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Market size, income heterogeneity, and trade

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Market size, income heterogeneity, and trade

Sergei Kichko*and Pierre M. Picard‡

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Abstract

This paper studies the effects of market enlargement in the context of monopolistic competition, variable markups and income heterogeneity. Market enlargement increases product diversity and entices firms to reduce prices and markups due to pro-competitive effects. It benefits all individuals but more high-income ones. The strength of market enlargement effect is independent of income inequality for Pollak (1971) preferences. In open economy, the market enlargement of one country reduces prices globally while it fosters firm entry in this country and exit in the other country. Welfare gains are also larger for higher income groups. A calibration exercise suggests that effects on market outcome and welfare gains are sizable.

Keywords: Monopolistic competition, additive preferences, income inequality, pro-competitive effects, welfare, trade.

JEL codes: D43, F12, F14.

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1 Introduction

Market sizes and their enlargement are known to have a significant impact on economic growth, trade and welfare. They stimulate competition and economies of scale and enhance exports, foreign investment, job creation and standards of living. Nevertheless, market size effects are intricately intertwined with those of income inequality. Specifically, one might question whether larger markets exacerbate income inequality, and conversely, whether income inequality amplifies the effects of market enlargement.

The contribution of this paper lies in the examination of the effects of market size on product markets, welfare, and trade within monopolistically competitive economies characterized by pro-competitive effects. Krugman (1979) highlights the market size effects in a monopolistically competitive framework where economies of scale are enhanced by larger consumer bases. Since this seminal contribution, market size effects have frequently been explored in models featuring CES preferences, leading to equilibrium prices that remain unaltered by changes in market sizes. This contrasts with empirical evidence regarding the existence of pro-competitive effects, where prices and markups are lower in larger markets (Syverson, 2007; De Loecker *et al.*, 2016; and Feenstra and Weinstein, 2017). As a result, a body of the literature studies the above issue in economies featuring pro-competitive effects, typically under the assumption of non-homothetic preferences (e.g. Melitz and Ottaviano, 2008; Zhelobodko *et al.* 2012; Behrens and Murata, 2012; Kichko *et al.* 2014; Simonovska, 2015; Dhingra and Morrow 2019; Kichko and Picard, 2023). However, these preferences also generate varying levels of price sensitivity and love for variety among distinct income groups, resulting in divergent perceptions of market size effects between the rich and the poor. As a result, market size and pro-competitive effects are conceptually intertwined with income inequality issues.

We study market size effects within a monopolistic competition framework with (direct explicit) additive preferences that yield subconvex demands (Mrazova and Neary, 2017) and increasing love for variety (Vives, 2001). The first characteristic aligns with Marshall's Second Law of Demand, which posits that demand becomes less elastic at higher prices and is consistent with empirical findings (Syverson, 2007; De Loecker *et al.*, 2016). The second property is considered as the most plausible case in economic theory (Vives, 2001).

The paper first focuses on market enlargement in a closed economy. It shows that such enlargement features pro-competitive effects as it diminishes product prices and markups, and raises product diversity and firm output *for any income distribution.* Larger market size stimulates more entry when firms have greater market power. Importantly, while market enlargement brings welfare gains to all income groups, lower-income individuals obtain lower benefits. Finally, although income distribution generically alters the strength of pro-competitive and market size effects, it is shown to have no effect *only* in the specific cases of CARA, logarithmic, and quadratic preferences. Under those preferences, any changes in income distribution do not alter the level and elasticity of market demands and, therefore, do not entice firms to change their prices.[1]

[1]This property stems from the local income-linearity of the demand system (Pollak, 1971).

In a two-country economy, the market enlargement of the home country reduces prices globally and fosters product variety in this country at the expense of the other. This occurs for any income distribution. In each country, firms produce more for the home market and less for the foreign one. The number of firms globally increases but varies oppositely in the two countries: firms enter the home country and exit the foreign one. In other words, market enlargement mitigates intensive margins in each country and fosters extensive margins worldwide. The increase in the number of home firms is larger in the open economy than in the closed economy because price falls are tempered by foreign markets. When it comes to income inequality, the paper shows that the market enlargement of the home country benefits more to the richer individuals in both countries.

Finally, the paper discusses a calibration exercise on the US population of firms and workers for a subset of additive preferences presented in the literature. The strength of pro-competitive effects is large as the elasticity of product price with respect to market size is $7-9\%$, while the elasticity of the number of firms is about 50%. A 100% market enlargement leads to increases of equivalent consumption of about 7% and 24% for the lowest and highest income deciles. In comparison, CES preferences yield no price change, a unit elasticity of the number of firms, and an equal welfare gains of 16% for all income groups.

2 Model

The economy includes L individuals. Each individual h is endowed with s_h labor units distributed according the cumulative distribution function $G : [s_0, s_1] \to [0, 1]$, where $0 < s_0 < s_1$. Until Section 4, we normalized wage per labor unit to one, so that s_h stands for individual h income. In what follows, a variable without subscript h denotes its average over individuals. The average productivity is then given by $s = \int s_h \mathrm{d}G$ where we use $\mathrm{d}G$ as a short notation for $\mathrm{d}G(s_h)$ when it does not bring confusion.

2.1 Demands

Individuals consume a set of symmetric varieties $\omega \in [0, n]$ where n denotes their endogenous number. Each individual s_h maximizes her utility $U(x_h) = \int_0^n u(x_h(\omega))\mathrm{d}\omega$ subject to her budget constraint $\int_0^n p(\omega)x_h(\omega)\mathrm{d}\omega = s_h$, where $x_h(\omega)$ is her consumption of variety ω and $p(\omega)$ is its price. The utility function is increasing and concave, $u''(x_h) < 0 < u'(x_h)$. We assume that s_0 is large enough for all consumers to purchase all available varieties. The solution to consumer problem yields the inverse demand function $p(\omega) = \lambda_h^{-1} u'(x_h(\omega))$, where λ_h is the consumer's budget constraint multiplier. Then, the individual demand is given by $x_h(\omega) \equiv v(\lambda_h p(\omega))$ where v is the inverse function of $u'(x_h)$.

