, the average-wage gains from trade are smaller the greater the degree of monopsony power in the labor market. Intuitively, although trade liberalization drives market-share reallocations toward more productive firms, these are dampened by the negative impact of monopsony power on exporting, reducing the positive effect of trade liberalization on the average wage.

Whereas love-of-variety on the consumption side works through the total number of available varieties (both domestically produced and imported), the firm-variety channel works solely through the number of domestic firms. In spite of trade wiping out the least productive firms, we show that the firm-variety channel is an additional source of gains from trade when monopsony power is high (*i.e.,* in that case, trade liberalization increases the mass of domestic firms). For lower degrees of monopsony power—and as in a standard Melitz model with a competitive labor market—trade liberalization reduces the mass of domestic firms, and hence, the firm-variety channel is a source of welfare loss from trade. Therefore, looking at real income alone understates the gains from trade for high degrees of monopsony power, and overstates the gains from trade for low degrees of monopsony power.

The paper is organized as follows. In section 2 we provide the stylized facts that motivate our theoretical model, whereas section 3 provides a discussion of the related theoretical literature. In sections 4 and 5 we present the model for the closed economy, and in sections 6 and 7 we extend it to the open-economy case. Finally, section 8 provides some concluding remarks.

2 Empirical Background

This section describes five stylized facts that provide the empirical underpinnings of our model: *(i)* individual firms face an upward-sloping labor supply, *(ii)* more monopsony power is associated with lower wages, *(iii)* larger firms set higher wages, *(iv)* exporters set higher wages than non-exporters, and *(v)* trade affects the number of firms in the economy, and hence, the variety of employers.

Stylized Fact 1. *Labor markets are monopsonistic; that is, individual firms face an upward-sloping labor supply.*

In a competitive labor market each firm faces an infinitely elastic labor supply curve at the equilibrium wage. On the other hand, a labor market is monopsonistic—so that the firm has wage-setting power—if and only if each firm faces an upward-sloping labor supply; that is, if and only if the elasticity of firm-level labor supply is finite.

There is an abundance of empirical studies documenting finite firm-level labor supply elasticities.[2] Using the U.S. Census's Longitudinal Employer-Household Dynamics (LEHD) data for 47 states during 1985-2008, Webber (2015) estimates a different labor-supply elasticity for each individual firm in his sample, obtaining a mean of 1.08 and a median of 0.75 (as well, 90 percent of firms have elasticities below 1.73).[3] Naidu, Posner, and Weyl (2018) provide an extensive survey of studies that estimate firm-level labor supply elasticities and give a range of 1 to 5.

It is worth pointing out that while many of these studies find the elasticity of labor supply to vary across firms, in our theoretical model the elasticity of labor supply is constant across firms, which allows us to derive analytical results in a tractable and intuitive fashion. In principle it is

[2] Falch (2010), estimates a labor-supply elasticity of 1.4 to individual schools in the Norwegian teacher labor market. Staiger, Spetz, and Phibbs (2010) rely on an exogenous wage change in Veteran Affairs hospitals and find a labor-supply elasticity of 0.1 (for individual hospitals) in the labor market for nurses. Looking instead at an online labor market, Amazon MTurk platform, Dube, Jacobs, Naidu, and Suri (2020) calculate a labor supply elasticity for task requesters of about 0.1. Manning (2003) uses U.S. and U.K. data and estimates labor-supply elasticities to individual firms in the range between 0.75 and 1.5.

[3] Relatedly, Hirsch, Jahn, and Schnabel (2018) use German linked employer-employee quarterly data from 1985 to 2010 to study the evolution through time of the firm-level labor supply elasticity. They find that the labor supply elasticity ranges between 1.86 and 2.81, taking lower values—so that firms have more monopsonistic power—during downturns. More recently, using the U.S. Census's Longitudinal Business Database, Berger, Herkenhoff, and Mongey (2019) estimate firm-level labor supply elasticities ranging from 0.76 (for a firm that controls an entire local labor market) to 3.74 for the smallest firms.

straightforward to extend the model to allow for variable elasticity of labor supply across firms; this comes, however, at the cost of sacrificing analytical tractability.[4]

Stylized Fact 2. *More monopsony power is related to lower wages.*

As shown in our theoretical model, monopsony power implies that wages are marked down below the marginal product of labor and the gap is larger the lower the elasticity of labor supply. There is considerable empirical support for this adverse effect of monopsony power on wages. After controlling for person and firm fixed effects, as well as for demographic and employer controls, Webber (2015) finds that a unit increase in the labor supply elasticity is associated with a 15 percent increase in earnings. Hirsch, Schank, and Schnabel (2010) use matched employer-employee data from Germany and estimate firm-level labor supply elasticities ranging between 1.87 and 2.59 for females, and between 2.49 to 3.66 for males. These differences imply between 4.6 percent to 17.4 percent higher wages for males, which can explain at least a third of the gender wage gap.[5] Extending his previous work, Webber (2016) uses U.S. LEHD data and finds average firm-level labor supply elasticities of 0.94 for females and 1.09 for males, which are associated with a 3.3 percent higher average wage for males.

Stylized Fact 3. *The employer-size wage effect: on average, larger firms pay higher wages. This effect remains after controlling for worker characteristics.*

A monopsonistic labor market implies that larger firms pay higher wages: for two firms facing a similar upward-sloping labor supply, the firm with the largest labor demand will pay a higher equilibrium wage. Thus, the so-called "employer-size wage effect"—which has strong empirical support—is a natural consequence of the heterogeneous-firm model in this paper. Given our model's homogeneous-labor assumption, the robustness of stylized fact 3 to worker-level controls is important, as it highlights that the employer-size wage effect cannot be explained solely by larger firms hiring more-skilled workers.

The classic reference documenting the prevalence of the employer-size wage effect is the paper by Brown and Medoff (1989), who show using U.S. data that a large positive relationship between employer size and wages appears within groups of *similar workers* and after including industry-level controls. Oi and Idson (1999) describe similar results in their extensive survey of the size-wage premium for several countries. Troske (1999) uses detailed matched employer-employee data of U.S.

[4] See MacKenzie (2018) for a model studying the implications of trade in an oligopsonistic labor market with variable labor supply elasticity. This paper conducts a quantitative exercise instead of deriving analytical results.

[5] Using data from a U.S. grocery retailer Ransom and Oaxaca (2010) obtain female elasticities between 1.5 and 2.5, and male elasticities between 2.4 and 3, with predicted wage gaps ranging between 4 and 20 percent.

manufacturing establishments and workers, and finds—after controlling for worker characteristics—a 13 percent higher wage for establishments one standard deviation above the mean when compared to those one standard deviation below.[6] The gap declines to 11 percent after controlling for plant-level variables of workforce skill, indicating that matching of high-skilled workers with larger plants only explains about 20 percent of the employer-size wage premium.[7]

Stylized Fact 4. *The exporter wage premium: on average, exporters pay higher wages than non-exporters. The premium persists even after controlling for worker characteristics.*

In the Melitz (2003) model, firm-level labor demand has two characteristics: first, it is increasing in productivity, and second, given the existence of a cutoff productivity level that separates exporting and non-exporting firms, there is a discrete jump in labor demand at this cutoff as exporters require more workers to produce for the foreign market. The same happens if firms face an upward sloping labor supply (as in our model), but now there are also implications for wages, which show a positive relationship with productivity, and a positive discrete jump at the exporting cutoff level.

Therefore, in our model the exporter wage premium is an enhanced employer-size wage effect: exporters pay higher wages than non-exporters because they are more productive and thus larger, but on top of that, exporting requires a discrete jump in employment that further exacerbates the wage gap. Given the solid empirical evidence showing that exporters are on average larger than non-exporters (Bernard, Jensen, Redding, and Schott, 2007), stylized fact 4 can be seen as an extension of stylized fact 3, but fortunately, it has been independently verified by a large number of studies.[8]

Baumgarten (2013) uses linked employer-employee data during 1996-2007 to study the exporter wage gap within and between skill groups for male German workers in manufacturing. Supporting our model's assumptions, which abstract from skill differences and within-firm wage heterogeneity, he finds that two thirds of the wage inequality increase during the period occurred within skill groups, 80 percent occurred within industry, and two thirds occurred between establishments. Moreover,

[6] Bayard and Troske (1999) expand the sample to include non-manufacturing establishments, finding premiums of 10 and 11 percent in retail trade and services, respectively.

[7] Gibson and Stillman (2009) use worker-level data from a literacy survey for nine OECD countries and after controlling for demographic variables, they obtain statistically significant employer-size wage premiums in seven of them. They further add controls for worker skills (including education and literacy levels), but find that they do nothing or very little to reduce these premiums.

[8] Bernard and Jensen (1995) present the first evidence showing that U.S. manufacturing exporters pay higher wages than non-exporters for both production and non-production workers. Expanding these results, Bernard and Jensen (1999) find that firms that will become exporters are ex-ante more productive, larger, and have higher wages than non-exporters, and once they start exporting their short-run growth rates of employment and wages—after controlling for plant characteristics—are also larger. These findings align well with the mechanisms described in our model. Schank, Schnabel, and Wagner (2007) surveys 22 studies for 21 different countries that obtain similar findings, and more recently, Brambilla, Depetris Chauvin, and Porto (2017) provide evidence of the exporter wage premium using data from 61 non-advanced countries.

conditional on skill levels, he finds that the increase in the exporter wage premium contributed to the rise in inequality, but the effect becomes smaller and statistically insignificant when controlling for establishment size. The last finding is consistent with our model, as in our theory the higher wages for exporters are a consequence of their size.

Similarly, Frías, Kaplan, Verhoogen, and Alfaro-Serrano (2018) use linked employer-employee data from Mexico to study the exporter wage premium while carefully accounting for changes in the skill composition within firms. Using the large Mexican peso devaluation at the end of 1994 as the shock affecting exporting incentives, they find an increase in the exporting wage premium and that this is driven by different wage policies across exporting and non-exporting plants, rather than by changes in the workforce composition.[9]

Since the studies using matched employer-employee data are better able to control for the sorting of high productivity workers into more productive firms, the consistent evidence of exporter wage premium conditional on worker characteristics in these studies supports our result of the exporter wage premium being an enhanced employer-size wage effect.

Stylized Fact 5. *Trade affects the number of firms in the economy, and hence, the variety of employers.*

One novel result in our paper is that trade affects welfare through the firm-variety channel by affecting the number of firms in the economy. There are several empirical papers documenting the rise in the probability of death of firms—job destruction at the extensive margin—in response to a trade shock (see, for example, Levinsohn, 1999, Groizard, Ranjan, and Rodriguez-Lopez, 2015, Bernard, Jensen, and Schott, 2006a,b). In a recent paper, Asquith, Goswami, Neumark, and Rodriguez-Lopez (2019) find that the 'China shock' affected U.S. employment mainly through deaths of establishments. The death of establishments acquires increased salience in our model because it adversely affects the welfare of workers by reducing their choice of employers.

3 Theoretical Background

Robinson (1933) introduced the first formal discussion of monopsony; however, for several decades it was confined to the fringes of labor economics and to the simple textbook partial-equilibrium case discussing the possibility of a minimum wage raising employment. Since the 1990s, Alan Manning has played a key role in reviving the theoretical and empirical literature on monopsony. Interestingly,

[9] Macis and Schivardi (2016) perform a similar exercise with linked employer-employee data from Italy and using the 1992 lira depreciation as an identification tool. Keeping worker characteristics constant, they find that exporting causes firms to pay higher wages.

in his book *Monopsony in Motion* (Manning, 2003), he gives credit to Burdett and Mortensen (1998) for reviving his interest in the subject after he encountered an early version of this paper. Following Burdett and Mortensen (1998), who introduce a wage-posting model where monopsony power arises due to search frictions, Manning (2003) provides a series of dynamic models to explore the welfare consequences of firms' wage-setting power and to explain several empirical labor-market observations (see Manning, 2011 for a more recent survey of this literature). Unlike these dynamic models of monopsony power, we use a static framework similar to Thisse and Toulemonde (2010) and Card, Cardoso, Heining, and Kline (2018) where workers have idiosyncratic preferences for different employers. The static framework keeps the model tractable and allows us to study the interaction between the degree of monopsony power and trade barriers in the open economy. Neither Thisse and Toulemonde (2010) nor Card, Cardoso, Heining, and Kline (2018) explore the implications of globalization in the presence of monopsony.

