Kukharskyy, Bohdan

Working Paper

Trade, Superstars, and Welfare

BGPE Discussion Paper, No. 120

Provided in Cooperation with:
Friedrich-Alexander University of Erlangen-Nuremberg (FAU), Bavarian Graduate Program in Economics (BGPE)

Suggested Citation: Kukharskyy, Bohdan (2012) : Trade, Superstars, and Welfare, BGPE Discussion Paper, No. 120, Friedrich-Alexander-Universität Erlangen-Nürnberg, Bavarian Graduate Program in Economics (BGPE), Nürnberg

This Version is available at:
https://hdl.handle.net/10419/73461

BGPE Discussion Paper

No. 120

Trade, Superstars, and Welfare

Bohdan Kukharskyy

July 2012

ISSN 1863-5733

Editor: Prof. Regina T. Riphahn, Ph.D.
Friedrich-Alexander-University Erlangen-Nuremberg

B G P E Discussion Paper Series

Trade, Superstars, and Welfare*

Bohdan Kukharskyy†

University of Passau

July 2, 2012

Abstract

In recent decades, many countries experienced both a rise in top income shares and an increase of income inequality among the top earners. In this paper, I study the role of international trade as a catalyst for this development and analyze the associated welfare effects. I build a simple general equilibrium model that incorporates Lucas' (1978) idea of individual heterogeneity regarding managerial talents into the framework of intra-industry trade with two symmetric countries. By scrutinizing effects of trade integration on entrepreneurial compensation and endogenous occupational decisions, this model can reproduce the observed pattern of income changes in the top percentiles. Despite positive *joint* welfare effects of trade liberalization, *individual* gains from trade may be non-monotonic in agents' skills. While the welfare of workers and most productive entrepreneurs unambiguously rises, the least- and medium-productive entrepreneurs may be worse off, if their preferences for the traded goods are small enough.

JEL Classification: F12, F16, J24, D31.

Keywords: Distributional effects of trade, individual welfare, occupational choice, superstars.

*I would like to thank Rainald Borck, Elias Dinopoulos, Carsten Eckel, Hartmut Egger, Philipp Ehrl, Malte Mosel, Michael Pflüger, Stephan Russek, the participants of the 13th ETSG Conference in Copenhagen and seminar participants in Augsburg, Mainz and Passau for helpful comments and suggestions. Financial support from the Bavarian Graduate Program in Economics is gratefully acknowledged.

†Bohdan Kukharskyy, Faculty of Economics, University of Passau, Innstrasse 27, 94032 Passau, Germany, Tel (Fax) + 49 (0) 851 509-2536 (2532), E-mail: bohdan.kukharskyy@uni-passau.de.

1 Introduction

> "*A business man of average ability and average good fortune gets now a lower rate of profits ... than at any previous time; while yet the operations, in which a man exceptionally favoured by genius and good luck can take part, are so extensive as to enable him to amass a huge fortune with a rapidity hitherto unknown.*"
>
> Alfred Marshall (1895: 775)

Alfred Marshall traced back this phenomenon back to the emergence of new trading opportunities, brought about by the development of new facilities for communication, in the course of industrial revolution. More than ever are these predictions significant in the age of globalization, whose key features are an increase in the market size and the reduction of transportation and communication costs. Figure 1 illustrates an immense increase in the extent of the market stemming from the ongoing trade liberalization. Figure 2 shows that world trade as a share of GDP has nearly doubled in the last four decades.

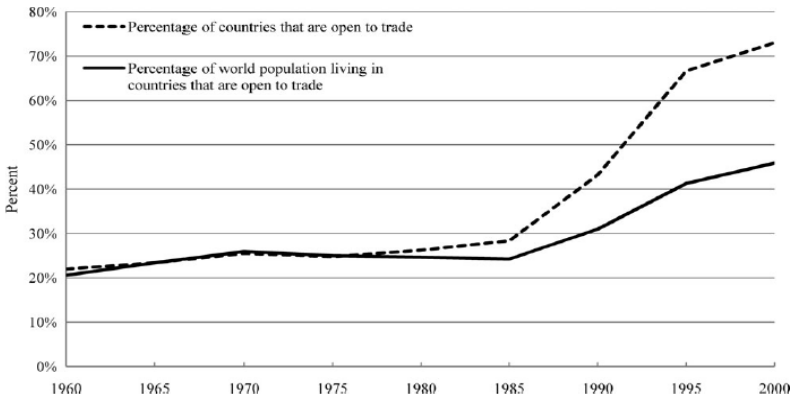

Figure 1: *Openness to trade, 141 countries, 1960-2000. Source: Wacziarg and Welch (2008).*[1]

Figure 2: *World trade (the sum of world exports and imports) as a share of world GDP. Source: Adapted from Jones and Romer (2010).*

Remarkably, one of the most striking trends accompanying globalization is the increase in income inequality. Using US as an example, figure 3 depicts a considerable increase in the share of income going to the top decile of income distribution. By looking more thoroughly on income dynamics inside this decile, one discovers as well a rising skewness of incomes towards the top percentile, cf. figure 4.[2]

This paper discusses the role of international trade as a catalyst for the described patterns of income dynamics. Furthermore, it analyzes the associated general equilibrium effects on

[1] The 'openness to trade' is quantified according to Sachs and Warner (1995) criteria. The authors classify a country as open if *none* of the five following criteria hold: a country has average tariff rates higher than 40 percent; its nontariff barriers cover 40 percent of trade; a black market exchange rate is at least 20 percent lower than the official exchange rate; it has a state monopoly on major exports and a socialist economic system.

[2] Similar trends were identified in many other developed and developing economies. See surveys by Atkinson and Piketty (2010), Atkinson et al. (2011) and Leigh (2009) for an overview.

aggregate and individual welfare. In this spirit, it concurs with Alfred Marshall's (1895: 213) view that one of the most important applications of economic science to the "art of living" is not the study of income development per se, but the discussion of its influence on "*general well-being* which is exerted by the mode in which each individual spends his income".

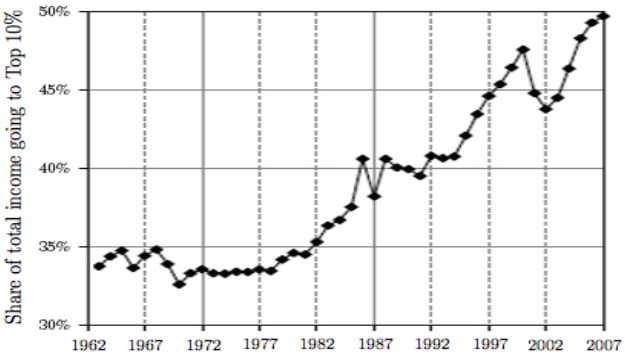

Figure 3: *The Top Decile Income Share in the US, 1962-2007. Source: Adapted from Atkinson et al. (2011).*

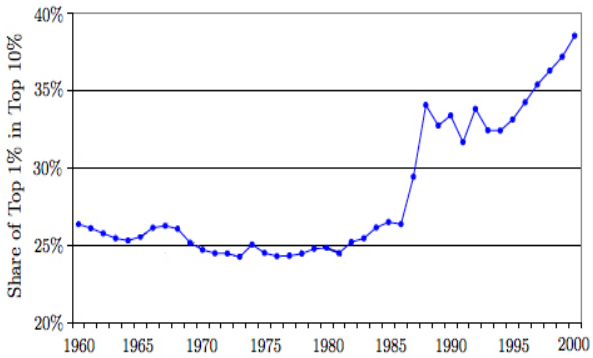

Figure 4: *Share of Top Percentile in Top Decile in the US, 1960-2000. Source: Adapted from Atkinson (2003).*

One of the most influential explanations of the rise in top income shares is a 'superstar' theory of Rosen (1981).[3] Referring back to Alfred Marshall's (1895) "Principles of Economics", Rosen argues that, due to increase of market scale and development of new communication facilities, the rewards are skewed towards the most talented *individuals* in a particular activity. In this context, the keyword 'superstars' has been recently used by trade economist to characterize exporting *firms*, see Mayer and Ottaviano (2007). In fact, a great surge of empirical studies since the mid-1990s document that aggregate exports are driven by a small number of top exporters, which are more productive and profitable than non-exporters (see Bernard et al. (2007) for an overview). While these facts on the *firm level* are well-explained by the seminal Melitz (2003) model, the skill-dependent distributional effects of trade are still imperfectly understood, since *individuals* in theories with firm heterogeneity are commonly assumed to be *homogeneous*.[4]

In the present model, individuals are assumed to be *heterogeneous* with respect to their skills. Following Lucas (1978), individual skill level is interpreted as the 'talent for managing' or, in other words, as the ability to extract output from a given combination of inputs. One entrepreneur (owner-manager) is needed to establish a firm. Contrary to the abstract productivity lottery from the Melitz' (2003) model, firm productivities in the present model can be traced back to particular entrepreneurial skills.[5] Depending on the managerial talent, most skillful individuals self-select to become entrepreneurs and, thereby, realize operating

[3] See, e.g., the survey by Atkinson et al. (2011: 59) for a critical discussion of alternative explanations.

