



E. J. Ourso College of Business
Department of Economics

DEPARTMENT OF ECONOMICS WORKING PAPER SERIES

Firm Productivity, Occupational Choice, and Inequality
in a Global Economy

Elias Dinopoulos
University of Florida

Bulent Unel
Louisiana State University

(revised March 20, 2015)

Working Paper 2014-04
http://bus.lsu.edu/McMillin/Working_Papers/pap14_04.pdf

*Department of Economics
Louisiana State University
Baton Rouge, LA 70803-6306
<http://www.bus.lsu.edu/economics/>*

Firm Productivity, Occupational Choice, and Inequality in a Global Economy*

Elias Dinopoulos
University of Florida

Bulent Unel
Louisiana State University

March 20, 2015

Abstract

This study proposes a simple theory of trade with endogenous firm productivity, occupational choice, and income inequality. Individuals with different managerial talent choose to become self-employed entrepreneurs or workers. Entrepreneurs enhance firm productivity by investing in managerial capital. The model generates three income classes: low-income workers facing the prospect of unemployment; middle-income entrepreneurs managing domestic firms; and high-income entrepreneurs managing global firms. A reduction in per-unit trade costs raises productivity of global firms, reduces productivity of domestic firms, and worsens personal income distribution by generating labor-market polarization. A reduction in fixed exporting costs reduces productivity of every firm and has an ambiguous effect on personal income distribution. Trade-liberalization policies raise unemployment and improve welfare.

JEL Classification: F1, J2, J3, J6, L1

Keywords: Inequality, Managerial Capital, Occupational Choice, Search and Matching, Trade, Unemployment

*Elias Dinopoulos: Department of Economics, University of Florida, Gainesville, FL 32611. E-mail: elias.dinopoulos@cba.ufl.edu; Tel: (352) 392-8150. Bulent Unel: Department of Economics, Louisiana State University, Baton Rouge, LA 70803. E-mail: bunel@lsu.edu; Tel: (225)578-3790. We thank Svetlana Demidova, Maurizio Iacopetta, Philip Luck, and Yoto Yotov for comments and discussions. We also thank seminar participants at Drexel University, University of Florida, and Skema School of Business for their helpful comments.

1 Introduction

We propose a new tractable model of intra-industry trade with endogenous firm productivity, occupational choice, and labor market frictions. In our model, labor is the only factor of production and individuals differ in managerial talent (ability). Each individual can enter the labor market as a worker earning a wage independently of managerial talent and facing the prospect of unemployment; or she can choose to become a self-employed entrepreneur earning income equal to firm profits. Entrepreneurs can enhance their firm productivity (efficiency) by investing in managerial (organization or knowledge) capital.

A main modeling innovation of our paper is the treatment of firm productivity. Using elements from the “knowledge production function” theory (Griliches (1979)) and human capital theory (Becker (1994)), we postulate that firm-level productivity can be modeled by a knowledge production function according to which firm productivity increases with managerial capital. The latter is modeled as a separate input of production designed to capture all decisions, information flows, and organizational structure that affect firm efficiency and productivity. The acquisition of managerial capital involves fixed and variable costs with the latter increasing with managerial capital and decreasing with the level of firm owner’s managerial talent. This approach captures the notion that managerial talent matters for firm productivity and leads to firm heterogeneity. Specifically, more talented entrepreneurs create and manage larger, more efficient, and more profitable firms.

We embed the proposed approach to endogenous firm productivity in a general equilibrium model of occupational choice and intra-industry trade. Specifically, we consider a global economy consisting of two symmetric countries with each country producing a homogeneous good under perfect competition and a set of differentiated goods under monopolistic competition. The homogeneous good is produced by single-worker firms, it is not traded in equilibrium, and serves as the model’s numeraire; whereas each variety is produced by an entrepreneur using managerial capital and multiple workers. We assume that labor markets exhibit frictions leading to search-based unemployment, and that wages are determined through bargaining between each firm and hired workers. Exporting is costly involving fixed and variable trade costs as in Melitz (2003); and only the most talented entrepreneurs, who manage the most productive and profitable firms, serve the foreign market through exporting.

Our first finding is that the effect of trade on firm productivity depends on the nature of trade liberalization: a reduction in per-unit trade costs (tariffs) lowers productivity of

firms serving the domestic market and raises productivity of exporting firms; in contrast, a reduction in fixed exporting costs reduces firm productivity of every firm producing a variety independently of export status. Intuitively, trade liberalization intensifies product-market competition by raising the number of consumed varieties. As a result, market share and firm profits of all firms decline and induce entrepreneurs to acquire less managerial capital. This mechanism is the only one present in the case of lower fixed exporting costs and leads to a reduction of firm productivity for all firms. In contrast, a reduction in per-unit trade costs increases directly profits of exporting firms by lowering variable production costs. The latter effect dominates and leads to higher productivity for exporting firms.

The identification of conditions under which trade reduces firm incentives to invest in productive efficiency is a new major result. It questions one of the main findings of the theory of heterogeneous firms that trade boosts industry-wide productivity by replacing inefficient firms serving the domestic market with more efficient global firms, the so called reallocation effect. Our model features both the trade-induced reallocation effect (extensive productivity margin) and the firm-level productivity effect (intensive productivity margin).

The effect of trade on personal income distribution also depends on the nature of trade liberalization. A reduction in per-unit trade costs generates labor-market polarization. Because a decline in per-unit trade costs lowers firm productivity and market share of each domestic firm, domestic entrepreneurs experience an income loss. Consequently, some of them become workers and some of them engage in exporting to take advantage of lower per-unit trade costs. A reduction in per unit-trade costs, on the other hand, increases market size and firm efficiency of exporting firms. As a result, entrepreneurs serving the global market experience an increase in income. In sum, lower per-unit trade costs lead to labor-market polarization: they squeeze employment of domestic entrepreneurs and lower their income; they do not affect expected income of low-income workers; and they increase employment and income of export-oriented entrepreneurs.

Where trade liberalization takes the form of lower fixed exporting costs, it intensifies product-market competition and thus squeezes income and employment of entrepreneurs serving the domestic market. However, entrepreneurs serving the export market face two conflicting income effects: they benefit directly from a reduction in fixed exporting costs; and suffer an income loss from a reduction in firm market size caused by more intense competition. These two effects result in income loss for most talented entrepreneurs and income gain for entrepreneurs with intermediate level of managerial talent.

Another finding is that trade liberalization unambiguously increases the rate of unemployment. Intuitively, more trade intensifies product-market competition and induces entrepreneurs with low managerial talent to shut down their firms, fire their workers, and enter the labor force as workers. The increased supply of workers searching jobs in turn increases aggregate unemployment. This supply-side mechanism, which is based on occupational choice, complements the demand-side mechanism proposed by Helpman and Itskhoki (2010) where trade *lowers* aggregate unemployment if and only if the differentiated-good sector exhibits lower labor-market frictions.

Our fourth finding is that trade liberalization policies improve welfare despite the presence of labor-market frictions and product-market distortions. The beneficial welfare effect of trade stems from the expansion of consumed varieties. The variety-expansion effect dominates the welfare losses resulting from resource misallocation caused by trade expansion when market distortions are present.

We also analyze the impact of policies reducing managerial-capital costs. Fixed costs of managerial capital play the same role as up-front costs related to establishing a new firm. A reduction in fixed managerial capital costs reduces the supply of workers by inducing more individuals to become entrepreneurs, improves the distribution of personal income, decreases unemployment, and improves welfare. A reduction in variable costs of managerial capital improves welfare and has no impact on the supply of workers, personal income distribution, and unemployment.

Our main results are consistent with empirical findings. A novel prediction of our model is that trade liberalization in the form of reducing variable trade costs induce more productive firms upgrade their managerial capital, while inducing the least productive ones downgrade. Using data on Argentinean firms, Bustos (2011b) documents skill upgrading after a regional free trade agreement. Specifically, she finds that the most productive Argentinean firms (exporters) upgrade skill, while the least productive ones downgrade after a reduction in Brazil's tariffs. In another paper, Tello-Trillo (2014) investigates whether trade can create incentives for managers to reduce costs (and thus improve productivity). She introduces a principle-agent problem into the Melitz and Ottaviano (2008) model, and shows that reducing variable trade costs increases managerial incentives to reduce costs in more productive firms (exporters) and reduces incentives in least productive ones. Using the data on U.S. manufacturing firms she find evidence consistent with these predictions.

The result that exporting is associated with more managerial capital and greater firm

productivity is also consistent with the finding of Criscuolo et al. (2010), Melitz and Trefler (2012, table 1) that exporters tend to have higher productivity with the latter linked to innovation/knowledge inputs and outputs such as R&D researchers and patenting. The prediction that a reduction in tariffs increases firm productivity of exporting firms is consistent with the findings of De Locker (2007), Aw et al. (2008), Lileeva and Trefler (2010), and Bustos (2011). These studies establish a positive correlation between increased access to foreign markets and R&D investments enhancing firm productivity.

Another important prediction of our model that lowering unit-trade costs leads to labor-market polarization is consistent with the recent empirical studies that have documented the phenomenon of U.S. labor-market polarization in the 1990s and 2000s (Autor et al. (2008), and in particular, Autor and Dorn (2013)). The result that top incomes are positively correlated to firm size and firm profits is consistent with the findings of Gabaix and Landier (2008) who argue persuasively that changes in CEO pay can be fully explained by changes in market capitalization of large firms. They also establish a positive correlation between CEO compensation and firm size across advanced countries. The prediction that trade liberalization can increase income inequality is consistent with the main findings of Goldberg and Pavcnik (2007).

Finally, our finding that trade liberalization increases unemployment is consistent with Biscourp and Kramarz (2007) who, using French Customs files, show that increasing imports lead to job destruction of production jobs. Similarly, Menezes-Filho and Muendler (2011) find that trade liberalization increased unemployment in Brazil, and Autor et al. (2013) report similar findings for the U.S.¹

The rest of the paper is organized as follows. Section 2 presents an overview of related literature. Section 3 describes the elements of the model and derives its general-equilibrium solution. Section 4 analyzes the effects of trade liberalization policies and the impact of changes in the cost of managerial capital. Section 5 concludes.