Egger, Kreickemeier, Moser, and Wrona (2021) also develop a model of trade with heterogeneous firms and monopsonistic labor markets, with a special emphasis on the effects of offshoring on the wages and employment of skilled and unskilled workers. The main point of their paper is that firm-level upward sloping labor supplies increase firms' incentives to offshore a fraction of their unskilled tasks: by splitting a firm's labor requirements into two countries, the firm pays lower wages than if it hires domestically the same amount of unskilled labor. In other words, firms "act small" to suppress wages. In contrast, we focus on laying out the main mechanisms through which monopsony power affects inequality and welfare in the open economy, and identify a novel firm-variety channel through which trade liberalization affects welfare.[10]

Instead of using a random utility framework, MacKenzie (2018) uses a random productivity framework to generate labor market power. His market structure is oligopolistic on the product side and oligopsonistic on the labor market side, with a fixed mass of firms. After conducting a quantitative analysis using data from India, he finds that trade has a larger impact on firms' markups in the product market than on markdowns in the labor market. In MacKenzie (2018) the expected wage income of workers is equalized across firms. That is, all firms offer the same average wage to workers, and therefore, there is no wage dispersion across firms. Since wage dispersion across firms is a key feature of our model, a random utility framework is better suited for our purposes.

Other related work are papers using Melitz-type heterogeneous-firm models where different wages

[10] Heiland and Kohler (2018) study the implications of trade and migration in a model where the monopsonistic power of firms arises because workers have firm-specific skills. Trade and migration affect welfare through match quality. The former lowers match quality by making firms larger whereas the latter improves match quality by increasing labor supply.

across firms are the result of rent-sharing mechanisms between firms and workers. These include the fair-wage models of Amiti and Davis (2011) and Egger and Kreickemeier (2009, 2012), the screening model of Helpman, Itskhoki, and Redding (2010), and the search models of Coşar, Guner, and Tybout (2016), Felbermayr, Impullitti, and Prat (2018), Holzner and Larch (2011) and Fajgelbaum (2016). In these models more productive firms are larger and have a larger surplus to share with their workers, and hence they also feature an employer-size wage premium and an exporter wage premium.[11] Compared to these papers, the underlying source of wage inequality is different in our setup: due to the idiosyncratic preferences of workers, a firm has to offer a higher wage if it wants to attract more workers, resulting in a labor market with monopsonistic competition. By capturing firms' wage-setting power in a single parameter—the firm-level labor supply elasticity—our model delivers clear insights for the consequences of trade liberalization on wage inequality and welfare.

One key result in the models of Egger and Kreickemeier (2009) and Helpman, Itskhoki, and Redding (2010) is that there is an inverted-U relationship between trade barriers and wage inequality: starting from a situation with high trade barriers, trade liberalization initially increases inequality but further reductions in trade costs eventually start to reduce inequality. Our framework shows that this result crucially depends on the level of monopsony power, and in particular, it only occurs when monopsony power is low (*i.e.*, for high levels of the firm-level labor supply elasticity). For higher degrees of monopsony power, trade liberalization monotonically increases inequality.

An important contribution of our model is that it allows to study the impact of trade liberalization on welfare operating through the firm-variety channel. In search and matching models the number of jobs also matters for welfare; for example, a higher number of vacancies translates into a higher probability of finding a job, which leads to welfare improvements. In contrast, in our framework what is crucial is the number of firms because each firm provides a different set of amenities which appeal to different workers. As a consequence, when trade liberalization affects the number of domestic firms, it also affects the choice of workers in terms of which firm to work for, yielding welfare gains or losses. Empirically, this makes the impact of trade liberalization on the extensive margin of employment (due to births and deaths of firms) more salient.

[11] In contrast to the conventional Melitz model with constant marginal costs, all these monopolistic-competition models (in addition to the model of Egger, Kreickemeier, Moser, and Wrona, 2021 mentioned above) feature increasing marginal costs. For example, Holzner and Larch (2011) use a convex vacancy creation cost, Fajgelbaum (2016) uses a convex cost of search by firms for workers, Felbermayr, Impullitti, and Prat (2018) use a convex recruitment cost, and Helpman, Itskhoki, and Redding (2010) use a convex cost of screening workers.

4 The Closed-Economy Model

To develop intuition on how monopsony power affects the allocation of market shares, inequality and welfare, we start with a closed-economy model.

4.1 Preferences and Demand

The country is populated by a measure of $\mathbb{L}$ workers who are employed by differentiated-good firms. Each worker derives utility from the consumption of differentiated goods and from an idiosyncratic term that indicates the worker's preference for her employer.

The country produces a single final good Z which is a CES aggregator of differentiated goods,

$$Z = \left(\int_{\omega \in \Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}} .$$

In Z, $q(\omega)$ is the usage of variety ω, Ω is a set of measure M of the varieties available for purchase, and $\sigma > 1$ denotes the elasticity of substitution between differentiated-good varieties. This final good is used for consumption by workers as well as by firms to meet entry costs and fixed costs of operation. The demand for variety ω is then given by $q(\omega) = Z \left[\frac{p(\omega)}{P}\right]^{-\sigma}$, where $p(\omega)$ is the price of variety ω, and $P = \left[\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}}$ is the price of the final good, Z. With each firm producing a single variety, ω also identifies the firm.

A worker's utility from consumption is given by $u(C) = \alpha \ln C$, where C is the consumption of the final good. The final good is the numéraire, and hence $P = 1$. With this normalization, the amount of final good consumed by a worker is simply equal to her wage. In addition to consumption, workers' utility also depends on their job match. In particular, the utility of worker i who works at firm ω receiving wage $w(\omega)$ is

$$v_i(\omega) = \alpha \ln w(\omega) + \varepsilon_i(\omega), \tag{1}$$

where α captures the importance of consumption in overall utility, and $\varepsilon_i(\omega)$ is an idiosyncratic draw from a Type I Extreme Value distribution (*i.e.*, the Gumbel distribution) with mean zero and variance $\pi^2\rho^2/6$, with $\rho > 0$ denoting the distribution's dispersion parameter. The idiosyncratic term $\varepsilon_i(\omega)$ denotes the quality of the worker-firm match (from the worker's perspective), capturing non-pecuniary factors affecting the worker's preference for firm ω, such as distance and personal motives.[12]

[12]See Thisse and Toulemonde (2010), Card, Cardoso, Heining, and Kline (2018), and Egger, Kreickemeier, Moser, and Wrona (2021) for models that use a random utility framework along similar lines.

4.2 The CELS Monopsonistic Labor Market

Given the utility function in (1), with workers being free to choose where to work, and under the extreme value distribution of the idiosyncratic draws of a worker's job preferences over different firms, $\{\varepsilon_i(\omega)\}$, it follows from Ben-Akiva, Litinas, and Tsunokawa (1985) (who generalize the discrete-choice logit model of McFadden (1973) to the continuous-choice case) that each worker's logit probability of working at firm ω is

$$\mathbb{P}(\omega) = \frac{\exp\left[\frac{\alpha}{\rho}\ln w(\omega)\right]}{\int_{\nu\in\Omega}\exp\left[\frac{\alpha}{\rho}\ln w(\nu)\right]d\nu}. \tag{2}$$

Thus, the labor-supply function faced by firm ω is simply given by $L^S(\omega) = \mathbb{P}(\omega)\mathbb{L}$, which simplifies to

$$L^S(\omega) = \mathbb{B}w(\omega)^{\frac{\alpha}{\rho}} \equiv \mathbb{B}w(\omega)^{\theta}, \tag{3}$$

where $\theta \equiv \frac{\alpha}{\rho}$ is the wage elasticity of labor supply for every firm, and $\mathbb{B} \equiv \left[\int_{\nu\in\Omega} w(\nu)^{\theta}d\nu\right]^{-1}\mathbb{L}$ is a labor-supply shifter taken as given by each firm. With $\theta > 0$ being constant across firms, so that all firms face a similar upward-sloping labor supply, this model features a CELS (constant elasticity of labor supply) monopsonistic labor market.

The elasticity θ captures the degree of monopsony power, with a lower value indicating higher wage-setting power. From its definition, note that θ is directly related to α and inversely related to ρ.[13] From (1), note that the parameter α captures the weight that workers put on wage (and therefore consumption) as opposed to the idiosyncratic component ε, which captures the quality of a job match. Therefore, the higher the parameter α, the less important the job match is from the workers' perspective, and hence the lower the monopsony power. A large ρ, on the other hand, implies that small wage differences will not induce many workers to change jobs, thereby making the labor-supply elasticity lower and thus granting more monopsony power to firms. Alternatively, a large ρ can indicate lower labor mobility, which results in a less elastic labor supply. In contrast, in the extreme case of $\rho \to 0$, workers are perfectly mobile—there is no random variation in the utility function in (1)—and the labor market approaches the perfectly competitive case with $\theta \to \infty$. To reduce notational clutter, in the rest of the paper we set $\alpha = 1$ and therefore, $\theta \equiv \frac{1}{\rho}$.

[13] In MacKenzie (2018), worker's idiosyncratic productivity is drawn from a Fréchet distribution. For the Fréchet distribution to have a finite mean, its shape parameter must be greater than 1. In a random utility framework, this restriction on the Fréchet shape parameter reduces the range of values for the elasticity of labor supply. This can be seen in the CESifo working paper version of Egger, Kreickemeier, Moser, and Wrona (2021), which uses a random utility framework but also assumes that the idiosyncratic component is drawn from a Fréchet distribution. In that setup, the shape parameter becomes the elasticity of labor supply, which then is restricted to be greater than 1 (recall that the empirical evidence mentioned in section 2 for stylized fact 2 finds values for θ as low as 0.1). As in our framework, the published version of Egger, Kreickemeier, Moser, and Wrona (2021) assumes instead a Gumbel distribution, and hence, the elasticity of labor supply is not restricted to be larger than one.

4.3 Production

Firms are heterogeneous in productivity as in Melitz (2003). After paying a sunk entry cost of f_E units of the final good, a firm draws its productivity φ from a distribution with probability density function $g(\varphi)$ and cumulative function $G(\varphi)$. A firm produces for the market if and only if it can cover a fixed cost of operation, f, also in terms of the final good. After meeting the fixed cost, the production function for a firm with productivity φ is $y(\varphi) = \varphi L$, where L is the amount of labor hired by the firm. In contrast to the Melitz model, however, firms face an upward sloping labor supply curve and thus, producing firms with different productivities pay different wages.

The Melitz structure of the model yields a cutoff productivity level, $\hat{\varphi}$, such that firms drawing a productivity $\varphi < \hat{\varphi}$ will exit immediately. This implies that the conditional probability density function of surviving firms is $g(\varphi|\varphi \geq \hat{\varphi})$. We denote the equilibrium mass of firms by M. Using these elements, we now describe the workers' expected maximized utility, which is our model's measure of welfare.

4.4 Expected Maximized Utility and Love of Firm Variety

An implication of the workers' preferences described by equation (1) is that the measure of welfare is the expected maximized utility of workers, $\mathbb{U}$, which is defined as

$$\mathbb{U} \equiv E[\max_{\omega}\ v(\omega)].$$

Using equations (1) and (2), and denoting firms by their productivity rather than by ω, we follow Ben-Akiva, Litinas, and Tsunokawa (1985) and obtain that $\mathbb{U}$ is given by

$$\mathbb{U} \equiv \frac{1}{\theta} \ln \left(M \int_{\hat{\varphi}}^{\infty} w(\varphi)^{\theta} g(\varphi|\varphi \geq \hat{\varphi}) d\varphi \right). \tag{4}$$

Note from (4) that $\mathbb{U}$ is increasing in the number of producing firms, M. This captures the firm-variety effect in workers' welfare: due to the idiosyncratic preferences of workers, they benefit from having a larger number of firms to choose from—that is, workers have love-of-variety for firms. To see this clearly, suppose that all firms pay identical wages. Then $w(\varphi) = w$ for every φ. In this case, equation (4) collapses to $\mathbb{U} = \ln w + \frac{1}{\theta} \ln M$, showing that the larger the number of firms, the higher the welfare of workers. The love of firm variety in our setting is analogous to the idea of love of variety in consumption resulting from idiosyncratic preferences on the consumption side.[14] An

[14] The workers' love-of-variety for firms is very similar to the love of variety for consumers. Anderson, De Palma, and Thisse (1992, Chapter 3.7) show the equivalence between the demand system arising from a random utility framework (similar to the one that we use) and the demand system arising from CES preferences (of the type used in trade models). Berger, Herkenhoff, and Mongey (2019) show the equivalence between the labor supply function arising from

implication is that international trade affects welfare through the novel firm-variety channel. For example, a decline in the number of producing domestic firms may reduce welfare even if the total number of firms selling in the domestic market increases.

