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Entrepreneurs, Jobs, and Trade

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Abstract

We propose a simple theory of endogenous firm productivity, unemployment, and personal income distribution. High-talented individuals choose to become self-employed entrepreneurs and acquire more managerial capital; whereas low-talented individuals become workers and face the prospect of unemployment. The theory identifies the conditions under which a move from autarky to free trade raises firm-level productivity, reduces unemployment, raises inequality and reduces welfare. Job-creating policies generally lead to lower unemployment, higher welfare, and higher income inequality. In a two-country global economy, a country exports the good with lower costs of managerial capital. Unilateral job-creating policies may widen the unemployment gap and increase income inequality across countries.

JEL Classification: F1, J2, J3, J6, L1
Keywords: Inequality, Managerial Capital, Search and Matching, Trade, Unemployment

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1 Introduction

The last decade has witnessed substantial changes in the U.S. distribution of earnings. According to Haskel et al. (2012), since 2000 real earnings for most U.S. workers have declined independently of educational status, and corporate profits have increased substantially reaching 12.4 percent of GDP in 2010 (the highest percentage in the past 60 years). In addition, the share of U.S. income accounted by the top 1 percent earners rose steadily from 13.5 percent in 1995 to 18.3 percent in 2007.

During the same period, globalization has steadily intensified primarily due to further improvements in communication and transportation technology. The 2007-08 financial crisis and its offspring the great trade collapse of 2008-09 generated high unemployment and substantial changes in terms of trade among many countries. For instance, U.S. unemployment rate stayed above 7.5 percent for more than five years; and Europe experienced double-digit persistent unemployment, reaching over 25 percent in such countries as Greece and Spain. Additionally, according to Gopinath et al. (2012), the global trade collapse let to significant changes in terms of trade across many countries.

These developments have generated renewed interest among economists and policy makers in the nexus among unemployment, inequality, and trade. Is more trade job-creating or job-destroying? What are the effects of trade on firm productivity, personal income distribution, structural unemployment, and welfare? What are the determinants of comparative advantage in a global economy with structural unemployment? Do unilateral job-creating policies destroy jobs in other countries?

In this paper, we propose a simple theory exploring these questions. We develop a two-sector model where labor is the only factor of production and consists of a fixed measure of individuals differing in managerial talent (ability). The economy produces a traditional good and a modern one, under perfect competition. The assumption of perfect competition provides analytical mileage and implies that the model generates interindustry (as opposed to intraindustry) trade based on comparative advantage. It also implies that we can use the standard small open economy (SOE) assumption to study the role of unilateral policies.

The traditional sector consists of single-worker firms as in the standard theory of equilibrium unemployment (Pissarides (2004)), and exhibits exogenous firm productivity. In contrast, the modern good is produced by multiple-worker heterogeneous firms managed by self-employed entrepreneurs. Firm productivity in the modern sector is endogenous and thus may be influenced by appropriate policies. Specifically, an entrepreneur may enhance the productivity of her firm by investing in managerial capital; and it is assumed that the costs of acquiring managerial (organization) capital increase with managerial capital and decline with the managerial talent of the entrepreneur.

Entrepreneurs do not face the prospect of unemployment and their earnings equal firm profits. Worker productivity is independent of worker ability, and labor markets for workers exhibit search frictions as in the standard Diamond-Mortensen-Pissarides (DMP) theory of equilibrium unemployment.[1] We model labor-market frictions leading to unemployment as in Helpman and Itskhoki (2010): hiring is costly and the wage is determined through bargaining as in Stole and Zwiebel (1996).

In the model, high-talented individuals choose to become entrepreneurs, whereas the remaining individuals become workers as in Lucas (1978). In addition, more talented entrepreneurs acquire more managerial capital; manage larger, more productive, and more profitable firms; and enjoy higher earnings. As a result, the model generates a perfectly competitive market structure with heterogeneous firms and endogenous firm productivity.

The model delivers several novel results that contribute to the literature on firm productivity, inequality, and trade. The first main finding is that comparative advantage regulates the relationship between productivity and trade. Consider, for instance, an economy with comparative advantage in the modern good. More trade, caused by an increase in the relative price of the modern good, raises firm profitability in the modern sector, encourages more individuals to become entrepreneurs, and incumbent entrepreneurs invest more in managerial capital leading to higher productivity. However, the opposite holds if the economy has a comparative advantage in the traditional good.

