# Increasing Returns, Monopolistic competition, and Optimal Unemployment

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What is the link between market competition and the equilibrium level of unemployment? This paper augments the standard Krugman (1979) and Melitz (2003) models with labor matching frictions and non-CES preferences. It connects the two well-known market distortions: the allocational distortion (too many firms producing too little) and the labor market distortion (firms posting too few vacancies). First, I show that if one distortion is corrected, the other one is likely to be amplified. Therefore, the standard policies designed for the models without matching frictions are not optimal and need to be modified to take into account the labor market side. Second, I investigate whether a more productive economy results in a lower unemployment rate. I find that the employment rate can rise or fall, depending on the nature of productivity improvement and its effect on the competition level.

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# 1 Introduction

Market and allocative efficiency are the focal points of the literature of imperfectly competitive markets. For instance, the equilibrium number of firms is usually shown to differ from the social optimum. Likewise, production resources are likely to be misallocated among firms of different size and productivity. As a result, these findings motivate the analysis of the corresponding policy tools which can correct the distorted markets, such as competition and market regulation.

At the heart of such policies lies the positive effect of increased market competition and productivity, which decreases the wedge between market equilibria and social optima. Consider the argument for European market integration. It is generally agreed that by allowing for larger economies of scale and tougher international competition, firms gain in the form of higher real wages. Essentially, the benefits come from a more efficient economy.

Efficiency, however, is about reducing the minimal amount of input needed for production. This implies two opposing effects for the aggregate labor demand. On the one hand, firms require fewer resources, and the labor demand curve is shifted downward. On the other hand, higher productivity implies lower prices and larger aggregate demand for products, shifting the demand for labor upwards. Thus, market efficiency alters labor market conditions through the productivity and revenue effects, having (a priori) ambiguous and significant effect on the labor employment rate.

Yet, such considerations are typically missed from the theoretical analysis of market competition. The discourse is focused on the production side and product market, rarely allowing for market imperfections on the labor side. Indeed, canonical models of monopolistic competition (e.g. Krugman, 1979, or Melitz, 2003) often assume full employment and no disutility of labor. Therefore, it is impossible to draw any conclusions on the impact of product market regulation on the unemployment level. At the same time, Fiori, et al. (2012) presents an abundance of empirical evidence that these two markets are closely related to each other.

Understanding the intermarket effects is important for two reasons. First, it helps to clarify the interconnection between product market competition and employment rate. This kind of analysis becomes more pertinent in the light of the empirical evidence presented in De Loecker et al. (2020), who document a rise in market power of the upper percentiles of firms and a simultaneous fall in the labor force participation. Secondly, it allows a policy-maker to modify the existing market regulation policies to take into account the repercussions for the labor market. As a result, optimal product-market policy may vary on the basis of the labor market institutions in each country.

These are the issues I examine in this paper. I start by extending, in Section 1, the standard static model of monopolistic competition à la Melitz along the two dimensions. First, I assume an imperfect labor market with matching frictions, as in Mortensen–Pissarides framework. Matching frictions result in equilibrium unemployment, which depends on the aggregate level of economic activity. Secondly, I employ more general non-CES preferences, which are viewed to be more realistic and yield richer results. Namely, non-CES preferences generate variable markups and pro-competitive effects, associated with increased productivity. On the other hand, non-CES preferences introduce market and allocative inefficiencies, which provide the motivation for product market regulation.

I characterize the market equilibrium in Section 2. The standard equilibrium is augmented with the Nash-bargaining process over the surplus generated by a worker in a firm.

I then proceed to Section 3, to compare market equilibrium with the social optimum. It turns out that the classical Dixit-Stiglitz excessive entry and output distortions are mirrored to this new setup. Moreover, there is a new source of market distortion, corresponding to the vacancy posting rate by firms. Namely, firms are shown to underemploy workers, relative to the social optimum.

The explanation for the labor market distortion rests in the two externalities acting in opposite directions. First, a firm that incurs the costs of publishing a vacancy does not appropriate the full surplus created by the job, which deters firms from posting vacancies. Secondly, firms also do not internalize the mutual negative externality of an increased labor market tightness and longer search time, which can result in over-employment.

It turns out that the magnitude of the labor market distortion depends on the Dixit-Stiglitz distortion. Whenever the Dixit-Stiglitz distortion is mitigated, the unemployment distortion is amplified. This bears an important point for the policy implications: there is a trade-off between the two distortions. For example, firm licensing is a standard policy tool considered for the correction of excessive entry distortion. As licensing costs increase and the proceedings are redistributed back to the consumers, the Dixit-Stiglitz distortion falls, while unemployment rises. As a consequence, the optimal level of market regulation will be lower in the model with labor market frictions, compared to the classical model of monopolistic competition.

Thus, the standard market regulation policies should be modified to take into account labor market ramifications. What is the optimal policy in this situation? The analysis shows that wage subsidies do not have an effect, as they will be exactly compensated by the increased competition among firms. The modeling shows that, instead, the optimal policy should focus on subsidizing hiring costs or to improve matching efficiency in the economy. The example considered is where the number of firms is still licensed, but the proceedings are redirected to the hiring subsidies, and not to the direct revenue subsidy to the consumers.

The second main contribution, in Section 4, concerns the effect of productivity and market competition on the equilibrium level of employment. Should the government focus on productivity improvement for all types of firms, or should it subsidize productivity improvement to only a particular group of firms (e.g. small businesses)? I show that the direction of the employment change depends on the source of productivity improvement. If all firms experience a growth in their productivity (a fall in the marginal costs of production), employment level rises as well as welfare. If, on the other hand, a productivity improvement comes from a growth in the share of more productive firms, the employment rate falls. The important difference is that in the second case the productivity improvement is characterized by a reallocation of the market power towards larger firms at the expense of the smaller firms. As a result, the competition level falls, as well as the employment rate.

Finally, I consider two other sources of productivity change, commonly used in the international trade and market competition literature. First, growth in the market size is shown to be beneficial for the consumers, as well as for the employment rate. This happens because even though the average costs are lower (economy of scale) and the economy is more productive, the fall in the prices boosts the aggregate demand and shifts the labor demand upwards. Second, I demonstrate that in a country where entry is restricted due to higher fixed production costs (e.g. bureaucratic costs of registering a firm) the employment rate is lower as well as the welfare. This happens due to lower competition and higher real prices, even though the number of firms can shrink or grow (due to lower hiring costs). Likewise, if the number of firms is restricted (quotas on the number of firms), this results in both lower employment and lower welfare.