¹The empirical literature investigating the impact of trade on unemployment is inconclusive. For example, Hasan et al. (2012) find that trade has no impact on unemployment in India, whereas Dutt et al. (2009), using cross-country data on trade policy and unemployment, find that trade liberalization lowers unemployment. This suggests that the impact of trade on unemployment is governed by complex interactions between labor-market frictions and comparative advantage.

2 Related Literature

Our paper is related and contributes to several strands of trade literature. It is related to an emerging literature that investigates the interaction between exporting and technology adoption. Important contributions include Yeaple (2005), Ederington and McCalman (2008), De Locker (2007), Atkeson and Burstein (2010), Lileeva and Trefler (2010), Bustos (2011a), and Unel (2013) among many others. These studies typically model technology adoption as a binary firm decision about whether or not a firm adopts an innovation raising its productivity by a fixed amount upon paying a fixed cost. In contrast, firm productivity in our model is a continuous increasing function of managerial capital involving both fixed and variable costs.

Our paper is also related to theoretical studies of trade with heterogeneous firms analyzing the income distributional effects of trade liberalization and technological change, under neoclassical (frictionless) factor markets and exogenous firm productivity. For example, Manasse and Turrini (2001) analyze the income-distributional effects of globalization in an economy where more talented entrepreneurs manage larger firms with higher quality products, and enjoy higher earnings; and Monte (2011) employs a model of trade with heterogeneous firms featuring interactions between the quality of ideas and worker ability to analyze the effects of skill-biased technical change on wage income distribution.

The literature on trade and unemployment is vast and renders a full account of related studies beyond the scope of the present paper. Our paper is more closely related to a strand of literature that incorporates search and matching frictions as determinants of unemployment. For example, the work of Davidson et al. (1988 & 1999) addresses the impact of labor-market frictions on inter industry trade patterns and the relationship among product prices, factor prices and unemployment.² Dutt et al. (2009) develop and test a model with equilibrium unemployment and trade based on comparative advantage.

Another branch of literature addresses the impact of trade on unemployment by embedding search-based labor-market frictions into Melitz's (2003) framework of trade with heterogeneous firms (e.g., Helpman and Itskhoki (2010), Helpman et al. (2010)). These studies abstract from occupational choice and endogenous firm-level productivity which are the main features of our paper.

²Davidson et al. (2008) propose a model of trade with high- and low-skill managers, single-worker firms and binary firm choice between a more and less productive technology. The model analyzes the impact of trade on firm technology adoption and the wage gap between high-skill and low-skill managers.

The present paper is also related to the model proposed by Dinopoulos and Unel (2013) which also investigates the effects of trade on firm productivity, personal income distribution, and unemployment. In our previous work product markets are perfectly competitive; as a result, the export status of firms is indeterminate, trade is of inter-industry type, and changes in trade stem from changes in the terms of trade. In contrast, the present paper embeds endogenous firm productivity in the theory of intra-industry trade with heterogeneous firms, where entrepreneurs face variable and fixed trade costs and only more talented entrepreneurs serve the global market.

3 The Model

Consider a world of two symmetric countries with each producing a homogeneous good under perfect competition and a set of differentiated goods under monopolistic competition. Each country is populated by a unit mass of identical families. Family size is normalized to unity. Individuals possess different managerial talent (ability) indexed by a . The distribution of managerial talent is governed by an exogenous cumulative distribution $G(a)$ with density $g(a)$ and support $[1, \infty)$.

Individuals decide optimally to become workers or entrepreneurs as in Lucas (1978). Each worker is then assigned to a sector, searches for a job and bargains with a firm to determine the negotiated wage. Each entrepreneur creates and manages a firm producing a differentiated product. Entrepreneurs first invest in managerial capital, then determine whether to serve the domestic or global market, and then decide how many workers to hire. Each entrepreneur bargains over the wage with each hired worker and then chooses the profit-maximizing price of each variety.

3.1 Consumers

Family members have identical preferences as described by the following Cobb-Douglas utility function

$$U = \left(\frac{q_0}{1-\theta} \right)^{1-\theta} \left(\frac{Q}{\theta} \right)^\theta, \quad 0 < \theta < 1, \quad (1)$$

where q_0 denotes consumption of the homogeneous good and subscript zero refers to variables and parameters of the homogeneous-good sector. Variable Q is a consumption index

defined as

$$Q = \left[\int_{\omega \in \Omega} q(\omega)^\rho d\omega \right]^{1/\rho}, \quad (2)$$

where Ω denotes the set of varieties available for consumption, and $q(\omega)$ refers to consumption of brand ω . The price elasticity of demand for each variety equals the constant elasticity of substitution between any two brands $\sigma = 1/(1 - \rho) > 1$, under the standard restriction $0 < \rho < 1$.

Denote with E each country's aggregate consumer expenditure. Utility maximization implies that consumers spend $(1 - \theta)E$ on the homogeneous good and θE on differentiated goods. Following standard calculations, the demand for a typical variety $q(\omega)$ is given by

$$q(\omega) = Q[p(\omega)/P]^{-\sigma}, \quad (3)$$

where $p(\omega)$ is the price of variety ω , and P is the aggregate price index (i.e., $PQ = \theta E$):

$$P = \left[\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}. \quad (4)$$

We choose the homogeneous good as the numeraire and set its price equal to one, that is $p_0 = 1$. Substituting $q_0 = (1 - \theta)E$ and $Q = \theta E/P$ in the utility function (1) delivers the following aggregate indirect utility function

$$\mathbb{V} = EP^{-\theta}, \quad (5)$$

where P is given by (4).

We assume that each family engages in income transfers equalizing the level of utility across its members independently of occupational status. This is a standard assumption ensuring that individuals searching for jobs have sufficient income to survive in the absence of savings (given the static nature of our model) and lack of unemployment compensation. As a result, equation (5) provides the level of family welfare and will serve as an index of aggregate welfare.

3.2 Firm Productivity and Wage Bargaining

Identical single-worker firms produce the homogeneous good and face labor-market frictions as in Helpman and Itskhoki (2010). Each firm posts a job vacancy which is not instantaneously filled. If a vacancy is filled, one unit of output is produced. Following a successful match, the firm and worker bargain over firm revenue (which equals unity) generated by

selling one unit of output q_0 at $p_0 = 1$. Assuming equal bargaining power between firm and worker, and no unemployment benefits, the worker receives half of the revenue, that is $w_0 = 1/2$. The remaining revenue equals per worker hiring costs, as will be shown in the subsection on equilibrium unemployment.

Differentiated goods are produced by a continuum of firms under monopolistic competition with each firm producing a single variety and employing multiple workers. Each firm is created, owned, and managed by an entrepreneur with managerial talent a . Firm output depends on the number of hired workers and the level of managerial (organization/knowledge) capital denoted by z . Managerial capital captures the level of firm resources and capabilities including worker training programs, implementation of worker incentive schemes, information flows relevant to technology adoption, and managerial decisions affecting firm efficiency. The production function of a firm with managerial capital z is

$$q(z) = z^{\frac{1}{\sigma-1}}l, \tag{6}$$

where l is the number of hired workers. Thus, firm productivity is given by $\varphi = z^{1/(\sigma-1)}$ and increases with managerial capital z . The latter is endogenously determined based on profit and occupational-choice considerations.³

Managerial capital acquisition involves fixed and variable costs (measured in units of the homogeneous good). Specifically, an entrepreneur with managerial talent a faces $f_e + \lambda z^2/(2a)$ costs of acquiring z units of managerial capital, where $f_e > 0$ and $\lambda > 0$ are constant parameters. This specification of managerial capital costs follows the spirit of human capital theory (Becker (1994)). The fixed-cost component f_e captures up-front R&D, legal, and financial costs required to establish a new firm. We assume that entrepreneurs with higher managerial talent face lower marginal costs of improving firm efficiency through better management of firm resources and capabilities. Parameter λ captures, in a reduced form, the idea that managerial capital involves variable costs such as experience of the entrepreneur, schooling, learning by doing and other inputs facilitating the acquisition of firm-specific knowledge capital.

As discussed in the introduction, the proposed approach to firm productivity differs in important respects from the approach adopted by recent studies (Yeaple (2005), Ederington

³Note that the exponent on the production function depend on the elasticity of substitution σ . This specification of firm productivity simplifies the algebra and exposition without affecting the main results. For instance, setting $\sigma = 2$ yields the standard Ricardian production function $q(z) = zl$. Results based on this specification are available from the authors upon request.

and McCalman (2008), Lileeva and Treffer (2010), and Bustos (2011) among others). These studies view technology as a project which increases firm productivity by a fixed amount after a firm incurs sunk R&D costs. In addition, they focus on technology selection issues such as how the set of firms adopting new technology is affected by exporting. In contrast, we propose a general framework of endogenous firm efficiency according to which more talented entrepreneurs face lower costs of creating and maintaining firm-specific knowledge capital which enhances firm productivity. In our model, the level of firm productivity can be influenced by trade-liberalization policies.

The decision to export occurs after the decision to acquire managerial capital. If an entrepreneur decides to serve the foreign market, she faces variable and fixed trade costs as in Melitz (2003): upon paying a fixed foreign-market-entry cost $f_x > 0$ (measured in units of the homogeneous good), a firm must produce and ship $\tau > 1$ units for each unit of a good arriving in the foreign country.

Consider an entrepreneur with managerial talent a who hires l workers and produces $q(z)$ units of output. Let $q_d(z)$ and $q_x(z)$ denote output sold in the domestic and foreign markets so that

$$q_d(z) + \mathbb{I}_x q_x(z) = q(z) = z^{\frac{1}{\sigma-1}} l, \quad (7)$$

where \mathbb{I}_x is an indicator function that equals one if the firm exports and zero otherwise. Using the demand function (3), domestic and foreign revenues are written as

$$r_d(z) = PQ^{1-\rho} q_d(z)^\rho, \quad r_x(z) = PQ^{1-\rho} \left(\frac{q_x(z)}{\tau} \right)^\rho, \quad (8)$$

and total firm revenue $r(z) = r_d(z) + \mathbb{I}_x r_x(z)$ is given by

$$r(z) = [1 + \mathbb{I}_x \tau^{1-\sigma}]^{1-\rho} PQ^{1-\rho} z^{1-\rho} l^\rho, \quad (9)$$

where $\sigma = 1/(1 - \rho) > 1$ is the price elasticity of demand.⁴ As expected, firm revenue increases with the level of managerial capital z , number of hired workers l , and export status.