Because of the product symmetry, we define the *individual demand elasticity* for each product as

$$\varepsilon_h = \varepsilon(x_h) \equiv -\frac{u'(x_h)}{x_h u''(x_h)}. \tag{1}$$

We focus on subconvex demands where $\varepsilon_h' < 0$ (Mrazova and Neary, 2017), which feature the inverse relationship between consumption and individual demand elasticity. We also define that the *elasticity of utility* as

$$\eta_h = \eta(x_h) \equiv \frac{x_h u'(x_h)}{u(x_h)} \in (0,\ 1). \tag{2}$$

With a higher elasticity of utility, individuals value more quantity than product diversity. The love for variety is, therefore, measured by $1 - \eta_h$. We rely on an increasing love for variety so that η_h is a decreasing function of consumption.

2.2 Firms

Labor is the only production factor. Each firm produces a single variety ω and finds the price $p(\omega)$ that maximizes its profit $\pi(\omega) = L \int (p(\omega) - c) x_h(\omega) \mathrm{d}G - f$. In this expression, c and f are the firm's marginal and fixed costs. Since demands are symmetric across varieties we omit the reference to ω. Plugging the individual demand function into profit, the first order condition for the producer problem yields

$$p = \frac{\varepsilon}{\varepsilon - 1} c, \tag{3}$$

where

$$\varepsilon \equiv \frac{\int x_h \varepsilon_h \mathrm{d}G}{\int x_h \mathrm{d}G} > 1 \tag{4}$$

is the *market demand elasticity.* We assume that the second order condition of the producer problem holds.

2.3 Equilibrium

An equilibrium is defined as the price p, the set of consumption x_h, the number of firms n, and the firm output y that are consistent with the firm's optimal price (3), the consumers' budget constraints

$$npx_h = s_h, \tag{5}$$

the zero-profit condition

$$p = \frac{f}{y} + c, \tag{6}$$

the product market clearing condition

$$y = L \int x_h \mathrm{d}G. \tag{7}$$

An equilibrium where all individuals consume all available varieties exists and is unique if $\varepsilon(x_0) > 1$ (Kichko and Picard, 2023).

3 Market size and heterogeneous incomes

The literature on monopolistic competition emphasizes the importance of market size and its effect on competition. We therefore study the impact of an infinitesimal increase in market size d$L>$ 0. Towards this aim, we totally differentiate equilibrium conditions (3), (5)-(7) with respect to L (see Appendix A) and discuss the elasticity of every relevant variable z as

$$\mathcal{E}_L(z) \equiv \frac{\mathrm{d}\ln z}{\mathrm{d}\ln L}.$$

The first contribution of this framework is to highlight the presence of pro-competitive effects for any *arbitrary* income distribution under demand subconvexity. Pro-competitive effects are present when markups and prices fall in response to a larger market size (Zhelobodko *et al.*, 2012). We calculate the elasticity of equilibrium price with respect to market size as

$$\mathcal{E}_L(p) = \frac{1}{\varepsilon\Psi}\int \varepsilon_h' x_h s_h \mathrm{d}G \tag{8}$$

where

$$\Psi \equiv (\varepsilon - 1)s - \int \varepsilon_h' x_h s_h \mathrm{d}G > 0 \tag{9}$$

due to subconvex demands. Thus, $\mathcal{E}_L(p) < 0$. As a result, market enlargement induces a fall in equilibrium prices. Using (9), we get

$$\mathcal{E}_L(p) = -\frac{1}{\varepsilon} + \frac{\varepsilon - 1}{\varepsilon\Psi}s \ \in (-\frac{1}{\varepsilon}, 0), \tag{10}$$

which is disproportionally smaller than the market enlargement. Furthermore, the upper-bound for the elasticity of equilibrium price is given by $1/\varepsilon$, which is equal to the equilibrium markup, $m \equiv (p-c)/p = 1/\varepsilon$. The drop in prices may be stronger in sectors where firms have higher markups and exert more market power. Finally, market enlargement also reduces firm markup as $\mathcal{E}_L(m) = (\varepsilon - 1)\mathcal{E}_L(p) \in (-(\varepsilon-1)/\varepsilon, 0)$, which confirms the presence of pro-competitive effects.

Market enlargement increases product diversity and rises firm size. Indeed, the elasticity of the equilibrium number of firms is given by

$$\mathcal{E}_L(n) = 1 + (\varepsilon - 1)\mathcal{E}_L(p) \ \in (1/\varepsilon, 1), \tag{11}$$

while $\mathcal{E}_L(y) = -\varepsilon\mathcal{E}_L(p) \in (0, 1)$. It also induces a reduction of individual's consumption of a variety and an increase in individual's total consumption as $\mathcal{E}_L(x_h) = -1 - \varepsilon\mathcal{E}_L(p) \in (-1, 0)$, while $\mathcal{E}_L(nx_h) = -\mathcal{E}_L(p) \in (0, 1/\varepsilon)$.

The second contribution is to draw unambiguous welfare implications of market enlargement. Using the definition of utility and expression (8), the elasticity of individual utility writes as

$$\mathcal{E}_L(U_h) = (1 - \eta_h)\left(\mathcal{E}_L(p) + \frac{1}{\varepsilon}\right)\varepsilon - \mathcal{E}_L(p). \tag{12}$$

Under demand subconvexity, this expression takes values between $1-\eta_h$ and $1/\varepsilon$ and is thus positive. As a consequence, all consumers gain from market enlargement. However, these gains are unequally distributed across income groups because love for variety $1-\eta_h$ increases with individual income s_h. As a result, the elasticity of individual utility is lower for lower-income earners. Since their initial absolute utility level is also lower, their absolute increase in utility is smaller than those of higher-income earners.