**Related work.** My paper is closely related to two big strands of the literature. The first one examines the market competition and optimal product diversity in the presence of preferences with variable elasticity of substitution (VES). Examples of such works include Krugman (1979) who study the effects of market growth, Arkolakis et al. (2019) and Bykadorov, Kokovin, Molchanov (2020) who study the effects of trade liberalization, and Dhingra and Morrow (2019) who examines the allocative efficiency in a heterogeneous firms model. Our paper contributes to this literature by relaxing the assumption of full employment and frictionless labor market. This allows the modeller to connect two pertinent features of reality: market competition and employment. As a consequence, the policy implications developed in these papers can be reviewed in the presence of equilibrium unemployment. Moreover, I am the first to examine the interaction between the traditional output-diversity tradeoff from this literature with the employment externality in the labor market.

The questions of monopolistic competition and imperfect labor market are partially examined in Felbermayr and Prat (2011) who study how the product market regulation affects firm productivity distribution and unemployment. Their framework, however, assumes the constant elasticity of substitution (CES) preferences, which exclude the output-diversity tradeoff from the consideration[2]. Moreover, in their model firms do not take the wage as given, and over-employ workers to reduce their marginal contribution into the profit. Instead, I allow for VES preferences but consider firms as wage takers, with the goal to focus on the interaction between the two classical distortions only.

Another consequence of allowing for VES preferences is the emerging income effect, not present in CES modelling. Thus, a change in unemployment also changes the aggregate demand for all firms. This would result in yet another additional positive externality not internalized by firms and which would complicate the analysis of the interaction between the two classical distortions. To avoid this, I employ a device proposed by Shimer et al. (2010), where labor income is brought by many workers to a household, which then decides on the consumption. Thus, unemployment affects only the aggregate income of the household and does not introduce consumer heterogeneity and subsequent problems with the composite demand function.

## 2 Model setup

The model consists of two major elements. The basis of the model adopts the Krugman (1979) and Melitz (2003) frameworks. While the second element includes the labor matching frictions. The model is inherently static (long-term equilibrium) and there is no dynamic job-separation. Put differently, there is no evolution of unemployment, all workers get fired at the end of the period and matching process repeats itself.

A single-sector economy exhibits monopolistic competition and involves a continuum of heterogeneous firms producing horizontally differentiated good, one variety per firm. To enter the market, a firm must pay a sunk entry cost of $f_e$, after which it receives the unit costs $c$ drawn from a distribution $G(c)$. Each vareity is indexed by the unit cost (productivity) of its producer. The mass of entrants is denoted by $M_e$. Upon entry, a fixed production cost $f$ has to be paid in order for a firm to start operating. This cost generates a positive maximal marginal costs, $c_d$, beyond which a firm renders it unprofitable to operate on the market.

The only production factor is labor, supplied inelastically by workers. Each worker belongs to a household, whereas each household consists of a continuum of workers of measure 1. The mass of the households is $\mathcal{L}$. The household aggregates income of many workers and

[2] Ziesemer (2005) and Lingens (2006) also assume CES preferences and consider comparative static with respect to the parameters of the model.

decides on the consumption pattern. Labor matching frictions imply that a worker matches with a firm only with a probability $m(\theta)\theta$, where $m(\theta) = m_0\theta^{-\eta}$ is the constant-returns-to-scale matching function and $\theta \equiv \frac{N\,of\,vacancies}{\mathcal{L}}$ is market tightness[3]. Each firm can match with multiple workers, while a worker is matched only with one firm.

**A representative houshold** maximizes her utility with respect to per-variety consumption $x_\omega$, subject to the budget constraint:

$$\max_{\{x_c\}_0^{c_d}} \log\left[M_e \int_0^{c_d} v(x_c)\,dG\right] - \Gamma m(\theta)\theta,$$

$$M_e \int_0^{c_d} p_c x_c dG \leqslant w m(\theta)\theta,$$

where price $p_c$ corresponds to variety of a firm with productivity $c$, $m(\theta)\theta$ is the fraction of workers who find a job, and $\Gamma$ is the disutility of work. The disutility of work is assumed small enough so that a houshold would always wants all its workers to participate in the job market. Note that there is no disutility of a job search. This particular form of the utility function of consumption and disutility of work is commonly used in the macroeconomic literature Shimer et al. (2010) and provides the basic framework for the analysis.

To ensure the existence and uniqueness of each consumer's/producer's choice in any market situation, I impose further some restrictions, standard for VES models. As in Mrázová and Neary (2014), the elementary utility $v(\cdot)$ is thrice continuously differentiable, strictly concave, increasing at least on some interval $[0, \breve{z})$, where $\breve{z} \equiv \arg\max_z u(z)$ denotes the satiation point, which can be infinite (for HARA utility) or finite (for quadratic utility). Additionally, using the Arrow-Pratt concavity measure $r_g(z) \equiv -\frac{zg''(z)}{g'(z)}$ (defined for any function $g$), I restrict throughout concavity of $u$, $u'(z)z$ as

$$\{0 < r_v(z) < 1 \;\&\; r_{v'}(z) < 2\ \forall z \in (0, \breve{z})\},\ v(0) = 0. \tag{1}$$

Notably, I follow Krugman (1979) in assuming decreasing elasticity of consumption, $(\mathcal{E}v(x))' < 0$. Secondly, I assume increasing elasticity of demand, $r_v' > 0$, which is considered more plausible from the empirical literature (see Mrázová and Neary, 2014) and results in a pro-competitive effect. Using these assumptions and the consumer's first-order condition (FOC), I standardly derive the inverse demand function for each variety:

$$p_\omega = \frac{1}{M_e \int_0^{c_d} v(x_c)\,dG} \frac{v'(x_\omega)}{\lambda}. \tag{2}$$

[3]Constant returns to scale for the matching function means that a proportional increase in the number of vacancies and unemployed does not change the matching probability for the open vacancy.

Here $\lambda$ is the Lagrange multiplier for the budget constraint. Being the marginal utility of income, $\lambda$ serves as the main market aggregator, similar to the price index. As the marginal utility of consumption relative to the disutility of work falls with the total utility, the price is determined both by the $\lambda$ and total utility acting together. We can find the direct expression for $\lambda$ by multiplying the inverse demand by the consumption quantity and integrate it over all varieties:

$$\lambda = \frac{1}{wm(\theta)\theta} \frac{M_e \int_0^{c_d} v'(x_c) x_c dG}{M_e \int_0^{c_d} v(x_c) dG} = \frac{1}{wm(\theta)\theta} \bar{\mathcal{E}} v(x_c), \tag{3}$$

where $\bar{\mathcal{E}} v(x_c) \equiv \frac{\int_0^{c_d} v(x_c) \mathcal{E} v(x_c) dG}{\int_0^{c_d} v(x_c) dG}$ is the average elasticity of utility across firms, with the weights being the utility function of each variety.