An entrepreneur decides how much managerial capital to acquire and how many workers to hire. She can employ instantaneously l workers by incurring hiring costs cl , measured in

⁴Maximizing total revenue $r(z) = r_d(z) + r_x(z)$ subject to $q = q_d + q_x$ (assuming that a firm exports) yields $q_x(z) = \tau^{1-\sigma} q_d(z)$. Substituting this expression in $r_x(z)$ from (8) yields $r_x(z) = \tau^{1-\sigma} r_d(z)$. Substituting $q_x(z) = \tau^{1-\sigma} q_d(z)$ in (7) yields $q_d(z) = [1 + \mathbb{I}_x \tau^{1-\sigma}]^{-1} z^{\frac{1}{\sigma-1}} l$. Inserting this expression in $r_d(z)$, substituting the resulting expression for $r_d(z)$ together with $r_x(z) = \tau^{1-\sigma} r_d(z)$ in $r(z) = r_d(z) + \mathbb{I}_x r_x(z)$, and using $\rho/(\sigma - 1) = 1 - \rho$ delivers (9).

terms of the homogeneous good, where $c > 0$ is a derived parameter denoting per-worker hiring costs. In addition to hiring costs, the firm's owner must pay a wage bill wl , where w is the negotiated wage. As a result, firm profit is

$$\pi(z) \equiv \max \left\{ r(z) - wl - cl - \mathbb{I}_x f_x - f_e - \frac{\lambda z^2}{2a} \right\}, \quad (10)$$

where total revenue $r(z)$ is given by (9).

Following Helpman and Itskhoki (2010), we model the wage bargaining process as in Stole and Zwiebel (1996): an entrepreneur engages in bilateral bargaining with each hired worker and internalizes the effect of a worker's departure on the wages of remaining workers. As all workers are identical, an entrepreneur treats each worker as marginal. Assuming that the value of outside options for each party is zero and that workers and entrepreneurs have equal bargaining power, the Stole and Zwiebel solution determines the negotiated wage⁵

$$w = \frac{1}{1 + \rho} \frac{\partial r}{\partial l} = \left(\frac{\rho}{1 + \rho} \right) \frac{r}{l}, \quad (11)$$

where the last equality follows from differentiating (9) with respect to l .

Faced with the negotiated wage, an entrepreneur chooses the number of employees l to maximize profits (10). This maximization problem yields

$$w = c = \left(\frac{\rho}{1 + \rho} \right) \frac{r}{l}. \quad (12)$$

Thus, all entrepreneurs (irrespective of managerial capital, firm size, and export status) pay the same wage. Substituting $l = \rho r / [(1 + \rho)c]$ from (12) in (9) yields

$$r(z) = \underbrace{\left[\frac{\rho}{(1 + \rho)c} \right]^{\sigma-1} Q P^\sigma z}_{r_d(z)} + \mathbb{I}_x \tau^{1-\sigma} \underbrace{\left[\frac{\rho}{(1 + \rho)c} \right]^{\sigma-1} Q P^\sigma z}_{r_x(z)}, \quad (13)$$

and thus, firm revenue $r(z)$ is an increasing linear function of managerial capital z .

3.3 Occupational Choice

Individuals choose their occupation as workers, entrepreneurs serving the domestic market, or entrepreneurs serving the global market by maximizing expected-income. Following Lucas (1978), we assume that entrepreneurial income equals firm profits. This restrictive

⁵Formally, the negotiated wage is the solution to equation $\partial[r(z) - wl] \partial l = w$.

assumption abstracts from the effects of profit taxation and a variety of mechanisms distributing profits to firm owners (stockholders) and employees. It is made for tractability purposes and is consistent with casual empirical evidence regarding top incomes and profits of small, family-owned firms.⁶

Returning to the model, we assume that an entrepreneur with managerial talent a maximizes her income (firm profits) by optimally choosing the level of managerial capital z . Using (12) and (13), the profit function (10) can be written as

$$\pi(a) \equiv \max_z \left\{ [1 + \mathbb{I}_x \tau^{1-\sigma}] \psi z - \mathbb{I}_x f_x - f_e - \frac{\lambda z^2}{2a} \right\}, \quad (14)$$

where

$$\psi = \left(\frac{1-\rho}{1+\rho} \right) \left[\frac{\rho}{(1+\rho)c} \right]^{\sigma-1} P^\sigma Q = \left(\frac{1-\rho}{1+\rho} \right) \left[\frac{\rho}{(1+\rho)c} \right]^{\sigma-1} \theta E P^{\sigma-1} \quad (15)$$

is a measure of firm market size and $E = PQ/\theta$ is aggregate expenditure. The demand for each variety $q(\omega) = [QP^\sigma]p(\omega)^{-\sigma}$ is directly proportional to $P^\sigma Q$ and therefore ψ . As a result, for a given value of per-worker hiring costs c , a decline in aggregate price index P or aggregate expenditure E decreases the demand for each variety and lowers firm-market size ψ . This property will be useful in describing the intuition behind some of our main findings.

Maximizing (14) with respect to z yields

$$z(a) = \frac{(1 + \mathbb{I}_x \tau^{1-\sigma}) \psi a}{\lambda}, \quad (16)$$

stating that the optimal level of managerial capital increases linearly with managerial talent a and firm-market size ψ ; and decreases with the marginal cost of managerial capital λ . Equation (16) establishes a general-equilibrium, demand-based channel through which trade affects firm productivity via its impact on managerial capital. This channel is missing from Melitz (2003) type models where firm productivity is exogenous and therefore independent of policy-related parameters.

Substituting $z(a)$ from (16) in (14) yields the following entrepreneurial income (profit) expression:

$$\pi(a) = \frac{[(1 + \mathbb{I}_x \tau^{1-\sigma}) \psi]^2 a}{2\lambda} - f_e - \mathbb{I}_x f_x, \quad (17)$$

⁶Firm founders, CEOs, and billionaires such as Bill Gates of Microsoft, Amancio Ortega of Zara, and Warren Buffet of Berkshire Hathaway were ranked among the top five richest people of the world in 2013. Firm profits are also related to CEO incomes through executive compensation schemes including bonuses, stock options etc. Kaplan and Rauh (2010) argue that top executives, managing directors, investment bankers, corporate lawyers, athletes and celebrities contributed to increased skewness at top incomes. Firm profits is the primary source of income for small-firm owners/managers serving local markets such as family-owned retail stores, hotels, hair salons, gas stations, flower shops, restaurants, bookstores, etc.

where firm-market size ψ is given by (15). Note that entrepreneurial income increases linearly with managerial talent a .

Occupational choice is driven by expected-income maximization. Workers are ex-ante mobile between sectors, and therefore each worker must earn the same expected wage. As will be shown later, expected worker income equals $\zeta_0/2$, where ζ_0 is the job-finding probability in the homogeneous-good sector. Entrepreneurs do not face the prospect of unemployment, by assumption, and receive income $\pi(a)$ with certainty. Consequently, an individual with managerial talent a chooses to become an entrepreneur if and only if entrepreneurial income exceeds expected wage income, that is $\pi(a) \geq \zeta_0/2$. As entrepreneurial income increases with managerial talent, there exists a managerial talent cutoff a_d , at which an individual is indifferent between becoming a worker or an entrepreneur, i.e. $\pi(a_d) = \zeta_0/2$. Because entrepreneurs with ability a_d serve only the domestic market (i.e., $\mathbb{I}_x = 0$), equation (17) yields

$$a_d = \frac{\lambda(\zeta_0 + 2f_e)}{\psi^2}. \quad (18)$$

As a result, individuals with lower managerial talent than a_d choose to enter the labor force as workers, whereas individuals with managerial talent higher than a_d choose to become self-employed entrepreneurs producing varieties.

The mechanism determining the domestic cutoff level of entrepreneurial talent differs from the corresponding mechanism embedded in monopolistic competition models with heterogeneous firms (Melitz (2003)). According to the latter, after incurring fixed R&D costs, each firm draws its fixed productivity parameter from a given distribution and faces additional fixed production costs. Setting fixed production costs equal to operating profits determines the domestic cutoff level of firm productivity. In sum, Melitz type models focus on the role of product markets, uncertainty, and R&D investments as determinants of firm heterogeneity. In contrast, our model highlights the role of labor markets and managerial talent as primary determinants of firm heterogeneity within a framework where firm productivity is endogenous.

We next analyze the decision to engage in exporting. An entrepreneur serves the foreign market if and only if exporting is profitable and leads to higher entrepreneurial income, that is

$$\frac{[(1 + \tau^{1-\sigma})\psi]^2 a}{2\lambda} - f_e - f_x \geq \frac{\psi^2 a}{2\lambda} - f_e.$$

The managerial talent cutoff a_x , at which an entrepreneur is indifferent between serving the foreign market or not, is determined by setting the above expression as equality, which

yields

$$a_x = \frac{2\lambda f_x}{\tau^{1-\sigma}(2 + \tau^{1-\sigma})\psi^2}. \quad (19)$$

Combining equations (18) and (19) delivers

$$a_x = Aa_d, \quad A \equiv \frac{2f_x}{(\zeta_0 + 2f_e)\tau^{1-\sigma}(2 + \tau^{1-\sigma})}. \quad (20)$$

Note that $a_x > a_d$ if and only if $A > 1$. Hereafter, we assume that $f_x \geq 3(2f_e + 1)/2$ so that $A > 1$ for any $\zeta_0 \in (0, 1)$ and $\tau \geq 1$. The assumption $A > 1$ ensures that only a subset of firms export which is consistent with the main finding of several empirical studies that only larger and more productive firms export (e.g., Bernard et al. (2007)).