[4] For some exceptions see the literature overview further below.

[5] There is a vast organizational literature which finds that management crucially matters for determining firm productivity and building of the competitive advantage of a firm, see, e.g., Bealieu et al. (2011), Bloom et al. (2011), Bloom and Van Reenen (2007, 2010), Gibbons et al. (2011), Syverson (2011).

profits, while least skillful agents choose to become employees in exchange for a given wage.

Trade integration provides additional profit opportunities via exporting. Assuming that entering a new market is associated with fixed cost, only most skillful entrepreneurs find it profitable to start exporting. Since domestic consumers redirect part of their demand to the most competitive foreign firms active in the home market, all domestic firms loose in terms of profits from domestic sales. Bearing in mind that least productive domestic entrepreneurs were previously indifferent between establishing a firm and working as an employee, they revise their occupational choice and become workers. The effect of the trade-induced exit of the least productive domestic firms on the aggregate performance resemble the one from the Melitz' (2003) model: consumer price index decreases, while average firm productivity and social welfare increase. Yet, the present model with skill heterogeneity provides a richer set of predictions concerning the effect of trade on income distribution and individual welfare.

Assuming that the top ten percent of income distribution are represented by former domestic entrepreneurs, I show that exposure to trade and further trade liberalization (cf. figure 1) increases the share of income accruing to the top decile (cf. figure 3).[6] However, not all individuals within the top decile experience an income rise. Only the most talented entrepreneurs, whose benefits from the possibility of exporting compensate the contraction of domestic sales, experience an increase in income due to trade integration (cf. figure 4).[7] The income of the middle- and least-skillful entrepreneurs, however, declines in accordance with Marshall's proposition in the epigraph.

Regarding welfare analysis, my model follows Marshall's (1895) suggestion by studying the "mode in which each individual spends his income". More specifically, it incorporates a variable which governs the share of tradable goods in consumption and analyzes its interplay with the income dynamics. Given that income of workers and superstar entrepreneurs is not decreasing in the course of trade liberalization, their economic well-being unambiguously increases due to decreasing price index of the tradable goods. The middle- and least-skillful entrepreneurs, however, can only benefit from trade integration if their preferences for the traded goods are high enough to overcompensate the trade-induced income loss.

Related literature. This paper builds on the recent literature that stresses the importance of skill heterogeneity for understanding the distributional effects of trade. It complements, however, this literature with the study of associated effects on *individual* welfare.

[6] The underlying assumption is easy to justify in a simple model with two occupations – workers and entrepreneurs. For instance, Hipple (2010) shows that nearly one in nine workers in the US is active as an entrepreneur. Parker (2009) argues that around 10 percent of the workforce in most OECD countries is self-emloyed and between 80 and 90 percent of businesses are operated by self-employed individuals. Undoubtedly, entrepreneurs are not the sole top earners in reality. However, they constitute one of the largest groups inside the upper tail of income distribution, cf., for instance, Bach et al. (2007).

[7] The Economist (2012) provides anecdotal evidence for this development.

Manasse and Turrini (2001) consider a variant of the Krugman (1980) model with a non-homothetic production function. Production of a single variety of differentiated goods requires a single managerial skill level ('talent') as a fixed and unskilled ('raw') labor as a variable input. Each household is endowed with a homogeneous 'raw' labor and a heterogeneous managerial skill level. Furthermore, it is assumed that each agent can make a productive use both of her managerial talent (by establishing a new firm) *and* her 'raw' labor (by supplying it on a labor market). Similar to the present paper, the authors find that in the course of trade liberalization entrepreneurial profits in exporting firms increase relatively to those in exclusively domestic firms. However, their model differs from the one presented here in two important respects. First, the mass of firms is exogenously fixed in Manasse and Turrini. Second, while the relative income of entrepreneurs in my model increases, their model predicts a decrease of entrepreneurial earnings relatively to the earning of the workers.

Meckl and Weigert (2011) extend the model by Manasse and Turrini (2001) by endogenizing the occupational choice of individuals and, thereby, the mass of firms. They do so by assuming that individuals can not simultaneously make productive use both of their managerial talents and labor endowments. As a result, their model predicts the following sorting pattern: the least skillful agents become employees, medium-skilled individuals establish the firms which remain active exclusively in the domestic market, while the most skillful entrepreneurs self-select into the export markets. Meckl and Weigert, however, neglect to conduct an analysis of the impact of trade liberalization on the inequality and welfare.[8]

This omission has been made up by Egger and Kreickemeier (2008) in the framework conceptually similar to mine, except for the assumption of perfectly competitive labor markets (employees in their model exhibit fair wage preferences). The authors find that exposure to trade increases inequality both between the group of entrepreneurs and workers and within each group. The crucial difference between their approach and the present paper resides in the focus of investigation. While objects of comparison in Egger and Kreickemeier are the occupational *groups* of individuals, the objects of investigation in my model are the *individuals* themselves. Thus, in contrast to Egger and Kreickemeier, my model allows analysis of trade-induced impact on *individual* welfare for any given skill level.

Pica and Rodríguez Mora (2009) address the issue of income inequality along the lines similar to what I do in this paper, albeit, in a model of foreign direct investment. As mentioned before, I argue in the present paper that the mere effect of globalization on the distribution of incomes is not sufficient to estimate the impact of the former on the economic

[8] In fact, their framework does not prove to be convenient for the analysis of these issues, since the central endogenous variable – threshold entrepreneurial ability – can not be explicitly derived in the model. Technically, this is due to the underlying assumption of homothetic preferences.

well-being. For this purpose, I analyze the effects of globalization both on the aggregate and individual welfare by means of the corresponding indirect utilities. This approach has been envisioned by Baldwin and Forslid (2010), who show in a short side note to a Melitz-type model with homogenous agents how the results of their paper can be reinterpreted in order to analyze the distributional effects of trade liberalization.

In terms of the welfare analysis, my paper is closest to Yeaple (2005). In his model, the economic status (wage in terms of the numéraire) of moderately skilled agents erodes relative to both high and low skilled individuals. As a result, the impact of trade liberalization on the welfare (real income) of medium-skilled workers is ambiguous. One key difference between the present paper and his model is that I allow for endogenous occupational choices. While in Yeaple's model heterogeneous workers are the only factor of production and they are assigned to exogenously given technologies by ex ante homogenous (impersonal) firms, my paper relies on Lucas' (1978) idea that most skillful agents endogenously self-select in the entrepreneurial status and influence via their skills the productivity of the employed workers.

In terms of empirical predictions, this model is consistent with recent findings by Mion and Opromolla (2011). They find that export experience of employed managers positively affects firm's probability to start exporting and that the share of managers with these particular skills is more important for the likelihood of export entry than firm productivity and size.[9] Furthermore, they find that managerial export experience is associated with a wage premium. Hence, in accordance with the present model, the authors argue that trade fosters wage disparities both within the group of managers and between managers and workers.

The remainder of the paper is organized as follows. Section 2 develops the closed economy version of the model. Section 3 embeds this model into the framework of two symmetric open economies. Section 4 analyzes the effects of exposure to trade and trade liberalization on the inequality and welfare. Section 5 concludes this paper.

2 Closed Economy

Consider an economy with two industries: a traditional (T) and a modern (M) one. The traditional industry produces homogeneous goods under constant returns to scale and perfect competition. The modern industry produces a continuum of differentiated varieties in a monopolistically competitive setting as in Dixit and Stiglitz (1977). Each variety is produced by a single firm under increasing returns to scale.

The economy is populated by a unit measure of consumers. Each consumer is endowed

[9] Recall that firms' export entry decisions in the present model are determined solely by heterogeneous managerial skills, whereby the number of managers per firm has been normalized to unity for simplicity.

with one unit of inelastically supplied labor and an entrepreneurial skill level φ. Following Lucas (1978), individuals are assumed to be heterogeneous in their managerial abilities $\varphi \in (0, \infty)$. Higher managerial talent is characterized by higher φ. The distribution of skills in the population is given by a cumulative distribution function $G(\varphi)$ with a differentiable density $g(\varphi)$.