The final contribution is to discuss the implications of income inequality for pro-competitive effects. These implications are clear for demands that are locally linear in income (Pollak, 1971), which include CES, CARA, logarithmic, and quadratic preferences.[2] While pro-competitive effects are absent under CES, their strength do not depend on income distribution for other Pollak preferences. Indeed, Kichko and Picard (2023) show that those preferences imply the relationship: $x_h\varepsilon_h' = r - 1 - \varepsilon_h$, where r is a constant. Then, replacing $x_h\varepsilon_h'$ in (8) yields the elasticity

$$\mathcal{E}_L(p) = -\frac{1+\varepsilon-r}{1+\varepsilon^2-r},$$

which do not vary with any changes in income distribution. The same holds for $\mathcal{E}_L(m)$. As a result, the strength of pro-competitive effects is not affected by income distribution.[3] For broader classes of additive preferences, the impact of stronger income inequality on the strength of pro-competitive effects is mixed. In the absence of clear-cut analytical results, we resort to a calibration exercise in Section 5.

Finally, by a continuity argument, the above results are valid for any market enlargement. We then summarize the above contributions in the following Proposition:

Proposition 1. *Under demand subconvexity, market enlargement features pro-competitive effects for any income distribution as it diminishes product prices and markups, and raises product diversity and firm output; welfare gains are smaller for lower-income individuals under increasing love for variety. Income distribution has no impact on the strength of pro-competitive effects under CARA, logarithmic, and quadratic preferences.*

4 Trade

The monopolistic competition framework is widely applied in trade models. Whereas trade patterns are studied for various demand systems with firm heterogeneity, not much is known about trade patterns when consumers are heterogeneous in income. In this section, we analyze the impact of market enlargement of a country on pricing-to-market, production, product diversity, and individuals' welfare in both countries. To capture the sole effects of market size,

[2]Those preferences are defined as $u(x_h) = (\alpha/(\alpha-1))x_h^{(\alpha-1)/\alpha}$ for CES, $u(x_h) = 1 - \mathrm{e}^{-\alpha x_h}$ for CARA (Behrens and Murata, 2012), $u(x_h) = x_h(\alpha - x_h)$ for quadratic, and $u(x_h) = \log(1 + x_h/\alpha)$ for logarithmic utility (Simonovska, 2015) where $\alpha > 0$ is a parameter.

[3]Intuitively, under linear in income demands, changes in income distribution reshuffle consumption in a way that market demand and, therefore, its elasticity remains unchanged. Firms' prices and markups are unaltered. In other words, the level of inequality does not alter the degree of competition in the market.

we focus on two initially symmetric countries, home and foreign, with the same preferences, cost structures, and income distributions. By doing so, we exclude any sources of country asymmetries other than home market size. This analysis differs from the closed economy by the existence of two (home and foreign) markets for each variety and labor force. Thus, the home market enlargement gives rise to asymmetric economic outcomes in the two countries.

4.1 Trade model

Population sizes are denoted by L and L^*, where asterisks refer to the variables of the foreign country. Each home individual consumes a set of home and foreign varieties $\omega \in [0, n]$ and $\omega^* \in [0, n^*]$ where n and n^* are the masses of varieties produced in each country. She purchases the quantities $x_h(\omega)$ and $i_h(\omega^*)$ of the domestically produced and imported varieties at the home prices $p(\omega)$ and $p_i(\omega^*)$. She maximizes her utility $U_h = \int_0^n u(x_h(\omega))\mathrm{d}\omega + \int_0^{n^*} u(i_h(\omega^*))\mathrm{d}\omega^*$ subject to her budget constraint $\int_0^n p(\omega)x_h(\omega)\mathrm{d}\omega + \int_0^{n^*} p_i(\omega^*)i_h(\omega^*)\mathrm{d}\omega^* = s_h w$, where s_h is her endowment of labor units and w is the price of home labor unit. The first-order conditions yield inverse demand functions $p(\omega) = \lambda_h^{-1}u'(x_h(\omega))$ and $p_i(\omega^*) = \lambda_h^{-1}u'(i_h(\omega^*))$, where λ_h is her budget constraint multiplier. As before, by symmetry of varieties, we drop the index ω. A consumer in the foreign country makes a similar choice of local and import consumption (x_h^*, i_h^*) given the prices (p^*, p_i^*) she faces there. The price of foreign labor units w^* is normalized to one.

Each home firm chooses its local and export prices, p and p_i^*, that maximizes its profit $\pi = L\int(p - cw)x_h\mathrm{d}G + L^*\int(p_i^* - cw)i_h^*\mathrm{d}G - fw$. Its optimal prices are given by

$$p = \frac{\varepsilon}{\varepsilon - 1}cw \quad \text{and} \quad p_i^* = \frac{\varepsilon_i^*}{\varepsilon_i^* - 1}cw, \tag{13}$$

where

$$\varepsilon = \frac{\int x_h\varepsilon(x_h)\mathrm{d}G}{\int x_h\mathrm{d}G} > 1 \quad \text{and} \quad \varepsilon_i^* = \frac{\int i_h^*\varepsilon(i_h^*)\mathrm{d}G}{\int i_h^*\mathrm{d}G} > 1$$

are the home and foreign market demand elasticities for home-produced goods. The prices set by foreign firms (p^*, p_i) have symmetric expressions.

The trade equilibrium for home is defined as the consumption, prices and numbers of products that are consistent with budget constraint $npx_h + n^*p_i i_h = s_h w$, firm pricing (13), zero-profit condition $y/(\varepsilon - 1) + y_i^*/(\varepsilon_i^* - 1) = f/c$, and market clearing conditions, $y + y_i^* = L\int x_h\mathrm{d}G + L^*\int i_h^*\mathrm{d}G$ and $L\int s_h\mathrm{d}G = n\left(f + c(y + y_i^*)\right)$. Symmetric expressions hold for the foreign one.