We summarize the analysis so far by considering the properties of the following key profiles: managerial capital $z(a)$, firm productivity $\varphi(a) = z(a)^{1/(\sigma-1)}$, firm revenue $r(a)$, and entrepreneurial income $\pi(a)$.⁷

$$z(a) = (1 + \mathbb{I}_x \tau^{1-\sigma}) \left(\frac{\zeta_0 + 2f_e}{\lambda a_d} \right)^{\frac{1}{2}} a, \quad (21a)$$

$$\varphi(a) = (1 + \mathbb{I}_x \tau^{1-\sigma})^{\frac{1}{\sigma-1}} \left(\frac{\zeta_0 + 2f_e}{\lambda a_d} \right)^{\frac{1}{2(\sigma-1)}} a^{\frac{1}{\sigma-1}}, \quad (21b)$$

$$r(a) = \frac{(1 + \rho)(1 + \mathbb{I}_x \tau^{1-\sigma})^2 (\zeta_0 + 2f_e) a}{(1 - \rho) a_d}, \quad (21c)$$

$$\pi(a) = \frac{(1 + \mathbb{I}_x \tau^{1-\sigma})^2 (\zeta_0 + 2f_e) a}{2a_d} - f_e - \mathbb{I}_x f_x. \quad (21d)$$

Note that managerial capital $z(a)$, firm revenue $r(a)$, and firm profit (entrepreneurial income) $\pi(a)$ are linear functions of managerial talent a .

Figure 1 illustrates these profiles by plotting each corresponding variable as a function of managerial talent a . Consider first panel a which illustrates the managerial capital profile $z(a)$. Individuals with managerial talent $a < a_d$ choose to enter the labor market as workers, and thus $z(a) = 0$ for $1 \leq a < a_d$. Managerial capital rises for higher levels of managerial talent that a_d , jumps at the export cutoff level a_x (where \mathbb{I}_x changes value from zero to unity), and increases with a steeper slope for higher values of managerial talent than a_x .

Panel b illustrates the firm productivity profile $\varphi(a)$, which is increasing and concave function of managerial talent, if the price elasticity of demand is $\sigma > 2$.⁸ As in the case of managerial capital, firm productivity jumps at the export cutoff level a_x .

⁷Equation (21a) follows from (16) and (18). Equations (13) and (15) imply that $r(a) = (1 + \rho)(1 + \mathbb{I}_x \tau^{1-\sigma})\psi z(a)/(1 - \rho)$, and substituting $z(a)$ from (16) and ψ from (15) into the latter yields equation (21c). Finally, substituting ψ from (18) into profit function (17) delivers (21d).

⁸If $1 < \sigma < 2$, then firm productivity $\varphi(a)$ is an increasing *convex* function of managerial talent.

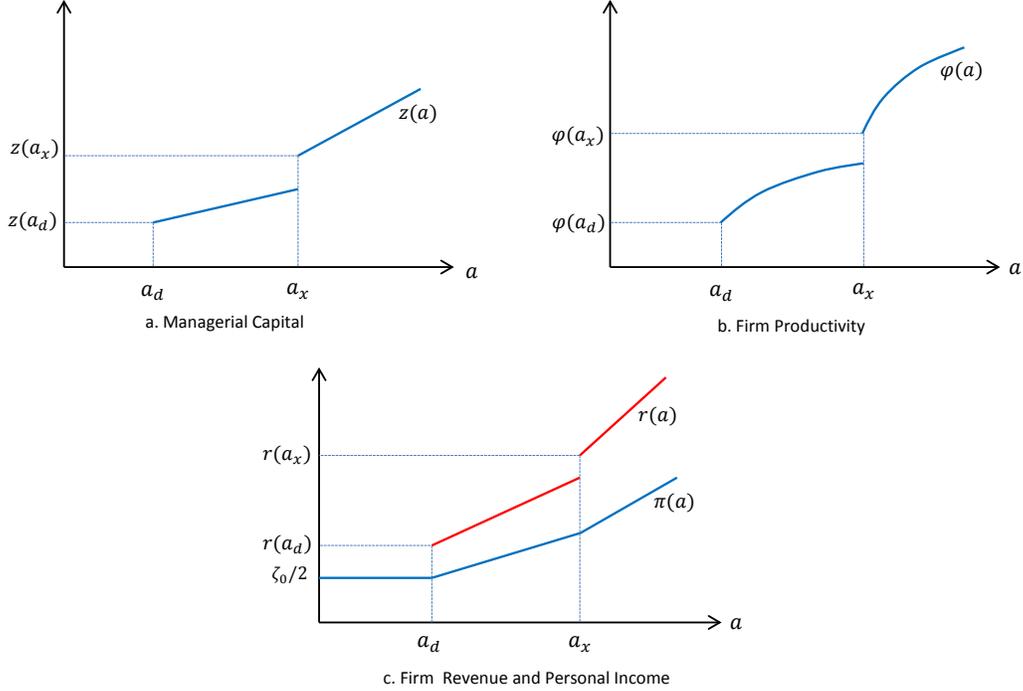


Figure 1: Key Profiles as Functions of Managerial Talent

Panel c illustrates the profiles of firm revenue $r(a)$ and personal income. The latter consists of expected worker income and entrepreneurial income (firm profit) $\pi(a)$. The firm-revenue profile starts at the domestic cutoff level a_d , exhibits an upward jump at the export cutoff a_x , and rises linearly with a steeper slope for higher values of managerial talent. Serving the foreign market requires a jump in operating firm profit to cover trade costs. The income profile consists of three connected linear segments: individuals with low managerial talent $a \in [1, a_d)$ choose to become workers earning expected wage income $\zeta_0/2$; individuals with $a \in [a_d, a_x)$ become entrepreneurs serving the domestic market and earning income which increases with a ; finally, entrepreneurs with $a \geq a_x$ become exporters and earn a higher income which also increases with managerial talent.

3.4 Equilibrium Unemployment

This subsection derives the values of sector-specific hiring costs per worker, job finding rates, and aggregate unemployment. In the present model, the labor market exhibits search frictions as in the standard Diamond-Mortensen-Pissarides (DMP) theory of unemployment (e.g., Pissarides, 2004). Following Blanchard and Gali (2010) and especially Helpman et al.

(2010), we assume that hiring costs per worker in each sector are given by

$$c_0 = \mu_0 \zeta_0^\gamma, \quad c = \mu \zeta^\gamma, \quad (22)$$

where parameters μ_0 and μ capture the degree of labor market frictions in homogeneous-good and differentiated-good sectors, respectively; ζ_0 and ζ are the corresponding job-finding rates; and $\gamma > 0$ is a constant parameter.

In the homogeneous-good sector, where output is produced by single-worker firms, each firm faces entry costs equal to the cost of posting a vacancy ν_0 (measured in units of homogeneous good). The zero-profit condition implies

$$\zeta_0 = (2\mu_0)^{-\frac{1}{\gamma}}, \quad c_0 = \frac{1}{2}. \quad (23)$$

We assume that $\mu_0 > 1/2$ to ensure that the job-finding rate ζ_0 is less than one.⁹

Consider next the differentiated-good sector. Ex-ante labor mobility between sectors implies that expected earnings of a worker must be the same across both sectors, i.e. $\zeta_0 w_0 = \zeta w$. Using $w_0 = 1/2$, $w = c$, and equations (22) and (23), $\zeta_0/2 = \zeta c$ yields

$$\zeta = 2^{-\frac{1}{\gamma}} \mu_0^{-\frac{1}{\gamma(1+\gamma)}} \mu^{-\frac{1}{1+\gamma}} = \zeta_0 \left(\frac{\mu_0}{\mu} \right)^{\frac{1}{1+\gamma}}, \quad c = \frac{1}{2} \left(\frac{\mu}{\mu_0} \right)^{\frac{1}{1+\gamma}}. \quad (24)$$

Armed with these results, we can derive an expression for aggregate unemployment. Let N_0 and N denote the number of workers searching for jobs in the homogeneous-good and differentiated-good sectors, respectively. Since the size of population is normalized to unity, $N_0 + N = G(a_d)$, where $G(a_d)$ is the supply of workers. It can be shown that the number of workers assigned to the differentiated-good sector is given by

$$N = \frac{2\rho\theta E}{(1+\rho)\zeta_0}, \quad (25)$$

where $\theta E = \int r(a)M\phi(a)da$ is expenditure spent on all product varieties.¹⁰

⁹Equations in (23) are derived as follows. Denote with χ_0 the probability that a firm fills a job vacancy. Then expected hiring cost per worker must be equal to the cost of posting a vacancy (i.e., $\chi_0 c_0 = \nu_0$) implying $\chi_0 = \nu_0/c_0$. Because each firm receives half of generated revenue, expected firm revenue is $\chi_0/2$. Consequently, the free-entry condition implies $\chi_0/2 = \nu_0$. Substituting $\chi_0 = \nu_0/c_0$ in the zero-profit condition yields $c_0 = 1/2$; and substituting $c_0 = 1/2$ into (22) delivers $\zeta_0 = (2\mu_0)^{-\frac{1}{\gamma}}$.

¹⁰Observe that $\zeta N = \int_{a_d}^{\infty} l(a)M\phi(a)da$, where $l(a)$ is the number of workers hired by an entrepreneur with managerial talent a , M is the number of firms producing varieties (the mass of entrepreneurs), and $\phi(a)$ is the ex-post distribution of firms managed by entrepreneurs. Substituting $l(a) = \rho r(a)/[(1+\rho)c]$ from (11) in the integral and using $c\zeta = \zeta_0/2$ yields (25).

The measure of unemployed workers in the homogeneous-good and differentiated-good sectors are $U_0 = (1 - \zeta_0)N_0$ and $U = (1 - \zeta)N$, respectively. As a result, the economy-wide unemployment rate is given by $\mathcal{U} = U_0 + U$, that is

$$\mathcal{U} = (1 - \zeta_0)G(a_d) + (\zeta_0 - \zeta)N = (1 - \zeta_0)G(a_d) + \frac{2(\zeta_0 - \zeta)\rho\theta E}{\zeta_0(1 + \rho)}, \quad (26)$$

where ζ_0 and ζ are sector-specific job-finding rates given by (23) and (24) and $N_0 = G(a_d) - N$ is the measure of workers assigned to the homogeneous-good sector. Equation (26) reveals two channels through which economic policies affect the rate of unemployment. The first is based on occupational choice and operates through the supply of workers seeking jobs $G(a_d)$: ceteris-paribus increase in the domestic cutoff level of managerial talent raises the supply of workers and the rate of unemployment. The second channel operates through aggregate expenditure E : for any given supply of workers, an increase in aggregate expenditure increases the share of workers assigned to the differentiated-good sector according to (25), and therefore raises unemployment if and only if the the job-finding rate in the homogeneous-good sector is higher ($\zeta_0 > \zeta$).