Each individual decides whether to become an entrepreneur (owner-manager) by establishing a new firm or to work as an employee. In the former case, her entrepreneurial talent determines firm's productivity and she becomes a residual claimant of firm's profits. In the latter case, the agent can either be employed in an existing firm in the modern sector or become a worker in the traditional sector. In neither sector can the worker make productive use of his entrepreneurial talent. By assuming that employees are completely mobile between industries, all workers in this economy obtain the same wage, w.

2.1 Preferences and Demand

Household h's preferences are defined over the traditional good x_T^h and the set of differentiated varieties Ω according to a logarithmic quasi-linear utility function with CES sub-utility:

$$U^h = x_T^h + \mu \ln X^h \qquad , \qquad X^h = \left[\int_{v \in \Omega} x^h(v)^{\alpha} \mathrm{d}v \right]^{1/\alpha}, \tag{1}$$

where X^h denotes an index of aggregate consumption of differentiated varieties $v \in \Omega$, $x^h(v)$ expresses household h's consumption of variety v and where $0 < \alpha < 1$, $\mu > 0$ are parameters. The reason for using non-homothetic preferences is twofold. Firstly, they allow for closed-form solutions of all endogenous variables and, thereby, enable a simple analysis of inequality issues (see footnote 8). Second, they imply a constant marginal utility of income and, thus, enable a simple (utilitarian) welfare analysis in a model with income heterogeneity.

As it is well-known from Dixit and Stiglitz (1977), the price index corresponding to the CES-aggregate can be expressed as

$$P = \left[\int_{v \in \Omega} p(v)^{1-\sigma} \mathrm{d}v \right]^{1/(1-\sigma)}, \tag{2}$$

where $\sigma \equiv 1/(1-\alpha)$ is the elasticity of substitution between any two varieties. By choosing the (price of the) traditional good as numéraire, the budget constraint of h reads: $PX^h + x_T^h = y^h$, where y^h denotes the household's income. Standard utility maximization implies equilibrium demand functions $X^h = \mu P^{-1}$ and $x_T^h = y^h - \mu$ for manufacturing aggre-

gate and the traditional good, respectively.[10] Bearing in mind that the mass of consumers was normalized to unity, per-capita expenditure on the manufacturing aggregate, μ also represents the overall manufacturing expenditure. Hence, total demand for manufacturing aggregate and homogeneous good is given by $X = \mu P^{-1}$ and $x_T = Y - \mu$ respectively, where Y represents aggregate income specified further below. Total demand and total revenue for each differentiated variety are given by $x(v) = \mu p(v)^{-\sigma} P^{\sigma-1}$ and $r(v) = \mu(P/p(v))^{\sigma-1}$ respectively. Aggregation of households' indirect utilities yields a social welfare function:

$$V = Y - \mu \ln P + \mu(\ln \mu - 1). \tag{3}$$

2.2 Production

The traditional good is produced under constant returns to scale and perfect competition with a unit labor input requirement. This pins down the wage in this economy at unity.

Production of a single variety of differentiated goods requires one entrepreneur as fixed input and workers' labor as variable input. For simplicity, I follow Lucas (1978) and Manasse and Turrini (2001), by assuming that labor productivity in any given firm is equal to the entrepreneurial talent of its owner, φ.[11] As in Melitz (2003), higher productivity is captured by a lower variable labor input requirement $l(\varphi) = x/\varphi$, needed to produce x units of output.

Due to the CES preference structure for heterogeneous goods, each firm faces a residual demand curve with constant price elasticity $-\sigma$, regardless of a particular productivity φ . Hence, a profit maximizing monopolist charges the price $p(\varphi) = 1/\alpha\varphi$, demanding thereby a constant mark up $\sigma/(\sigma-1)$ over marginal cost $1/\varphi$. The revenue of a firm with productivity φ is then given by $r(\varphi) = \mu(\alpha\varphi P)^{\sigma-1}$. With mill pricing and constant mark-ups, the *operating* profits of each firm equal the profit margin $1/\sigma = (1-\alpha)$ times the value of sales $r(\varphi)$:

$$\pi(\varphi) = (1-\alpha)\mu(\alpha\varphi P)^{\sigma-1}. \tag{4}$$

Since entrepreneurial skills are used only in the fixed cost component of production, the reward of entrepreneurs (owner-managers) is a Ricardian surplus of a typical variety, i.e., the operating profits given by (4).

Due to free entry in the monopolistically competitive modern sector, entrepreneurs will enter the market as long as their variable profits are higher than equilibrium opportunity

[10] I assume preference for differentiated goods to be small enough (i.e., $\mu < y^h$) to ensure positive consumption of the homogenous good in equilibrium.

[11] The model's results will not qualitatively change, if one instead assumes that entrepreneurial talents φ are transformed into firm productivities by some monotonic function.

cost, $w = 1$, i.e., $\pi(\varphi) \geq 1$.[12] Given that $\pi(\varphi)$ from (4) is increasing and continuous and that $\pi(0) = 0$, there exists a single cutoff entrepreneurial ability φ^*, for which individual is indifferent between founding a firm or becoming a worker:

$$\varphi^* = ((1-\alpha)\mu)^{\frac{1}{1-\sigma}} (\alpha P)^{-1}. \tag{5}$$

2.3 Aggregation

As is well known from Melitz (2003), the CES price index from (2) can be rewritten as:

$$P = \left[\int_0^\infty p(\varphi)^{1-\sigma} N \gamma(\varphi) d\varphi\right]^{\frac{1}{1-\sigma}}, \quad \text{with} \quad \gamma(\varphi) \equiv \begin{cases} \frac{g(\varphi)}{1-G(\varphi^*)} & \text{if } \varphi \geq \varphi^* \\ 0 & \text{otherwise} \end{cases}, \tag{6}$$

where N denotes the mass of producing firms, $\gamma(\varphi)$ represents a conditional distribution of $g(\varphi)$ on $[\varphi^*, \infty)$ and $(1 - G(\varphi^*))$ is the share of individuals with entrepreneurial ability $\varphi \geq \varphi^*$. Bearing in mind that the mass of individuals is normalized to unity, this share simultaneously denotes the mass of producing firms, i.e., $N = 1 - G(\varphi^*)$. Furthermore, since all firm-specific variables differ only with respect to productivity φ, the price index from (6) can be rewritten as follows:

$$P = N^{\frac{1}{1-\sigma}} p(\tilde{\varphi}) = [1 - G(\varphi^*)]^{\frac{1}{1-\sigma}} \frac{1}{\alpha\tilde{\varphi}}, \quad \text{with} \quad \tilde{\varphi} \equiv \left[\frac{1}{1-G(\varphi^*)} \int_{\varphi^*}^\infty \varphi^{\sigma-1} g(\varphi) d\varphi\right]^{\frac{1}{\sigma-1}}, \tag{7}$$

where $\tilde{\varphi}$ can be interpreted as the average productivity. Using this definition together with the expression for P from (7) in (4), one obtains aggregate profits in this economy $\Pi(\tilde{\varphi}) \equiv N\pi(\tilde{\varphi}) = [1-G(\varphi^*)](1-\alpha)\mu(\alpha\tilde{\varphi}P)^{\sigma-1} = (1-\alpha)\mu$. Intuitively, aggregate profits are composed of overall manufacturing expenditure multiplied by profit margin.

Bearing in mind that $G(\varphi^*)$ denotes the mass of workers in the traditional and modern sector and that the wage rate in both sectors was normalized to unity, aggregate wages are given by $W = G(\varphi^*)$. Adding aggregate workers' earnings and joint entrepreneurial profits yields endogenous aggregate income:

$$Y = G(\varphi^*) + (1-\alpha)\mu. \tag{8}$$

As is well-known from two sector models of the New Trade Theory (cf. Helpman and Krugman 1985), of which the present model is a variant, the general equilibrium of the economy follows immediately once the industry equilibrium in the modern sector is derived. Equilibrium in the modern sector defines the labor use of that industry. The remaining labor

[12] Notice that firm's fixed cost in this model are implicitly defined by entrepreneur's opportunity cost.

is used to produce the homogenous good. By Walras law, it follows that the expenses on the aggregate consumption of the traditional good and the modern good just match the income generated in this economy. I verify in Appendix A that the existence of a unique cutoff φ^* is a sufficient condition for the existence and uniqueness of equilibrium in the closed economy.

2.4 Parametrization of productivity distribution and equilibrium

Both to accord with empirical findings and in order to obtain closed-form solutions I assume that firm productivities are distributed Pareto with lower bound b and shape parameter z:[13]

$$G(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^z \quad \Rightarrow \quad g(\varphi) = \frac{dG(\varphi)}{d\varphi} = zb^z\varphi^{-z-1}, \quad \varphi \geq b > 0,\ b, z = const. \tag{9}$$

I impose the assumption $z > 2$ to ensure that the Pareto-distributed variable has a finite variance and the further assumption $z > \sigma - 1$ to obtain economically meaningful solutions.