Let us determine the value for a household of one additional worker employed with a wage $w$, different from all others' wage, $\bar{w}$. Namely, assume that, in a household, a fraction of workers $m(\theta)\theta$ is employed with the wage $\bar{w}$ and the fraction $\epsilon$ of workers are employed with the wage $w$. Denote by $H(\epsilon)$ the maximized (w.r.t. consumption) utility function, that is

$$H(\epsilon) = \max_{x_\omega} \log\left(M_e \int_0^{c_d} v(x_c) dG\right) - \Gamma(m(\theta)\theta + \epsilon) - \lambda\left(M_e \int_0^{c_d} p_c x_c dG - \bar{w} m(\theta)\theta - w\epsilon\right).$$

Then the marginal value of the utility function evaluated at $\epsilon = 0$ gives the value of the marginal worker bringing income $w$,

$$H'_\epsilon(\epsilon = 0) = -\Gamma + \lambda w - \lambda'_\epsilon \cdot \left(M_e \int_0^{c_d} p_c x_c dG - \bar{w} m(\theta)\theta\right) = \lambda w - \Gamma.$$

**Producers.** Upon the sunk entry cost is paid, firms have a linear cost function, $cx\mathcal{L} + f$. A firm faces an inverse demand (2) and takes the aggregate demand shifter $\lambda$ and total consumer's utility as given. From now on, the individual firm index $c$ will be omitted, except in the cases where it's required.

Labor is hired by posting $V$ amount of vacancies. Each vacancy is fulfilled with probability $m(\theta)$, where market tightness $\theta$ is taken is given by each firm. The firm uses its own labor (the same type of labor as for the production) to post vacancies, with the costs of $h$ units of labor per vacancy. Thus, if $L$ is the total labor employed by the firm, then the labor used in production is $L - hV - f$. That is, the output of the firm is determined by

$$x\mathcal{L} = \frac{1}{c}(L - hV - f).$$

By substituting the hiring technology, $L = Vm(\theta)$, I find the work-size of a firm is the production costs augmented by the hiring costs,

$$L = (cx\mathcal{L} + f)\frac{m(\theta)}{m(\theta) - h}. \tag{4}$$

Standardly to the labor-market literature, firms assume wage as given, keeping the model tractable[4]. A mathematical technique which dispenses from this assumption is presented in Felbermayr and Prat, 2011, who, on the other hand, assume a CES utility function.

Using the demand functions, the profit maximization program of a firm can be written as

$$\max_x \pi \equiv \frac{1}{\lambda}\frac{1}{M_e \int_0^{c_d} v(x_c)\, dG} v'(x)\, x\mathcal{L} - w(cx\mathcal{L} + f)\frac{m(\theta)}{m(\theta) - h}. \tag{5}$$

The first-order condition of the firm is

$$\frac{1}{\lambda}\frac{1}{M_e \int_0^{c_d} v(x_c)\, dG} v'(x)(1 - r_v(x)) = wc\frac{m(\theta)}{m(\theta) - h}. \tag{6}$$

The second-order condition (SOC) under linear costs holds true under our assumptions ($r_{u'}(z) < 2$) and guarantees symmetry of producers' behavior (see Mrázová and Neary, 2014). Since the first-order condition is symmetric over firms, from now on we can ommit indices $\omega$ where possible. As a result, the expression for the market competition index (3) reduces to $\lambda = \frac{\mathcal{E}v(x)}{m(\theta)\theta}$.

A surplus of a hired worker is the reduction in profit if he is to suddenly separate from the firm, while the hiring costs are sunk. To evaluate the firm's surplus over a marginal worker, consider a firm that hired $L$ amount of workers for the wage $\bar{w}$ and $\epsilon$ amount of workers for the wage $w$. Denote by $\Pi(\epsilon)$ the maximized profit function,

$$\Pi(\epsilon) = \max\ \frac{1}{\lambda}\frac{1}{M_e \int_0^{c_d} v(x_c)\, dG} v'(x(\epsilon))\, x(\epsilon)\,\mathcal{L} - \bar{w}L - w\epsilon,$$

where $x(\epsilon) = \frac{1}{c\mathcal{L}}(L + \epsilon - hV - f) = \frac{1}{c\mathcal{L}}\left(\frac{m(\theta) - h}{m(\theta)}L + \epsilon - f\right)$. Differentiate it with respect to $\epsilon$ and evaluate at $\epsilon = 0$:

$$\Pi'_\epsilon(\epsilon = 0) = \frac{1}{\lambda}\frac{1}{M_e \int_0^{c_d} v(x_c)\, dG} v'(x)(1 - r_v(x))\frac{1}{c\mathcal{L}}\mathcal{L} - w.$$

[4]This has two possible interpretations. (i) Wage curve (a result of wage negotiation), is formed prior to employment and based on the average marginal product of labor across firms. (ii) The hiring department is autonomous from the profit maximization department. — an assumption common in the literature on imperfect information. "Moreover, both the worker and firm anticipate agreeing on the equilibrium wage wt in any future period t when they are matched."

Utilizing the initial FOC (6), it transforms to

$$\Pi'_{\epsilon}(\epsilon = 0) = \bar{w}\frac{m(\theta)}{m(\theta) - h} - w = (\bar{w} - w) + \frac{h}{m(\theta) - h}\bar{w}.$$

Note that the firm's surplus over the worker does not depend on the productivity, even though firms differ in marginal productivity. This result is achieved because the output adjusts in such a way that the marginal revenue equalizes the effective marginal costs.

**Wage bargaining.** Each firm negotiates the wage individually with each worker (no labor unions). The negotiation takes the form of the Nash bargaining process over the surplus defined as

$$(H'_{\epsilon}(\epsilon = 0))^{\gamma} (\Pi'_{\epsilon}(\epsilon = 0))^{1-\gamma},$$

where $\gamma$ is the bargaining power of the worker. The first-order condition of the bargaining process is

$$\gamma \frac{H''_{\epsilon,w}(\epsilon = 0)}{H'_{\epsilon}(\epsilon = 0)} = -(1-\gamma)\frac{\Pi''_{\epsilon,w}(\epsilon = 0)}{\Pi'_{\epsilon}(\epsilon = 0)},$$

$$\gamma\lambda\bar{w}\frac{m(\theta)}{m(\theta) - h} + (1-\gamma)\Gamma = \lambda w.$$

Since all workers are symmetric, their negotiated wage is also symmetric, $w = \bar{w}$, and

$$w = \frac{m(\theta) - h}{m(\theta) - \frac{h}{1-\gamma}}\frac{\Gamma}{\lambda}.$$

One can derive that $w'_{\theta} > 0$, that is wages are higher in the more tight market, if the marginal utility of consumption is hold constant. However, since we can use the wages as a numeraire and normalize $w \equiv 1$, the wage bargaining condition above simply determines the market competition $\lambda$ as a function of labor market tightness $\theta$.