The second main finding is that trade has an ambiguous effect on unemployment. This ambiguity stems from the presence of two channels through which trade influences unemployment: the occupational choice channel and the sectoral worker reallocation one. To see how these channels operate, consider a SOE exporting the modern good. More trade, caused by an increase in the relative price of modern good, induces more workers to become self-employed entrepreneurs. This trade-triggered reduction in the supply of workers reduces unemployment through occupational-choice considerations. In addition, an increase in the price of the modern good induces incumbent workers to move from the traditional to the modern sector where there is an excess demand for labor. This sectoral reallocation

[1] Botero et al. (2004) among others document the prevalence of labor-market frictions stemming primarily from national labor regulation policies. These policies different across countries, affect adversely labor force participation, and contribute to unemployment.

of workers reduces economy-wide unemployment if and only if the job-finding rate in the modern sector is higher than the job-finding rate in the traditional sector. In other words, more trade reduces structural unemployment if the economy exports the modern good and if the modern sector exhibits lower labor-market frictions (a higher job-finding rate).

Our third main finding is that trade can reduce welfare: the presence of labor-market frictions generates welfare distortions that can reduce and even eliminate the gains from interindustry trade. Even if more trade reduces unemployment and raises productivity, the accompanied increase in hiring costs may reduce national welfare. This finding differs from the recent studies[2] establishing that trade improves welfare in monopolistic competition models with heterogeneous firms and unemployment. In these models, more (intraindustry) trade increases the mass of consumed varieties and confers additional welfare gains. These extra gains dominate the welfare losses caused by misallocation of resources and unemployment.

Another finding is that comparative advantage regulates the effect of trade on personal income distribution. Where trade raises the relative price of modern good, it increases firm-level productivity, firm profits and thus entrepreneurial income. As the income of employed workers is invariant to changes in trade, more trade increases income inequality between entrepreneurs and employed workers. Where a country has comparative advantage in the traditional good, more trade leads to the reverse outcome and thus improves the distribution of income.

These novel findings are first established by employing a SOE with a given comparative advantage. We then extend our analysis to a two-country framework with endogenous determination of terms of trade. We find that the country exports the good with lower costs of managerial capital and/or lower labor-market frictions. Assuming that Home has comparative advantage in modern good, a move from autarky to free trade increases the relative price of the modern good in Home and reduces it in Foreign. Therefore, trade liberalization has asymmetric effects on managerial capital, firm productivity, income inequality, and unemployment across the two countries. We also find that trade improves Foreign welfare and has an ambiguous effect on Home welfare. In other words, trade can reduce one country's welfare as mentioned earlier.

As unemployment is important in it own right, we investigate the effects of job-creating

[2]See, e.g., Helpman and Itskhoki (2010), Helpman et al. (2010), and Dinopoulos and Unel (2014) among many others.

policies that lower the costs of managerial capital or reduce the costs of job vacancies in the context of a SOE and a two-country global economy. Independently of comparative advantage, these policies reduce unemployment, increase income inequality and raise welfare. However, unilateral job-creating policies have "beggar-thy-neighbor" effects: they create jobs and raise firm productive in the policy-implementing country, whereas they destroy jobs and reduce firm productivity in the trading partner.

Our main findings are consistent with empirical evidence. The finding that more talented entrepreneurs manage larger firms and receive higher income is consistent with the study of Gabaix and Landier (2008) according to which CEO pay in the U.S. between 1980 and 2003 can be fully explained by the increase in size of large companies. The finding that trade affects firm-level productivity is consistent with the recent studies documenting a positive correlation between exporting and firm productivity stemming from technology adoption (i.e., more managerial capital in our model).[3]

The prediction that trade reduces unemployment is consistent with the main finding of Felbermayr et al. (2011b) that higher trade openness is associated with lower structural unemployment. This prediction is also consistent with the rise of unemployment following the great trade collapse of 2008-09. Finally the finding that trade liberalization can increase income inequality is supported by the observed positive correlation between globalization and income inequality mentioned earlier (see Goldberg and Pavcnik (2007)).