4.5 Profit Maximization

The profit-maximization problem for a firm with productivity φ is

$$\max_{w(\varphi)} \left\{ p(\varphi)q(\varphi) - w(\varphi)L(\varphi) \right\},$$

where $q(\varphi) = \mathbb{A}p(\varphi)^{-\sigma}$ is the demand faced by a firm with productivity φ, with $\mathbb{A} \equiv P^{\sigma}Z = Z$ denoting the demand shifter. In equilibrium, the demand for a firm's variety equals its production ($q(\varphi) = y(\varphi)$), and thus we can write the inverse demand function as $p(\varphi) = \left[\frac{\varphi L(\varphi)}{\mathbb{A}}\right]^{-\frac{1}{\sigma}}$. Moreover, in equilibrium the labor requirements of a firm with productivity φ equal the labor supply; hence, we use (3) to substitute for $L(\varphi)$ and rewrite the profit-maximization problem as

$$\max_{w(\varphi)} \left\{ \mathbb{A}^{\frac{1}{\sigma}} \left[\mathbb{B}\varphi w(\varphi)^{\theta}\right]^{\frac{\sigma-1}{\sigma}} - \mathbb{B}w(\varphi)^{1+\theta} \right\}.$$

The profit-maximizing wage of a firm with productivity φ is then given by

$$w(\varphi) = \left(1 - \frac{1}{1+\theta}\right) \underbrace{\left[\left(\frac{1+\theta}{\theta}\right)^{\theta} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \frac{\mathbb{A}}{\mathbb{B}}\right]^{\frac{1}{\sigma+\theta}} \varphi^{\frac{\sigma-1}{\sigma+\theta}}}_{MRPL(\varphi)}, \tag{5}$$

where $MRPL(\varphi)$ is the firm's marginal revenue product of labor. From equation (5), note that each firm sets a wage below its marginal revenue product of labor, with the CELS proportional markdown given by $\frac{1}{1+\theta} \in (0, 1)$. More monopsony power (a lower θ) implies a larger markdown. Note also that $w'(\varphi) > 0$, and thus, more productive firms pay higher wages. Hence, the combination of an upward sloping labor supply curve and firm heterogeneity generates wage inequality among firms. Substituting (5) into (3), we obtain that the amount of labor hired by a firm with productivity φ is

$$L(\varphi) = \left\{ \left[\frac{(\sigma-1)\,\theta}{\sigma\,(1+\theta)}\right]^{\sigma\theta} \mathbb{A}^{\theta}\mathbb{B}^{\sigma} \right\}^{\frac{1}{\sigma+\theta}} \varphi^{\frac{(\sigma-1)\theta}{\sigma+\theta}}, \tag{6}$$

which is also increasing in productivity. Therefore, more productive firms not only pay higher wages, but also have more employment.

a random utility framework, and a CES disutility function that exhibits love of variety for firms. They do not exploit the love-of-firm-variety feature of their CES disutility function because they use an oligopsony model where the number of firms is fixed. They use this framework to study the impact of labor market power in a closed economy.

We can also verify that

$$p(\varphi)=\left\{\left[\frac{\sigma\,(1+\theta)}{(\sigma-1)\,\theta}\right]^{\theta}\frac{\mathbb{A}}{\mathbb{B}}\right\}^{\frac{1}{\sigma+\theta}}\varphi^{-\frac{1+\theta}{\sigma+\theta}}=\left(\frac{\sigma}{\sigma-1}\right)\left[\left(\frac{1+\theta}{\theta}\right)\frac{w(\varphi)}{\varphi}\right]. \tag{7}$$

The first equality shows that even though more productive firms pay higher wages, they still charge a lower price ($p'(\varphi)<0$). The second equality presents the standard CES pricing equation of a fixed markup over marginal cost, with the difference that the marginal cost is now $\left(\frac{1+\theta}{\theta}\right)\frac{w(\varphi)}{\varphi}$: the factor $\frac{1+\theta}{\theta}>1$ captures the monopsonistic-power feature that producing an extra unit of output increases the wage not only for the extra units of labor needed, but also for all the previously hired labor.

Moreover, we can rearrange (7) to see the double markdown in wages resulting from monopoly power in the product market and monopsony power in the factor market. Rewriting (7) as

$$w(\varphi)=\left(\frac{\theta}{1+\theta}\right)\left(\frac{\sigma-1}{\sigma}\right)p(\varphi)\varphi,$$

notice that since φ is the marginal product of labor, $p(\varphi)\varphi$ is the value of the marginal product, which would equal the firm's wage if both the product and the labor markets were competitive. Hence, $\frac{\sigma-1}{\sigma}$ captures the markdown due to the imperfect product market and $\frac{\theta}{1+\theta}$ captures the markdown due to the imperfect labor market. Lastly, the gross profit (before deducting fixed costs) of a producing firm with productivity φ, $\pi(\varphi)\equiv p(\varphi)q(\varphi)-w(\varphi)L(\varphi)$, can be written as

$$\pi(\varphi)=\left\{\frac{[(\sigma-1)\theta]^{(\sigma-1)\theta}\,\mathbb{A}^{1+\theta}\mathbb{B}^{\sigma-1}}{[\sigma(1+\theta)]^{\sigma(1+\theta)}}\right\}^{\frac{1}{\sigma+\theta}}(\sigma+\theta)\,\varphi^{\beta}, \tag{8}$$

where $\beta\equiv\frac{(\sigma-1)(1+\theta)}{\sigma+\theta}$ is the elasticity of $\pi(\varphi)$ with respect to φ.

Monopsony power dampens the effect that firm-productivity differences have in the allocation of market shares across firms. This happens because more productive firms pay higher wages, which reduces their cost advantage over less productive firms. As a consequence, when compared with the case of a competitive labor market ($\theta\to\infty$), monopsony power implies that *(i)* less labor goes to high-productivity firms and more to low-productivity firms, *(ii)* gross profit differences between high- and low-productivity firms are smaller, and *(iii)* the superstar-firm effect is smaller.[15]

To see this, let φ_h denote the productivity of a high-productivity firm, and φ_l denote the productivity of a low-productivity firm, so that $\varphi_h>\varphi_l$. Note from equation (6) that the ratio of employment in the high-productivity firm to employment in the low-productivity firm is given by $\frac{L(\varphi_h)}{L(\varphi_l)}=\left(\frac{\varphi_h}{\varphi_l}\right)^{\frac{(\sigma-1)\theta}{\sigma+\theta}}$. The exponent $\frac{(\sigma-1)\theta}{\sigma+\theta}\in(0,\sigma-1)$ is strictly increasing in θ, and hence, the

[15] These results are a consequence of the positive relationship between firm-level productivity and wages, and therefore, they also appear in the heterogenous-firm models with fair wages, screening, and search discussed in section 3.

employment ratio is also increasing in θ, approaching 1 as $\theta \to 0$ and $\left(\frac{\varphi_h}{\varphi_l}\right)^{\sigma-1}$ as $\theta \to \infty$. That is, when compared with the competitive labor market case ($\theta \to \infty$), with finite θ less labor goes to the high-productivity firm and more to the low-productivity firm. Similarly, from equation (8) it follows that $\frac{\pi(\varphi_h)}{\pi(\varphi_l)} = \left(\frac{\varphi_h}{\varphi_l}\right)^{\beta}$, where β is increasing in θ (it approaches $\frac{\sigma-1}{\sigma}$ as $\theta \to 0$, and approaches $\sigma - 1$ as $\theta \to \infty$). Thus, gross-profit differences between low- and high-productivity firms are smaller when there is monopsony power.

Autor, Dorn, Katz, Patterson, and Van Reenen (2020) argue that an increase in product market competition—an increase in the elasticity of product demand (σ) in our setting—will lead the high-productivity superstar firms to capture a larger share of the market. Here we compare the output of a high-productivity firm with the output of a low-productivity firm. Since the demand for a firm's output is $q(\varphi) \equiv \mathbb{A}p(\varphi)^{-\sigma}$, we use the expression for $p(\varphi)$ from above to obtain $\frac{q(\varphi_h)}{q(\varphi_l)} = \left(\frac{\varphi_h}{\varphi_l}\right)^{\frac{\sigma(1+\theta)}{\sigma+\theta}}$. The exponent $\frac{\sigma(1+\theta)}{\sigma+\theta}$ is strictly increasing in both θ and σ. For $\theta \to \infty$ (the competitive-labor-market case) the right-hand side above becomes $\left(\frac{\varphi_h}{\varphi_l}\right)^{\sigma}$, whereas for $\theta \to 0$ the right-hand side approaches $\frac{\varphi_h}{\varphi_l}$. Therefore, any increase in σ increases the relative market share of the high-productivity firm, but the effect is smaller the lower the value of θ. That is, monopsony power in the labor market dampens the superstar-firm effect. Alternatively, just as an increase in product-market competition enhances the superstar-firm effect, an increase in labor-market competition (an increase in θ) does the same.

4.6 Free-Entry Condition and Aggregate Productivity

As mentioned above, there exists a cutoff productivity level, $\hat{\varphi}$, that determines the tradability of a firm's variety in the market: a firm with productivity φ sells in the market if and only if $\varphi \geq \hat{\varphi}$. The firm at the cutoff has a zero net profit, $\pi(\hat{\varphi}) = f$. Using this zero-cutoff-profit condition, we rewrite the gross profit function in (8) as

$$\pi(\varphi) = \left(\frac{\varphi}{\hat{\varphi}}\right)^{\beta} f. \tag{9}$$

Firms enter up to the point that the expected value of entry is equal to the entry cost, f_E. With firms knowing their productivity only after paying the entry cost, and assuming a death shock that wipes out a fraction δ of firms every period, the free-entry condition is $\frac{1}{\delta}\int_{\hat{\varphi}}^{\infty}\left[\pi(\varphi) - f\right] g(\varphi)d\varphi = f_E$, which using (9) becomes

$$\frac{1}{\delta}\int_{\hat{\varphi}}^{\infty}\left[\left(\frac{\varphi}{\hat{\varphi}}\right)^{\beta} - 1\right] f g(\varphi)d\varphi = f_E. \tag{10}$$

This condition pins down the solution for $\hat{\varphi}$. It follows that the elasticity of $\hat{\varphi}$ with respect to θ, $\zeta_{\hat{\varphi},\theta}$, is

$$\zeta_{\hat{\varphi},\theta} = \left[\frac{\beta\theta}{(1+\theta)^2}\right]\left[\int_{\hat{\varphi}}^{\infty} \varphi^{\beta} g(\varphi)d\varphi\right]^{-1}\left\{\int_{\hat{\varphi}}^{\infty}\left[\ln\left(\frac{\varphi}{\hat{\varphi}}\right)\right]\varphi^{\beta} g(\varphi)d\varphi\right\} > 0.$$

Therefore, more monopsony power in the labor market (*i.e.*, a lower θ) implies a smaller $\hat{\varphi}$, so that it is easier for low-productivity firms to survive.

To gain tractability, we follow Chaney (2008) and Melitz and Ottaviano (2008) and assume a Pareto distribution for firm-level productivity. In particular, the cumulative distribution function is $G(\varphi) = 1 - \left(\frac{1}{\varphi}\right)^k$, and the probability density function is $g(\varphi) = \frac{k}{\varphi^{k+1}}$, where $\varphi \in [1, \infty)$ and $k > \sigma - 1 > \beta$. The parameter k indicates the degree of productivity dispersion, with a higher k implying less heterogeneity (if $k \to \infty$, firms are homogeneous with productivity equal to 1). We also assume that $k > 2$, so that the distribution of productivity has a finite variance. Hence, under the assumed Pareto distribution, we solve for $\hat{\varphi}$ from (10) as

$$\hat{\varphi} = \left[\left(\frac{f}{\delta f_E}\right)\frac{\beta}{k-\beta}\right]^{\frac{1}{k}}, \tag{11}$$

which yields $\zeta_{\hat{\varphi},\theta} = \frac{\beta\theta}{(k-\beta)(1+\theta)^2}$. The average productivity in the economy is then given by

$$\bar{\varphi} = \left[\int_{\hat{\varphi}}^{\infty} \varphi^{\beta} g(\varphi|\varphi \geq \hat{\varphi})d\varphi\right]^{\frac{1}{\beta}} = \left(\frac{k}{k-\beta}\right)^{\frac{1}{\beta}}\hat{\varphi}, \tag{12}$$

which is also strictly increasing in θ.[16] Thus, monopsony power reduces the economy's aggregate productivity.

4.7 Autarky Equilibrium

Besides the cutoff productivity level, $\hat{\varphi}$, which is uniquely determined by (10), the model has three more endogenous variables: the mass of entrants, M_E, the demand shifter, $\mathbb{A}$, and the labor-supply shifter, $\mathbb{B}$.