Using the definition of $G(\varphi)$ from (9) in (7), one obtains the average productivity $\tilde{\varphi} = \varphi^* \left[z/(z-\sigma+1)\right]^{\frac{1}{\sigma-1}}$, which is a function of the cutoff productivity φ^*. Utilizing this in the CES price index given by (7) and substituting the resulting expression for P in (5) yields the cutoff skill level needed to establish a successful firm:

$$\varphi^* = b\left[\frac{\sigma z}{\mu(z-\sigma+1)}\right]^{\frac{1}{z}}. \tag{10}$$

As argued above, this cutoff productivity is a sufficient statistic for the existence of equilibrium and the determination of all endogenous variables of interest.

3 Open Economy

Consider now a world consisting of two symmetric countries, whose economies are of the type described in section 2. The traditional good is always produced in both countries and, since both countries are symmetric, this good is not traded. The homogeneous good is again chosen as a numéraire, which pins down the wage rate in both economies at unity.

Firms in the modern sector have opportunity to export their goods. Trade in modern

[13] Several empirical studies had shown that Pareto is a fairly good approximation of productivity distributions prevailing in reality (cf., e.g., Del Gatto et al. (2006) and Eaton et al. (2008)). Consequently, this distribution has been extensively used in the literature on heterogeneous firms (see, e.g., Chaney (2007), Helpman et al. (2004, 2008) and Melitz and Ottaviano (2008)). This paper, however, is particularly well-suited for the assumption of Pareto distribution due to a further reason: a vast empirical literature which argues that top tails of income distributions resemble Pareto distribution (see Atkinson et al. (2010), Gabaix (2009) and Gabaix and Landier (2008) for the discussion). Since firm productivities in this model get reflected (up to a constant) in managerial incomes, assumption of Pareto distributed productivities simultaneously accounts for the second empirical finding as well.

goods is inhibited by frictional trade barriers, which are modeled in the standard iceberg formulation. That is, $\tau > 1$ units of a differentiated good must be shipped in order for one unit to reach the other region. We assume that regional markets are segmented, i.e., each firm sets a delivered price specific to the market in which its variety is sold. As is well known from Krugman (1980), the mere existence of per-unit export cost τ cannot generate self-selection of firms with respect to export status if the preference structure for differentiated varieties is of CES-type as in (1). In order to reproduce an empirically plausible pattern of the partitioning of firms into domestic producers and exporters, I follow in the present model Melitz (2003) by assuming fixed cost of exporting, f_x, borne in terms of workers.

3.1 Indifference conditions

Firm's pricing rule in its *d*omestic market is given, as before, by $p_d(\varphi) = 1/\alpha\varphi$, implying profits $\pi_d(\varphi) = (1-\alpha)\mu(\alpha\varphi P_t)^{\sigma-1}$, where P_t denotes CES price index under *t*rade. Due to transportation cost τ, exporting firms charge higher prices in foreign markets, $p_x(\varphi) = \tau/\alpha\varphi = \tau p_d(\varphi)$, obtaining thereby pure profits $\pi_x(\varphi) = (1-\alpha)\mu(\alpha\varphi P_t)^{\sigma-1}\tau^{1-\sigma} - f_x$. As in the closed economy, individuals will establish new firms and produce for their domestic market as long as respective entrepreneurial profits are higher than equilibrium opportunity cost, i.e., $\pi_d(\varphi) \geq 1$. Yet, the entrepreneurs will additionally engage in exporting as long as their profits are non-negative, i.e., $\pi_x(\varphi) \geq 0$. These conditions implicitly determine productivity cutoffs needed to become a successful domestic producer and exporter, respectively:

$$\varphi_d^* = \left((1-\alpha)\mu\right)^{\frac{1}{1-\sigma}} (\alpha P_t)^{-1} \quad , \quad \varphi_x^* = \left(\frac{(1-\alpha)\mu}{f_x}\right)^{\frac{1}{1-\sigma}} (\alpha P_t)^{-1} \tau = \varphi_d^* f_x^{\frac{1}{\sigma-1}} \tau. \tag{11}$$

It can be immediately seen that the empirically relevant case of firm partitioning with respect to export status (i.e, $\varphi_x^* > \varphi_d^*$) occurs if and only if $f_x^{\frac{1}{\sigma-1}}\tau > 1$, which will be assumed throughout:

Assumption 1. $f_x^{\frac{1}{\sigma-1}}\tau > 1$.

3.2 Aggregation

As before, the price index can be expressed in terms of the average firm productivity, $\tilde{\varphi}_t$:

$$P_t = N_d^{\frac{1}{1-\sigma}} p(\tilde{\varphi}_t) = [1 - G(\varphi_d^*)]^{\frac{1}{1-\sigma}} \frac{1}{\alpha\tilde{\varphi}_t} \ , \ \tilde{\varphi}_t \equiv \left[\tilde{\varphi}_d^{\sigma-1} + \frac{1-G(\varphi_x^*)}{1-G(\varphi_d^*)} \left(\frac{\tilde{\varphi}_x}{\tau}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}, \tag{12}$$

where $\tilde{\varphi}_d \equiv \left[\frac{1}{1-G(\varphi_d^*)} \int_{\varphi_d^*}^{\infty} \varphi^{\sigma-1} g(\varphi) d\varphi\right]^{\frac{1}{\sigma-1}}$ and $\tilde{\varphi}_x \equiv \left[\frac{1}{1-G(\varphi_x^*)} \int_{\varphi_x^*}^{\infty} \varphi^{\sigma-1} g(\varphi) d\varphi\right]^{\frac{1}{\sigma-1}}$ represent the average productivity of domestic firms, $N_d = 1 - G(\varphi_d^*)$, and exporters, $N_x = 1 - G(\varphi_x^*)$, respectively. Again, given the Pareto distribution from (9), one can derive the average firm productivity in the open economy, $\tilde{\varphi}_t = \varphi_d^* \left[z/(z-\sigma+1)\right]^{\frac{1}{\sigma-1}} \left(1 + f_x^{-\frac{z-\sigma+1}{\sigma-1}} \tau^{-z}\right)^{\frac{1}{\sigma-1}}$. Utilizing $\tilde{\varphi}_t$ in the price index given by (12) and substituting for P_t in (11) yields the cutoff skill level needed to establish a successful firm in the open economy:

$$\varphi_d^* = b \left[\frac{\sigma z}{\mu(z-\sigma+1)}\right]^{\frac{1}{z}} \Phi^{\frac{1}{z}} = \varphi^* \Phi^{\frac{1}{z}}, \quad \text{with} \quad \Phi \equiv \left(1 + f_x^{-\frac{z-\sigma+1}{\sigma-1}} \tau^{-z}\right). \tag{13}$$

Since $\Phi > 1$ for all possible parameters, the cutoff productivity needed to establish a profitable firm rises in the course of exposure to trade, i.e., $\varphi_d^* > \varphi^*$. Even though this result replicates a well-known finding by Melitz (2003), it is driven in the current paper by endogenous occupational choices. Some least-skillful domestic entrepreneurs, who were previously indifferent between establishing a firm and working as an employee, shut down their firms in the course of exposure to trade and become workers. Two corollaries follow immediately from this result. First, the average productivity increases due to trade integration, i.e., $\tilde{\varphi}_t > \tilde{\varphi}$. Second, as long as assumption 1 holds, the price index in the open economy is lower than the autarky price index, i.e. $P_t < P$.

Having determined the cutoff productivity of domestic firms, one can calculate both the cutoff productivity of exporters and the average productivities in the open economy, cf. table 1. Notice that all open economy values can be traced back to the closed economy cutoff. This allows a simple comparison of both states, which will be accomplished in section 4.