3.5 Equilibrium Properties

In order simplify the subsequent exposition and enhance the intuition of main results, we assume that the distribution function of managerial talent $G(a)$ is Pareto and given by

$$G(a) = 1 - a^{-k}, \quad (27)$$

where k is the shape parameter. In our model, the assumption of Pareto distribution implies that firm productivity φ also follows a Pareto distribution.¹¹ Models of trade with heterogeneous firms routinely employ the assumption that firm productivity is Pareto distributed (e.g., Helpman et al., 2010) because it simplifies the algebra and enjoys empirical support (e.g., Axtell, 2001). In addition, we assume that $k > \min\{1, 1/\rho - 1\}$ in order to ensure convergence of aggregate variables.

The probability of becoming an entrepreneur is $1 - G(a_d)$, and thus the ex-post distribution of managerial talent is given by $\phi(a) = g(a)/[1 - G(a_d)]$ if $a \geq a_d$, and zero otherwise.

¹¹ $\varphi(a) = z(a)^{1/(\sigma-1)} \propto a^{1/(\sigma-1)}$, where the last relation follows from (16). If ability a follows the Pareto distribution (27), then productivity $\varphi \propto a^{1/(\sigma-1)}$ also follows a Pareto distribution with shape parameter $k(\sigma - 1)$.

In addition, note that each firm is managed by an entrepreneur and produces a single variety. Therefore the number products produced in each country is given by the measure of entrepreneurs $M = 1 - G(a_d) = a_d^{-k}$. As a result, aggregate spending on differentiated products is $R = \int Mr(a)\phi(a)da = \int r(a)g(a)da$. Substituting $r(a)$ from (21c) in R yields

$$R = \frac{(1 + \rho)(\zeta_0 + 2f_e)}{(1 - \rho)a_d} \left[\int_{a_d}^{a_x} ag(a)da + (1 + \tau^{1-\sigma})^2 \int_{a_x}^{\infty} ag(a)da \right].$$

Substituting $a_x = Aa_d$ from (20) and $R = \theta E$ in the above expression, and then using the Pareto cumulative distribution function (27) yields

$$E = \frac{(1 + \rho)k [\zeta_0 + 2f_e + 2f_x A^{-k}]}{\theta(1 - \rho)(k - 1)a_d^k}, \quad (28)$$

where $A > 1$ is given by (20).

Since $\zeta_0 N_0$ and ζN represent the number of employed individuals in homogeneous-good and differentiated-good sectors, aggregate income of employed workers equals $\zeta_0 N_0/2 + c\zeta N = \zeta_0 G(a_d)/2$, where the last equality follows from $\zeta_0/2 = c\zeta$ and $N_0 + N = G(a_d)$. Aggregate entrepreneurial income, which equals economy-wide profits, is $\Pi = \int M\pi(a)\phi(a)da = \int \pi(a)g(a)da$. Substituting $\pi(a)$ from (21d) into Π , and using the Pareto distribution function (27) yields

$$\Pi = \frac{k [\zeta_0 + 2f_e + 2f_x A^{-k}]}{2(k - 1)a_d^k} - \frac{f_e}{a_d^k} - \frac{f_x A^{-k}}{a_d^k}. \quad (29)$$

Thus, aggregate income is $Y = \zeta_0 G(a_d)/2 + \Pi$.

In equilibrium, aggregate expenditure must be equal to aggregate income, i.e. $E = Y$. Using (28) and (29), the equilibrium condition $E = Y$ yields the equilibrium cutoff level of managerial talent a_d . Furthermore, substituting a_d in $a_x = Aa_d$ yields the export cutoff level a_x . Specifically, we obtain

$$a_d = \left[b(1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0) \right]^{1/k}, \quad (30a)$$

$$a_x = \left[bA^k(1 + 2f_e/\zeta_0) + 2f_x/\zeta_0 \right]^{1/k}, \quad (30b)$$

where $A > 1$ and ζ_0 are given by (20) and (23), and b is an inconsequential constant:

$$b = \frac{2k(1 + \rho) - \theta(1 - \rho)}{\theta(1 - \rho)(k - 1)} > 0. \quad (31)$$

Once the domestic and export cutoffs are determined, one can solve for other remaining endogenous variables. For instance, substituting a_d into (21a) and (21d) respectively yields managerial capital, revenue, and income of an entrepreneur with managerial talent a .

Substituting a_d into (28) yields aggregate expenditure (GDP)

$$E = Y = \frac{k(1 + \rho)\zeta_0}{2k(1 + \rho) - \theta(1 - \rho)}, \quad (32)$$

where ζ_0 is given by (23). According to (32), aggregate expenditure E (and income Y) increases with the job-finding rate ζ_0 ; and is independent of trade costs (τ and f_x) and managerial capital costs (λ and f_e).

Before proceeding, it is important to clarify the role of endogenous firm productivity which generates a supply-side mechanism governing the properties of domestic and export cutoffs. Since equilibrium aggregate expenditure E depends only on technology and preference parameters, the equilibrium cutoffs adjust the distribution of personal income to ensure that aggregate income is always equal to policy-invariant aggregate expenditure E . For instance, a model where managerial capital is set equal to managerial talent as in Lucas (1978) ($z = a$) generates a lower domestic cutoff level of managerial talent a_d , a higher export cutoff level a_x , and a higher measure of global firms.¹² Comparing the two models reveals that endogenous firm productivity worsens the personal income distribution by increasing top incomes and by reducing income and employment of entrepreneurs serving the domestic market. In other words, endogenous firm efficiency is managerial-talent (ability or skill) biased: entrepreneurs serving the global market increase firm efficiency and personal income by investing more in managerial capital. In addition, more entrepreneurs become exporters. However, since economy-wide income remains constant, the increase in top incomes is compensated by a reduction in income earned by entrepreneurs serving the domestic market and an expansion in employment of low-income workers. As a result, introducing endogenous firm productivity increases income inequality through supply (as opposed to demand) based channels.

Once the aggregate expenditure E is determined, one can pin down aggregate unemployment from (26). Specifically, substituting E from (32) in (26) yields

$$\mathcal{U} = (1 - \zeta_0)(1 - a_d^{-k}) + \varepsilon(\zeta_0 - \zeta), \quad (33)$$

where $\varepsilon = 2k\rho\theta/[2k(1 + \rho) - \theta(1 - \rho)]$ is a positive constant and $G(a_d) = (1 - a_d^{-k})$ is the supply of workers seeking jobs. Observe that aggregate unemployment depends on the domestic cutoff level a_d , and therefore responds to trade liberalization policies consisting

¹²The alternative model is a special case of our model with $\lambda = 0$ and $z = a$. Proofs of the above claims are available from the authors upon request.

of lower per-unit trade cost τ or lower fixed exporting costs f_x . In addition, note that the assumptions of identical countries and aggregate Cobb-Douglas preferences imply that aggregate expenditure E does not depend on trade liberalization policies. As a result, trade affects unemployment by changing the supply of workers seeking jobs and not by reallocating workers across the two sectors.

As the supply of workers is exogenous in Helpman and Itskhoki (2010), aggregate unemployment does not depend on trade liberalization policies if aggregate preferences are Cobb-Douglas.¹³ It should be emphasized though that in Helpman and Itskhoki (2010) trade liberalization affects unemployment under quasi-linear or CES preferences through its impact on aggregate expenditure.¹⁴ In other words, our model highlights supply-based (labor-market) channels transmitting the impact of trade liberalization on aggregate unemployment; whereas their model focuses on demand-based mechanism. The demand-based mechanism is present in Dinopoulos and Unel (2013) who focus on inter-industry trade triggered by differences in relative prices.

To analyze the effects of trade on welfare, we need to identify the components of price index P . Substituting $PQ = \theta E$ into (15) and using $\psi = [\lambda(\zeta_0 + 2f_e)/a_d]^{1/2}$ from equation (18) yields the following expression for the aggregate price index

$$P = \frac{(1 + \rho)c}{\rho} \left[\frac{b(k - 1)[\lambda(\zeta_0 + 2f_e)]^{1/2}}{k\zeta_0 a_d^{1/2}} \right]^{\frac{1}{\sigma-1}}, \quad (34)$$

where A is given by (20). Substituting P into (4) delivers an expression for welfare $\mathbb{V} = EP^{-\theta}$, where aggregate expenditure is given by (32). These calculations imply that trade policies affect welfare only through changes in aggregate price index P .

4 Comparative Statics

In this section, we study the impact of trade policies and policies affecting managerial capital costs. The following lemma summarizes the effect of key policy parameters on managerial

¹³Helpman and Itskhoki (2010, Appendix A1) present an alternative specification of their model with CRRA-CES preferences. By setting the relative risk aversion coefficient and the elasticity of substitution between the homogeneous-good and aggregate differentiated-good equal to one (i.e., $\zeta = \sigma = 1$ using their notation), one can easily show that the number of workers searching jobs in the differentiated-good sector is independent of trade costs. As worker supply is also fixed, it follows that changes in trade costs τ and f_x do not affect the unemployment rate.

¹⁴In Dinopoulos and Unel (2013), trade affects unemployment through a supply and a demand channel. The latter channel is reestablished in the case of a small open economy where terms-of-trade changes alter aggregate expenditure and lead to sectoral worker shifts.

talent cutoffs a_d and a_x (see the Appendix for the proof).

Lemma 1. Consider the managerial talent cutoffs a_d and a_x given by (30a) and (30b), respectively.

- a. $\partial a_d / \partial \tau < 0$, $\partial a_d / \partial f_x < 0$, and $\partial a_d / \partial f_e > 0$.
- b. $\partial a_x / \partial \tau > 0$, $\partial a_x / \partial f_x > 0$, and $\partial a_x / \partial f_e < 0$.
- c. $\partial a_d / \partial \lambda = 0$ and $\partial a_x / \partial \lambda = 0$.