In equilibrium, the mass of producing firms that die due to the death shock, δM, is exactly replaced by the mass of successful entrants, $[1 - G(\hat{\varphi})]M_E$, and thus, $M = [1 - G(\hat{\varphi})]\frac{M_E}{\delta}$. Moreover, the aggregate price is defined as $P = \left[M\int_{\hat{\varphi}}^{\infty} p(\varphi)^{1-\sigma} g(\varphi|\varphi \geq \hat{\varphi})d\varphi\right]^{\frac{1}{1-\sigma}}$, which conveniently simplifies to $P = M^{\frac{1}{1-\sigma}}p(\bar{\varphi})$. Given our assumption that $P = 1$ (the final good is the numéraire), and using equation (7) and the expression for M in terms of M_E, we obtain from the aggregate price equation that

$$\frac{M_E}{\delta} = \left\{\left[\frac{\sigma(1+\theta)}{(\sigma-1)\theta}\right]^{\theta}\frac{\mathbb{A}}{\mathbb{B}}\right\}^{\frac{\sigma-1}{\sigma+\theta}}\frac{1}{[1-G(\hat{\varphi})]\bar{\varphi}^{\beta}}. \tag{13}$$

[16] We obtain $\zeta_{\bar{\varphi},\theta} = \frac{\theta}{(1+\theta)^2}\left[\frac{2\beta}{k-\beta} - \ln\left(\frac{k}{k-\beta}\right)\right]$, which is always positive because natural log inequalities imply that $\frac{\beta}{k} < \ln\left(\frac{k}{k-\beta}\right) < \frac{\beta}{k-\beta}$.

The aggregate expenditure on the final good, Z, has three components: workers' expenditure on final-good consumption, producing firms' final-good requirements to cover the fixed costs of operation, and entrants' final-good requirements to cover the entry cost. From the definition of $\mathbb{A}$ we know that $Z \equiv \mathbb{A}$, and therefore, the economy's total expenditure on the final good is given by

$$\mathbb{A} = \frac{M_E}{\delta} \int_{\hat{\varphi}}^{\infty} w(\varphi) L(\varphi) g(\varphi) d\varphi + [1 - G(\hat{\varphi})] \frac{M_E}{\delta} f + M_E f_E, \tag{14}$$

where the first term on the right-hand side is the wage bill of producing firms (workers spend all their wages on the final good) with $w(\varphi)$ and $L(\varphi)$ given by (5) and (6), and the last two terms correspond to total fixed and entry costs. Lastly, from section 4.2 we know that the labor-supply shifter is defined as $\mathbb{B} = \left[M \int_{\hat{\varphi}}^{\infty} w(\varphi)^{\theta} g(\varphi | \varphi \geq \hat{\varphi}) d\varphi\right]^{-1} \mathbb{L}$, which can be rewritten as

$$\mathbb{B} = \left[\frac{M_E}{\delta} \int_{\hat{\varphi}}^{\infty} w(\varphi)^{\theta} g(\varphi) d\varphi\right]^{-1} \mathbb{L}. \tag{15}$$

We can now define the equilibrium in the closed-economy model.

Definition. *An autarky equilibrium solves for $\hat{\varphi}$ from (10), and then solves for M_E, $\mathbb{A}$, and $\mathbb{B}$ from (13), (14), and (15), with $w(\varphi)$ and $L(\varphi)$ given by (5) and (6).*

From (13), (14), and (15), and under our Pareto distribution for productivity, the solution for the mass of entrants is

$$M_E = \delta \hat{\varphi}^k \left\{ \frac{[k\sigma + \theta(k - \sigma + 1)] \mathbb{L} \hat{\varphi}}{\sigma f (1 + \theta) k^{\frac{\sigma - 2}{\sigma - 1}} (k - \beta)^{\frac{1}{\sigma - 1}}} \right\}^{\frac{\sigma - 1}{\sigma - 2}}, \tag{16}$$

where $\hat{\varphi}$ is given by (11). Given our modeling of the entry cost in terms of the final good, Walrasian stability requires that $\sigma > 2$, which we assume to be the case.[17] In terms of M_E and $\hat{\varphi}$, the solutions for the demand shifter, $\mathbb{A}$, and the labor-supply shifter, $\mathbb{B}$, are

$$\mathbb{A} = \frac{M_E k \sigma f_E}{\sigma - 1} \quad \text{and} \quad \mathbb{B} = \frac{(\sigma - 1)\theta f}{\sigma + \theta} \left[\frac{\mathbb{L} \delta \hat{\varphi}^k \left[k\sigma + \theta(k - \sigma + 1)\right]}{M_E k (\sigma - 1) \theta f}\right]^{1 + \theta}.$$

The mass of producing firms is $M = \frac{M_E}{\delta \hat{\varphi}^k}$ and hence, using (16) we obtain that the elasticity of M with respect to θ is

$$\zeta_{M,\theta} = -\frac{(\sigma - 1)\zeta_{\hat{\varphi},\theta}}{\sigma - 2} \left[k - 2 + \frac{(k - \beta)\sigma + \theta(k - \sigma + 1)}{k\sigma + \theta(k - \sigma + 1)}\right] < 0, \tag{17}$$

[17] Due to love-of-variety in the production of the final good, when a new firm enters it confers a positive externality on other firms by lowering their entry and fixed costs of production—these costs are in terms of the final good (as in Egger and Kreickemeier, 2009, 2012 and Felbermayr, Impullitti, and Prat, 2018). A new firm's product also substitutes for existing firms' products and therefore cuts into their demand. For the latter effect to dominate, which is required for stability (so that profits are declining in the mass of firms), the elasticity of substitution across varieties has to be sufficiently high to offset the love-of-variety effect. This happens when $\sigma > 2$.

which follows from $\zeta_{\hat{\varphi},\theta} > 0$, $k > 2$, and $k > \beta$. Therefore, more monopsony power in the labor market (a lower θ) implies a larger mass of producing firms. This occurs as a consequence of two effects. First, an increase in monopsony power reduces the cost advantage of high-productivity firms, which reduces the cutoff level $\hat{\varphi}$ and translates into higher survival rates and a larger mass of firms. And second, more monopsony power depresses hiring, which results in a smaller average firm size compared to a competitive labor market and thus implies a larger mass of firms.

5 Inequality and Welfare in the Closed Economy

This section discusses the effects of monopsony power on inequality, and shows a decomposition of our welfare measure that includes the conventional average wage channel and the novel love-of-firm-variety channel.

5.1 Monopsony Power and Inequality

Since a combination of monopsony power and firm heterogeneity leads to wage heterogeneity, we can assess the effects of monopsony power in the labor market on wage inequality. Each firm pays a different wage, and given a precise distribution of firm productivity, we can easily obtain a distribution of wages that will allow us to calculate a measure of wage dispersion.

A firm with productivity φ offers wage $w(\varphi)$, and its share of workers is $\ell(\varphi) \equiv \frac{L(\varphi)}{\mathbb{L}}$. With $g(\varphi|\varphi \geq \hat{\varphi})$ denoting the productivity distribution of active firms, it follows that the productivity-based probability density function of wages is $h(\varphi) \equiv M\ell(\varphi)g(\varphi|\varphi \geq \hat{\varphi})$. The average wage across all workers is then given by $\bar{w} = \int_{\hat{\varphi}}^{\infty} w(\varphi)h(\varphi)d\varphi$; note that the total wage bill (the first term on the right hand side of (14)) is equal to $\mathbb{L}\bar{w}$.

Applying a change of variables, we can also obtain the direct distribution of wages. Let $f(w)$ denote the probability density function of wages, and let $F(w)$ denote the cumulative distribution function. Hence, it must be the case that $h(\varphi) = f[w(\varphi)]w'(\varphi)$, so that the average wage can also be calculated as

$$\bar{w} = \int_{\hat{w}}^{\infty} wf(w)dw = \int_{\hat{\varphi}}^{\infty} w(\varphi)f[w(\varphi)]w'(\varphi)d\varphi,$$

where $\hat{w} = w(\hat{\varphi})$ is the lowest wage in the economy (paid by the least productive active firm). With $f[w(\varphi)] = \frac{h(\varphi)}{w'(\varphi)}$, under a Pareto distribution for productivity, and using (5) to write φ in terms of w, it follows that

$$f(w) = \frac{\gamma \hat{w}^{\gamma}}{w^{\gamma+1}} \quad \text{and} \quad F(w) = 1 - \left(\frac{\hat{w}}{w}\right)^{\gamma}, \tag{18}$$

which is also a Pareto distribution, where $\gamma \equiv \frac{k\sigma+\theta(k-\sigma+1)}{\sigma-1}$ is the parameter of wage dispersion (a higher γ implies less wage heterogeneity). Thus, the average wage is simply given by $\bar{w} = \frac{\gamma\hat{w}}{\gamma-1}$.

The responses of the wage dispersion parameter to changes in θ, k, and σ are $\frac{d\gamma}{d\theta} = \frac{k-\sigma+1}{\sigma-1} > 0$, $\frac{d\gamma}{dk} = \frac{\sigma+\theta}{\sigma-1} > 0$, and $\frac{d\gamma}{d\sigma} = -\frac{k(1+\theta)}{(\sigma-1)^2} < 0$. Therefore, wage dispersion declines (*i.e.*, γ rises) with either *(i)* less monopsony power in the labor market (a higher θ), *(ii)* less firm heterogeneity (a higher k), or *(iii)* more monopoly power in the goods market (a lower σ). When there is no monopsony power in the labor market ($\theta \to \infty$), then $\gamma \to \infty$ and the distribution collapses toward $\hat{w}$ so that all firms pay the same wage (the same happens if $k \to \infty$). On the other hand, as monopsony power increases (θ decreases), the dispersion parameter γ declines and wage heterogeneity increases; that is, an increase in monopsony power (a reduction in θ) increases wage inequality.

The closed-economy model yields γ as the natural measure of wage inequality (a lower γ implies more wage dispersion, and hence more wage inequality). We can introduce, however, a more traditional measure of inequality: the Gini coefficient, which is always between 0 (perfect equality) and 1 (perfect inequality). Denoting it by $\mathcal{G}$, the Gini coefficient is

$$\mathcal{G} = \frac{1}{\bar{w}} \int_{\hat{w}}^{\infty} F(w)[1 - F(w)]dw = \frac{1}{2\gamma - 1}, \tag{19}$$

which is strictly decreasing in θ ($\frac{d\mathcal{G}}{d\theta} = -\frac{2}{(2\gamma-1)}\frac{d\gamma}{d\theta} < 0$). When $\theta \to 0$, inequality approaches its upper bound ($\mathcal{G} \to \frac{\sigma-1}{2k\sigma-\sigma+1}$), whereas when $\theta \to \infty$ we achieve perfect equality ($\mathcal{G} = 0$; *i.e.*, wages are homogeneous). Intuitively, more monopsony power in the labor market (a lower θ) increases inequality because it allows low-wage/less-productive firms to survive ($\hat{\varphi}$ is lower). By widening the productivity range of producing firms, the range of wages in the economy also widens.

5.2 The Components of Welfare

Section A in the online Appendix shows that the expected maximized utility of workers in (4) can be written as

$$\mathbb{U} \equiv \ln \bar{w} + \frac{1}{\theta} \ln M + \mathcal{D}, \tag{20}$$

where $\mathcal{D} \equiv \frac{1}{\theta} \ln \left[\left(1 + \frac{\theta}{\gamma}\right) \left(1 - \frac{1}{\gamma}\right)^{\theta} \right] < 0$.[18] Equation (20) decomposes the expression for welfare into three terms: *(i)* $\ln \bar{w}$ captures the average wage effect, *(ii)* $\frac{1}{\theta} \ln M$ captures the love-of-firm-variety effect, and *(iii)* $\mathcal{D}$ captures the distributional effect after controlling for the average wage and the mass of firms. The term $\mathcal{D}$ goes to zero in the limit as $\theta \to \infty$. Therefore, when the labor market becomes competitive ($\theta \to \infty$), $\mathbb{U}$ converges to $\ln \bar{w}$.

[18] The Appendix is available at http://www.socsci.uci.edu/~jantonio/Papers/monopsonypower_trade_app.pdf.