# 3 Market Equilibrium

This section determines the market equilibrium. It consists of the following conditions.

- Labor market clearing condition, meaning full employment of matched labor at the equilibrium, is written as

$$M_e \left[\int_0^{c_d} (cx_c\mathcal{L} + f)\, dG + f_e\right] \frac{m(\theta)}{m(\theta) - h} = \mathcal{L}m(\theta)\,\theta. \quad (7)$$

- Zero-profit (free-entry) condition at equilibrium means that firms are free to entry until their expected operating profit equals the entry costs:

$$\int_0^{c_d} \pi\left(c,\lambda,\theta\right) dG = f_e \iff$$

$$\frac{1}{\lambda}\frac{1}{M_e\int_0^{c_d} v\left(x_c\right) dG}\mathcal{L}\int_0^{c_d} v'\left(x_c\right) x_c dG - \frac{m\left(\theta\right)}{m\left(\theta\right)-h}\int_0^{c_d}\left(cx_c\mathcal{L}+f\right) dG = f_e. \tag{8}$$

- Productivity cutoff condition determines the marginal costs of the firm who is indifferent between entering the market and paying fixed production cost, or not entering:

$$\pi\left(c_d,\lambda,\theta\right) = 0 \iff$$

$$\frac{1}{\lambda}\frac{1}{M_e\int_0^{c_d} v\left(x_c\right) dG} v'\left(x_{c_d}\right) x_{c_d}\mathcal{L} - \left(c_d x_{c_d}\mathcal{L}+f\right)\frac{m\left(\theta\right)}{m\left(\theta\right)-h} = 0. \tag{9}$$

- Producer's FOC determines the optimal output for each firm,

$$\frac{1}{\lambda}\frac{1}{M_e\int_0^{c_d} v\left(x_c\right) dG} v'\left(x_c\right)\left(1-r_v\left(x_c\right)\right) = wc\frac{m\left(\theta\right)}{m\left(\theta\right)-h}. \tag{10}$$

- Wage bargaining condition connects the market competition index and employment rate.

$$\lambda\frac{m\left(\theta\right)\left(1-\gamma\right)-h}{m\left(\theta\right)-h} = \left(1-\gamma\right)\Gamma. \tag{11}$$

Equilibrium is the bundle of consumptions, prices, the mass of firms, market tightness, and the market aggregate

$$\left(x_c^*, p_c^*, N^*, \theta^*, \lambda^*\right)$$

that satisfies all the requirements imposed, namely: (i) utility maximization (2); (ii) profit maximization (10); (iii) wage bargaining (11); (iv) free entry (8); (v) cut-off condition (9); and (vi) labor balance (7). As usual, the budget constraint entails the labor balance; being dependent, they are omitted from the equilibrium system.

- Welfare of a representative houshold is expressed as

$$W = \log\left[M_e\int_0^{c_d} v\left(x_c\right) dG\right] - \Gamma m\left(\theta\right)\theta. \tag{12}$$

Using the labor balance (7), the welfare function can be reformulated without variety mass,$M_e$:

$$W = \log\left[\frac{\mathcal{L}}{\int_0^{c_d}\left(cx_c\mathcal{L}+f\right) dG + f_e}\left(m\left(\theta\right)\theta - h\theta\right)\int_0^{c_d} v\left(x_c\right) dG\right] - \Gamma m\left(\theta\right)\theta. \tag{13}$$

# 4 Market efficiency

This section shows the system of equations for the market equilibrium and social optimum can be reduced to a system of only two equations and compared.

**Market equilibrium.** The total system is

$$\begin{cases} \frac{1}{\lambda}\frac{1}{M_e\int_0^{c_d}v(x_c)dG}v'(x_c)(1-r_v(x_c)) = wc\frac{m(\theta)}{m(\theta)-h} & FOC \\ \lambda = \frac{m(\theta)-h}{m(\theta)-\frac{h}{1-\gamma}}\Gamma & wage\,bargaining \\ M_e\left[\int_0^{c_d}(cx\mathcal{L}+f)\,dG+f_e\right] = \mathcal{L}(m(\theta)\theta-h\theta) & labor-market \\ \frac{1}{\lambda}\frac{1}{M_e\int_0^{c_d}v(x_c)dG}\mathcal{L}\int_0^{c_d}v'(x_c)x_c dG = w\left(\int_0^{c_d}(cx_c\mathcal{L}+f)\,dG+f_e\right)\frac{m(\theta)}{m(\theta)-h} & free-entry \\ \frac{1}{\lambda}\frac{1}{M_e\int_0^{c_d}v(x_c)dG}v'(x_{c_d})x_{c_d}\mathcal{L} = w(c_d x_{c_d}\mathcal{L}+f)\frac{m(\theta)}{m(\theta)-h} & \pi_{c_d}=0 \end{cases}$$

Substituting the FOC into the free-entry condition gives the equation determining the per-capita sales of a firm, $x^{mkt}$. While substitution of the expression (3) for $\lambda$ into the wage bargaining process, pins down the labor market tightness $\theta^{mkt}$. Finally, substituting the FOC into the cut-off condition we get the expression which determines $c_d$ without $\lambda$ or total utility:

$$\begin{cases} \frac{c\mathcal{L}x_c^{mkt}}{\int_0^{c_d}\left(cx_c^{mkt}\mathcal{L}+f\right)dG+f_e} = \frac{v\left(x_c^{mkt}\right)\mathcal{E}v\left(x_c^{mkt}\right)}{\int_0^{c_d}v\left(x_c^{mkt}\right)dG}\frac{1-r_v\left(x_c^{mkt}\right)}{\bar{\mathcal{E}}v\left(x_c^{mkt}\right)}, \\ \frac{cx_{c_d}\mathcal{L}}{c_d x_{c_d}\mathcal{L}+f} = 1-r_v\left(x_{c_d}\right), \\ \bar{\mathcal{E}}v\left(x_c^{mkt}\right)\frac{(1-\gamma)-\frac{h}{m(\theta^{mkt})}}{m\left(\theta^{mkt}\right)\theta^{mkt}-h\theta^{mkt}} = (1-\gamma)\Gamma. \end{cases} \tag{14}$$

The first two expressions are identical to the result obtained in Krugman-Melitz models with the frictionless labor market. Notably, the equilibrium size of a firm and cut-off productivity do not depend on the labor market conditions. The third expression tells us how the market tightness changes with the firm's size. Because I assume a decreasing elasticity of utility, a higher average output $x_c^{mkt}$ implies a lower value of $\theta^{mkt}$ and a lower rate of employment.