According to Lemma 1, trade liberalization policies (i.e., $\tau \downarrow$ or $f_x \downarrow$) raise the domestic cutoff a_d and lower the export cutoff a_x . Intuitively, as trade exposure increases the number of consumed varieties, it intensifies the product-market competition, and thus reduces firm-market size for all firms. The latter lowers the return to entrepreneurship, forces the least talented entrepreneurs to become workers, and leads to a higher domestic cutoff level of managerial talent a_d . Entrepreneurs serving the global market also face increased product-market competition. However, the positive profit effect of lower trade costs dominates the negative effect of product-market competition, inducing more entrepreneurs to become exporters and leading to a lower export cutoff level of managerial talent a_x .

Similar logic applies to the effects of lower fixed costs of entrepreneurial capital f_e . A reduction in f_e reduces managerial costs, raises firm profits, and induces more individuals to become entrepreneurs. It also intensifies product-market competition (due to availability of more varieties), and reduces firm-market size. The latter hurts entrepreneurs managing large firms and serving the global market more, lowering the mass of exporting firms and the share of exported varieties.¹⁵

Note that the revenue and profit profiles described by equations (21c) and (21d) are independent of shift parameter λ . Since expected worker income is constant, aggregate profits, aggregate income, and aggregate expenditure are also independent of λ . The domestic and export cutoffs are determined by setting aggregate expenditure equal to aggregate income and therefore are independent of λ .¹⁶

¹⁵Equation (19) can be written as $[(1 + \tau^{1-\sigma})^2 - 1]\psi^2 a_x / (2\lambda) = f_x$, where the LHS equals the difference between global and domestic profits of a firm managed by an entrepreneur with managerial talent a_x . A reduction in firm-market size ψ lowers the relative profitability of exporting and leads to an increase in the export cutoff level a_x . As a result, the mass of produced varieties increases and the mass of exported varieties declines.

¹⁶A change in λ is fully absorbed by an opposite change in firm-market size ψ such that the ratio λ/ψ^2 remains constant. This can be seen by substituting a_d from equation (30a) in (18).

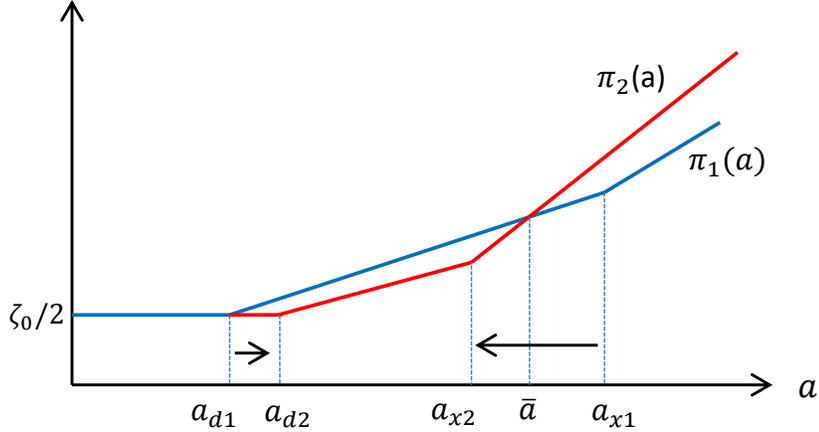


Figure 2: The Impact of Reducing Variable Trade Cost τ on Income Distribution

4.1 Trade Liberalization Policies

This subsection analyzes the general-equilibrium effects of trade liberalization policies. According to Lemma 1, lower variable trade costs τ lead to higher domestic cutoff a_d and lower export cutoff a_x . Consequently, this form of trade liberalization decreases the mass of produced varieties in each economy and increases the mass of exported varieties.

Equations (21a)–(21d) indicate that a reduction in τ reduces managerial capital, firm productivity, and profits of every firm serving the domestic market; and increases managerial capital, productivity, and profits of every exporting firm.¹⁷ As discussed in the introduction, these findings are consistent with empirical findings in Bustos (2011b) and Tello-Trillo (2014). Since entrepreneurial income equals firm profits, reducing variable trade cost τ lowers income of entrepreneurs serving the domestic market, and increases income of entrepreneurs serving the global market. Figure 2 illustrates the impact of lower per-unit trade costs on each economy’s income distribution by plotting the income profile as a function of managerial talent a . In this figure, $\pi_1(a)$ represents the graph of the initial income profile, and $\pi_2(a)$ illustrates the income profile corresponding to a lower level of per-unit trade costs τ .

The income distributional effects of lower per-unit trade costs are consistent with recent

¹⁷According to (21a), $z(a) = [(\zeta_0 + 2f_e)/(\lambda a_d)]^{1/2}a$, for $a \in [a_d, a_x]$. As a result, an increase in a_d decreases $z(a)$. Thus, $\varphi(a)$ and $\pi(a)$ also decrease, since they increase with $z(a)$. Consider next exporting firms. Differentiating $z_\tau \equiv (1 + \tau^{1-\sigma})/a_d^{1/2}$ with respect to τ and using (35a) in the Appendix yields $\partial z_\tau / \partial \tau = -(\sigma - 1)b(1 + 2f_e/\zeta_0)(1 - A^{-k+1})/(\tau^\sigma a_d^{k+1/2}) < 0$, since $1 - A^{1-k} > 0$. The same analytical approach applies to profiles of firm productivity $\varphi(a)$ and profit $\pi(a)$.

developments in U.S. income distribution. An influential strand of literature has documented the deterioration of U.S. wage income distribution during the 1990s and 2000s with employment and wage growth biased against middle-income workers and managers (Autor and Dorn (2013)). This literature establishes a positive correlation between employment and wage growth by skill (managerial talent) percentile suggesting that demand-based shifts are the prime causes of labor-market polarization.¹⁸ Our model offers a novel trade-based explanation for this phenomenon. Figure 2 shows that a reduction in per-unit trade costs raises the domestic cutoff level of managerial talent from a_{d1} to a_{d2} and leads to an increase in the supply of workers without changing expected wage. A reduction in τ lowers the export cutoff level from a_{x1} to a_{x2} by inducing more entrepreneurs to serve the global market. In addition, it makes the income profile of entrepreneurs serving the domestic market flatter and the income profile of entrepreneurs serving the global market steeper by changing incentives to acquire managerial capital. Consequently, a reduction in per-unit trade costs worsens the personal income distribution by squeezing middle-income, small-firm owners; by boosting top incomes; and by not affecting the expected wage of low-income workers.

What are the effects of a reduction in unit-trade costs τ on aggregate unemployment? Trade liberalization increases the supply of workers seeking jobs $G(a_d)$ by raising the domestic cutoff level of managerial talent without affecting aggregate expenditure E . It then follows from equation (33) that trade liberalization raises aggregate unemployment. This prediction complements the seminal work of Helpman and Itskhoki (2010). They find that lowering unit-trade costs raises aggregate unemployment if and only if the homogeneous-good sector is job friendly ($\zeta_0 > \zeta$). As mentioned earlier, in the Helpman and Itskhoki model trade liberalization operates through a demand channel by changing aggregate expenditure; whereas in our model, trade liberalization operates through a supply channel by affecting the occupational choice of individuals.

Finally, according to (34), a reduction in τ lowers aggregate price index P without affecting aggregate expenditure E . As a result, trade improves aggregate welfare $V = EP^{-\theta}$. Why does trade liberalization improve welfare even when it leads to more unemployment? In other words, is this result consistent with the generalized theory of distortions and wel-

¹⁸Lemieux (2008) and Autor et al. (2008) offer overviews of developments in the structure of U.S. wages and possible explanations. The latter include skill-biased technical change, changes in the relative supply of college workers, and institutional factors such as minimum wage changes and unionization. In our model, trade liberalization affects skill (managerial capital) formation, firm efficiency, and income depending on firm export status.

fare? A possible answer stems from comparing the results of the present model to those in Dinopoulos and Unel (2013), where the presence of aggregate unemployment may lead to welfare loss. The key difference is that Dinopoulos and Unel (2013) assume perfectly competitive product markets, whereas here one sector exhibits horizontal product differentiation. Consequently, trade liberalization increases the mass of varieties available for consumption leading to higher welfare despite the presence of higher unemployment.

Proposition 1. Trade liberalization caused by a reduction in per-unit trade cost τ

- a. increases the supply of workers seeking jobs;
- b. induces each entrepreneur serving the domestic market to acquire less managerial capital, and leads each entrepreneur serving the global market to invest in more managerial capital;
- c. decreases firm productivity of non-exporting firms and increases productivity of exporting firms;
- d. generates labor-market polarization leading to worse personal income distribution;
- d. raises aggregate unemployment;
- e. and improves welfare.

A growing strand of literature has analyzed the effects of exporting on technology adoption and firm productivity.¹⁹ Although the findings of these studies are mixed, a main result is that following a tariff reduction exporting firms experience higher technology adoption rates and higher labor productivity compared to non-exporting firms. The finding that tariff cuts increase firm productivity of exporting firms is consistent with part c of Proposition 1.

We next investigate the impact of a reduction in fixed exporting costs f_x . According to Lemma 1, a reduction in f_x increases the domestic managerial talent cutoff level a_d and decreases the export cutoff level a_x . Consequently, a reduction in f_x : increases the supply of workers seeking jobs; raises the mass of entrepreneurs serving the global market; and reduces the mass of entrepreneurs serving the domestic market. According to equation (33), this facet of trade liberalization increases aggregate unemployment. In addition, an increase

¹⁹See, De Locker (2007), Aw et al. (2008), Lileeva and Treffer (2010), Bustos (2011a), and Unel (2013).

in a_d lowers aggregate price P , and thus raises aggregate welfare $\mathbb{V} = EP^{-\beta}$ (because E is independent of f_x). In sum, trade liberalization through a reduction in fixed exporting costs has similar effects to those obtained by a reduction in per-unit trade costs: it raises the supply of workers, increases the share of exporters, and raises unemployment.

Interestingly, the effects of a reduction in fixed exporting costs f_x on managerial capital, firm productivity and thus personal income distribution differ from the corresponding impact of a reduction in per-unit trade costs τ . Note that the profiles of managerial capital (21a) and firm productivity (21b) do not depend directly on f_x .²⁰ Instead, a reduction in f_x affects these profiles through increased product-market competition caused by a rise in consumed varieties. Higher product-market competition reduces firm market size, lowers the return on entrepreneurship, and leads to a reduction in the level of managerial capital and firm productivity for all firms independently of export status.