Regarding the average wage effect, which corresponds to the conventional measure of welfare, note that the average wage is equivalent to real income per worker or real net output per worker, where net output is total final-good output minus the fixed production and entry costs. By definition, the average wage is directly proportional to the total wage bill, $\mathbb{W} \equiv \mathbb{L}\bar{w}$, which—from (5), (6) and the results in section 4.7—is given by $\mathbb{W} = M \int_{\hat{\varphi}}^{\infty} w(\varphi)L(\varphi)g(\varphi|\varphi \geq \hat{\varphi})d\varphi = \frac{kf_E M_E \theta}{1+\theta}$. Thus, the elasticity of the average wage with respect to the labor-supply elasticity, θ, is $\zeta_{\bar{w},\theta} = \zeta_{M_E,\theta} + \frac{1}{1+\theta}$. Using that $\zeta_{M_E,\theta} = \zeta_{M,\theta} + k\zeta_{\hat{\varphi},\theta}$ and equation (17), we obtain

$$\zeta_{\bar{w},\theta} = \frac{(\sigma-1)\zeta_{\hat{\varphi},\theta}}{\sigma-2}\left[\frac{\sigma\beta}{k\sigma+\theta(k-\sigma+1)} + 1 - \frac{k}{\sigma-1}\right] + \frac{1}{1+\theta}.$$

This elasticity implies an inverted-U relationship between θ and $\bar{w}$; however, for conventional values of σ and k, the level of θ that maximizes the average wage is very large (recall that the empirical works mentioned in section 2 rarely find a labor-supply elasticity larger than 5). In other words, $\zeta_{\bar{w},\theta} > 0$ in the empirically relevant range of θ.[19]

Regarding the love-of-firm-variety effect, equation (17) shows that $\zeta_{M,\theta} < 0$, and therefore, a reduction in θ increases $\mathbb{U}$ through the firm-variety channel. Notice then that whereas more monopsony power—a lower θ—reduces welfare through the average-wage effect (in the empirically relevant range for θ), it increases welfare through the firm-variety effect. Finally, the distributional term $\mathcal{D}$ is a source of welfare loss when compared to the case of a competitive labor market.[20] As we show below, however, the term $\mathcal{D}$ becomes irrelevant in our analysis of the gains from trade because it is also present in the open-economy $\mathbb{U}$, so it cancels out in the calculation of welfare changes when moving from autarky to trade.

6 The Open-Economy Model

The closed-economy model shows that monopsony power in the labor market causes more productive firms to pay higher wages, leveling the competition field for less productive firms—who are able to survive thanks to their lower wages—and generating lower real income in the economy and an increase in wage inequality. But how do international trade possibilities affect these outcomes? This section extends the previous model to study the effects of monopsony power in a two-country setting, and analyzes how trade liberalization affects wage inequality and welfare.

[19] If we use $\sigma = 3.8$ and $k = 3.4$ (the values used by Ghironi and Melitz, 2005), the average wage is maximized at $\theta = 240$. The inverted-U relationship between θ and $\bar{w}$ is a consequence of the positive externality created by our modeling of fixed and entry costs in terms of the final good (see also footnote 17): a reduction in θ increases the mass of firms, which reduces fixed and entry costs for other firms because these costs are in terms of the CES aggregator of differentiated goods.

[20] The term $\mathcal{D}$ is positively related with k: $\frac{d\mathcal{D}}{dk} = \frac{(1+\theta)(\sigma+\theta)}{(\sigma-1)\gamma(\gamma+\theta)(\gamma-1)} > 0$. Therefore, more firm heterogeneity (a lower k) implies a larger welfare loss from $\mathcal{D}$.

6.1 Preferences and Production with a Monopsonistic Labor Market

There are two identical countries—each of them populated by $\mathbb{L}$ workers—that produce and trade differentiated goods. In each country, preferences and demand are as in section 4.1, with the difference that the final good, Z, which is the numéraire, is now a CES composite of domestic and imported differentiated-good varieties. As well, the labor supply faced by a firm in each country is given by (3), with the wage elasticity, θ, assumed to be the same in both countries.

In each country, producers of differentiated goods are heterogeneous in productivity. After paying an entry cost of f_E (in terms of the final good), each firm draws its productivity from the same cumulative distribution function, $G(\varphi)$. To access each market, a firm must pay a fixed cost in terms of the final good. The fixed costs to access the domestic market is f, and the fixed cost to access the export market is f_X. In addition, there is an iceberg exporting cost, $\tau \geq 1$, so that an exporting firm must ship τ units of its good for one unit to reach the export market. Based on a firm's ability to cover these fixed costs and the iceberg exporting cost, the firm will either not produce for any market, produce only for the domestic market, or produce for both the domestic and export markets.

Let $s \in \{N, T\}$ indicate firm status, with N identifying *non-trading* firms (which only sell in the domestic market), and T identifying *trading* firms (which sell in the domestic and export markets). For a non-trading firm with productivity φ, its production function is $y_N(\varphi) = \varphi L$ and its profit maximization problem is similar to section 4.3, and thus equations (5), (6), (7), and (8) for firm-level wage, labor, price, and gross profits hold. To indicate firm status, these variables are respectively relabeled as $L_N(\varphi)$, $w_N(\varphi)$, $p_N(\varphi)$, and $\pi_N(\varphi)$.

A trading firm with productivity φ produces for the domestic (D) and export (X) markets, so that its total production equals $y_T(\varphi) \equiv y_D(\varphi) + y_X(\varphi) = \varphi L$, where $y_r(\varphi)$ is the firm's production for market $r \in \{D, X\}$. The profit-maximization problem for this firm is

$$\max\{p_D(\varphi)q_D(\varphi) + p_X(\varphi)q_X(\varphi) - w_T(\varphi)\left[L_D(\varphi) + L_X(\varphi)\right]\},$$

where $q_r(\varphi) \equiv \mathbb{A}p_r(\varphi)^{-\sigma}$ is the demand faced by the firm in market r, with $\mathbb{A} \equiv Z$ denoting the demand shifter, $p_r(\varphi)$ is the price set by the firm in market r, and $L_r(\varphi)$ is the amount of labor hired by the firm to produce for market r—the total amount of labor hired by the firm is $L_T(\varphi) \equiv L_D(\varphi) + L_X(\varphi)$. From the upward-sloping labor supply in (3), it must hold that $w_T(\varphi) = \left[\frac{L_T(\varphi)}{\mathbb{B}}\right]^{\frac{1}{\theta}}$. Moreover, equilibrium in each differentiated-good's market requires that $q_D(\varphi) = y_D(\varphi)$ and $\tau q_X(\varphi) = y_X(\varphi)$ (a trading firm must produce τ units for each unit that reaches the export market), and thus, the inverse demand functions can be written as $p_D(\varphi) = \left[\frac{\varphi L_D(\varphi)}{\mathbb{A}}\right]^{-\frac{1}{\sigma}}$ and $p_X(\varphi) = \left[\frac{\varphi L_X(\varphi)}{\tau\mathbb{A}}\right]^{-\frac{1}{\sigma}}$.

After rewriting the profit-maximization problem of a trading firm with productivity φ in terms of $L_D(\varphi)$ and $L_X(\varphi)$, we obtain as solution

$$L_D(\varphi) = \left(1+\tau^{1-\sigma}\right)^{-\frac{\sigma}{\sigma+\theta}} L_N(\varphi) \quad \text{and} \quad L_X(\varphi) = \tau^{1-\sigma}\left(1+\tau^{1-\sigma}\right)^{-\frac{\sigma}{\sigma+\theta}} L_N(\varphi),$$

where $L_N(\varphi)$ is given by (6). The total amount of labor employed by the trading firm is then $L_T(\varphi) = \left(1+\tau^{1-\sigma}\right)^{\frac{\theta}{\sigma+\theta}} L_N(\varphi)$. Notice that $1+\tau^{1-\sigma} \in (1,2)$, so that it is always true that

$$L_X(\varphi) < L_D(\varphi) < L_N(\varphi) < L_T(\varphi).$$

Hence, a firm with productivity φ employs more labor if it exports, but the amount of labor it hires to produce for its domestic market is smaller than if it were a non-trading firm. This illustrates the impact of an upward-sloping labor supply: exporting makes a firm bigger, but hiring more labor implies a higher equilibrium wage for the firm, which makes it less competitive in the domestic market as it must set a higher price.

Verifying that exporting makes domestic operations costlier, we obtain that the wage offered by a trading firm with productivity φ and its domestic price are given by

$$w_T(\varphi) = \left(1+\tau^{1-\sigma}\right)^{\frac{1}{\sigma+\theta}} w_N(\varphi) \quad \text{and} \quad p_D(\varphi) = \left[\frac{\sigma(1+\theta)}{(\sigma-1)\,\theta}\right]\frac{w_T(\varphi)}{\varphi},$$

where $w_N(\varphi)$ is given by (5), so that it is always the case that $w_T(\varphi) > w_N(\varphi)$ and $p_D(\varphi) > p_N(\varphi)$, with $p_N(\varphi)$ given by (7). The price set by the trading firm in the export market is then $p_X(\varphi) = \tau p_D(\varphi)$. Note that the exporting wage premium for a firm with productivity φ is given by $\frac{w_T(\varphi)}{w_N(\varphi)} = \left(1+\tau^{1-\sigma}\right)^{\frac{1}{\sigma+\theta}} \in \left(1, (1+\tau^{1-\sigma})^{1/\sigma}\right]$, which is strictly decreasing in θ; that is, a lower θ (more monopsony power) increases the exporting wage premium.

Lastly, the gross profit of a trading firm with productivity φ can be written as

$$\pi_T(\varphi) = \left(1+\tau^{1-\sigma}\right)^{\frac{1+\theta}{\sigma+\theta}} \pi_N(\varphi),$$

where $\pi_N(\varphi)$ is given by (8). Therefore, in spite of a higher wage and lower domestic sales, the gross profits of a firm with productivity φ are always larger if it exports. Also, note from the previous expression that the ratio of an exporting firm' profit to an equally-productive non-exporting firm's profit is $\left(1+\tau^{1-\sigma}\right)^{\frac{1+\theta}{\sigma+\theta}}$, which is increasing in θ. Therefore, and as a consequence of a higher exporting wage premium, exporting becomes less attractive the lower the value of θ. This has implications for inequality and welfare in the open economy.

6.2 Indifference Conditions, Free-Entry, and Cutoff Productivity Levels

The open-economy model solves for two cutoff productivity levels, $\hat{\varphi}_N$ and $\hat{\varphi}_T$, that determine firm status: given $\hat{\varphi}_N < \hat{\varphi}_T$, a firm with productivity φ does not produce if $\varphi < \hat{\varphi}_N$, produces only for the domestic market if $\varphi \in [\hat{\varphi}_N, \hat{\varphi}_T)$, and produces for the domestic and export markets if $\varphi \geq \hat{\varphi}_T$. These cutoff levels satisfy the indifference conditions

$$\pi_N(\hat{\varphi}_N) = f,$$
$$\pi_T(\hat{\varphi}_T) - f - f_X = \pi_N(\hat{\varphi}_T) - f,$$

where the first condition is similar to the zero-cutoff-profit condition in the closed-economy model—the net profit of a non-trading firm at $\hat{\varphi}_N$ must be zero—whereas the second condition indicates that a firm at the exporting cutoff $\hat{\varphi}_T$ is indifferent between being a trading firm or a non-trading firm (*i.e.*, its net profits if it is a trading firm are the same as the net profits if it were a non-trading firm).[21] Notice that the determination of the exporting cutoff is different from the standard Melitz model, in which a firm exports if the gross profits obtained in the export market are greater or equal than the fixed cost of exporting. Here, since firm size affects wages, the impact of exporting on domestic sales will enter into the calculation as well.

Using the gross profit equation for trading firms at the end of section 6.1, we rewrite the second indifference condition as $\left[\left(1+\tau^{1-\sigma}\right)^{\frac{1+\theta}{\sigma+\theta}} - 1\right]\pi_N(\hat{\varphi}_T) = f_X$. With $\pi_N(\varphi)$ given by (8), we can then combine the two indifference conditions to obtain

$$\hat{\varphi}_T = \lambda\hat{\varphi}_N, \qquad \text{where} \qquad \lambda \equiv \left[\frac{\mathcal{F}}{(1+\tau^{1-\sigma})^{\frac{\beta}{\sigma-1}} - 1}\right]^{\frac{1}{\beta}} \geq 1 \tag{21}$$

and $\mathcal{F} \equiv \frac{f_X}{f}$. This is one of the two equations we need to solve for $\hat{\varphi}_N$ and $\hat{\varphi}_T$. The term λ is strictly increasing in τ, $\frac{d\lambda}{d\tau} > 0$, and is strictly decreasing in θ, $\frac{d\lambda}{d\theta} < 0$, approaching $\mathcal{F}^{\frac{1}{\sigma-1}}\tau$ as $\theta \to \infty$. Thus, an increase in monopsony power in the labor market (*i.e.*, a lower θ), widens the productivity gap between the least efficient non-trading firm and the least efficient trading firm. Intuitively, whereas monopsony power makes survival easier, it also makes exporting more difficult because exporters pay higher wages. The following lemma shows the elasticities of λ with respect to τ and θ.