Finally, as it is often useful to study a more tractable homogeneous firms model. The corresponding equilibrium system is read as following (where $F$ is fixed production costs and $M$ is the mass of firms):

$$\begin{cases} \frac{c\mathcal{L}x^{mkt}}{cx^{mkt}\mathcal{L}+F} = 1-r_v\left(x^{mkt}\right), \\ \mathcal{E}v\left(x^{mkt}\right)\frac{(1-\gamma)-\frac{h}{m(\theta^{mkt})}}{m\left(\theta^{mkt}\right)\theta^{mkt}-h\theta^{mkt}} = (1-\gamma)\Gamma. \end{cases} \tag{15}$$

**Social optimum.** A social planner maximizes the total welfare function (12) , subject to the labor balance constraint (7) and hiring technology constraint (4). If I substitute these two constraints, the maximization problem can be reformulated as a maximization of the reduced-form welfare function (13) with respect to firm's output, market tightness and productivity cut-off:

$$\max_{(x,\theta)} \log \left[ \frac{\mathcal{L}}{\int_0^{c_d} (cx\mathcal{L} + f)\, dG + f_e} (m(\theta)\theta - h\theta) \int_0^{c_d} v(x_c)\, dG \right] - \Gamma m(\theta)\theta.$$

The first-order conditions are

$$\begin{cases} \frac{c\mathcal{L}x_c^{opt}}{\int_0^{c_d}\left(cx_c^{opt}\mathcal{L}+f\right)dG+f_e} = \frac{v\left(x_c^{opt}\right)\mathcal{E}v\left(x_c^{opt}\right)}{\int_0^{c_d} v\left(x_c^{opt}\right)dG}, \\ \frac{c_d x\mathcal{L}+f}{\int_0^{c_d}(cx\mathcal{L}+f)dG+f_e} = \frac{v\left(x_{c_d}\right)}{\int_0^{c_d} v(x_c)dG} \\ \frac{(1-\eta)-\frac{h}{m(\theta_{opt})}}{m(\theta_{opt})\theta_{opt}-h\theta_{opt}} = (1-\gamma)\,\Gamma. \end{cases} \tag{16}$$

We can see the exact way how the two systems differ one from another. The first two equations again correspond to the standard expression in the Krugman-Melitz models and determine the optimal level of output and productivity cut-off. Because the first two equations of each of the two systems (14)-(16) are not affected in any way by the introduction of the labor market frictions, they are equivalent to the one derived under frictionless labor market. As a consequence, all results derived for the "standard" models are still applicable, and the firm's output will be inoptimale whenever the utility function is not CES. Namely, as Dhingra and Morrow (2019) show, under the assumptions of $r_v' > 0$ and $\mathcal{E}'v(x) < 0$, "heterogeneity in misallocation can be severe enough that small firms over-produce while large firms underproduce." The reason is the wedge between private and social incentives, explained by Dhingra and Morrow (2019) in details. From the formulas above, we can trace back that there are two main mechanisms at play which determine the output distortion. Assuming for simplicity that the cut-off productivity is hold equal between two models, one can see that the term $\frac{1-r_v\left(x_c^{mkt}\right)}{\bar{\mathcal{E}}v\left(x_c^{mkt}\right)}$ is solely responsible for the differences in the solutions of the first equation in the two systems.

(i) The term $1 - r_v\left(x_c^{mkt}\right)$ represents the share of the firm's revenue devoted to cover the variable cost of producing $x_c^{mkt}\mathcal{L}$ amount of good. In other words, the markup $r_v\left(x_c^{mkt}\right)$ corresponds to the monopolistic power of the firm, and its private incentive to underproduce. This incentive is less active for less productive firms, leading to the Dhingra-Morrow result of the underproduction by large firms.

(ii) On the other hand, there is a Dixit-Stiglitz firm entry distortion, represented by $\bar{\mathcal{E}}v\left(x_c^{mkt}\right)$. Namely, all things equal, a higher firm entry $M_e$ would lead to a lower firm's per-capita sales due to a higher aggregate competition (higher $\lambda = \frac{1}{wm(\theta)\theta}\bar{\mathcal{E}}v(x_c)$). This results in overall downward pressure on all incumbents imposed by entering firms. Said differently, the term $\bar{\mathcal{E}}v\left(x_c^{mkt}\right)$ corresponds to the aggregate business-stealing effect, not taken inco consideration by the entering firms.

Therefore, when firms are homogeneous, the sign of the distortion is evident: if $\mathcal{E}'v\left(x^{mkt}\right) < 0$ then $\mathcal{E}v\left(x^{mkt}\right) > 1 - r_v\left(x^{mkt}\right)$ and the output of *all* firms is too small, while firm entry is excessive. In the heterogeneous firm model, it is possible that the market power of all firms is so small that it would outweigh the general downward pressure of the exessive entry and would result into small firms over-producing, relative to the social optimum. Only under CES the two effects perfectly compensate each other.

Comparing the equations which determine the market-tightness distortions, we can see that the condition corresponding to the market equilibrium differs from the social optimum model in the multiplication by the $\bar{\mathcal{E}}v\left(x\right)$. In addition, the social planner is concerned with the elasticity of the matching function $\eta$ and not with the bargaining power of workers, $\gamma$. Since $\mathcal{E}v\left(x^{mkt}\right) < 1$ (and therefore the average elasticity of utility $\bar{\mathcal{E}}v\left(x^{mkt}\right)$) and empirically $\eta \geq \gamma$, we can conclude that $\theta_{opt} > \theta_{mkt}$, so that employment is inefficiently small. The results above can be summarized by the following Proposition.

**Proposition 1.** *Assume VES preferences exhibiting increasing (absolute value) elasticity of demand, $r_v'\left(x\right) > 0$, decreasing elasticity of utility, $\mathcal{E}'v\left(x\right) < 0$, and matching elasticity no less than worker's bargaining power, $\eta \geq \gamma$. Then large firms underproduce, while small firms (possibly) over-produce, relative to the social optimum. Moreover, the employment rate is too low relative to the socially optimal one.*

Let us notice several characteristics. First, two distortions can be identified sequentially: first, the Dixit-Stiglitz distortion, then the labor market distortion. Secondly, even when the Hossios condition holds, $\eta = \gamma$, and the utility is CES, $u = x^{\rho}$, the market tightness distortion is still present. The only case when the two systems coincide is when the utility is linear, $\rho = 1$. This happens because firms do not take into consideration the disutility of work for households. Finally, we can see that when both distortions are present, in the case of the homogeneous model, they affect each other in opposite directions: whenever the gap between the market and optimal firm's size is reduced, i.e. $x^{mkt}$ increases closer to $x^{opt}$, it lowers the elasticity of utility and intensifies the labor market distortion. The same result in not necessarily true for the heterogeneous firm model. It is possible to increase the output of some large firms, decrease the output for some small firms, so that the average elasticity of utility increases and the market tightness distortion is partially mitigated.