4.2 Home market enlargement

Consider an infinitesimal increase in the home country population, $\mathrm{d}L > 0$, while preserving the foreign country population, $\mathrm{d}L^* = 0$. We calculate the elasticities of economic variables with respect to home market size around the symmetric equilibrium (see Appendix B). Given the initial symmetry, prices of labor units are invariant to home market size: $\mathcal{E}_L(w) = 0$. Furthermore, the value and boundaries of the changes in prices, numbers of varieties, consumption, and production under demand subconvexity are reported in Table 1:

Home country		Foreign country	
$\mathcal{E}_L(p) = \mathcal{E}_L(p_i) = \frac{1}{2\Psi\varepsilon}\int \varepsilon'_h x_h s_h \mathrm{d}G$	$\in (-\frac{1}{2\varepsilon}, 0)$	$\mathcal{E}_L(p^*) = \mathcal{E}_L(p_i^*) = \frac{1}{2\Psi\varepsilon}\int \varepsilon'_h x_h s_h \mathrm{d}G$	$\in (-\frac{1}{2\varepsilon}, 0)$
$\mathcal{E}_L(n) = 1 + \mathcal{E}_L(n^*)$	$\in (\frac{\varepsilon+1}{2\varepsilon}, 1)$	$\mathcal{E}_L(n^*) = (\varepsilon - 1)\mathcal{E}_L(p)$	$\in (-\frac{\varepsilon-1}{2\varepsilon}, 0)$
$\mathcal{E}_L(x_h) = \mathcal{E}_L(i_h) = -\frac{(\varepsilon-1)s}{2\Psi}$	$\in (-\frac{1}{2}, 0)$	$\mathcal{E}(x_h^*) = \mathcal{E}_L(i_h^*) = -\frac{(\varepsilon-1)s}{2\Psi}$	$\in (-\frac{1}{2}, 0)$
$\mathcal{E}_L(y) = \mathcal{E}_L(y_i) = 1 + \mathcal{E}_L(x_h)$	$\in (0, \frac{1}{2})$	$\mathcal{E}_L(y^*) = \mathcal{E}_L(y_i^*) = \mathcal{E}_L(x_h)$	$\in (-\frac{1}{2}, 0)$

Table 1: Effects of home market enlargement.

As in the closed economy, demand subconvexity gives rise to pro-competitive effects for any *arbitrary* income distribution. Indeed, the first row of Table 1 shows the presence of pro-competitive effects of a home market enlargement as it reduces prices everywhere at the same rate. As in the closed economy, markups move in the same direction and stronger firms' market power (higher markups) leads to stronger price variation. The elasticity of prices is, however, twice smaller than in the closed economy, which indicates that pro-competitive effects are tempered by the presence of a second market.

Home market enlargement impacts product diversity in different ways. The second row of Table 1 shows that the number of firms expands at home, whereas it decreases abroad ($\mathcal{E}_L(n) > 0 > \mathcal{E}_L(n^*)$). This contrasts with the CES preferences under which the number of foreign firms and all prices are invariant to change in market size. All in all, the global number of firms rises as

$$\mathcal{E}_L(n + n^*) = \frac{1}{2}\mathcal{E}_L(n) + \frac{1}{2}\mathcal{E}_L(n^*) = \frac{1}{2}\left(1 + 2(\varepsilon - 1)\mathcal{E}_L(p)\right).$$

Because $\mathcal{E}_L(p)$ is here half of its value in the closed economy, the overall number of firms rises at a lower pace than in the closed economy.

Furthermore, individuals reduce their consumption of each variety in the same way in both countries. The enlargement thus fosters extensive margins and mitigates the intensive ones in both countries. By contrast, firms increase their sales in the home market ($\mathcal{E}_L(y) > 0$ and $\mathcal{E}_L(y_i) > 0$) and decrease them in the foreign market ($\mathcal{E}_L(y^*) < 0$ and $\mathcal{E}_L(y_i^*) < 0$). The overall production of each firm rises since it can be shown that$\mathcal{E}_L(y + y_i^*) = \mathcal{E}_L(y_i + y^*) = -\varepsilon\mathcal{E}(p^*) > 0$.

Finally, changes in volume and value of home imports are given by $\mathcal{E}_L(n^* y_i) = \mathcal{E}_L(n^*) + \mathcal{E}_L(y_i) = \frac{1}{2} - \mathcal{E}_L(p) \in ((\varepsilon - 1)/2\varepsilon, 1)$ and $\mathcal{E}_L(n^* y_i p_i) = \mathcal{E}_L(n^*) + \mathcal{E}_L(p_i) + \mathcal{E}_L(y_i) = 1/2$. Due to trade balance, these expressions reflect the volumes and values of both imports and exports. Hence, trade volumes and values increase with home market enlargement, whereas volumes increase faster than values.

As all prices fall and the overall product diversity rises, the home market enlargement has a positive effect on individuals' welfare in both countries. Indeed, using Table 1, the elasticities of home and foreign utility with respect to home market size are given by

$$\mathcal{E}_L(U_h) = \mathcal{E}_L(U_h^*) = \frac{(\varepsilon - 1)s}{2\Psi}(1 - \eta_h) - \mathcal{E}_L(p) > 0.$$

It, however, benefits relatively less the low-income earners because of their weaker love for variety $1-\eta_h$. Since they also begin with lower utility levels, they obtain lower utility gains.

Finally, the implications of income distribution for pro-competitive effects is straightforward with Pollak preferences. While income inequality has no impact under CES, we can apply the same argument as in the closed economy and conclude that the strength of pro-competitive effects do not depend on income distribution under CARA, logarithmic, and quadratic preferences. For other classes of preferences, we provide a quantification exercise in Section 5.

We summarize these findings in the following Proposition.

Proposition 2. *Under demand subconvexity, an increase in home market population reduces the price and consumption of each variety everywhere, increases the firm production scale everywhere, raises the world product diversity but reduces the number of varieties produced in foreign; home market enlargement benefits consumers in both countries whereas low-income earners obtain lower welfare gains. Income distribution has no impact on pro-competitive effects under CARA, logarithmic, and quadratic preferences.*

5 Quantification

In the previous sections, we have analytically studied how market enlargement shapes market outcomes in closed and open economies. We now quantify the general equilibrium effects of market enlargement to uncover their amplitudes. Toward this aim, we calibrate our model to the US industry and income distribution. We use the total employment of 148 million workers, a total number of 2,22 billion firms with more than 5 employees, and the average employment per firm of 66 workers (US Census data, 2015). We normalize the quantities of goods such that variable costs are equal to one while we set the fixed cost consistently with the above calibration values and equilibrium conditions (3), (5)-(7). The worker population is divided into deciles of after-tax disposable incomes in 2018 using the updated series from Piketty *et al.* (2018). The lowest and highest deciles' incomes are equal to 2,057 USD and 162,302 USD respectively. The average income is USD 48,434 and its standard deviation USD 45,710.