Lemma 1. $\zeta_{\lambda,\tau} = \left[\frac{(\lambda^\beta/\mathcal{F})^{1/\beta}}{\tau(1+\lambda^\beta/\mathcal{F})^{1/(1+\theta)}}\right]^{\sigma-1} > 0$ *and* $\zeta_{\lambda,\theta} = -\frac{\theta}{(1+\theta)^2}\left[\left(1+\frac{\lambda^\beta}{\mathcal{F}}\right)\ln\left(1+\frac{\mathcal{F}}{\lambda^\beta}\right) + \beta\ln\lambda\right] < 0.$

Similar to (9), we use the indifference conditions to rewrite $\pi_N(\varphi)$ and $\pi_T(\varphi)$ as

$$\pi_N(\varphi) = \left(\frac{\varphi}{\hat{\varphi}_N}\right)^\beta f \qquad \text{and} \qquad \pi_T(\varphi) = \left(1+\frac{\lambda^\beta}{\mathcal{F}}\right)\left(\frac{\varphi}{\hat{\varphi}_T}\right)^\beta f_X. \tag{22}$$

The free-entry condition is $\frac{1}{\delta}\left\{\int_{\hat{\varphi}_N}^{\hat{\varphi}_T}\left[\pi_N(\varphi) - f\right]g(\varphi)d\varphi + \int_{\hat{\varphi}_T}^{\infty}\left[\pi_T(\varphi) - f - f_X\right]g(\varphi)d\varphi\right\} = f_E$, which

[21] On the left-hand side of the second condition we subtract $f + f_X$ from the gross profits because a trading firm must pay a fixed cost to access each market.

using (22) is written as

$$\int_{\hat{\varphi}_N}^{\hat{\varphi}_T} \left(\frac{\varphi}{\hat{\varphi}_N}\right)^{\beta} f g(\varphi) d\varphi + \int_{\hat{\varphi}_T}^{\infty} \left(1 + \frac{\lambda^{\beta}}{\mathcal{F}}\right) \left(\frac{\varphi}{\hat{\varphi}_T}\right)^{\beta} f_X g(\varphi) d\varphi = \delta f_E + \left[1 - G(\hat{\varphi}_N)\right] f + \left[1 - G(\hat{\varphi}_T)\right] f_X . \tag{23}$$

Using (21) and (23), and under the assumed Pareto distribution for productivity, the equilibrium cutoff productivity levels are

$$\hat{\varphi}_N = \left[\frac{\mathcal{F} + \lambda^k}{\lambda^k}\right]^{\frac{1}{k}} \hat{\varphi} \quad \text{and} \quad \hat{\varphi}_T = \left(\mathcal{F} + \lambda^k\right)^{\frac{1}{k}} \hat{\varphi}, \tag{24}$$

where $\hat{\varphi}$ is the closed-economy solution given in (11).

From (24), the elasticities of the cutoff levels with respect to the iceberg trade cost are given by $\zeta_{\hat{\varphi}_N,\tau} = -\left(\frac{\mathcal{F}}{\mathcal{F}+\lambda^k}\right)\zeta_{\lambda,\tau} < 0$ and $\zeta_{\hat{\varphi}_T,\tau} = \left(\frac{\lambda^k}{\mathcal{F}+\lambda^k}\right)\zeta_{\lambda,\tau} > 0$, where $\zeta_{\lambda,\tau} > 0$ is given in Lemma 1. Therefore, as in the standard Melitz (2003) model, trade liberalization (a reduction in τ) produces two selection effects: *(i)* there is *selection-into-production*, whereby the reduction in τ wipes out the least productive firms due to the increase $\hat{\varphi}_N$, and *(ii)* there is *selection-into-exporting*, whereby the reduction in τ allows lower productivity firms to export due to the decline in $\hat{\varphi}_T$.

We can also see how more monopsony power (as captured by a lower θ) affects the cutoff productivity levels. The elasticities of the cutoff levels with respect to θ are

$$\zeta_{\hat{\varphi}_N,\theta} = \zeta_{\hat{\varphi},\theta} - \frac{\mathcal{F}\zeta_{\lambda,\theta}}{\mathcal{F} + \lambda^k} \quad \text{and} \quad \zeta_{\hat{\varphi}_T,\theta} = \zeta_{\hat{\varphi},\theta} + \frac{\lambda^k \zeta_{\lambda,\theta}}{\mathcal{F} + \lambda^k},$$

where $\zeta_{\lambda,\theta} < 0$ is given in Lemma 1 and $\zeta_{\hat{\varphi},\theta} = \frac{\beta\theta}{(k-\beta)(1+\theta)^2} > 0$. It follows that $\zeta_{\hat{\varphi}_N,\theta} > 0$, and hence, the behavior of $\hat{\varphi}_N$ is similar to $\hat{\varphi}$ in the closed-economy model: more monopsony power in the labor market (a lower θ) allows less productive firms to survive. On the other hand, $\zeta_{\hat{\varphi}_T,\theta}$ is negative for low levels of θ and positive for high levels of θ, so that $\hat{\varphi}_T$ has a U-shaped relationship with θ. Intuitively, although an increase in monopsony power dampens the advantage of high-productivity firms (which would induce lower-productivity firms to become exporters), when θ is sufficiently low, exporting becomes less attractive because the dominant force is the reduction in a trading firm's relative profitability driven by the increase in the exporting wage premium.

6.3 Equilibrium in the Open Economy

Denote by M_s the mass of firms with status $s \in \{N, T\}$ in each country, so that $M_P \equiv M_N + M_T$ is the total mass of producers in each country. Every period in each country, the mass of producing firms that die due to the death shock, δM_P, is exactly replaced by the mass of successful entrants, $[1 - G(\hat{\varphi}_N)]M_E$, and thus, we can write M_P as $M_P = [1 - G(\hat{\varphi}_N)]\frac{M_E}{\delta}$. By firm status, the masses of non-trading and trading firms in terms of M_E are respectively given by $M_N = [G(\hat{\varphi}_T) - G(\hat{\varphi}_N)]\frac{M_E}{\delta}$ and $M_T = [1 - G(\hat{\varphi}_T)]\frac{M_E}{\delta}$. In an open economy, the mass of produced varieties is no longer identical to the mass of consumed varieties, as each country also consumes imported varieties. In particular, with identical countries the total mass of varieties consumed in each country is $M_N + 2M_T$, where $M_N + M_T$ are domestic varieties, and M_T varieties are imported.

In addition to the solutions for the cutoff productivity levels in (24), the open-economy model solves for the equilibrium mass of entrants (M_E), the demand shifter ($\mathbb{A}$), and the labor-supply shifter ($\mathbb{B}$). Similar to the autarky equilibrium in section 4.7, we solve for these other variables using the open-economy expressions for the aggregate price (P), the final-good market clearing condition, and the labor-market clearing condition. To preserve space, we present the details of these conditions in section B of the Appendix.

From now on, let $\tilde{M}_E$, $\tilde{\mathbb{A}}$, and $\tilde{\mathbb{B}}$ denote the solutions for the open-economy model, so that M_E, $\mathbb{A}$, and $\mathbb{B}$ refer to the closed-economy solutions from section 4.7. Using the solutions for $\hat{\varphi}_N$ and $\hat{\varphi}_T$ in (24), and following the definition of an open-economy equilibrium from section B in the Appendix, we find that $\tilde{M}_E$ is given by

$$\tilde{M}_E = \Psi^{\frac{\sigma-1}{\sigma-2}} M_E, \tag{25}$$

where

$$\Psi \equiv \frac{\hat{\varphi}_N}{\hat{\varphi}} \left[\frac{\mathcal{F} + \lambda^k}{\lambda^k + (\mathcal{F} + \lambda^\beta)^{\frac{\theta}{1+\theta}} - \lambda^{\frac{\beta\theta}{1+\theta}}} \right] > 1. \tag{26}$$

The term Ψ captures the effect of trade on the mass of entrants. Given that $\Psi > 1$, entry in the open economy is always larger than in autarky. As $\tau \to \infty$, $\Psi \to 1$ and the mass of entrants collapses to the closed-economy outcome in (16). Lastly, the solution for the demand shifter is $\tilde{\mathbb{A}} = \Psi^{\frac{\sigma-1}{\sigma-2}} \mathbb{A}$ and the solution for the labor-supply shifter is $\tilde{\mathbb{B}} = \left[\left(\frac{\hat{\varphi}}{\hat{\varphi}_N} \right) \frac{1}{\Psi^{\frac{1}{\sigma-2}}} \right]^{1+\theta} \mathbb{B}$.

6.4 Trade Liberalization and the Composition of Firms

Section 6.2 shows that our model features conventional Melitz selection effects of trade liberalization: a decline in τ increases $\hat{\varphi}_N$ and reduces $\hat{\varphi}_T$, and thus, the fraction of trading firms in each country, $s_T \equiv \frac{M_T}{M_P}$, increases. However, we also know that monopsony power makes the survival of less-productive firms easier, and that high levels of monopsony power (*i.e.*, low values of θ) inhibit exporting. To better see how trade barriers and monopsony power interact, we now look at the behavior of s_T for different levels of τ, f_X, and θ.

Using the definitions of M_T and M_P from the previous section, the Pareto distribution of productivity, and (21), we obtain that

$$s_T = \frac{1 - G(\hat{\varphi}_T)}{1 - G(\hat{\varphi}_N)} = \left(\frac{\hat{\varphi}_N}{\hat{\varphi}_T}\right)^k = \lambda^{-k}.$$

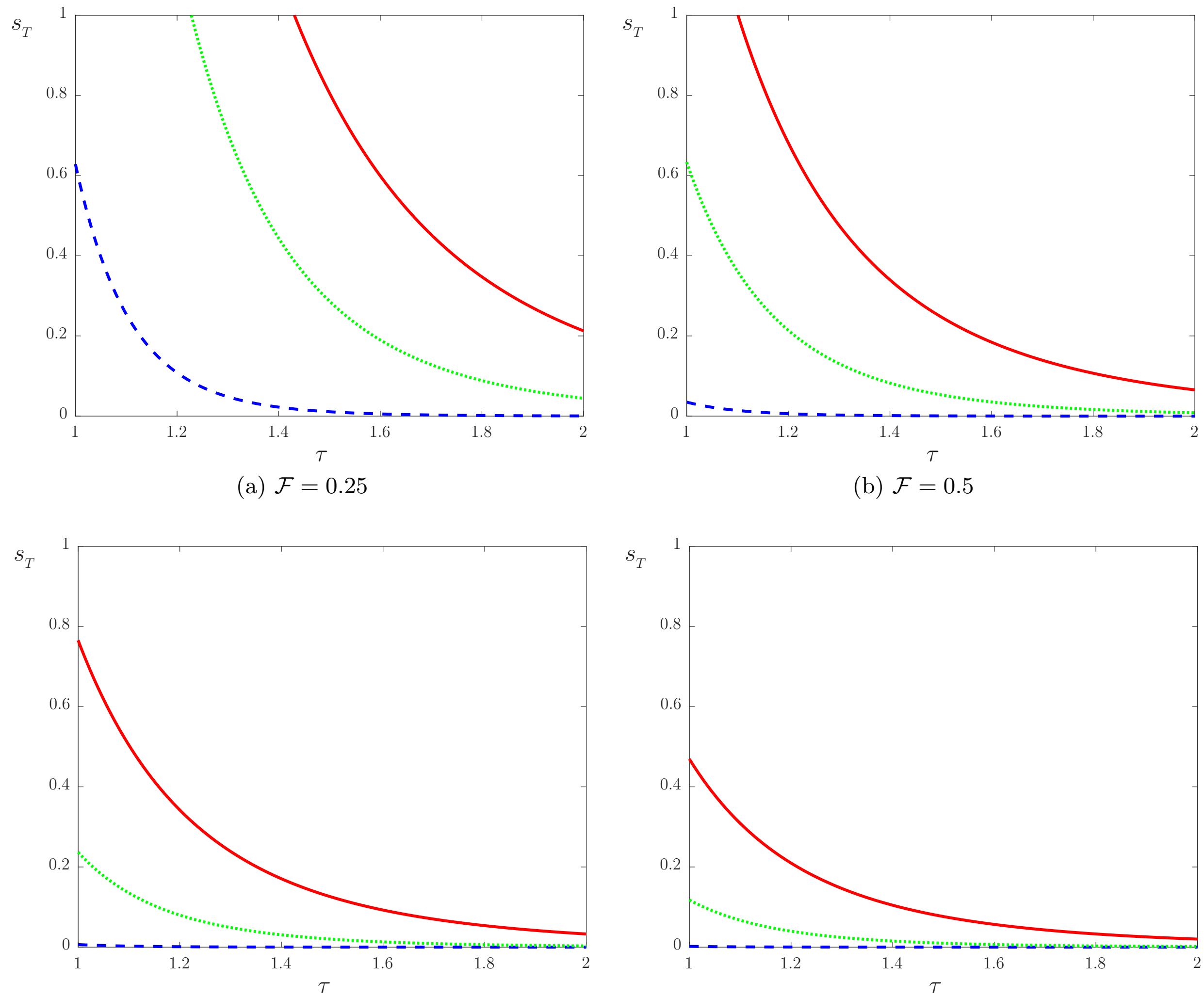
Therefore, using Lemma 1, the elasticities of s_T with respect to τ and θ are $\zeta_{s_T,\tau} = -k\zeta_{\lambda,\tau} < 0$ and $\zeta_{s_T,\theta} = -k\zeta_{\lambda,\theta} > 0$, which formally show that a reduction in variable trade costs increases the fraction of trading firms, but that more monopsony power (a lower θ) reduces the fraction of trading firms. The latter is a consequence of the increase in the exporting wage premium that follows a reduction in θ, which erodes the competitiveness of trading firms in their domestic market.