The rest of the paper is organized as follows. Section 2 offers a discussion of related studies. Section 3 presents the model. Section 4 introduces international trade considerations by analyzing the properties of a small, open economy and a global economy with two large countries. Section 5 concludes.

2 Related Literature

As the model addresses the general-equilibrium nexus among firm efficiency, comparative advantage, and inequality, it relates and contributes to several strands of literature. One such stand analyzes the effects of exporting on firm-level productivity in the context of intraindustry trade and heterogeneous firms. For instance, Bustos (2011), Lileeva and Trefler (2010), and Unel (2013a) analyze how exporting encourages the adoption of technology and raises firm productivity. Gopinath and Neiman (2014) examine how economic crises reduce

[3] See, for example, De Locker (2007), Lileeva and Trefler (2010), Bustos (2011) and Gopinath and Neiman (2014).

firm-level and aggregate productivity by increasing the costs and supply of intermediate imported inputs. These studies emphasize the role of intraindustry trade based on scale economies, and do not address the impact of trade on unemployment.

Another strand of literature analyzes the effects of intraindustry trade on income inequality under neoclassical labor markets. Manasse and Turini (2001) study the effects of intraindustry trade on inequality between entrepreneurs and workers under the assumption that the supply of workers is fixed. Monte (2011) proposes a monopolistic competition model of intraindustry trade to analyze the impact of skill-biased technical change on income inequality between high-skill workers who become entrepreneurs and low-skill workers.

The literature on trade and unemployment is vast and has identified a variety of labor-market frictions leading to unemployment. In Brecher (1974) and Egger et al. (2012), for example, unemployment stems from minimum wages; whereas in Copeland (1989) and Davis and Harrigan (2011), efficiency wages play the key role in generating equilibrium unemployment. In Kreickemeier and Nelson (2006), Amiti and Davis (2011), and Egger and Kreickemeier (2009 & 2012) unemployment stems from fair wages.

Our paper is more closely related to the strand of literature that uses the standard Diamond–Mortensen–Pissarides (DMP) theory of equilibrium unemployment. In an important contribution, Davidson et al. (1999) developed a general-equilibrium search model of trade between two countries to investigate the robustness of the main results obtained in traditional, full-employment trade models.[4] In their model, differences in labor-market frictions across sectors and countries determine the pattern of trade as in our model. However, their work abstracts from occupational-choice considerations and endogenous firm-level productivity, both of which are fundamental elements of our model. For instance, in our analysis, managerial-capital costs constitute a determinant of comparative advantage, and trade affects personal income distribution.[5]

Helpman and Itskhoki (2010) introduce search and matching frictions leading to equilibrium unemployment in a trade model with heterogeneous firms producing differentiated

[4]Davidson et al. (1999) build on Davidson et al. (1988) that study two-sector, closed-economy, general equilibrium models with frictional unemployment. Davidson and Matusz (2010) provides several extensions of the Davidson et al. (1999) model to study how international trade affects labor markets and how structural differences in labor markets affect international trade.

[5]Dutt et al. (2009) develop and test a model with equilibrium unemployment and trade based on comparative advantage. Their model abstracts from occupational-choice and human-capital considerations, and addresses different issues.

products.[6] Helpman et al. (2010) introduce match-specific heterogeneity in ability across workers to study the impact of trade on wage distribution. In a recent paper, Dinopoulos and Unel (2014) propose a model of intraindustry trade, endogenous firm productivity and labor-market frictions to analyze similar issues to the ones addressed in the present paper. However, unlike these studies, our paper highlights the role of inter-industry trade based on comparative advantage and focuses on unilateral (as opposed to global policies). As will be elaborated below, the results of the present paper differ and complement those obtained by these three studies.[7]

3 The Model

Consider an economy producing two homogeneous goods indexed by $i = 1, 2$. The economy is populated by a unit mass of identical families. Each family supplies labor, consisting of all family members, and has size equal to one. Family members differ in managerial talent (ability) indexed by a. In the present context, *managerial talent* is a broad generic term accounting for innate ability, level of training or education, and for any other attribute helping an individual to create and manage a firm. The distribution of managerial talent is given by cumulative distribution $G(a)$ with density $g(a)$ and support $[1, \infty)$.