5.1 Calibration and demand selection

We calibrate preferences to two target statistics. The first statistics is the market elasticity ε which estimation ranges between 6 and 11 (Bergstrand *et al.*, 2013). We choose a consensus value of 7. The second statistic is the pass-through elasticity, $\mathcal{E}_c(p) \equiv \mathrm{d}\log p/\mathrm{d}\log c$, which estimation ranges between 0.3 and 0.8 (Camba and Golberg, 2005; Amiti *et al.,* 2019; De Loecker *et al.,* 2016; Mion and Jacob, 2020). To reflect large variations in $\mathcal{E}_c(p)$, we match two pairs of target values $(\varepsilon, \mathcal{E}_c(p)) = (7, 0.4)$ and $(\varepsilon, \mathcal{E}_c(p)) = (7, 0.6)$. We focus on two preference systems with constant super-elasticity (CSED) of demand (Gopinath and Itskhoki, 2010), $p(x_h) = \frac{1}{\lambda_h} e^{-\frac{1}{\alpha\beta} x_h^{\alpha}}$, and constant proportional pass-through (CPPT) with $p(x_h) = \frac{1}{\lambda_h x_h}(x_h^{-\alpha} + \beta)^{-\frac{1}{\alpha}}$

(Mrazova and Neary, 2017), where α and β are positive scalars.[4] We also report the benchmark case of constant elasticity of substitution (CES), $p(x_h) = \frac{1}{\lambda_h} x_h^{-1/\alpha}$, where we match α with the first statistics.

5.2 Market size effects

Table 2 quantifies the elasticities of prices, number of varieties, firm output and welfare in the closed economy based on (8)-(12). To permit comparison between preference systems, welfare is measured in equivalent consumption. Elasticities are reported as percentages.

<table>
<tr><td rowspan="2"></td><td rowspan="2">CES</td><td colspan="4">After-tax incomes</td><td colspan="4">Homogenous incomes</td></tr>
<tr><td colspan="2">CPPT</td><td colspan="2">CSED</td><td colspan="2">CPPT</td><td colspan="2">CSED</td></tr>
<tr><td>α</td><td>7</td><td>1.11</td><td>0.83</td><td>1.06</td><td>0.77</td><td>1.50</td><td>0.66</td><td>1.28</td><td>0.57</td></tr>
<tr><td>β</td><td></td><td>14.43</td><td>4.36</td><td>0.10</td><td>0.36</td><td>66.16</td><td>2.38</td><td>0.04</td><td>0.71</td></tr>
<tr><td>ε</td><td>7</td><td>7</td><td>7</td><td>7</td><td>7</td><td>7</td><td>7</td><td>7</td><td>7</td></tr>
<tr><td>$\mathcal{E}_c(p)$</td><td>1</td><td>0.4</td><td>0.6</td><td>0.4</td><td>0.6</td><td>0.4</td><td>0.6</td><td>0.4</td><td>0.6</td></tr>
<tr><td>$\mathcal{E}_{\#L\#}(p)(\%)$</td><td>0</td><td>-7.50</td><td>-6.49</td><td>-7.91</td><td>-6.74</td><td>-8.57</td><td>-5.71</td><td>-8.57</td><td>-5.71</td></tr>
<tr><td>$\mathcal{E}_L(n)$ (%)</td><td>100</td><td>55.01</td><td>61.05</td><td>52.56</td><td>59.55</td><td>48.57</td><td>65.71</td><td>48.57</td><td>65.71</td></tr>
<tr><td>$\mathcal{E}_L(y)$ (%)</td><td>0</td><td>52.49</td><td>45.44</td><td>55.34</td><td>47.19</td><td>60.00</td><td>40.00</td><td>60.00</td><td>40.00</td></tr>
<tr><td>$\mathcal{E}_L(x_1)$ (%)</td><td>16.66</td><td>7.64</td><td>6.87</td><td>8.04</td><td>7.14</td><td rowspan="10">11.62</td><td rowspan="10">11.99</td><td rowspan="10">11.73</td><td rowspan="10">12.11</td></tr>
<tr><td>$\mathcal{E}_L(x_2)$ (%)</td><td>16.66</td><td>8.66</td><td>8.33</td><td>8.93</td><td>8.51</td></tr>
<tr><td>$\mathcal{E}_L(x_3)$ (%)</td><td>16.66</td><td>9.28</td><td>9.03</td><td>9.48</td><td>9.16</td></tr>
<tr><td>$\mathcal{E}_L(x_4)$ (%)</td><td>16.66</td><td>9.78</td><td>9.56</td><td>9.93</td><td>9.65</td></tr>
<tr><td>$\mathcal{E}_L(x_5)$ (%)</td><td>16.66</td><td>10.43</td><td>10.19</td><td>10.51</td><td>10.24</td></tr>
<tr><td>$\mathcal{E}_L(x_6)$ (%)</td><td>16.66</td><td>11.06</td><td>10.79</td><td>11.1</td><td>10.79</td></tr>
<tr><td>$\mathcal{E}_L(x_7)$ (%)</td><td>16.66</td><td>11.82</td><td>11.46</td><td>11.82</td><td>11.44</td></tr>
<tr><td>$\mathcal{E}_L(x_8)$ (%)</td><td>16.66</td><td>12.85</td><td>12.34</td><td>12.83</td><td>12.29</td></tr>
<tr><td>$\mathcal{E}_L(x_9)$ (%)</td><td>16.66</td><td>14.56</td><td>13.74</td><td>14.62</td><td>13.67</td></tr>
<tr><td>$\mathcal{E}_L(x_{10})$ (%)</td><td>16.66</td><td>21.95</td><td>19.21</td><td>24.11</td><td>19.69</td></tr>
</table>

Table 2: General equilibrium effects of market enlargement in a closed economy.