	Closed Economy	**Open Economy**		
Productivity	**Domestic firms**	**Domestic firms**	**Exporters**	**Aggregate**
Cutoff	$\varphi^* = b\left[\frac{\sigma z}{\mu(z-\sigma+1)}\right]^{\frac{1}{z}}$	$\varphi_d^* = \varphi^* \Phi^{\frac{1}{z}}$	$\varphi_x^* = \varphi_d^* f_x^{\frac{1}{\sigma-1}} \tau$	
Average	$\tilde{\varphi} = \varphi^* \left[\frac{z}{z-\sigma+1}\right]^{\frac{1}{\sigma-1}}$	$\tilde{\varphi}_d = \varphi_d^* \left[\frac{z}{z-\sigma+1}\right]^{\frac{1}{\sigma-1}} = \tilde{\varphi} \Phi^{\frac{1}{z}}$	$\tilde{\varphi}_x = \tilde{\varphi}_d f_x^{\frac{1}{\sigma-1}} \tau$	$\tilde{\varphi}_t = \tilde{\varphi}_d \Phi^{\frac{1}{\sigma-1}}$

Table 1: *Summary of productivity cutoffs and average productivities in the closed and open economy.*

Using information from table 1, one can calculate aggregate profits from domestic and foreign sales, given by $\Pi_d(\tilde{\varphi}_d) = N_d \pi_d(\tilde{\varphi}_d) = (1-\alpha)\mu\Phi^{-1}$ and $\Pi_x(\tilde{\varphi}_x) = N_x \pi_x(\tilde{\varphi}_x) = (1-\alpha)\mu(1-\Phi^{-1}) - [1 - G(\varphi_x^*)] f_x$. Adding these profits yields aggregate profits in the open economy, $\Pi_t = \Pi_d(\tilde{\varphi}_d) + \Pi_x(\tilde{\varphi}_x) = (1-\alpha)\mu - [1 - G(\varphi_x^*)] f_x$. Summing up the latter term with the aggregate wages under trade, $W_t = G(\varphi_d^*)$ provides expression for the aggregate

income in the open economy:

$$Y_t = G(\varphi_d^*) + (1-\alpha)\mu - [1 - G(\varphi_x^*)]f_x. \tag{14}$$

This expression finalizes the characterization of the equilibrium in the modern sector. Comparison of this expression with the closed economy counterpart yields:

Lemma 1. The aggregate income remains unchanged through trade opening.

Proof. Follows from comparison of (8) and (14), using information from Table 1. □

Intuitively, since underlying economy does not exhibit economic growth, the aggregate output and income remain unaltered due to trade integration. Yet, *real* aggregate income is higher in an open economy (i.e., $Y_t/P_t > Y/P$) due to the lower price index.

4 The impact of trade

4.1 Income distribution and inequality

In this section I compare the outcomes of sections 2 and 3 in order to analyze the effects of trade opening and further trade liberalization on income distribution and inequality. By interpreting the results, one should keep in mind that all variables in the closed and open economy are expressed in terms of the numéraire good.

It is well known from Melitz (2003) that exposure to trade is associated with reallocation of profits across firms. However, since firm profits in his model are distributed to shareholders and, by assumption, each worker holds a completely diversified portfolio of firm shares, all individuals are equally affected through a transition from autarky to trade. This is not the case in the present model with heterogeneous agents. Part *A* of figure 5 depicts wages and profits in terms of the numéraire under autarky (solid line) and trade (dashed line).

Former workers (i.e., individuals with skills $\varphi \in (0, \varphi^*]$) are equal off in terms of the numéraire in either state. In contrast, former entrepreneurs who either become workers (if their skill level is $\varphi \in (\varphi^*, \varphi_d^*]$) or keep producing exclusively for the domestic market (if $\varphi \in (\varphi_d^*, \varphi_x^*]$), lose in terms of the numéraire due to trade integration.[14] Although individuals with entrepreneurial skills $\varphi \in (\varphi_x^*, \infty)$ obtain under trade additional profits from exporting, not all of them are better off as compared to autarky. This becomes clear from the inspection of profits of a cutoff-exporter φ_x^*. Her profits from domestic sales, $\pi_d(\varphi_x^*, P_t)$ decrease relatively to her profits under autarky, $\pi(\varphi_x^*, P)$ due to lower price index, while

[14] The slope of $\pi_d(\varphi, P_t)$ in figure 5.A is smaller than the slope of $\pi(\varphi, P)$ due to the fact that $P_t < P$.

her profits from foreign sales, $\pi_x(\varphi_x^*, P)$ exactly offset the fixed cost of exporting, f_x.[15] As shown in Appendix B, the slope of $\pi_t(\varphi, P_t)$ in figure 5 is higher than the slope of $\pi(\varphi, P)$. A unique interception point of these lines implies the existence of a unique firm productivity $\varphi^\dagger = \varphi^* \left(f_x / (\Phi^{-\frac{\sigma-1}{z}}(1+\tau^{1-\sigma}) - 1) \right)^{1/(\sigma-1)}$, above which entrepreneurs in the open economy are better off in terms of the numéraire. The change of individual incomes after exposure to trade is summarized in figure 5.B. For any given distribution of skills, these results can be used to assess the effects of exposure to trade on the development of the entrepreneurial incomes and income inequality.

Assumption 2. Let the top 10% and the top 1% of incomes *under autarky* be realized by individuals in the skill range (φ^*, ∞) and $[\varphi^\dagger, \infty)$, respectively, (cf. figure 5.A).[16]

Proposition 1. Exposure to trade, income inequality and superstars. *Under Assumption 2, the share of income accruing to the top 10% is strictly higher under trade than under autarky. Furthermore, the share of the top 10% of income accruing to the top 1% is higher due to the exposure to trade.*

Proof. See Appendix C. □

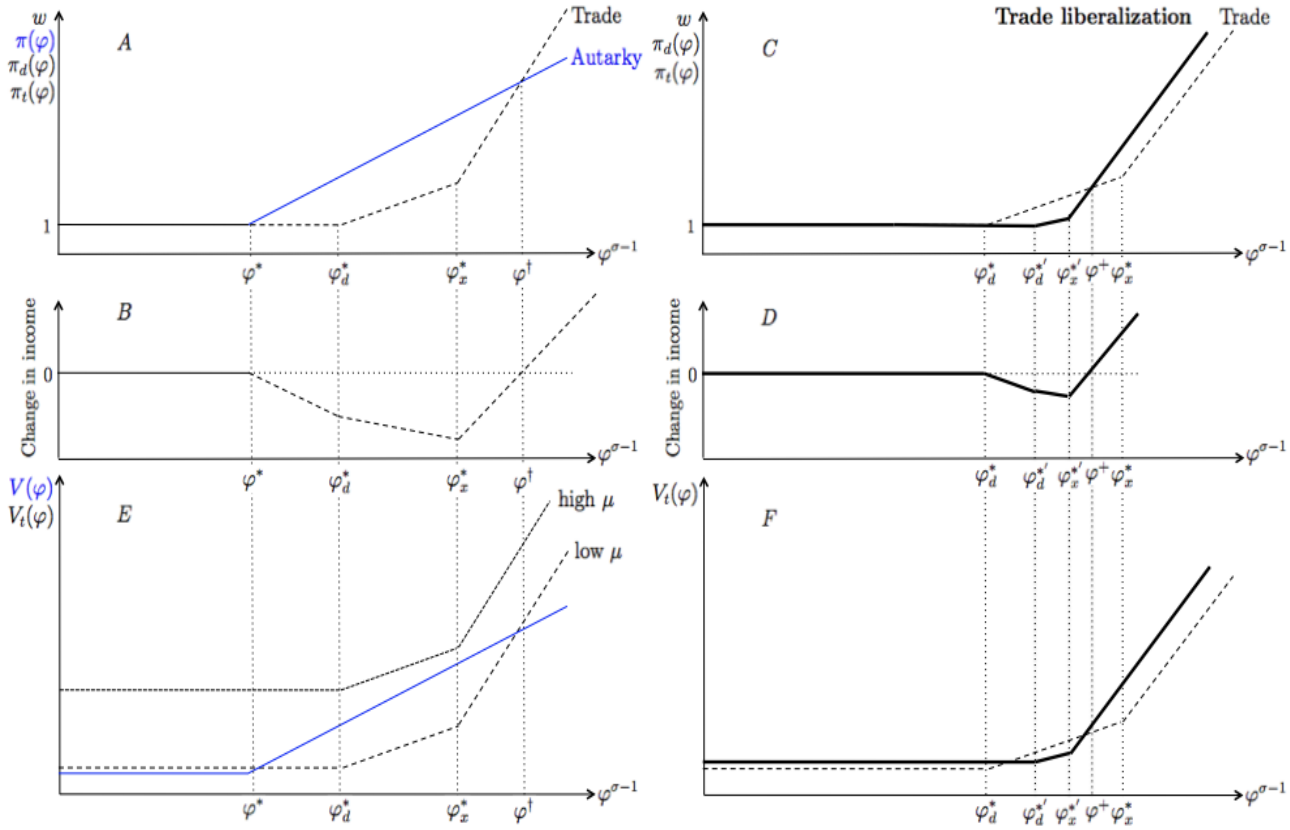

Figure 5: *Wages, profits and welfare under autarky and trade.*

[15] This claim can be verified analytically from the fact that $\pi(\varphi_x^*, P) > \pi_t(\varphi_x^*, P_t)$ for all parameter values.

[16] The choice of the skill range for the top *decile* was justified in the footnote 6. The choice of the skill range for the top *percentile* can be justified by a fact that the number of exporters is relatively small. Bernard et al. (2007) find that approximately 4 percent of US firms were exporting in 2000.