Decisions are made sequentially. An individual first decides whether to become an entrepreneur or a worker. An entrepreneur with a given entrepreneurial talent chooses the optimal level of managerial capital, followed by how many workers to employ. The latter choice is conditioned by the presence of hiring costs stemming from search-related frictions. Each entrepreneur bargains with hired workers to determine the negotiated wage while treating the level of managerial capital and hiring costs as sunk. Entrepreneurial income equals firm profits.

[6] See also Felbermayr et al. (2011) who incorporate the traditional dynamic version of DMP theory into the Melitz model to study the impact of trade on equilibrium unemployment.

[7] For instance, the seminal studies of Helpman and Itskhoki (2010) and Helpman et al. (2010) do not address the effects of trade on firm-level adjustment and abstract from occupational choice considerations; and Dinopoulos and Unel (2014) find that more (intraindustry) trade necessarily increases unemployment. In these studies trade is always welfare improving; whereas in the present model, it can reduce welfare.

3.1 Preferences

Family members have identical preferences described by the following utility function

$$u = \left(\frac{q_1}{1-\beta}\right)^{1-\beta}\left(\frac{q_2}{\beta}\right)^{\beta}, \tag{1}$$

where q_i is consumption of good $i = 1, 2$, and $0 < \beta < 1$ is an exogenous, constant parameter.

Denoting with e individual income (expenditure), one can express the demand for good i as

$$q_i = \beta_i e/p_i, \tag{2}$$

where $\beta_1 = 1 - \beta$, $\beta_2 = \beta$, and p_i is the price of good i. We choose good 1 as the model's numeraire by setting its price equal to one (i.e., $p_1 = 1$). To further simplify notation, we use p to denote the relative price of good 2.

Substituting q_i from (2) in (1) delivers the indirect utility

$$\mathrm{v}(e, p) = ep^{-\beta}, \tag{3}$$

which increases with income e and decreases with the relative price of good 2 p (i.e., p^{β} is the price index expressed in units of good 1). The linear dependence of indirect utility on income indicates that individuals are risk neutral. We assume that each family uses income transfers resulting in equal utility levels across all members independently of whether a member is an entrepreneur, a worker, or unemployed.[8] As a result, indirect utility (3) will be used as an index of economy-wide welfare.

3.2 Firm Productivity and Wage Bargaining

We refer to good 1 as the traditional good and to good 2 as the modern good. The terms "traditional" and "modern" are used to highlight that in the traditional sector firm productivity is exogenous, whereas in the modern sector firm productivity depends on the level of managerial capital and therefore is endogenous. In relative terms, agriculture and tourism are examples of traditional sectors; whereas manufacturing and high-tech industries, where managerial decisions on technology adoption and R&D investments enhance firm efficiency, fit more closely the modeling of the modern sector.

[8] Note that the indirect utility function is in the Gorman form, and thus allows aggregation of individual preferences to obtain social welfare which is independent of income distribution.

Production of the traditional good is carried out under perfect competition by identical and single-worker firms.[9] Each firm posts a job vacancy and hires one worker, but vacancies are not filled instantaneously due to labor-market frictions. When a firm hires a worker, the worker produces one unit of output independently of managerial talent. Upon matching, the firm and worker bargain over revenue earned by selling one unit of output at $p_1 = 1$. Assuming equal bargaining power and zero value of outside options (e.g., no unemployment insurance), the worker receives $\mathrm{w}_1 = 1/2$.

The modern good is produced by a continuum of heterogeneous firms under perfect competition with each firm created, owned and managed by a single entrepreneur. The production technology of modern good depends on the level of managerial (organization) capital and the number of hired workers. The former is modeled as a separate factor of production and denoted by z . As in Lucas (1978), we postulate that output exhibits diminishing returns with respect to managerial capital capturing "span of control" considerations.[10] The production function of a firm with managerial capital z is given by

$$y_2(z) = \left(\frac{z}{1-\eta}\right)^{1-\eta} \left(\frac{l}{\eta}\right)^{\eta}, \tag{4}$$

where l is the number of workers employed and $\eta \in (0, 1)$ is an exogenous parameter. According to (4), firm productivity depends positively on managerial capital z and exhibits diminishing returns for any given number of hired workers l.