Under CES preferences, a 100% market enlargement leads to the absence of prices and firm output variations but to a one-to-one change in the mass of firms. This drastically contrasts with the results under CPPT and CSED preferences. With the after-tax income distribution, market enlargement decreases prices by about $6-8\%$, increases firm sizes by $45-55\%$ and, increases product diversity by $52-61\%$ (columns $2-5$ in Table 2). Thus, an increase in product diversity is about twice as small as in the CES.

As to welfare effects, under CES, the increase of equivalent consumption is equal to 16.6% and common for all income deciles because of constant love for variety. By contrast, those

[4] Kichko and Picard (2023) show that a few preferences permit to match those moments.

changes substantially vary across income groups for CPPT and CSED. In relative terms, the highest decile has gains $11-14\%$ more than the lowest one. In absolute terms, the lowest decile gains an equivalent consumption valued at USD 157 while the highest decile gains are valued at USD $35,625$ for CPPT (the second column). Such important differences also apply for the other specifications.

Finally, the last four columns present the same outcomes for a representative consumer case, where every worker receives the average of the US after-tax income. It might be viewed as the strongest contraction of income distribution. Then, comparing these columns with the second to fifth columns reveals that the absence of income inequality significantly alters market outcomes. Its effect is more pronounced for the elasticities of equivalent consumption. Indeed, the top-income decile receives around twice larger gains compared to the representative consumer case whereas gains of bottom-income decile is about 1.5 times smaller. Hence, the adoption of the assumption of a representative consumer is not innocuous. Finally, when comparing these columns to the CES benchmark, it becomes evident the pro-competitive effect is the primary factor affecting the consequences of market size expansion on price, product variety, and output.

6 Conclusion

In this paper, we study the role of income heterogeneity on the economic impact of market enlargements. Our findings show that pro-competitive effects are important as prices and markups strongly respond to market enlargement. Welfare gains are also unequally distributed in favor of top-income earners. Our calibration exercise confirms that ignoring pro-competitive effects and income inequality in estimations of gains from market size is not innocuous. Market enlargement leads to significantly weaker welfare improvements for poorer deciles, compared to richer deciles and to the CES benchmark. Those results are robust for different demand specifications.

References

[1] Amiti M., Itskhoki O., Konings J. 2019. International shocks, variable markups, and domestic prices. *The Review of Economic Studies*, Vol. 86(6): 2356-2402.

[2] Behrens K., Murata Y. 2012. Trade, competition, and efficiency. *Journal of International Economics*. Vol 87 (1): 1-17.

[3] Bergstrand J. H., Egger P., Larch M. 2013. Gravity Redux: Estimation of gravity-equation coefficients, elasticities of substitution, and general equilibrium comparative statics under asymmetric bilateral trade costs. *Journal of International Economics*, Vol. 89(1): 110-121.

[4] Campa J. M., Goldberg L. S. 2005. Exchange rate pass-through into import prices. *Review of Economics and Statistics*, Vol. 87(4): 679-690.

[5] De Loecker, J., Goldberg, P. K., Khandelwal, A. K., Pavcnik, N. 2016. Prices, markups, and trade reform. *Econometrica*, 84(2), 445-510.

[6] Dhingra, S, Morrow, J. 2019. Monopolistic competition and optimum product diversity under firm heterogeneity. *Journal of Political Economy*, Vol. 127(1): 196-232.

[7] Feenstra R. C., Weinstein D. E. 2017. Globalization, markups, and US welfare. *Journal of Political Economy*, Vol. 125 (4): 1040-1074.

[8] Gopinath, G., Itskhoki, O. 2010. Frequency of price adjustment and pass-through. *The Quarterly Journal of Economics*, Vol. 125(2): 675-727.

[9] Kichko S., Kokovin S., Zhelobodko E. 2014. Trade patterns and export pricing under non-CES preferences. *Journal of International Economics*, Vol. 94 (1): 129-142.

[10] Kichko S., Picard P. M. 2023. On the effects of income heterogeneity in monopolistically competitive markets. *Journal of International Economics*, Vol. 143: 103759.

[11] Krugman, P. R. 1979. Increasing returns, monopolistic competition, and international trade. *Journal of international Economics*, 9(4): 469-479.

[12] Melitz, Marc J., and Gianmarco IP Ottaviano. 2008. Market size, trade, and productivity. *The Review of Economic Studies, Vol.* 75(1): 295-316.

[13] Mion, G., Jacob, N. 2020. On the productivity advantage of cities. CEPR DP 14644.

[14] Mrazova, M., Neary, J. P. 2017. Not so demanding: Demand structure and firm behavior. *American Economic Review*, Vol. 107 (12): 3835-74.

[15] Piketty, T., Saez, E., and Zucman, G. 2018. Distributional national accounts: methods and estimates for the United States. *Quarterly Journal of Economics*, Vol. 133(2): 553-609.

[16] Pollak, R. A. 1971. Additive utility functions and linear Engel curves. *The Review of Economic Studies*, Vol. 38(4): 401-414.

[17] Simonovska I. 2015. Income differences and prices of tradables: Insights from an online retailer. *The Review of Economic Studies*, Vol. 82 (4): 1612-1656.

[18] Syverson, C. 2007. Prices, spatial competition and heterogeneous producers: An empirical test. *Journal of Industrial Economics*, Vol. 55(2): 197–222.

[19] Vives, X. 2001. Oligopoly pricing: old ideas and new tools. MIT press.

[20] Zhelobodko, E., Kokovin, S., Parenti, M., Thisse, J.-F. 2012. Monopolistic competition: Beyond the constant elasticity of substitution. *Econometrica*, Vol. 80(6): 2765-2784.