The preceding analysis discussed the effect of opening up a closed economy on the income inequality. However, since very few of the world's economies can be considered as autarkies, it is reasonable to analyze the distributional effects of *trade liberalization* in the open economy. Symmetric reduction of trade cost from τ to $\tau^{'}$ increases exporting profits and leads to more entry into the export market. Using information from table 1, it can be easily verified analytically that productivity cutoff of exporting firms, $\varphi_x^*(\tau)$ decreases to $\varphi_x^{*'}(\tau')$. Since the same result holds for the foreign market, domestic producers face stronger competition on the part of foreign exporters. As a result, the cutoff skill level needed for establishing a profitable firm, φ_d^* increases to $\varphi_d^{*'}(\tau')$. The distributional effects of trade liberalization are summarized by a bold line in figure 5.C. Former least-skillful domestic entrepreneurs (with $\varphi \in (\varphi_d^*, \varphi_d^{*'}]$) become workers and are compensated with a (unity) wage rate. Medium-skilled domestic entrepreneurs (with $\varphi \in (\varphi_d^{*'}, \varphi_x^{*'}(\tau')]$) and least-skillful exporters (with $(\varphi_x^{*'}(\tau'), \varphi^+]$) remain active as managers, however, experience a profit loss due to trade liberalization. The most productive exporters (with $\varphi > \varphi^+$) experience a rise in profits in terms of the numéraire.

Assumption 3. Let top 10% and top 1% of incomes *under trade* be realized, respectively, by individuals in the skill range (φ_d^*, ∞) and $[\varphi^+, \infty)$.

Proposition 2. Trade liberalization, income inequality and superstars. *Under Assumption 3, the share of income accruing to the top 10% and the share of the top 10% of income accruing to the top 1% increases due to trade liberalization.*

Proof. The proof is conducted by analogy to the proof of Proposition 1. □

Propositions 1 and 2 suggest that ongoing trade integration since the late 1970s (cf. figure 1) can provide one possible explanation both for the development of overall income inequality, as depicted in figure 3, and the rising skewness of top incomes towards the top percentile, cf. figure 4. It has been argued that exposure to trade and further trade liberalization disproportionately favors the most skillful entrepreneurs and puts them into a superstar role in the spirit Rosen (1981). In the same time, trade integration relatively disadvantages the medium- and least-skillful entrepreneurs, as predicted in the epigraph by Marshall (1895). However, the impact of trade on the well-being of the latter group of agents can only be fully assessed by analyzing individual welfare effects. This will be done in the following section.

4.2 Welfare

The aggregate welfare effect of moving from autarky to trade is unambiguously positive as stated in

Proposition 3. Gains from trade. *Both countries experience higher social welfare under free trade, as compared to autarky.*

Proof. Proposition 3 follows immediately from the fact that aggregate incomes under autarky and trade are the same (see Lemma 1), whereas the price index under trade is lower ($P_t < P$), see section 3.2. This implies by equation (3) higher social welfare in the open economy ($V_t > V$). □

The result of gains from trade is well-established in the standard international trade models with heterogeneous firms, see Melitz (2003) and Baldwin and Forslid (2010). The present model replicates this result in a framework with skill heterogeneity and endogenous occupational choices. Yet, the underlying model with heterogeneous agents entails a richer set of predictions concerning the effects of trade on the *individual* well-being. These effects are summarized in:

Proposition 4. Exposure to trade and individual welfare. *The welfare effect of opening up a closed economy is strictly positive for the workers and the most skillful entrepreneurs, however, it is ambiguous for the least-skillful entrepreneurs. The welfare of the latter is more likely to rise the higher is per capita expenditure μ on the modern goods.*

Proof. See Appendix D. □

The intuition behind this Proposition can be most easily inferred from figure 5.E, which depicts individual well-being under autarky (continuous line) and trade (dashed line for low μ and dotted line for high μ) as a function of the skill level. The slopes of the welfare functions are identical to the corresponding lines from figure 5.A. Recall that the decrease of CES price index resulting from transition to trade increases individual's indirect utility for any given level of income, cf. (3). Since, by construction, the wage rate in this economy is unaffected by the exposure to trade, workers' welfare strictly increases. The income of domestic entrepreneurs, however, can either fall (for entrepreneurs with skill level $\varphi \in (\varphi^*, \varphi^\dagger)$) or rise (for individuals with $[\varphi^\dagger, \infty)$). In the former case, the positive effect of lower CES price index is more likely to overcompensate the negative welfare effect of lower income the higher are consumer preferences μ for modern varieties. In the latter case, the welfare unambiguously rises, since individuals experience both higher income (in terms of the traditional good) and lower price index. To sum up, if expenditures for tradable modern goods are high enough (see dotted line 'high μ' in figure 5.E), all agents benefit in welfare terms from exposure to trade. However, if preferences for modern goods are low (see dashed line 'low μ'), low-skilled entrepreneurs lose from opening up a closed economy.

A similar pattern arises from the symmetric trade liberalization in the open economies:

Proposition 5. Trade liberalization and individual welfare. *A symmetric decrease in trade cost leads to the increase in social welfare. The higher per capita expenditure μ, the higher are joint welfare gains from trade liberalization. While workers and former exporters strictly win from trade liberalization in welfare terms, the effect on former domestic producers is ambiguous. The welfare of the latter is more likely to increase the higher is μ.*

Proof. See Appendix E. □

Similarly to the discussion above, the intuition behind Proposition 5 can be most easily inferred from figure 5.F, which shows how the welfare schedule in the open economy (dashed line) reacts on the trade liberalization (bold line).

5 Conclusion

The aim of this paper is to study the role of ongoing trade integration as a possible catalyst for the observed patters of income inequality and scrutinize the trade-induced effects on the individual well-being. To this end, I suggest a general equilibrium trade model with skill heterogeneity and endogenous occupational choices, in which most talented agents (in terms of managerial ability) self-select to become entrepreneurs, whereas least talented ones are employed as workers. Trade integration favors most skillful entrepreneurs, who obtain additional profits via exporting activity. At the same time, increasing product market competition on the part of foreign exporters reduces profits of those domestic entrepreneurs who remain active exclusively in the domestic market. Hence, trade integration favors *in income terms* the most skillful entrepreneurs (superstars) at the cost of medium- and low-skilled entrepreneurs. Nevertheless, the *well-being* of the latter groups may rise, if consumers' preferences for the traded goods are strong enough. Furthermore, the aggregate welfare in this model unambiguously increases due to exposure to trade and further trade liberalization.

An appealing research agenda would be to relax the assumption that workers' skills are irrelevant for the productivity of firms. The interaction between entrepreneurial and workers' skills would give rise to an assortative matching problem and generate the empirically relevant case of wage heterogeneity between employees. Additionally, one could relax the assumption of identical consumer preferences for tradable goods. Such models would entail a richer set of predictions concerning the impact of trade integration on inequality and economic well-being. Finally, the present model may be extended to the environment with asymmetric countries whose residents differ with respect to their entrepreneurial abilities. The objective of this analysis would be to scrutinize the empirically well-established link between entrepreneurship and economic well-being.

References

Atkinson, A. (2003): Income Inequality in OECD Countries: Data and Explanations. *CESifo Economic Studies*, 49(4), 479-513.

Atkinson, A., T. Piketty, eds. (2010): *Top Incomes: A Global Perspective*. Oxford and New York: Oxford University Press.

Atkinson, A., T. Piketty, E. Saez (2011): Top Incomes in the Long Run of History. *Journal of Economic Literature*, 49(1), 3-71.

Bach, S., V. Corneo, V. Steiner (2007): From Bottom to Top: The Entire Distribution of Market Income in Germany, 1992-2001. *IZA Discussion Paper No. 2723*.

Baldwin, R., R. Forslid (2010): Trade Liberalization with Heterogeneous Firms. *Review of Development Economics*, 14(2), 161-176.

Bernard, A., B. Jensen, S. Redding, P. Schott (2007): Firms in International Trade. *Journal of Economic Perspectives*, 21(3), 105-130.

Beaulieu, N., R. Gibbons, R. Henderson (2011): Microeconometric Evidence of Persistent Performance Differences among Seemingly Similar Enterprises. Forthcoming in Gibbons, R., J. Roberts (eds.): *Handbook of Organizational Economics*. Princeton: Princeton University Press.

Bloom, N., B. Eifert, A. Mahajan, D. McKenzie, J. Roberts (2011): Does Management Matter? Evidence From India. *NBER Working Paper No. 16658*.

Bloom, N., J. Van Reenen (2007): Measuring and Explaining Management Practices Across Firms and Countries. *Quarterly Journal of Economics*, 122(4), 1341-1408.