# 5 Optimal policy

This section studies the homogeneous firm model and discusses the main predictions of the framework regarding optimal market policies. Where possible, the results are extended to the heterogeneous firms model.

To articulate the question studied in this section consider the following thought experiment designed for the homogeneous firms model. Imagine a policymaker who assumes the Dixit-Stiglitz model of the world, without taking into account labor market frictions or disutility of labor. That is a social planner who maximizes

$$\max_{x} \ \log\left[\mathcal{L}\cdot\frac{v\left(x\right)}{cx\mathcal{L}+F}\left(m\left(\bar{\theta}\right)\bar{\theta}-h\bar{\theta}\right)\right]-\Gamma m\left(\bar{\theta}\right)\bar{\theta},$$

assuming $\theta=\bar{\theta}$ given exogenously and is fixed. Then, being capable of dictating the optimal firm's size (but ignorant about the wage determination process), she would prefer to increase $x$ and decrease the number of firms $M$ to correct the Dixit-Stiglitz distortion. This would allow to exploit economies of scale better and render the economy more efficient (lower the average cost). What would be the effect of such policy on the equilibrium employment? First, since per-capita sales are larger, the marginal utility of income $\lambda$ falls, which reduces the bargaining surplus of the workers and the subsequent real wage. However, at the same time, there is less market competition and each incumbent firm has higher market power now. Additionally, because fewer resources are wasted on fixed costs, firms can satisfy the same level of demand using less labor. In the end, the productivity effect prevails and the aggregate employment falls, which can potentially harm aggregate welfare. The following proposition, however, shows that:

**Proposition 2.** *In a situation where a social planner (wrongly) assumes that the level of employment is fixed and increases per-capita sales towards the optimal level $x_{mkt}<x_{opt}$, the employment falls but the total welfare still improves, $\frac{dW}{dx}>0$.*

*Proof. See Appendix.*

We can see that even though labor market frictions add new consideration to the total welfare, old policies concerning the increase in the reduction of the number of firms can remain beneficial to the consumers (although not optimal). Below I examine several policies able to correct the Dixit-Stiglitz distortion and choose the best one in terms of welfare change.

**I.** Restricted entry. The most simple policy to correct for the Dixit-Stiglitz output distortion is to restrict the number of firms directly. That is if the government issues quotas on the maximal number of firms.

**Proposition 3.** *In the economy where entry is suppressed directly, $M < M_{mkt}$, the per-capita sales $x$ are higher, while the employment falls. The result is generalized to the heterogeneous firm model if the selection effect is of second order or held constant.*

Proof. This policy is effectively equivalent to the Proposition 2, where the mass of firms is adjusted instead of the firm's size. The proof for the heterogeneous model is shown in the Appendix.

**II.** Licencing fees. Another evident solution is to introduce licencing fees, $F$, and redistribute the proceeds back to the housholds, each to receive $\frac{FN}{\mathcal{L}}$ amount of non-labor income. This artificially increases fixed costs, reduces the number of firms and increases per-capita sales. One can show that such policy modifies the equilibrium market consdition in the following way:

$$\begin{cases} \frac{cx^{mkt}\mathcal{L}}{cx^{mkt}\mathcal{L}+f+F} = \left(1 - r_v\left(x^{mkt}\right)\right), \\ \mathcal{E}v\left(x^{mkt}\right)\frac{(1-\gamma)-\frac{h}{m(\theta)}}{m(\theta)\theta - h\theta} \times \frac{m(\theta)\theta}{m(\theta)\theta + \frac{FN}{\mathcal{L}}} = (1-\gamma)\Gamma. \end{cases}$$

As a consequence, unemployment falls not only because $x^{mkt}$ rises, but also because of the additional multiplicative factor introduced by the taxation. A heterogeneous firm model is richer of results. Namely, as pointed out by Felbermayr and Prat (2011), a change in the fixed production or entry costs have opposite impacts on the selection effect and employment rate. Namely, fixed costs of production make it harder for the marginal firms to break-even, pushing up the minimal productivity of firms. An increase in the fixed entry costs, on the contrary, reduces entry and protects inefficient firms from the entrants' competition, reducing the minimal productivity of firms. These results can be shown for the CES utility function, but are hard to achieve in the general VES modelling. In the appendix, I discuss the numerical simulations that confirm these results. They also show that higher fixed production or lower entry costs are associated with the lower rate of employment.

**III.** Wage subsidy. We see that the standard Dixit-Stiglitz policy has to be modified to take into account the employment distortion. Consider a policy with licensing fees, but where the proceeds are spent on either (i) wage subsidy to the workers, $s_{worker}$ or (ii) wage subsidy to the firm, $s_{firm}$. It is imperative to distinguish these two subsidies because workers and firms have different bargaining powers. As a consequence, each subsidy will affect the *equilibrium* wage differently. Surprisingly, I find that

**Proposition 4.** *A policy that introduces licencing fees and spends the proceeds to subsidize the wage has no effect on the employment and is equivalent to all previously mentioned policies. The result holds true for the heterogeneous firm model.*

Proof. The houshold surpluss of an additional job is now expressed as $H'_{\epsilon}(\epsilon = 0) = \lambda(1 + s_{worker})w - \Gamma$, while the firm's surplus of an additional worker becomes $\Pi'_{\epsilon}(\epsilon = 0) = (1 - s_{firm})\bar{w}\frac{m(\theta_t)}{m(\theta_t)-h} - (1 - s_{firm})w$ . Recall that Nash negotiating process maximizes the following weighted product of surpluses:

$$\max_{w} \ (\lambda(1 + s_{worker})w - \Gamma)^{\gamma}\left((1 - s_{firm})\bar{w}\frac{m(\theta_t)}{m(\theta_t) - h} - (1 - s_{firm})w\right)^{1-\gamma}.$$

Because the firm subsidy affects all terms in the firm's job surplus, it acts as a constant multiplier of the objective function and can be disregarded from the optimization problem. The neutrality of the firm's subsidy seems specific to the Nash-bargaining process. Furthermore, taking the first-order condition results in the following equation:

$$\left(\frac{(1-\gamma)m(\theta) - h}{m(\theta) - h}\right)\lambda(1 + s_{worker})w = (1-\gamma)\Gamma.$$

Since household's income also changes, the marginal utility of income becomes $\lambda = \frac{1}{(1+s_{worker})wm(\theta)\theta}\mathcal{E}v(x)$. Substituting this into the expression above, one can see that it completely mitigates the worker's wage subsidy in the expression above, leaving the wage-bargaining equation unchanged. Thus the effect of the worker's subsidy is also neutral, due to the competition effect. Thus, all policies considered so far yield the same results.