Online Appendices

Appendix A. Log-linearization of closed economy equilibrium

We first log-linearize condition (6): $(p-c)/p = 1/\varepsilon$. Using the definition of ε, we write the latter as

$$(p-c)\int x_h \varepsilon_h \mathrm{d}G = p \int x_h \mathrm{d}G$$

and totally differentiate it as

$$\mathrm{d}p \int x_h \varepsilon_h \mathrm{d}G + (p-c)\int (x_h\varepsilon_h)' \,\mathrm{d}x_h \mathrm{d}G = \mathrm{d}p \int x_h \mathrm{d}G + p\int \mathrm{d}x_h \mathrm{d}G.$$

Using $p-c = p/\varepsilon$ and $(x_h\varepsilon_h)' = \varepsilon_h + x_h\varepsilon_h'$, this yields

$$\mathrm{dln}p = -\frac{\int x_h \varepsilon_h' \mathrm{d}x_h \mathrm{d}G}{\varepsilon(\varepsilon-1)x}$$

where we denote $\mathrm{dln}p = \mathrm{d}p/p$. Conditions (5), (6), and (7) are log-linearized in the same way and are shown in Table A1:

Budget	$\mathrm{dln}x_h = -\mathrm{dln}p - \mathrm{dln}n$
Entry	$\mathrm{dln}y = -\varepsilon \mathrm{dln}p$
Product market	$\mathrm{dln}y = \frac{1}{x}\int x_h \mathrm{dln}x_h \mathrm{d}G + \mathrm{dln}L$
Labor market	$\mathrm{dln}n = \mathrm{dln}L - \frac{\varepsilon-1}{\varepsilon}\mathrm{dln}y$

Table A1: Log linearization around equilibrium.

Using Table 1, we replace $\mathrm{d}x_h$ and simplify the expression of $\mathrm{dln}p$ as

$$\mathcal{E}_L(p) = \frac{1}{\varepsilon\Psi}\int \varepsilon_h' x_h s_h \mathrm{d}G,$$

where $\Psi \equiv (\varepsilon-1)s - \int \varepsilon_h' x_h s_h \mathrm{d}G > 0$ under subconvex demands because $\varepsilon_h' < 0$.

Appendix B. Market size and trade

We consider an increase in the home population size $\mathrm{dln}L > 0$ while $\mathrm{dln}L^* = 0$. To this end, we apply log-linearization to equilibrium system around symmetric configuration where $L = L^*$ and $G = G^*$. In this symmetric configuration, equilibrium output, prices, and mass of firms are the same across countries ($x_h = i_h = x_h^* = i_h^*$, $p = p_i = p^* = p_i^*$, $n = n^*$). Changes in home variables around this equilibrium are given in Table A2.

Consumer choice	$\mathrm{dln}n+\mathrm{dln}p+\mathrm{dln}x_h+\mathrm{dln}n^*+\mathrm{dln}p_i+\mathrm{dln}i_h=2\mathrm{dln}w$
	$\mathrm{dln}i_h-\mathrm{dln}x_h=\varepsilon_h\left(\mathrm{dln}p-\mathrm{dln}p_i\right)$
Optimal price	$\mathrm{dln}p-\mathrm{dln}w=-\frac{1}{x(\varepsilon-1)\varepsilon}\int x_h\varepsilon_h' x_h\mathrm{dln}x_h\mathrm{d}G$
	$\mathrm{dln}p_i^*-\mathrm{dln}w=\frac{1}{x(\varepsilon-1)\varepsilon}\int x_h\varepsilon_h' x_h\mathrm{dln}i_h^*\mathrm{d}G$
Entry	$\frac{1}{2}\varepsilon\left(\mathrm{dln}p+\mathrm{dln}p_i^*\right)+\frac{1}{2}\left(\mathrm{dln}y+\mathrm{dln}y_i^*\right)=\varepsilon\mathrm{dln}w$
Product market	$\mathrm{dln}y=\mathrm{dln}L+\frac{1}{x}\int x_h\mathrm{dln}x_h\mathrm{d}G$
	$\mathrm{dln}y_i^*=\frac{1}{x}\int x_h\mathrm{dln}i_h^*\mathrm{d}G$
Labor market	$\mathrm{dln}L=\mathrm{dln}n+\frac{1}{2}\frac{\varepsilon-1}{\varepsilon}\left(\mathrm{dln}y+\mathrm{dln}y_i^*\right)$

Table A2: Log linearization around open economy equilibrium.

Step 1. First, we show that $\mathrm{dln}w=0$. To this end, we take the difference of price changes in the home country and get

$$\mathrm{dln}p-\mathrm{dln}p_i=\mathrm{dln}w-\frac{\int x_h\varepsilon_h' x_h(\mathrm{dln}x_h-\mathrm{dln}i_h)\mathrm{d}G}{(\varepsilon-1)\varepsilon x}.$$

Combining it with the second line of Table 2 leads to

$$\mathrm{dln}p-\mathrm{dln}p_i=\frac{1}{a}\mathrm{dln}w,$$

where $a=\int\left(\varepsilon-1-x_h\varepsilon_h'\right)\varepsilon_h x_h\mathrm{d}G/\left[(\varepsilon-1)\varepsilon x\right]>0$ by subconvexity. By symmetry in the foreign country, we get $\mathrm{dln}p^*-\mathrm{dln}p_i^*=-\frac{1}{a}\mathrm{dln}w$ and therefore

$$\mathrm{dln}i_h-\mathrm{dln}x_h=\frac{\varepsilon_h}{a}\mathrm{dln}w.$$

By symmetry, we have $\mathrm{dln}i_h^*-\mathrm{dln}x_h^*=\left(\mathrm{dln}p^*-\mathrm{dln}p_i^*\right)\varepsilon_h=-\frac{\varepsilon_h}{a}\mathrm{dln}w$ in the foreign country.