Bloom, N., J. Van Reenen (2010): Why Do Management Practices Differ across Firms and Countries? *Journal of Economic Perspectives*, 24(1), 203-224.

Chaney, T. (2008): Distorted Gravity. *American Economic Review*, 98, 1707-1721.

Del Gatto, M., G. Mion, G. Ottaviano (2006): Trade Integration, Firm Selection and the Costs of Non–Europe. *CEPR Discussion Paper 5730*.

Dew-Becker, I., R. Gordon (2007): Selected Issues in the Rise of Income Inequality. *Brookings Papers on Economic Activity*, 2, 169-190.

Dixit, A., J. Stiglitz (1977): Monopolistic competition and optimum product diversity. *American Economic Review*, 67, 297-308.

Eaton, J., S. Kortum, F. Kramarz (2008): An Anatomy of International Trade: Evidence from French Firms. *NBER Working Paper No. 14610.*

The Economist (2012): Executive Pay: Money for Nothing? January 14th.

Egger, H., U. Kreickemeier (2008): Fairness, Trade, and Inequality. *CESifo Working Paper No. 2344.*

Gabaix, X. (2009): Power Laws in Economics and Finance. *Annual Review of Economics*, 1(1), 255-293.

Gabaix, X., A. Landier (2008): Why Has CEO Pay Increased So Much? *Quarterly Journal of Economics*, 123, 49-100.

Gibbons, R., R. Henderson, N. Repenning, J. Sterman (2011): What Do Managers Do (To Build Competitive Advantage)? The Development of Relational Contracts and the Origins of Organizational Capability. Forthcoming in Gibbons, R., J. Roberts (eds.): *Handbook of Organizational Economics*. Princeton: Princeton University Press.

Helpman, E., P. Krugman (1985): *Market Structure and Foreign Trade*. Cambridge, MA: MIT Press.

Helpman, E., M. Melitz, S. Yeaple (2004): Export versus FDI with Heterogenous Firms. *American Economic Review*, 94, 300-316.

Helpman, E., M. Melitz, Y. Rubinstein (2008): Estimating trade flows: Trading partners and trading volumes. *Quarterly Journal of Economics*, 123, 441-487.

Hipple, S. (2010): Self-Employment in the United States. *Monthly Labor Review*, 9(133), 17-32.

Jones, C., P. Romer. (2010): The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital. *American Economic Journal: Macroeconomics*, 2:1, 224-245.

Kortum, S. (1997): Research, Patenting, and Technological Change. *Econometrica*, 65, 1389-1419.

Krugman, P. (1980): Scale Economies, Product Differentiation, and the Pattern of Trade. *American Economic Review*, 99(3), 950-959.

Krugman, P. (1980): Trade and Wages, Reconsidered. *Brookings Papers on Economic Activity*, 1, 103-154.

Lucas, R. (1978): On the Size Distribution of Business Firms. *Bell Journal of Economics*, 9(2), 508-523.

Manasse, P., A. Turrini (2001): Trade, Wages, and 'Superstars'. *Journal of International Economics*, 54, 97-117.

Marshall, A. (1895): *Principles of Economics*, 3rd ed. London: MacMillan.

Mayer, M., G. Ottaviano (2007): The Happy Few: The Internationalisation of European Firms. New Facts Based on Firm-level Evidence. *Bruegel Blueprint Series*, Vol. 3.

Meckl, J., B. Weigert (2011): Occupational Choice, Aggregate Productivity, and Trade. Forthcoming in *Review of Development Economics*.

Melitz, M. (2003): The Impact of Trade on Intraindustry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71, 1695-1725.

Melitz, M., G. Ottaviano (2008): Market Size, Trade, and Productivity. *Review of Economic Studies*, 75, 295-316.

Mion, G., L. Opromolla (2011): Managers' Mobility, Trade Status, and Wages. *mimeo*.

Parker, S. (2009): *The Economics of Entrepreneurship*. Cambridge University Press.

Pica, G., J. Rodríguez Mora (2009): Who's Afraid of a Globalized World? Foreign Direct Investments, Local Knowledge and Allocation of Talents. *mimeo*.

Piketty, T., E. Saez (2003): Income Inequality in the United States, 1913-1998. *Quarterly Journal of Economics*, 118(1), 1-39.

Rosen, S. (1981): The Economics of Superstars. *American Economic Review*, 71(5): 845-858.

Sachs, J., A. Warner (1995): Economic Reform and the Process of Global Integration. *Brookings Papers on Economic Activity*, 1, 1-118.

Syverson, C. (2011): What Determines Productivity? *Journal of Economic Literature*, 49(2), 326-365.

Wacziarg, R., K. Welch (2008): Trade Liberalization and Growth: New Evidence. *The World Bank Economic Review*, 22(2), 187-231.

Yeaple, S. (2005): A Simple Model of Firm Heterogeneity, International Trade, and Wages. *Journal of International Economics*, 65, 1-20.

Appendix

A General equilibrium in the closed economy

Since the mass of individuals was normalized to unity, the *endogenous* supply of workers in the traditional sector is given by $L_T = 1 - (N + L_M)$, where L_M denotes the supply of workers employed in modern sector. In equilibrium, the latter equals total labor demand in the modern sector, $Nl(\tilde{\varphi}) = Nx(\tilde{\varphi})/\tilde{\varphi} = [1 - G(\varphi^*)]\mu\alpha^\sigma (\tilde{\varphi}P)^{\sigma-1}$. Utilizing this term in the resource constraint yields the supply of workers in the traditional sector, $L_T = G(\varphi^*) - [1 - G(\varphi^*)]\mu\alpha^\sigma (\tilde{\varphi}P)^{\sigma-1}$. Due to the normalization of labor input requirement in the traditional sector to one, L_T simultaneously determines the aggregate supply of homogenous goods. Using (7), (9) and (10), it can be easily verified that L_T corresponds for any given φ^* to the aggregate demand for traditional goods, $x_T = Y - \mu$, where Y is given by (8). Hence, for any given φ^* all markets clear.

B Inspection of the slopes of $\pi(\varphi, P)$ and $\pi_t(\varphi, P_t)$

The slope of $\pi_t(\varphi, P_t)$ with respect to φ is higher than the slope of $\pi(\varphi, P)$ if and only if $P_t^{\sigma-1}(1 + \tau^{1-\sigma}) > P^{\sigma-1}$. Using (7), (12) and information from table 1, the CES price index in the open economy can be expressed in terms of the closed economy CES price index as $P_t = P\Phi^{-\frac{1}{z}}$. Hence, the sufficient condition for $\partial\pi_t(\varphi, P_t)/\partial\varphi > \partial\pi(\varphi, P)/\partial\varphi$ reduces to:

$$\Phi^{-\frac{\sigma-1}{z}}(1 + \tau^{1-\sigma}) > 1, \quad \text{where} \quad \Phi = \left(1 + f_x^{-\frac{z-\sigma+1}{\sigma-1}}\tau^{-z}\right). \tag{15}$$

Differentiating the left-hand side (LHS) of this inequality with respect to τ and simplifying the resulting equation yields that $\partial LHS/\partial\tau < 0$ if and only if $f_x^{\frac{1}{\sigma-1}}\tau > 1$, which always holds true by Assumption 1. Furthermore, taking limits yields $\lim_{\tau\to\infty} LHS(\tau) = 1$, implying that inequality (15) strictly holds for all $\tau < \infty$.

C Proof of Proposition 1

The proof of Proposition 1 proceeds in three steps. In the first (second) step I show that the proportion of income accruing to the share $[1 - G(\varphi^*)]$ of population under trade is equal to (strictly higher than) its income share under autarky, if individuals with skill level φ^* are included (excluded). Both steps use Lemma 1, stating that aggregate income in terms of the numéraire under autarky is equal to the aggregate income under trade, i.e., $Y = Y_t$. In step three, I analyze the trade-induced rise of income inequality inside the top decile.