Following the insights of human capital theory, we postulate that an individual with ability (managerial talent) a faces $\lambda z^2/2a$ costs of acquiring z units of managerial capital, where $\lambda > 0$ is an exogenous shift parameter. The costs of managerial capital are measured in units of the traditional good, decline with managerial talent a, and increase with managerial capital z. The proposed cost function captures, albeit in a reduced form, the idea that human capital formation is costly involving various inputs, experience, schooling, on-the-job training, etc. These dynamic elements are not explicitly modeled but captured by shift parameter λ. In what follows, we refer to an increase in λ as a rise in the costs of managerial capital.[11]

[9] The concept of single-worker firms has been used extensively in the DMP literature of unemployment (e.g., Chapter 1 in Pissarides, 2004).

[10] Lucas (1978) proposes a model where the size distribution of firms is determined by the distribution of managerial talent. Building on it, Atkeson and Kehoe (2005) develop a model where life cycle of manufacturing plants is driven by "organization capital."

[11] The production-function based approach to human capital formation has long tradition going back to Becker (1994).

This modeling of firm productivity delivers a market structure with heterogeneous firms producing a homogeneous product under perfect competition. Heterogeneous firm productivity stems from endogenous investments in managerial capital by entrepreneurs with different managerial talent. As a result, differences in firm productivity, firm size and firm profits originate from differences in managerial talent across entrepreneurs.

An entrepreneur with managerial talent a maximizes earnings $e_2(a)$, equal to firm profits, by choosing the level of managerial capital z and the number of employees l. Hiring in the modern sector is costly due to labor-market frictions. A firm with productivity z may hire l workers instantaneously by incurring hiring costs $c_2 l$, measured in units of the traditional good. As will be established in the next section, c_2 depends on sector-specific labor market conditions, and therefore is common across all firms in the modern sector. In addition to hiring costs, the firm incurs a wage bill $\mathrm{w}_2 l$, where w_2 denotes the negotiated wage. This discussion leads to the following expression for entrepreneurial income (firm profits):

$$e_2(a) \equiv \max \left\{ p y_2(z) - \mathrm{w}_2 l - c_2 l - \frac{\lambda z^2}{2a} \right\}, \tag{5}$$

where firm output $y_2(z)$ is given by (4).

Recognizing that wage bargaining occurs after hiring and managerial-capital formation, we next describe the determination of negotiated wage rate w_2 and employed workers l . Specifically, upon a match an employee cannot be replaced without costs, and thus a hired worker is not interchangeable with an outside worker. Consequently, hired workers have bargaining power.

Following Helpman and Itskhoki (2010), we employ the Stole and Zwiebel (1996) solution to intrafirm wage bargaining: the entrepreneur engages in bilateral bargaining with each worker and internalizes the effect of a worker's departure on the wages of remaining workers. In our model all workers are identical in regards to output productivity, as the latter is independent of managerial talent by assumption.[12] As a result, a firm treats each worker as marginal; and firm surplus from a worker departure equals the marginal change in firm value (profits) with respect to labor. For expositional simplicity, we assume that the value of outside options for each party is zero, and that each worker and entrepreneur possess equal bargaining power. Using "Result 2" in Stole and Zwiebel (1996), one can readily show

[12] Helpman et al. (2010) develop a model of unemployment and inequality where worker productivity is endogenous and depends on worker ability and costly worker screening. Screening leads to more productive firms offering higher wages. Our model complements their analysis by focusing on equally productive workers and entrepreneurs differing in managerial talent and earnings.

that the negotiated wage is given by

$$\mathrm{w}_2 = \frac{p}{1+\eta}\left[\frac{\eta z}{(1-\eta)l}\right]^{1-\eta}. \tag{6}$$

According to (6), the negotiated wage increases with relative price p and firm productivity z; and decreases with hired workers l.

Faced with the negotiated wage, an entrepreneur chooses the number of employees l to maximize (5) and takes into account how l affects w_2 . This maximization yields

$$\mathrm{w}_2 = \frac{p}{1+\eta}\left[\frac{\eta z}{(1-\eta)l}\right]^{1-\eta} = c_2. \tag{7}$$

Consequently, all entrepreneurs (irrespective of firm size) pay the same wage to workers, that is $\mathrm{w}_2 = c_2$. The above equation can be solved for the number of hired workers

$$l = \frac{\eta}{1-\eta}\left[\frac{p}{(1+\eta)c_2}\right]^{\frac{1}{1-\eta}} z. \tag{8}$$

Thus, entrepreneurs with higher managerial capital z and lower per-worker hiring costs c_2 employ more workers.