What are the effects of a reduction in fixed exporting costs f_x on personal income distribution? The income profile (21d) indicates that lower fixed exporting costs f_x reduce firm profits of all non-exporting entrepreneurs. The impact of this policy on exporters' income is ambiguous. Differentiating the profit function (21d) with respect to f_x and using equation (36a) in the Appendix yields

$$\frac{\partial \pi(a)}{\partial f_x} = \frac{(k-1)(\zeta_0 + 2f_e)(1 + \tau^{1-\sigma})^2 A^{-k} a}{k(\zeta_0 + 2f_e + 2f_x A^{-k})a_d} - 1.$$

Note that $d\pi(a)/df_x > 0$ for sufficiently high values of a . Furthermore, it can be shown that $d\pi(a)/df_x < 0$ at $a = a_x$,²¹ i.e., the income of entrepreneur with managerial talent a_x increases. Thus, more entrepreneurs engage in exporting, and entrepreneurs earning very top-income experience an income loss due to lower firm productivity.

Figure 3 illustrates the effects of lower fixed exporting costs on income distribution. Curve $\pi_1(a)$ is the graph of the initial income profile, and curve $\pi_2(a)$ illustrates the income profile corresponding to a lower level of fixed exporting costs f_x . A reduction in f_x squeezes the mass of entrepreneurs serving the domestic market to (a_{d2}, a_{x2}) and leads to a flatter income profile for all entrepreneurs including exporters. Consequently, individuals with managerial talent $a \in (a_{d1}, \bar{a}_1)$ as well as top-income individuals, whose managerial talent exceeds \bar{a}_2 , experience an income loss. In other words, a reduction in fixed exporting costs

²⁰ A reduction in f_x increases the level of foreign-market profits directly in accordance to equation (17).

²¹ Substituting $a_x = Aa_d$ into $d\pi(a)/df_x$ and using (30a) yields $\partial \pi(a_x)/\partial f_x = -b[k - (k-1)A^{1-k}](\zeta_0 + 2f_e) + 2bf_x A^{-k}/(ka_d^k) < 0$.

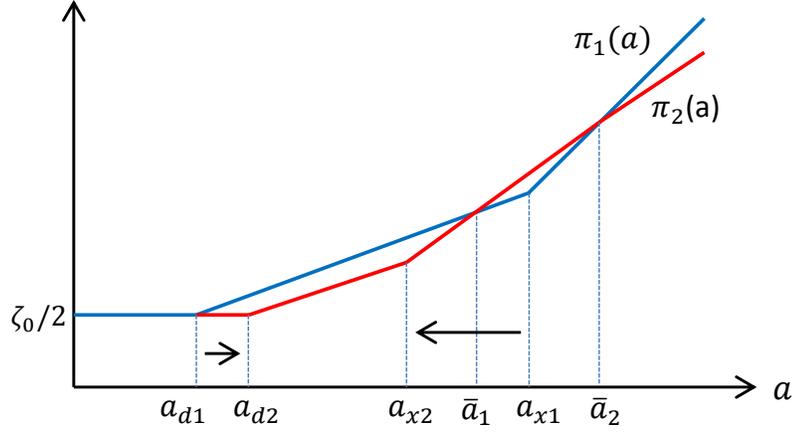


Figure 3: The Impact of Reducing Fixed Exporting Cost f_x on Income Distribution

leads to “reverse income polarization” by benefiting upper-middle income entrepreneurs managing medium-size firms. A fraction of these entrepreneurs with managerial talent $a \in (\bar{a}_1, a_{x1})$ switch from non-exporting into exporting status. In general, trade liberalization in this case has an ambiguous effect on income distribution: it reduces top incomes, does not affect worker income, reduces income of lower middle class managers, and improves income of higher-middle class managers.

Proposition 2. Trade liberalization caused by a reduction in fixed cost of entering the foreign market f_x :

- a. increases the supply of workers seeking jobs;
- b. induces each entrepreneur to acquire less managerial capital;
- c. decreases firm productivity independently of export status;
- d. has an ambiguous effect on personal income distribution;
- e. raises aggregate unemployment;
- f. and improves welfare.

4.2 Managerial Capital Costs

This subsection considers briefly the effects of managerial capital costs. We start with the fixed costs of managerial capital f_e . As Lemma 1 indicates, a reduction in f_e decreases

the domestic cutoff level of managerial talent a_d and increases the export cutoff level a_x . Observe that $z(a)$ and $\varphi(a)$ increase with firm-market size $\psi = [\lambda(\zeta_0 + 2f_e)/a_d]^{1/2}$ according to equations (21a) and (21b). Lowering fixed costs f_e reduces firm-market size and leads to lower managerial capital and firm productivity independently of export status.²²

The impact of lower f_e on firm profits and entrepreneurial income is more subtle. Differentiating the profit profile (21d) with respect to f_e and using equation (37a) in the Appendix yields

$$\frac{\partial\pi(a)}{\partial f_e} = \frac{(k-1)(1 + \mathbb{I}_x \tau^{1-\sigma})^2 (1 + 2f_e/\zeta_0)a}{k(1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0)a_d} - 1.$$

As the first term is positive and increases with managerial talent a , it follows that firm profits decline with lower managerial fixed costs ($\partial\pi(a)/\partial f_e > 0$) for sufficiently high values of managerial talent a .²³

Figure 4 illustrates the impact of a marginal reduction in f_e on income distribution. Policies resulting in lower fixed managerial capital costs benefit middle-income managers, hurt top-income entrepreneurs, and do not affect worker income. As a result, policies reducing f_e improve each economy's income distribution.

To determine the impact of lower fixed costs on aggregate unemployment consider equation (33). Because reducing f_e lowers a_d , it follows from (33) that the supply of workers declines as more individuals choose to become entrepreneurs. Consequently, the rate of unemployment declines.

As shown earlier, reducing f_e decreases firm-market size $\psi = [\lambda(\zeta_0 + 2f_e)/a_d]^{1/2}$; as a result, aggregate price index P decreases as well. As aggregate expenditure is constant, equation (5) implies that welfare increases.

Proposition 3. A reduction in fixed cost of managerial capital formation f_e

a. reduces the supply of workers seeking jobs;

²²Differentiating ψ with respect to f_e and using (37a) in the Appendix yields $\partial\psi/\partial f_e = (k-1)b(1 + 2f_e/\zeta_0)/(k\psi a_d^{1+k}) > 0$.

²³Lower fixed costs f_e generate higher profits around the domestic cutoff level of managerial talent ($\partial\pi(a)/\partial f_e < 0$ at $a = a_d$), whereas the effect of f_e on firm profits is ambiguous in the neighborhood of the export cutoff a_x . Substituting $a = a_x = Aa_d$ in $\partial\pi(a)/\partial f_e$ yields

$$\frac{\partial\pi(a_x)}{\partial f_e} = \frac{(k-1)A}{k} \left[\frac{1 + 2f_e/\zeta_0 + 2f_x A^{-1}/\zeta_0}{1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0} \right] - 1.$$

The term in square brackets is greater than one. A sufficient (but not necessary) condition ensuring $d\pi(a_x)/df_e > 0$ is $A > k/(k-1)$. In plotting Figure 4, we assume that $A > k/(k-1)$.

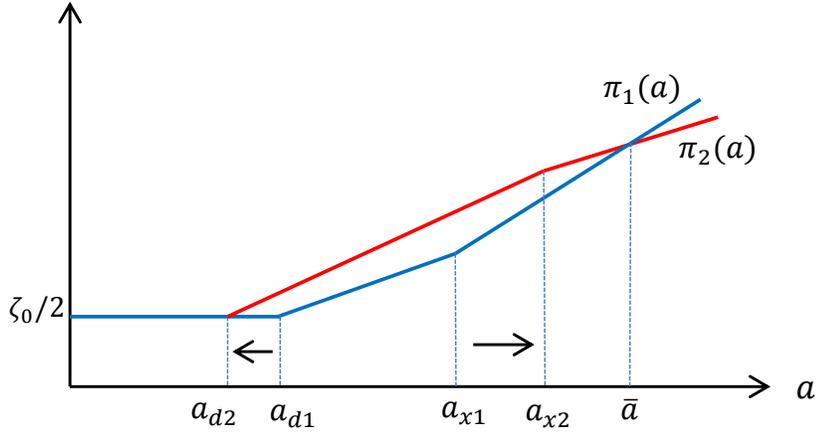


Figure 4: The Impact of Reducing Fixed Cost f_e on Income Distribution

- b.* induces each entrepreneur to acquire less managerial capital;
- c.* decreases productivity of all firms independently of export status;
- d.* improves personal income distribution;
- e.* lowers aggregate unemployment;
- f.* and improves welfare.

Finally, we state the effects of a reduction in variable costs of capital captured by parameter λ . According to Lemma 1.c, a reduction in λ has no impact on domestic and export cutoffs a_d and a_x . It turns out that a reduction in marginal costs of managerial capital is absorbed by an equivalent reduction in firm-market size ψ .²⁴ According to (21a)–(21d), a reduction in λ induces each entrepreneur to acquire more managerial capital, increases firm productivity, and has no effect on entrepreneurial income. Equation (33) implies that λ does not affect aggregate unemployment. Since the domestic cutoff level a_d and aggregate expenditure E are independent of λ , equation (34) implies that reducing λ lowers aggregate price P , and thus improves welfare (see equation (5)).

Proposition 4. A reduction in variable costs of managerial capital formation caused by a reduction in shift parameter λ

²⁴Substituting a_d from (30a) in (18) establishes that ψ^2 is directly proportional to λ .

- a.* has no impact on the supply of workers seeking jobs;
- b.* induces each entrepreneur to acquire more managerial capital;
- c.* increases firm productivity independently of export status;
- d.* has no impact on personal income distribution;
- e.* has no impact on aggregate unemployment;
- f.* and improves welfare.

5 Conclusion

The present paper proposed a simple and tractable model of intra-industry trade with heterogeneous firms, endogenous firm productivity, and occupational choice. The model complements and augments the theory of trade with heterogeneous firms in two important respects: it models firm productivity as an endogenous process depending on the level of managerial (knowledge) capital and involving costs that decline with managerial talent (ability); and adds occupational choice considerations which lead to endogenous worker supply, endogenous firm separation by export status, and endogenous personal income distribution.