Step 1. The proportion of income Y accruing to the share $[1-G(\varphi^*)]$ of population *under autarky* is captured by the aggregate entrepreneurial profits, $\Pi = \int_{\varphi^*}^{\infty} \pi(\varphi)g(\varphi)d\varphi = (1-\alpha)\mu$, see Section 2.3. The proportion of income Y_t accruing to the share $[1-G(\varphi^*)]$ of population *under trade* has two components: the aggregate wages of workers in the skill range $[\varphi^*, \varphi_d^*]$, $W_t|_{\varphi^*}^{\varphi_d^*} = \int_{\varphi^*}^{\varphi_d^*} g(\varphi)d\varphi = G(\varphi_d^*) - G(\varphi^*)$ and the aggregate entrepreneurial profits of individuals in the skill range (φ_d^*, ∞), $\Pi_t = \int_{\varphi_d^*}^{\infty} \pi_d(\varphi)g(\varphi)d\varphi + \int_{\varphi_x^*}^{\infty} \pi_x(\varphi)g(\varphi)d\varphi = (1-\alpha)\mu - [1-G(\varphi_x^*)]f_x$, cf. Section 3.2. Using information from table 1, it can be easily verified analytically that $\Pi = W_t|_{\varphi^*}^{\varphi_d^*} + \Pi_t$. Since $Y = Y_t$, income shares of individuals in the skill range $[\varphi^*, \infty)$ are the same under autarky and trade:

$$LHS \equiv \frac{\int_{\varphi^*}^{\infty} \pi(\varphi)g(\varphi)d\varphi}{Y} = \frac{\int_{\varphi^*}^{\varphi_d^*} g(\varphi)d\varphi + \int_{\varphi_d^*}^{\infty} \pi_d(\varphi)g(\varphi)d\varphi + \int_{\varphi_x^*}^{\infty} \pi_x(\varphi)g(\varphi)d\varphi}{Y_t} \equiv RHS \quad (16)$$

In terms of figure 5.A, this equation reveals that, for a given skill distribution, the integral of earnings in the range $[\varphi^*, \infty)$ below the continuous line (Autarky) exactly equals the integral below the dashed line (Trade) in the same skill range.

Step 2. Notice from figure 5.A that continuous profit line (Autarky) lies strictly above the piecewise linear dashed line (Trade) in the range $(\varphi^*, \varphi^\dagger)$. Therefore, continuous increase of lower bounds of integral (starting from φ^*) decreases the numerator of the LHS in (16) more rapidly than the numerator of the RHS. In other words, if the decile of population is represented by the individuals with the skill level *strictly* higher than φ^*, the proportion of incomes accruing to the top 10% under trade is *strictly* higher than under autarky.

Step 3. The top 1% of aggregate income both under autarky and trade is assumed to be realized by individuals in the skill range $[\varphi^\dagger, \infty)$. To start with, consider the identity

$$lhs \equiv \frac{\int_{\varphi^\dagger}^{\infty} \pi(\varphi)g(\varphi)d\varphi}{\int_{\varphi^\dagger}^{\infty} \pi(\varphi)g(\varphi)d\varphi} = \frac{\int_{\varphi^\dagger}^{\infty} \pi_d(\varphi)g(\varphi)d\varphi + \int_{\varphi^\dagger}^{\infty} \pi_x(\varphi)g(\varphi)d\varphi}{\int_{\varphi^\dagger}^{\infty} \pi_d(\varphi)g(\varphi)d\varphi + \int_{\varphi^\dagger}^{\infty} \pi_x(\varphi)g(\varphi)d\varphi} \equiv rhs, \quad (17)$$

that is, the ratio of top 1% of income under autarky (lhs) to itself is equal to the ratio of top 1% of income under trade (rhs) to itself, cf. figure 5.A. Next, start expanding simultaneously the lower bounds of integral(s) in the denominators of lhs and rhs of (17). Since continuous profit line (Autarky) lies strictly above the piecewise linear dashed line (Trade) in the range $(\varphi^*, \varphi^\dagger)$, the denominator of lhs increases more rapidly than the denominator of rhs. Hence

$$\frac{\int_{\varphi^\dagger}^{\infty} \pi(\varphi)g(\varphi)d\varphi}{\int_{\varphi^*+\varepsilon}^{\infty} \pi(\varphi)g(\varphi)d\varphi} < \frac{\int_{\varphi^\dagger}^{\infty} \pi_t(\varphi)g(\varphi)d\varphi}{\int_{\varphi^*+\varepsilon}^{\varphi_d^*} g(\varphi)d\varphi + \int_{\varphi_d^*}^{\infty} \pi_d(\varphi)g(\varphi)d\varphi + \int_{\varphi_x^*}^{\infty} \pi_x(\varphi)g(\varphi)d\varphi},$$

where $\varepsilon \in (0, \varphi_d^*]$ is a positive number. This completes the proof of Proposition 1.

D Proof of Proposition 4

Using (3), household h's welfare under autarky and in the open economy is given, respectively, by $V = y^h(\varphi) - \mu \ln P + \mu(\ln \mu - 1)$ and $V_t = y_t^h(\varphi) - \mu \ln P_t + \mu(\ln \mu - 1)$, where

$$y^h(\varphi) = \begin{cases} w = 1 & \text{if } \varphi \in (0, \varphi^*] \\ \pi(\varphi, P) & \text{if } \varphi \in (\varphi^*, \infty) \end{cases} \quad , \quad y_t^h(\varphi) = \begin{cases} w = 1 & \text{if } \varphi \in (0, \varphi_d^*] \\ \pi_d(\varphi, P_t) & \text{if } \varphi \in (\varphi_d^*, \varphi_x^*) \\ \pi_t(\varphi, P_t) & \text{if } \varphi \in [\varphi_x^*, \infty) \end{cases},$$

and $P_t = P\Phi^{-\frac{1}{z}} < P$, since $\Phi > 1$. Since $\pi(\varphi, P)$, $\pi_d(\varphi, P_t)$ and $\pi_t(\varphi, P_t)$ are monotonically increasing in φ (see figure 5.A), the inspection of following four cases suffices for the proof of Proposition 4:

(i) Consider first individuals with entrepreneurial skill level φ^*. These agents are employed as workers both in the closed and open economy, being compensated in either case with income equal to unity (in terms of the numéraire). However, the decrease of the CES price index associated with the exposure to trade increases their consumption level of modern goods, and, thus, rises these households' welfare. This result holds for all $\varphi \in (0, \varphi^*]$, i.e., all individuals who remain active as workers after exposure to trade.

(ii) Consider agents with entrepreneurial talent φ_d^*. Under autarky, these individuals were active as entrepreneurs and attained profits $\pi(\varphi_d^*, P) = \Phi^{\frac{\sigma-1}{z}} > 1$. In the open economy, these agents are compensated with unity wage for being workers. Each household's welfare increases due to transition to trade if $V_t - V = \frac{\mu}{z} \ln \Phi + (1 - \Phi^{\frac{\sigma-1}{z}}) > 0$, i.e., the positive effect of lower CES price index (captured in the first term on the right-hand side) overcompensates the decline in agents' income (negative term in the brackets). Notice that the former effect is increasing in the expenditure share μ for modern goods. If μ is low enough, the household's welfare decreases as the economy opens up to trade. This holds for all $\varphi \in (\varphi_d^*, \varphi_x^*)$.

(iii) Individuals with entrepreneurial ability φ_x^* start exporting as the economy opens up to trade. Their joint entrepreneurial profits $\pi(\varphi_x^*, P) = \Phi^{\frac{\sigma-1}{z}} f_x \tau^{\sigma-1}$ decrease to $\pi_t(\varphi_x^*, P_t) = f_x \tau^{\sigma-1}$ due to reduction of a price index and their welfare increases only if $V_t - V = \frac{\mu}{z} \ln \Phi + f_x \tau^{\sigma-1}(1 - \Phi^{\frac{\sigma-1}{z}}) > 0$. Again, the welfare differential is more likely to be positive the higher is per capita expenditure μ on the modern good. This holds for all $\varphi \in [\varphi_x^*, \varphi^\dagger)$.

(iv) Individuals with managerial talent $\varphi^\dagger$ are exactly equal off in terms of the numéraire good under autarky and trade. However, the trade opening makes these agents better off in welfare terms due to the consumption of the modern goods at a lower price. The positive welfare effect is even more pronounced for all $\varphi \in (\varphi^\dagger, \infty)$.

E Proof of Proposition 5

Using (12) and (14), the welfare in the open economy, $V_t = Y_t - \mu \ln P_t + \mu(\ln \mu - 1)$ can be expressed as:

$$V_t(\tau) = G(\varphi_d^*) + (1-\alpha)\mu - [1 - G(\varphi_x^*)]f_x - \mu \ln \left([1 - G(\varphi_d^*)]^{\frac{1}{1-\sigma}} \frac{1}{\alpha \tilde{\varphi}_t} \right) + \mu \ln(\mu - 1),$$

where φ_d^*, φ_x^* and $\tilde{\varphi}_t$ are defined in table 1. Differentiating V_t with respect to τ yields:

$$\frac{\partial V_t}{\partial \tau} = -\mu \frac{f^{-\frac{z-\sigma-1}{\sigma-1}} \tau^{-z-1}}{\Phi} < 0.$$

Hence, a symmetric decrease in trade cost increases social welfare. This effect is higher the higher is per capita expenditure on the modern goods, μ.