Within the model, trade liberalization can also occur through reductions in the fixed cost of exporting, f_X. From the definition of λ in (21), we can see that $\zeta_{\lambda,f_X} = \zeta_{\lambda,\mathcal{F}} = \frac{1}{\beta}$, and therefore $\zeta_{s_T,f_X} = \zeta_{s_T,\mathcal{F}} = -\frac{k}{\beta} < 0$, so that—similar to a reduction in τ—a decline in f_X increases the fraction of trading firms. To summarize these results, Figure 1 presents the relationship between τ and s_T for various values of θ and $\mathcal{F} \equiv \frac{f_X}{f}$. As in Ghironi and Melitz (2005), we use $\sigma = 3.8$ and $k = 3.4$. We set low, middle, and high levels for θ as $\theta^L = 0.15$, $\theta^M = 1.8$, $\theta^H = 6$. Each panel in the figure presents a different value of $\mathcal{F} \in \{0.25, 0.5, 0.75, 1\}$. The figure verifies that the lower the value of θ, the lower the fraction of exporters. Also, note from the figure that the relationship between the fraction of trading firms and the variable trade cost, τ, is sensitive to $\mathcal{F}$. However, when the value of θ is low, the response of s_T to reductions in τ is negligible in three of the four panels.

A novelty of this paper is that the mass of producing firms, M_P, matters for welfare due to workers' love of firm variety. Therefore, our trade-and-welfare analysis below requires that we know how M_P responds to trade liberalization. From the definition of M_P and under the Pareto distribution for productivity, it follows that $M_P = \frac{\tilde{M}_E}{\delta \hat{\varphi}_N^k}$, and thus, $\zeta_{M_P,\tau} = \zeta_{\tilde{M}_E,\tau} - k\zeta_{\hat{\varphi}_N,\tau}$. Note that the response of M_P depends on the effect of trade liberalization on entry (driven by $\zeta_{M_E,\tau}$), and the Melitz selection-into-production effect (driven by $-k\zeta_{\hat{\varphi}_N,\tau}$). From section 6.2 we know that $\zeta_{\hat{\varphi}_N,\tau} < 0$; hence, after a decline in τ, the selection-into-production effect reduces M_P ($-k\zeta_{\hat{\varphi}_N,\tau} > 0$). For the entry effect, note first from (25) that $\zeta_{\tilde{M}_E,\tau} = \left(\frac{\sigma-1}{\sigma-2}\right)\zeta_{\Psi,\tau}$. The following lemma shows the signs of the elasticities of Ψ with respect to each τ and θ (the latter will be useful in our welfare analysis below), as well as the sign of $\zeta_{M_P,\tau}$ for different levels of θ.

Lemma 2. *$\zeta_{\Psi,\tau} < 0$ and $\zeta_{\Psi,\theta} > 0$. If $k > \frac{\sigma-1}{\sigma-2}$, for every τ there is a unique level of θ, $\hat{\theta}$, such that $\zeta_{M_P,\tau} < 0$ if $\theta < \hat{\theta}$ and $\zeta_{M_P,\tau} > 0$ if $\theta > \hat{\theta}$; otherwise, $\zeta_{M_P,\tau} < 0$ for every τ and θ.*

The proof for this lemma is presented in section C in the Appendix. From $\zeta_{\Psi,\tau} < 0$, it follows that $\zeta_{\tilde{M}_E,\tau} < 0$ and hence, the mass of entrants increases upon trade liberalization. Therefore, the



(a) $\mathcal{F} = 0.25$

(b) $\mathcal{F} = 0.5$

(c) $\mathcal{F} = 0.75$

(d) $\mathcal{F} = 1$

Figure 1: Trade costs, the fraction of trading firms, and monopsony power: θ^L (dashed), θ^M (dotted), θ^H (solid)

net effect of trade liberalization on M_P depends on whether the entry effect dominates the selection-into-production effect. The second part of Lemma 2 states that as long as $k > \frac{\sigma-1}{\sigma-2}$, there is a labor supply elasticity level, $\hat{\theta}$, such that the entry effect dominates the selection-into-production effect ($\zeta_{\tilde{M}_E,\tau} - k\zeta_{\hat{\varphi}_N,\tau} < 0$) if $\theta < \hat{\theta}$, whereas the selection-into-production effect dominates if $\theta > \hat{\theta}$.[22] Intuitively, by leveling the competition field for low-productivity firms, monopsony power weakens the selection-into-production effect of trade liberalization, and thus, the lower the value of θ, the

[22]Given that $k > \sigma - 1$, the condition $k > \frac{\sigma-1}{\sigma-2}$ always holds if $\sigma \geq 3$ (in our figures we assume $\sigma = 3.8$). Hottman, Redding, and Weinstein (2016) provide a detailed estimation of σ for 98 product groups using U.S. Nielsen data. Close to the value we use, they find a median value for σ of 3.9, with only 25 percent of the groups yielding an elasticity of 3.1 or less, and only 10 percent yielding an elasticity of 2.6 or less. Based on this evidence, the $k > \frac{\sigma-1}{\sigma-2}$ case is more empirically relevant.

weaker the response of $\hat{\varphi}_N$. If $k \leq \frac{\sigma-1}{\sigma-2}$, the entry effect always dominates, so that trade liberalization always increases M_P.

7 Inequality and Welfare in the Open Economy

This section looks at the effects of trade liberalization on inequality and welfare when firms have monopsony power.

7.1 Monopsony Power and Inequality in the Open Economy

In the closed-economy model, the Pareto parameter of the wage distribution, $\gamma \equiv \frac{k\sigma+\theta(k-\sigma+1)}{\sigma-1}$, summarizes the relationship between inequality and monopsony power in the labor market. More monopsony power (a lower θ) reduces γ, which increases wage dispersion and thus inequality. In terms of productivity, this effect is captured by a reduction in the cutoff productivity level, so that low-productivity firms (which pay lower wages) are more likely to survive after a reduction in θ. In an open economy the mechanisms of action are richer, as a decline in θ reduces the cutoff level for non-trading firms, $\hat{\varphi}_N$, but may reduce or increase the cutoff level for trading firms, $\hat{\varphi}_T$. Given that the degree of inequality is not solely captured by γ, the Gini coefficient takes a greater relevance in an open-economy setting.

As in Helpman, Itskhoki, and Redding (2010), the distribution of wages, $F(w)$, is now a weighted average of the distribution of wages of workers in non-trading firms and the distribution of wages of workers in trading firms. To preserve space, we present the derivation of the distribution of wages in section D in the Appendix. After obtaining $F(w)$, we get that the average wage in the open economy, $\tilde{w}$, is given by

$$\tilde{w} = \underbrace{\left[\frac{\mathcal{F}+\lambda^k}{\lambda^k + (\mathcal{F}+\lambda^\beta)^{\frac{\theta}{1+\theta}} - \lambda^{\frac{\beta\theta}{1+\theta}}}\right]}_{>1} \frac{\gamma \hat{w}_N}{\gamma - 1}, \tag{27}$$

where the term in brackets accounts for the positive impact that exporting has on the average wage. Moreover, letting $\tilde{\mathcal{G}} = \frac{1}{\tilde{w}} \int_{\hat{w}_N}^{\infty} F(w)[1-F(w)]dw$ denote the open-economy Gini coefficient, we obtain

$$\tilde{\mathcal{G}} = \mathcal{G}\left[1 + \frac{2(\gamma-1)(1-\mu_T)\mathcal{F}}{\mathcal{F}+\lambda^k}\left\{1 - \frac{\lambda^\beta}{\mathcal{F}}\left[\left(\frac{\mathcal{F}}{\lambda^\beta}+1\right)^{\frac{\theta}{1+\theta}} - 1\right]\left[\frac{\gamma(\lambda^{\frac{\beta(\gamma-1)}{1+\theta}}-1)}{(\gamma-1)(\lambda^{\frac{\beta\gamma}{1+\theta}}-1)}\right]\right\}\right], \tag{28}$$

where $\mu_T \equiv \frac{(\mathcal{F}+\lambda^\beta)^{\theta/(1+\theta)}}{\lambda^k + (\mathcal{F}+\lambda^\beta)^{\theta/(1+\theta)} - \lambda^{\beta\theta/(1+\theta)}}$ denotes the fraction of workers employed in trading firms, and $\mathcal{G} = \frac{1}{2\gamma-1}$ is the closed-economy Gini coefficient. The following proposition, whose proof is in section C in the Appendix, describes the relationship between $\tilde{\mathcal{G}}$ and $\mathcal{G}$.

Proposition 1. ***(Inequality in the open economy and in autarky)***

For every τ and θ, it always holds that $\tilde{\mathcal{G}} \geq \mathcal{G}$, with equality if and only if $\lambda = 1$ (so that $\hat{\varphi}_N = \hat{\varphi}_T$ and $s_T = \mu_T = 1$), and $\tilde{\mathcal{G}} \to \mathcal{G}$ if $\tau \to \infty$ (so that $\lambda \to \infty$). Therefore, as long as not all producing firms are also exporters, inequality in the open economy is larger than inequality in the closed economy.

Hence, as long as there are non-trading firms, the exporting wage premium causes higher inequality. Focusing on the impact of trade liberalization on inequality, and given that λ captures trade barriers due to both fixed costs of exporting (f_X) and variable trade costs (τ), the results in Proposition 1 indicate that there is an inverted-U relationship between $\tilde{\mathcal{G}}$ and λ. Intuitively, as the fraction of workers employed in trading firms increases from zero ($\lambda \to \infty$), reductions in λ initially increase inequality because exporters pay higher wages than non-exporters; however, once μ_T (the fraction of workers employed by trading firms) reaches a critical mass, further reductions in λ reduce inequality as non-trading firms become insignificant in the distribution of wages.

Using different models of labor market imperfections, Egger and Kreickemeier (2009) and Helpman, Itskhoki, and Redding (2010) also find an inverted-U relationship between inequality and trade costs. Our setting with monopsony power, however, imposes an important parametric limitation for the feasibility of the inverted-U relationship. Given that $\tau \geq 1$, λ has a lower bound that may occur in the downward-sloping part of its relationship with $\tilde{\mathcal{G}}$, so that trade liberalization (a reduction in τ) always yields higher inequality. Section E in the Appendix shows that this case appears for low levels of θ (so that monopsony power is high) and sufficiently large fixed exporting costs. Intuitively, in such a case the fraction of trading firms is small and will barely change after trade liberalization, which prevents the economy from ever reaching the point where further liberalization starts to reduce inequality.

7.2 Welfare in the Open Economy

Following similar steps to those to obtain equation (20), section F in the Appendix shows that the expected maximized utility of workers in the open economy is given by

$$\tilde{\mathbb{U}} \equiv \ln \tilde{w} + \frac{1}{\theta} \ln M_P + \mathcal{D} + \mathcal{T}, \tag{29}$$

where $\mathcal{D}$ is defined as in section 5.2, and $\mathcal{T} \equiv \frac{1}{\theta} \ln \left\{ \frac{[\lambda^k + (\mathcal{F}+\lambda^\beta)^{\theta/(1+\theta)} - \lambda^{\beta\theta/(1+\theta)}]^{1+\theta}}{(\mathcal{F}+\lambda^k)^\theta \lambda^k} \right\} \leq 0$. Therefore, subtracting (20) from (29), we obtain that the change in welfare due to opening to trade is

$$\tilde{\mathbb{U}} - \mathbb{U} = \ln\left(\frac{\tilde{w}}{\bar{w}}\right) + \frac{1}{\theta} \ln\left(\frac{M_P}{M}\right) + \mathcal{T}. \tag{30}$$

In (30), the first term captures the impact of trade on the average wage, the second term captures the impact of trade on welfare through the novel love-of-firm-variety channel, and the third term captures the impact of trade on welfare through changes in the distribution of wages. The following proposition describes what we learn from our analysis of (29) and (30); section C in the Appendix shows the most technical parts of the proof of this proposition.

Proposition 2. ***(Trade, monopsony power, and welfare)***

The interaction between trade liberalization and monopsony power yields three important welfare results: (i) trade liberalization increases the average wage, but monopsony power dampens this response; (ii) if $k > \frac{\sigma-1}{\sigma-2}$, there is a cutoff wage elasticity of labor supply, $\hat{\theta}$, so that trade liberalization increases welfare through the firm-variety channel if $\theta < \hat{\theta}$ and reduces welfare if $\theta > \hat{\theta}$, whereas if $k \leq \frac{\sigma-1}{\sigma-2}$, trade liberalization increases welfare through the firm-variety channel for every θ; and (iii) even if the firm-variety channel is a source of welfare loss, overall welfare increases after trade liberalization.