**IV.** Hiring subsidy. As it turns out, the only effective way to boost employment is by subsidizing the hiring costs:

**Proposition 5.** *A policy that introduces licencing fees and spends the proceeds to subsidize hiring costs, denoted by s, is the most welfare-enhancing relative to all other policies considered. The result is extended to the heterogeneous firms model if the selection effect is of second order or held constant.*

*Proof. Appendix.*

In this situation, it is instructive to examine the new equilibrium system:

$$\begin{cases} \frac{cx_{mkt}\mathcal{L}}{cx_{mkt}\mathcal{L}+f+F} = (1 - r_v(x_{mkt})), \\ \mathcal{E}v(x_{mkt})\frac{(1-\gamma)-\frac{(h-s)}{m(\theta)}}{m(\theta)\theta-(h-s)\theta} = (1-\gamma)\Gamma. \end{cases}$$

We can see that the first equation stays the same, while the wage bargaining equation is augmented by the hiring subsidy. Specifically, a subsidy incentivizes *higher* employment by firms. Note that the results are even better than for the case of a social planner who wrongly assumes a fixed employment rate. Namely, while $x_{mkt}$ can be increased in both situations, only the current policy allows compensating for the employment decrease. In other words, hiring costs introduces the additional instrument needed to afffect the labor distortion. However, the trade-off between the output and employment distortions still remains pertinent and nothing guarantees that the proceeds will be sufficient to fully correct the underemployment distortion. It suggests that the optimal policy could consist of correcting both distortions only partially.

Finally, it is interesting to imagine a policymaker who tries to correct the labor market distortion, not taking into account the effect on firms and production. That is a social planner who maximizes

$$\max_{x} \; \log\left[\mathcal{L}\cdot\frac{v\left(\bar{x}\right)}{\left(c\bar{x}\mathcal{L}+f\right)}\left(m\left(\theta\right)\theta-h\theta\right)\right]-\Gamma m\left(\theta\right)\theta,$$

taking $\bar{x}$ as given. The first order condition w.r.t. $\theta$ is the same as in (16). The firm's FOC and the free-entry condition still hold, thus the equilibrium market output is determined by the first equation from the (14). The equilibrium system is

$$\begin{cases}\frac{c\mathcal{L}x_c^{mkt}}{\int_0^{c_d}\left(cx_c^{mkt}\mathcal{L}+f\right)dG+f_e}=\frac{v\left(x_c^{mkt}\right)\mathcal{E}v\left(x_c^{mkt}\right)}{\int_0^{c_d}v\left(x_c^{mkt}\right)dG}\frac{1-r_v\left(x_c^{mkt}\right)}{\bar{\mathcal{E}}v\left(x_c^{mkt}\right)},\\ \frac{(1-\eta)-\frac{h}{m(\theta_{opt})}}{m(\theta_{opt})\theta_{opt}-h\theta_{opt}}=\left(1-\gamma\right)\Gamma.\end{cases}$$

In short, the two variables are determined independently from each other. Therefore, a policymaker concerned only with the labor market distortion will not affect the equilibrium firm size, only the number of firms.

Indeed, it is common that the two policy departments to develop their economic plans separately. Here, we can see that if the labor department has the prerogative to act first, the situation for the policymaker concerned with the output distortions will not change. However, as shown in the beginning of the section, if the order is reversed and the output distortion is corrected first, the policymaker concerned with the labor market will have harder times as the underemployment distortion will be intensified, if not compensated by the proper hiring subsidy.

# 6 Market productivity and employment

What is the effect of productivity improvement on the market competition and the equilibrium employment rate? By a productivity improvement I mean any change in the economy, that permits firms to produce more with the same amount of resources. A priori, the outcome is not evident. On the one hand, given the production plan fixed, firms require less labor, which reduces the demand for labor. On the other hand, firms set up lower prices and attract additional demand, which affects positively the demand for labor. As it turns out, the final effect on the employment rate depends on the nature of productivity improvement.

First consider a homogeneous firm model, where technological progress increases the productivity for all firms, that is marginal cost $c$ falls. One can show that

**Proposition 6.** *After an increase in productivity (a fall of the marginal cost), per-capita sales $x^{mkt}$ and prices fall, while variety, employment, market competition index $\lambda$ and household's welfare rises.*

A fall in the per-capita sales due to a technological improvement is a standard outcome in Krugman and Melitz types of models. The reason is that a fall in the marginal costs permits additional entry by new firms, which increases market competition. Consequently, negative competition effect outweighs the *individual* positive effect of the productivity improvement and each firm produces less. At the same time, the total production and employment rate increase.

Now, we leave the convenient homogeneous firm world and examine another source of productivity improvement, possible in the heterogeneous firm model. Namely, we are to reflect the following empirical fact, discussed in De Loecker et al. (2020). They document an increase in the firm heterogeneity in the last 3 decades, proxied by the distribution of markups and profitability. Moreover, the change is mainly driven by the upper tail of the productivity distribution, while the median firm characteristics remain unchanged. As a result, market power is reallocated from less to more productive firms. This shows that productivity may change not only because of the aggregate technological improvement but because of the change in specific parts of the distribution, without affecting some firms.

To emphasize this argument, let's consider an even stronger hypothetical situation. Imagine that there is an increase in the ex-post (after entry) variance of the productivity distribution, while the *mean* remains the same. I do not consider a change in the ex-ante productivity distribution on purpose to avoid the additional input of the selection effect, which will change the mean of the ex-post productivity distribution and make the mechanism less transparent.

For example, let us assume that there is a shrinking "middle class" of firms, that is to say, some probability density of medium-productive firms is equally redistributed to larger and smaller firms. Other variables hold constant, the economy should become more productive because even though the average productivity doesn't change, larger firms produce disproportionally more than the smaller firms, relative to the productivity difference. For example, under the CES utility in Melitz model, the optimal output per firm is a power function of the productivity, $x \propto (c^{-1})^{\sigma}$ where $\sigma > 1$. Therefore, a reallocation of the probability density should increase the total production (expectation of the convex function), because a decline in the production share of "middle class" firms will be over-compensated by the rising share of their more productive counterparts.