3.3 Occupational Choice

An entrepreneur with managerial talent a maximizes earnings (firm profits) by choosing the level of managerial capital z after taking into account labor costs. Substituting $\mathrm{w}_2 = c_2$ from (7) and (8) into equation (5), and maximizing the resulting function with respect to z yields

$$z = \frac{a}{\lambda}\left[\frac{p}{(1+\eta)c_2^{\eta}}\right]^{\frac{1}{1-\eta}}. \tag{9}$$

Thus the optimal level of managerial capital z increases with managerial talent a and price p; and decreases with hiring costs c_2, and managerial-capital costs λ. It is obvious from equation (9) that the profile of managerial capital is an increasing linear function of managerial talent.

The choice of becoming an entrepreneur or a worker reflects expected-income considerations. Substituting $\mathrm{w}_2 = c_2$ from (7), l from (8), and z from (9) in equation (5) provides a closed-form expression for income earned by an entrepreneur with managerial talent a :

$$e_2(a) = \frac{a}{2\lambda}\left[\frac{p}{(1+\eta)c_2^{\eta}}\right]^{\frac{2}{1-\eta}}. \tag{10}$$

Entrepreneurial income $e_2(a)$ is an increasing linear function of managerial talent a and behaves similarly to the equilibrium level of managerial capital z: it increases with relative price p, and declines with the costs of managerial capital λ and per-worker hiring costs c_2.

Entrepreneurs are fully employed and receive $e_2(a)$ with certainty. Worker income is independent of managerial talent a, by assumption, whereas entrepreneurial income increases with managerial talent, as indicated by (10). As a result, there exists a cutoff level of managerial talent $a^* > 0$, which is unique such as all individuals with managerial talent a^* are indifferent between becoming entrepreneurs or workers. Furthermore, the assumptions of risk neutrality and ex-ante sectoral worker mobility imply equalization of expected worker income across the two sectors. As a result, deriving an explicit expression for a^* requires determination of expected worker income in one of the two sectors. It is simpler to focus on the traditional sector, where worker income is $e_1 = \mathrm{w}_1 = 1/2$. Let ζ_1 denote the job-finding probability in the traditional good (to be determined in the next section). Then, expected worker income is simply $\mathbb{E}[e_1] = \zeta_1 \mathrm{w}_1 = \zeta_1/2$.

An individual chooses to become an entrepreneur if and only if $e_2(a) \geqslant \mathbb{E}[e_1]$. The cutoff level of managerial talent $a^*$is given by $e_2(a^*) = \zeta_1/2$. Using (10) yields

$$a^* = \lambda\zeta_1 \left[\frac{(1+\eta)c_2^\eta}{p}\right]^{\frac{2}{1-\eta}}. \tag{11}$$

As in Lucas (1978), only the most talented individuals become entrepreneurs. All individuals with talent $a < a^*$ choose to become workers, whereas all individuals with talent $a \geqslant a^*$ choose to become self-employed entrepreneurs. However, unlike Lucas (1978), here entrepreneurs acquire managerial capital and workers face the threat of unemployment.

The cutoff level of managerial talent a^* is endogenous and increases with hiring costs c_2, the probability of finding a job as a worker ζ_1 (a component of opportunity costs of entrepreneurship), and the costs of managerial capital λ. The cutoff level of managerial talent a^* decreases with relative price p.

Combining equations (9) and (11) yields

$$z(a) = \left(\frac{\zeta_1}{\lambda a^*}\right)^{\frac{1}{2}} a, \tag{12}$$

stating that the optimal level of managerial capital increases with the job-finding rate ζ_1, and decreases with the talent cutoff level a^* and costs of managerial capital λ.