In our model, individuals with low managerial talent become workers; individuals with intermediate managerial talent create and manage small and medium-size firms serving the domestic market and receiving middle-class incomes; and high-talented individuals choose to become entrepreneurs managing large firms, serving the global market through exporting, and receiving higher incomes.

We employ the model to analyze the effects of trade-liberalization policies and policies affecting firm productivity. Despite the presence of product-market and labor-market distortions, these policies deliver higher national and global welfare. They also raise the rate of unemployment. However, their effects on other endogenous variables are policy specific. For instance, a reduction in fixed trade costs or fixed managerial costs reduces firm productivity of all firms independently of export status; a reduction in per-unit trade costs raises firm productivity of exporting firms and reduces firm productivity of non-exporting firms; and a reduction in marginal costs of managerial capital raises firm productivity of all firms. Similarly, the impact of these policies on personal income distribution depends on which of them is implemented. For example, tariff cuts generate labor-market polarization

by hurting middle-class incomes and by raising top incomes; whereas a reduction in fixed costs of managerial capital improves middle-class incomes and lowers top incomes.

The present model can be extended in several fruitful directions. For example, Cobb-Douglas preferences could be replaced by more general functional forms leading to the incorporation of demand-based channels affecting job creation and firm-level adjustments. The assumption that worker productivity is independent of ability is unrealistic and could be relaxed by introducing costly worker screening along the lines of Helpman et al. (2010). Finally, the model could incorporate the decision to serve foreign markets through foreign direct investment.

Appendix

Proof of Lemma 1. Differentiating (30a) and (30b) with respect to τ yields

$$\frac{\partial a_d}{\partial \tau} = -\frac{4(\sigma - 1)(1 + \tau^{1-\sigma})f_x A^{-k} a_d}{\zeta_0 \tau (2 + \tau^{1-\sigma})(1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0)} < 0, \quad (35a)$$

$$\frac{\partial a_x}{\partial \tau} = \frac{2(\sigma - 1)(1 + \tau^{1-\sigma})(1 + 2f_x A^{-k}/\zeta_0)a_x}{\tau(2 + \tau^{1-\sigma-1})(1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0)} > 0. \quad (35b)$$

Differentiating a_d and a_x with respect to f_x yields

$$\frac{\partial a_d}{\partial f_x} = -\frac{2(k - 1)A^{-k} a_d}{k\zeta_0(1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0)} < 0, \quad (36a)$$

$$\frac{\partial a_x}{\partial f_x} = \frac{a_x}{f_x} \left[1 + \frac{(k - 1)(1 + 2f_e/\zeta_0)}{k(1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0)} \right] > 0. \quad (36b)$$

Differentiating (30a) and (30b) with respect to f_e yields

$$\frac{\partial a_d}{\partial f_e} = \frac{2a_d}{k\zeta_0} \left[\frac{1 + 2kf_x A^{-k}/(\zeta_0 + 2f_e)}{1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0} \right] > 0, \quad (37a)$$

$$\frac{\partial a_x}{\partial f_e} = -\frac{2(k - 1)a_x}{k(1 + 2f_e/\zeta_0 + 2f_x A^{-k}/\zeta_0)} < 0. \quad (37b)$$

References

- Atkeson, Andrew and Ariel T. Burstein, “Innovation, Firm Dynamics, and International Trade,” *Journal of Political Economy*, 2010, *118*, 433–84.
- Autor, David H., Lawrence F. Katz, and Melissa S. Kearney, “Trends in U.S. Wage Inequality: Revising the Revisionists,” *Review of Economics and Statistics*, 2008, *90*, 300–23.
- Autor, David H. and David Dorn, “The Growth of Low Skill Service Jobs and Polarization of the U.S. Labor Market,” *American Economic Review*, 2013, *103*, 1553–97.
- Autor, David H., David Dorn, and Gordon Hanson, “The China Syndrome: Local Labor Market Effects of Import Competition in the United States,” *American Economic Review*, 2013, *103*, 2121–68.
- Axtell, Robert, “Zipf Distribution of U.S. Firm Sizes,” *Science*, 2001, *293*, 1818–20.
- Aw, Bee Yan, Mark J. Roberts, and Daniel Yi Xu, “R&D Investments, Exporting, and the Evolution of Firm Productivity,” *American Economic Review Papers and Proceedings*, 2008, *98*, 451–56.
- Becker, Gary S., *Human Capital: A Theoretical and Empirical Analysis*, 3rd edition, the University of Chicago Press: Chicago, IL, 1994.

- Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott, “Firms in International Trade,” *Journal of Economic Perspectives*, 2007, 21, 105–30.
- Biscourp, Pierre and Francis Kramarz, “Employment, Skill Structure and International Trade: Firm-Level Evidence for France,” *Journal of International Economics*, 2007, 72, 22–51.
- Blanchard, Olivier and Jordi Gali, “Labor Markets and Monetary Policy: A New Keynesian Model with Unemployment,” *American Economic Journal: Macroeconomics*, 2010, 2, 1–30.
- Bustos, Paula, “Trade Liberalization, Exports and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinean Firms,” *American Economic Review*, 2011a, 101, 304–40.
- Bustos, Paula, “The Impact of Trade Liberalization on Skill Upgrading. Evidence from Argentina,” *CREI Working Paper*, 2011b.
- Criscuolo, Chiara, Jonathan E. Haskel, and Matthew J. Slaughter, “Global Engagement and the Innovation Activities of Firms,” *International Journal of Industrial Organization*, 2010, 28, 191–202.
- Davidson, Carl, Lawrence Martin, and Stephen J. Matusz, “The Structure of Simple General Equilibrium Models with Frictional Unemployment,” *Journal of Political Economy*, 1988, 96, 1267–93.
- Davidson, Carl, Lawrence Martin, and Stephen J. Matusz, “Trade and Search Generated Unemployment,” *Journal of International Economics*, 1999, 48, 271–99.
- Davidson, Carl, Stephen J. Matusz, and Andrei Shevchenko, “Globalization and Firm-Level Adjustment with Imperfect Labor Markets,” *Journal of International Economics*, 2008, 75, 295–309.
- De Locker, Jan, “Do Exports Generate Higher Productivity? Evidence from Slovenia,” *Journal of International Economics*, 2007, 73, 69–98.
- Dinopoulos, Elias and Bulent Unel, “Entrepreneurs, Jobs, and Trade,” 2013. Mimeo, University of Florida.
- Dutt, Pushan, Devashish Mitra, and Priya Ranjan, “International Trade and Unemployment: Theory and Cross-National Evidence,” *Journal of International Economics*, 2009, 78, 32–44.
- Ederington, Josh and Phillip McCalman, “Endogenous Firm Heterogeneity and the Dynamics of Trade Liberalization,” *Journal of International Economics*, 2008, 74, 422–40.
- Gabaix, Xavier and Augustin Landier, “Why CEO Pay Increased so Much?,” *Quarterly Journal of Economics*, 2008, 123, 49–100.
- Goldberg, Pinelopi K. and Nina Pavcnik, “Distributional Effects of Globalization in Developing Countries,” *Journal of Economic Literature*, 2007, 45, 39–92.
- Griliches, Zvi, “Issues in Assessing the Contribution of Research and Development to Productivity Growth,” *Bell Journal of Economics*, 1979, 10, 92–116.
- Hasan, Rana, Devashish Mitra, Priya Ranjan, and Reshad Ahsan, “Trade Liberalization and Unemployment: Theory and Evidence from India,” *Journal of Development Economics*, 2012, 97, 269–80.

- Helpman, Elhanan and Oleg Itskhoki, "Labor Market Rigidities, Trade and Unemployment," *Review of Economic Studies*, 2010, 77, 1100–37.
- Helpman, Elhanan, Oleg Itskhoki, and Stephen Redding, "Inequality and Unemployment in a Global Economy," *Econometrica*, 2010, 78, 1239–83.
- Kaplan, Steven N. and Joshua Rauh, "Wall Street and Main Street: What Contributes to the Rise in the Highest Incomes?," *Review of Financial Studies*, 2010, 23, 1004–50.
- Lemieux, Thomas, "The Changing Nature of Wage Inequality," *Journal of Population Economics*, 2008, 21, 21–48.
- Lileeva, Alla and Daniel Trefer, "Improved Access to Foreign Markets Raises Plant-Level Productivity... for Some Plants," *Quarterly Journal of Economics*, 2010, 125, 1051–1099.
- Lucas, Robert Jr., "On the Size Distribution of Business Firms," *The Bell Journal of Economics*, 1978, 9, 508–23.
- Manasse, Paolo and Alessandro Turrini, "Trade, Wages, and Superstarts," *Journal of International Economics*, 2001, 54, 97–117.
- Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 2003, 71, 1695–1725.
- Melitz, Marc J. and Gianmarco Ottaviano, "Market Size, Trade, and Productivity," *Review of Economic Studies*, 2008, 75, 295–316.
- Melitz, Marc J. and Daniel Treffer, "Gains from Trade When Firms Matter," *Journal of Economic Perspectives*, 2012, 26, 91–118.
- Menezes-Filho, Naércio and Marc-Andreas Muendler, "Labor Reallocation in Response to Trade Reforms," *NBER Working Paper No. 17372*, 2011.
- Monte, Ferdinando, "Skill Bias, Trade, and Wage Dispersion," *Journal of International Economics*, 2011, 83, 202–18.
- Pissarides, Christopher A., *Equilibrium Unemployment Theory*, 2nd edition, MIT Press, MA, 2004.
- Rosen, Sherwin, "Authority, Control and the Distribution of Earnings," *Bell Journal of Economics*, 1982, 13, 311–23.
- Stole, Lars A. and Jeffrey Zwiebel, "Organizational Design and Technology Choice under Intrafirm Bargaining," *American Economic Review*, 1996, 86, 195–222.
- Tello-Trillo, Cristina J., "The Impact of Trade on Managerial Incentives and Productivity," 2014. Mimeo, Yale University.
- Unel, Bulent, "The Interaction Between Technology Adoption and Trade When Firms are Heterogeneous," *Review of International Economics*, 2013, 21, 797–808.
- Yeaple, Stephen R., "A Simple Model of Firm Heterogeneity, International Trade, and Wages," *Journal of International Economics*, 2005, 65, 1–20.