With the average wage being equivalent to real income per worker, the first part of the proposition concerns the conventional gains from trade, which include gains from Melitz's selection effects and Krugman's love-of-variety in consumption. Similar to the closed economy, the wage bill is given by $\tilde{\mathbb{W}} = \mathbb{L}\tilde{w} = \frac{kf_E \tilde{M}_E \theta}{1+\theta}$. Hence, the ratio of the average wage in the open economy ($\tilde{w}$) to the average wage in the closed economy ($\bar{w}$) is $\frac{\tilde{w}}{\bar{w}} = \frac{\tilde{M}_E}{M_E}$, which using (25) can be rewritten as

$$\frac{\tilde{w}}{\bar{w}} = \Psi^{\frac{\sigma-1}{\sigma-2}},$$

where Ψ is given by (26). Since $\Psi > 1$, the average wage in the open economy is higher than in autarky. Therefore, the first term on the right-hand side of (30) is positive, $\ln\left(\frac{\tilde{w}}{\bar{w}}\right) = \left(\frac{\sigma-1}{\sigma-2}\right)\ln\Psi > 0$. Moreover, using Lemma 2 we obtain $\frac{d\ln\tilde{w}}{d\ln\tau} = \left(\frac{\sigma-1}{\sigma-2}\right)\zeta_{\Psi,\tau} < 0$, and thus, further reductions in τ increase the average wage.

Monopsony power affects the size of the conventional gains from trade. To see this, note from Lemma 2 that $\frac{d\ln(\tilde{w}/\bar{w})}{d\ln\theta} = \left(\frac{\sigma-1}{\sigma-2}\right)\zeta_{\Psi,\theta} > 0$. Hence, in comparison to a competitive labor market ($\theta \to \infty$), the average-wage gains from trade are smaller when the labor market is monopsonistic. Intuitively, by dampening the effect of firm heterogeneity on the allocation of market shares, monopsony power erodes the benefits of exporting. Thus, although trade liberalization drives Melitz-type market-share reallocations toward more productive firms, these are weaker the lower the value of θ, which then translate into a smaller impact on the average wage.

The second part of Proposition 2 refers to the novel love-of-firm-variety effect—which arises from the idiosyncratic preferences of workers for different firms—and is captured by the second term on the right-hand side of equations (29) and (30). For a reduction in τ, the result immediately follows from Lemma 2. The proof in the Appendix shows that the same is true when moving from autarky to trade: the second term on the right-hand side of (30) is positive—so that opening to trade yields welfare gains through the love-of-firm-variety channel—if and only if $M_P > M$ (recall that M is the mass of producing firms in autarky), which occurs if either $k \leq \frac{\sigma-1}{\sigma-2}$, or if $\theta < \hat{\theta}$ in the $k > \frac{\sigma-1}{\sigma-2}$ case.

In comparison to the conventional Melitz model ($\theta \to \infty$), our love-of-firm-variety analysis yields two novel insights. First, trade liberalization does not necessarily reduce the mass of producing firms in each country, and in particular, this mass increases if monopsony power is high (*i.e.*, if θ is low). This is a consequence of the dampening effect of monopsony power on the Melitz's selection-into-production effect of trade. Second, with workers valuing access to firm variety, welfare gains from more firm variety counteract the lower average-wage gains when monopsony power is high, whereas the welfare losses due to less firm variety (in the $k > \frac{\sigma-1}{\sigma-2}$ case) offset the higher average-wage gains when monopsony power is low.

Terms $\mathcal{D}$ and $\mathcal{T}$ in equations (29) and (30) account for how changes in the distribution of wages affect welfare. Term $\mathcal{D}$ is irrelevant for the gains from trade because it is independent of τ and appears in both $\tilde{\mathbb{U}}$ and $\mathbb{U}$, so it disappears in $\tilde{\mathbb{U}} - \mathbb{U}$. As shown in section F in the Appendix, $\mathcal{T}$ is a source of welfare loss and only equals zero if $\lambda = 1$, in which case all firms are exporters and the wage distribution is, as in the closed economy, a Pareto distribution with parameter γ.

The third part of Proposition 2 states that trade liberalization always yields an increase in welfare: $\tilde{\mathbb{U}} - \mathbb{U} > 0$ when the country moves from autarky to trade, and $\frac{d\tilde{\mathbb{U}}}{d\ln\tau} < 0$ for incremental trade liberalization. That is, even if the firm-variety effect and the wage distributional changes cause welfare losses from trade, they are more than offset by the positive welfare effect of a rise in real income. To see this, note from section F in the Appendix that the sum of the three components of equation (30) yields

$$\tilde{\mathbb{U}} - \mathbb{U} = \frac{1+\theta}{\theta} \ln\left[\left(\frac{\hat{\varphi}_N}{\hat{\varphi}}\right) \Psi^{\frac{1}{\sigma-2}}\right].$$

Given that $\hat{\varphi}_N > \hat{\varphi}$ and $\Psi > 1$, it follows that $\tilde{\mathbb{U}} - \mathbb{U} > 0$. Moreover, $\frac{d\tilde{\mathbb{U}}}{d\ln\tau} = \frac{1+\theta}{\theta}\left(\zeta_{\hat{\varphi}_N,\tau} + \frac{\zeta_{\Psi,\tau}}{\sigma-2}\right)$, which is negative because from section 6.2 and Lemma 2 we know that $\zeta_{\hat{\varphi}_N,\tau} < 0$ and $\zeta_{\Psi,\tau} < 0$.

To summarize our welfare results, Figure 2 plots θ against $\tilde{\mathbb{U}} - \mathbb{U}$ and its three components given in equation (30). We use $\sigma = 3.8$, $k = 3.4$, $\mathcal{F} = 0.5$, and assume a change in trade barriers from $\tau \to \infty$ (autarky) to $\tau = 1.1$. Note that our assumed values of σ and k correspond to the $k > \frac{\sigma-1}{\sigma-2}$ case, which is the most empirically relevant case (see footnote 22). The solid line shows $\tilde{\mathbb{U}} - \mathbb{U}$, the dashed line shows the change in welfare accounted for by the change in real income, $\ln\left(\frac{\tilde{w}}{\bar{w}}\right)$, the

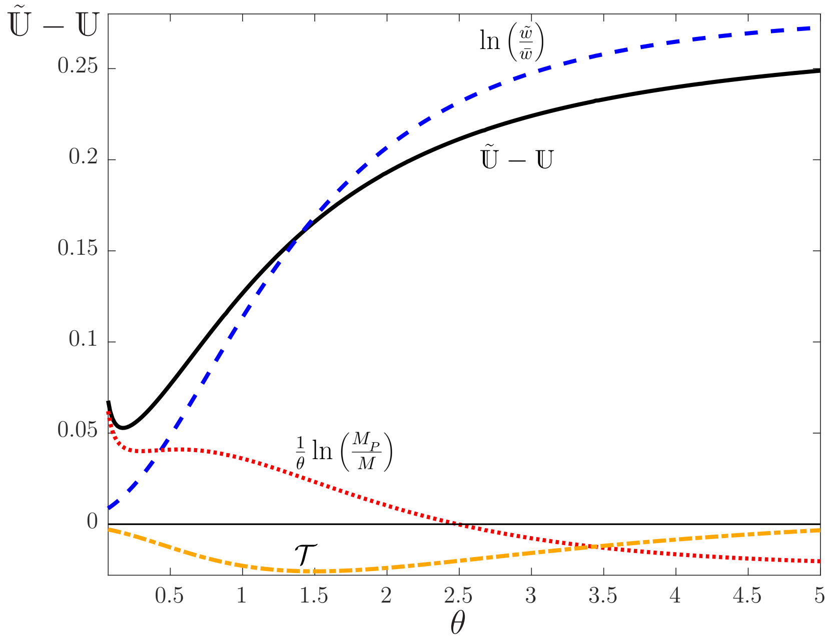


Figure 2: Monopsony power and the welfare gains from trade

dotted line shows the change in welfare due to the firm-variety channel, $\frac{1}{\theta}\ln\left(\frac{M_P}{M}\right)$, and the dashed-dotted line shows the change in welfare due to changes in the distribution of wages, $\mathcal{T}$. Comparing $\tilde{\mathbb{U}} - \mathbb{U}$ with $\ln\left(\frac{\tilde{w}}{\bar{w}}\right)$, note that for low values of θ, the welfare gains from trade exceed the gains in real income, whereas for larger values of θ, the opposite is true. The difference is accounted for by *(i)* the welfare loss due to changes in the distribution of wages, and by *(ii)* the love-of-firm-variety channel, which is a source of welfare gains for low values of θ, and a source of welfare loss for larger values of θ. Thus, looking at the real income per worker alone—the conventional measure of gains from trade—can overstate the welfare gains from trade when monopsony power is low (*i.e.*, for high values of θ) and understate the welfare gains when monopsony power is high (*i.e.*, for low values of θ).

Figure 2 highlights different features of the novel firm-variety channel, showing that it yields welfare gains that exceed real income gains for low values of θ, whereas it is a source of welfare loss for larger values of θ. From an empirical perspective, this suggests that the welfare effects of trade through the firm-variety channel will vary across industries and countries exhibiting different degrees of monopsony power. Hence, our theoretical findings can serve as guide for empirical applications that attempt to quantify the importance of this channel.

It is worth pointing out that while we have identified the firm-variety effect by incorporating monopsonistic labor markets in a Melitz-type model, this effect will be present in any model where firms are involved in trade and the mass of domestic firms changes after trade liberalization. As shown in section 6.4, in our model the impact of trade on the mass of domestic firms depends on both the impact on the mass of entrants, and the Melitz selection-into-production effect. Importantly, the entry effect of trade liberalization—and hence the firm-variety effect—will be present even in the absence of the Melitz selection effect. For example, the firm-variety channel will also operate in the model of Krugman (1979), where the mass of domestic firms declines after opening to trade even though there is no Melitz selection effect. Empirically, however, there is strong support for the Melitz selection effect (Melitz and Trefler, 2012).[23]

8 Concluding Remarks

Monopsony power is a prevalent aspect of labor markets. Here we constructed a model to study how the effects of globalization on inequality and welfare are affected by the presence of a monopsonistic labor market. We show that monopsony power dampens the effects of firm heterogeneity on the allocation of market shares by leveling the competition field for low-productivity firms, which pay lower wages than more productive firms. In a closed economy, this effect translates into a wider distribution of wages and hence more inequality. In an open economy, we showed that monopsony power inhibits exporting because it commands higher exporting wage premiums. As a consequence, trade liberalization always increases wage inequality when monopsony power is high.

Due to workers' idiosyncratic preferences for different employers, we show the existence of a novel firm-variety channel through which trade liberalization affects welfare. For empirically relevant parameter values, the novel firm-variety channel is a source of additional gains from trade when monopsony power is high, but detracts from the gains from trade for lower degrees of monopsony power. Therefore, ignoring the welfare implications arising through the firm-variety channel could understate or overstate the gains from trade depending on the degree of monopsony power.

Our framework provides a simple yet powerful structure to study the effects of monopsony power in the labor market on trade-related outcomes. Our assumptions on preferences yield a constant elasticity of labor supply, which allows us to provide clear intuition on the first-order effects of labor market power. However, our model can be easily enriched to incorporate endogenous markdowns for

[23] Arkolakis, Costinot, and Rodriguez-Clare (2012) showed that the welfare gains in three standard trade models of international trade (Armington-Krugman, Eaton-Kortum, and Melitz-Chaney) can be summarized by a unified welfare measure that depends on two things: the share of domestic goods in aggregate expenditure and a trade elasticity parameter. This was taken by some to imply that there is not much use in having different trade models because they all produce the same gains from trade. Melitz and Redding (2015) clarified the issue and showed that the gains from trade are much larger in a setting with heterogeneous firms than with homogeneous firms. An excellent discussion of this issue can be found in Robert Feenstra's graduate textbook, Feenstra (2015), on pages 164-168. The key point is that neither the trade share nor the trade elasticity are the same in the Melitz model with heterogeneous firms as in the Krugman model with homogeneous firms.

wages, with each firm facing a different elasticity of labor supply. In such a setting, a minimum wage can serve as a "choke" wage that would generate markdown heterogeneity in the labor market in a similar way that a choke price causes variable markups in the product market (as in, for example, Melitz and Ottaviano, 2008), with low-productivity firms facing higher labor-supply elasticities and thus setting lower markdowns. We leave this venue of research for the future.

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