As I have shown below, even though the economy becomes more productive in the aforementioned sense, the employment level falls:

**Proposition 7.** *In the heterogeneous firms model, a mean preserving spread of the ex-post productivity distribution leads to an expansion of each firm's size, reduction in market competition index and employment rate.*

To see this, substitute the firm's first-order condition (10) into the free-entry condition to get the follownig expression:

$$\int_0^{c_d} \frac{\mathcal{L} x_c c}{1 - r_v(x_c)} dG = \int_0^{c_d} (c x_c \mathcal{L} + f)\, dG + f_e.$$

A total derivative of that expression reads as

$$\int_0^{c_d} \left( \frac{\mathcal{L} x_c c}{1 - r_v(x_c)} - (c x_c \mathcal{L} + f) \right) d\left[g(c)\right] dc$$

$$= -\int_0^{c_d} \left( \frac{\mathcal{L} x_c c}{1 - r_v(x_c)} + \frac{\mathcal{L} x_c c r_v'(x_c)}{(1 - r_v(x_c))^2} - c x_c \mathcal{L} \right) \frac{dx_c}{x_c} dG.$$

From the initial equation we know that $\int_0^{c_d} \left( \frac{\mathcal{L} x_c c}{1 - r_v(x_c)} - (c x_c \mathcal{L} + f) \right) dG = f_e > 0$. A redistribution of density function from less productive firms to more productive firms will increase this integral, because $\frac{1}{1 - r_v(x_c)}$ is higher for more productive firms. Therefore, the l.h.s. is positive. The term on the r.h.s. is negative because $\frac{\mathcal{L} x_c c}{1 - r_v(x_c)} > c x_c \mathcal{L}$ and (according to the initial firm's FOC) all firms react in terms of the output in the same direction. Therefore, $dx_c < 0$ for all firms.

Effectively, firms increase their output exactly because a reallocation of the probability density redistributes production share more to the larger firms than to the smaller ones. Given that there is more competition *from the larger firms* which makes firm entry less profitable and decreases the mass of firms, firms expand their size.

The second step is to analyze the average elasticity of utility, needed for the determination of the market tightness:

$$\bar{\mathcal{E}}v\left(x_c^{mkt}\right) = \frac{\int_0^{c_d} v(x_c)\, \mathcal{E}v(x_c)\, dG}{\int_0^{c_d} v(x_c)\, dG} = \frac{\int_0^{c_d} v'(x_c)\, x_c dG}{\int_0^{c_d} v(x_c)\, dG},$$

$$d\bar{\mathcal{E}}v\left(x_c^{mkt}\right) = \frac{1}{\int_0^{c_d} v\left(x_c\right) dG} \int_0^{c_d} v\left(x_c\right) \left( \frac{v'\left(x_c\right) x_c}{v\left(x_c\right)} - \frac{\int_0^{c_d} v'\left(x_c\right) x_c dG}{\int_0^{c_d} v\left(x_c\right) dG} \right) d\left[g\left(c\right)\right] dc$$

$$+ \frac{1}{\int_0^{c_d} v\left(x_c\right) dG} \int_0^{c_d} v'\left(x_c\right) \left( 1 - r_v\left(x_c\right) - \frac{\int_0^{c_d} v'\left(x_c\right) x_c dG}{\int_0^{c_d} v\left(x_c\right) dG} \right) dx_c dG.$$

There are two mechanisms which affect the average elasticity of utility. First is the direct effect of the higher dispersion, keeping the individual production plans fixed. By the mean-value theorem, there exists $\bar{c}$ such that $\frac{v'(x_{\bar{c}})x_{\bar{c}}}{v(x_{\bar{c}})} = \frac{\int_0^{c_d} v'(x_c)x_c dG}{\int_0^{c_d} v(x_c)dG}$. Then, for firms with the marginal costs higher than this average value, $c > \bar{c}$, the difference $\left( \frac{v'(x_{\bar{c}})x_{\bar{c}}}{v(x_{\bar{c}})} - \frac{\int_0^{c_d} v'(x_c)x_c dG}{\int_0^{c_d} v(x_c)dG} \right) > 0$, because the elasticity of utility is assumed to be monotonically decreasing function in consumption. Moreover, because $v\left(x_c\right)$ is bigger for firms with lower marginal costs, then the total change in the first term is negative.

Second, there is an indirect effect of higher output, $dx_c > 0$, shown above. As the elasticity of utility is a decreasing function and larger firms have higher weight $v\left(x_c\right)$, the average elasticity of utility shall also fall. Thus, both the direct and indirect effects of productivity heterogeneity decrease the average elasticity of utility and, therefore, the market competition index. Therefore, the employment rate falls.

It is interesting that the two sources of productivity improvement lead to different labor market outcomes. The key point here is to see how productivity change affects competition. In the first case, analyzed for the homogeneous firm model, productivity increases for all firms, boosting the total competition. In the second case, there is an increase in the market share of more productive firms at the expense of less productive firms. This leads to a redistribution of market power and, even though bigger firms use better technology, more productive firms "business steal" from less productive ones, leading to the exit of firms and a decrease in the competition level.

Finally, there is another source of productivity improvement standardly analyzed in the literature: a growth in the market size, created by a market integration. The logic is that in a bigger market firms better exploit the economies of scale, reducing the average costs of production. The following proposition shows that an increase in the market size is very similar to an increase in the average productivity. Additionally, the marginal utility of income increases and so as the worker's surplus. This reduces the real negotiated wage and boosts employment. Because the optimal employment rate does not depend on the market size, the gap $(\theta_{opt} - \theta_{mkt})$ between the optimal and market tightness is narrowed.

**Proposition 8.** *In a heterogeneous firms model, growth in the market size, $\mathcal{L}$, leads to a* *larger mass of entry $M_e$, lower per-capita sales $x_c^{mkt}$, lower prices, and higher employment rate. Consequently, household's welfare improves, $\frac{dW}{d\mathcal{L}} > 0$.*

Proof. The proof is relegated to the Appendix. It consists of taking the total derivative of the market equilibrium system (14) with respect to the market size $\mathcal{L}$.

# 7 Conclusion

I show that the Dixit-Stiglitz output distortion and the employment distortion can often go in opposite directions. First, I show that among all available policies, only one is capable of affecting aggregate employment and output in a positive way. Namely, a policymaker should introduce licensing fees for firms and spend the proceeds to subsidize the hiring costs (reduce the matching frictions) for firms. Surprisingly, wage subsidies appear to be completely ineffective. However, policies designed for the models with fixed labor supply and no matching frictions can still be useful, though not optimal.

Secondly, I demonstrate that the change in the employment rate depends on the source of productivity improvement. If all firms benefit from the increase in productivity, the employment rate rises. If, on the other hand, more productive firms benefit at the expense of smaller firms, the employment rate falls, even though the economy is more productive. The explanation rests in the differences of competition change: while competition rises in the first case, it falls in the second one.

Finally, standard to the international trade literature, market integration allows the economy to better exploit the economies of scale and as well as boosts employment.

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