Plugging $\mathrm{dln}i_h-\mathrm{dln}x_h$ into the difference of firm output we get

$$\mathrm{dln}y-\mathrm{dln}y_i=\frac{\int(\mathrm{dln}x_h-\mathrm{dln}i_h)x_h dG}{x}=-\frac{\varepsilon}{a}\mathrm{dln}w.$$

By symmetry, in the foreign country,

$$\mathrm{dln}y^*-\mathrm{dln}y_i^*=\frac{\varepsilon}{a}\mathrm{dln}w.$$

Combining the entry conditions in both countries

$$\varepsilon\mathrm{dln}p+\varepsilon\mathrm{dln}p_i^*+\mathrm{dln}y+\mathrm{dln}y_i^*=2\varepsilon\mathrm{dln}w,\quad\text{and}\quad\varepsilon\mathrm{dln}p_i+\varepsilon\mathrm{dln}p^*+\mathrm{dln}y_i+\mathrm{dln}y^*=0$$

leads to

$$\varepsilon\left(\mathrm{dln}p-\mathrm{dln}p_i\right)+\varepsilon\left(\mathrm{dln}p^*-\mathrm{dln}p_i^*\right)+\mathrm{dln}y-\mathrm{dln}y_i+\mathrm{dln}y_i^*-\mathrm{dln}y^*=2\varepsilon\mathrm{dln}w.$$

Finally, plugging the differences for price and output changes into the last equation, we get

$$\frac{\varepsilon}{a}\mathrm{dln}w + \frac{\varepsilon}{a}\mathrm{dln}w - \frac{\varepsilon}{a}\mathrm{dln}w - \frac{\varepsilon}{a}\mathrm{dln}w = 2\varepsilon\mathrm{dln}w,$$

which has the unique solution, $\mathrm{d}w = 0$.

Step 2. Using $\mathrm{dln}w = 0$, we get the following relationships: $\mathrm{dln}p = \mathrm{dln}p_i$, $\mathrm{dln}x_h = \mathrm{dln}i_h$, $\mathrm{dln}i_h^* = \mathrm{dln}x_h^*$, $\mathrm{dln}y = \mathrm{dln}y_i$, and finally $\mathrm{dln}n = \mathrm{dln}L + \mathrm{dln}n^*$. By plugging last equations into consumer choice (Table 5), we get $2\mathrm{dln}x_h + 2\mathrm{dln}p + 2\mathrm{dln}n + \mathrm{dln}L = 0$ and $2\mathrm{dln}x_h^* + 2\mathrm{dln}p^* + 2\mathrm{dln}n^* + \mathrm{dln}L = 0$. Combining with the price changes

$$\mathrm{dln}p = \mathrm{dln}p_i = \frac{\int x_h\varepsilon_h' x_h \mathrm{dln}x_h \mathrm{d}G}{(\varepsilon-1)\varepsilon x}, \qquad \text{and} \qquad \mathrm{dln}p^* = \mathrm{dln}p_i^* = \frac{\int x_h\varepsilon_h' x_h \mathrm{dln}x_h^* \mathrm{d}G}{(\varepsilon-1)\varepsilon x},$$

we get

$$\mathrm{dln}p = \mathrm{dln}p^* = \left((\varepsilon-1)\frac{\int(\mathrm{dln}x_h + \mathrm{dln}x_h^*)x_h\mathrm{d}G}{x} - \mathrm{dln}L\right)\frac{\int x_h\varepsilon_h' x_h\mathrm{d}G}{2\varepsilon\int\left(\int x_h\varepsilon_h' + \varepsilon^2 - \varepsilon\right)x_h\mathrm{d}G},$$

thus, $\mathrm{dln}p = \mathrm{dln}p^*$ and $\mathrm{dln}x_h = \mathrm{dln}x_h^*$.

Plugging the values $\mathrm{dln}y = \mathrm{dln}L + \frac{1}{x}\int x_h\mathrm{dln}x_h\mathrm{d}G$ and $\mathrm{dln}y^* = \frac{1}{x}\int x_h\mathrm{dln}x_h\mathrm{d}G$ into the labor market clearing condition $\mathrm{dln}n^* = -\frac{\varepsilon-1}{2\varepsilon}\left(\mathrm{dln}y + \mathrm{dln}y^*\right)$ and using the conditions $\mathrm{dln}x_h = \mathrm{dln}x_h^*$ yield

$$\mathrm{dln}n^* = -\frac{\varepsilon-1}{2\varepsilon}\left(\mathrm{dln}L + 2\mathrm{dln}x_h\right).$$

Plugging it and price change into

$$2\mathrm{dln}x_h + 2\mathrm{dln}p + 2\mathrm{dln}n^* + \mathrm{dln}L = 0$$

results in

$$2\mathrm{dln}x_h + 2\frac{\int\left(1+\varepsilon-r_h\right)x_h\mathrm{dln}x_h\mathrm{d}G}{(\varepsilon-1)\varepsilon x} - \frac{\varepsilon-1}{\varepsilon}\left(\mathrm{dln}L + 2\mathrm{dln}x_h\right) + \mathrm{dln}L = 0.$$

After simplification, we get

$$\mathrm{dln}x_h = -\frac{(\varepsilon-1)s}{\Psi}\mathrm{dln}L < 0.$$

Plugging back to prices and masses of firms, we obtain

$$\mathrm{dln}p = \mathrm{dln}L\frac{1}{2\varepsilon\Psi}\int\varepsilon_h' x_h s_h\mathrm{d}G, \qquad \text{and} \qquad \mathrm{dln}n^* = -\frac{(\varepsilon-1)}{2\varepsilon\Psi}\mathrm{dln}L\int\varepsilon_h' x_h s_h\mathrm{d}G,$$

$$\mathrm{dln}n = \mathrm{dln}L + \mathrm{dln}n^* = \left(2\varepsilon(\varepsilon-1)s - (\varepsilon+1)\int\varepsilon_h' x_h s_h\mathrm{d}G\right)\frac{1}{2\varepsilon\Psi}\mathrm{dln}L,$$

Lastly, the firm output change is given by

$$\mathrm{dln}y + \mathrm{dln}y^* = -\frac{\int\varepsilon_h' x_h s_h\mathrm{d}G}{\Psi}\mathrm{dln}L.$$