Finally, combining equations (10) and (11) yields

$$e_2(a) = \left(\frac{\zeta_1}{2a^*}\right) a, \tag{13}$$

and thus, income of an entrepreneur with managerial talent a increases with the job-finding rate ζ_1 and decreases with the talent cutoff level a^*. In other words, a lower cutoff level of managerial talent implies a higher mass of (less talented) individuals who decide to become entrepreneurs, and thus requires a ceteris-paribus higher level of entrepreneurial income to compensate for lower managerial talent.

3.4 Equilibrium Unemployment

Workers are risk neutral and decide whether to search for a job in the traditional or modern sectors. The labor market exhibits search frictions as in the standard DMP theory of unemployment. As mentioned previously, we assume that once committed to a sector a worker cannot move to another sector, i.e. there is no ex-post sectoral worker mobility.

Following Blanchard and Gali (2010) and especially Helpman and Itskhoki (2010), we assume that a firm can hire workers instantaneously by incurring costs expressed in units of the traditional good. Hiring costs per worker in sector i are given by

$$c_i(\zeta_i) = \tau_i \zeta_i^{\gamma}, \tag{14}$$

where the exogenous parameter τ_i is an index of labor-market frictions in sector i; ζ_i is the job-finding rate or the labor-market tightness index; and $\gamma > 0$ is a constant parameter. According to equation (14), higher market tightness ζ_i implies greater instantaneous hiring costs per worker c_i, for any given degree of labor-market frictions τ_i. As shown by Blanchard and Gali (2010, footnote 6), the above hiring cost function can be derived from a standard constant returns to scale Cobb-Douglas matching function.[13]

Consider first the traditional sector where each firm employs one worker. Market entry is unrestricted, but each firm faces entry costs equal to the cost of posting a vacancy (denoted by ν_1 and measured in units of the traditional good). The free-entry condition pins down

[13] Let successful matches in sector i is given by $M_i = m_i V_i^{\xi} N_i^{1-\xi}$, where parameter m_i measures matching efficiency, N_i is the number of workers searching for jobs, V_i is the number of vacancies posted, and $\xi \in (0, 1)$ is a constant parameter. The two parameters in (14) are given by $\gamma = (1 - \xi)/\xi > 0$ and $\tau_i = m_i^{-1/\xi}$. As a result, τ_i declines with matching efficiency m_i and therefore corresponds to an index of labor-market frictions (rigidities) in sector i.

equilibrium values for the job-finding rate and hiring costs:[14]

$$\zeta_1 = (2\tau_1)^{-\frac{1}{\gamma}}, \qquad c_1 = \frac{1}{2}. \tag{15}$$

We assume that $\tau_1 > 1/2$ to ensure that the job-finding rate ζ_1 is smaller than one. Note that ζ_1 decreases with the degree of labor-market frictions τ_1, and thus greater labor-market frictions lead to lower labor-market tightness.

Ex-ante labor mobility across sectors implies that a worker must be indifferent between being assigned to the traditional or modern sectors. It then follows that $\zeta_1 \mathrm{w}_1 = \zeta_2 \mathrm{w}_2$, and using $\mathrm{w}_1 = 1/2$ and $\mathrm{w}_2 = c_2$ yields $\zeta_2 c_2 = \zeta_1/2$. Substituting c_2 from (14) and ζ_1 from (15) in $\zeta_2 c_2 = \zeta_1/2$ yields

$$\zeta_2 = 2^{-\frac{1}{\gamma}} \tau_1^{-\frac{1}{\gamma(1+\gamma)}} \tau_2^{-\frac{1}{1+\gamma}} = \zeta_1 \left(\frac{\tau_1}{\tau_2}\right)^{\frac{1}{1+\gamma}}, \qquad c_2 = \frac{1}{2}\left(\frac{\tau_2}{\tau_1}\right)^{\frac{1}{1+\gamma}}. \tag{16}$$

Obviously, when labor-market frictions in the modern sector are less severe than that in the traditional sector (i.e., $\tau_2 < \tau_1$), the job-finding rate in the modern sector is higher (i.e., $\zeta_2 > \zeta_1$); and the corresponding hiring costs are lower (i.e., $c_2 < c_1$ if $\tau_2 < \tau_1$).

Armed with these results, we next derive an expression for the unemployment rate. Let N_i denote the mass of workers searching for jobs in sector i. It then follows that $G(a^*) = N_1 + N_2$ is the aggregate supply of workers because the mass of population is normalized to unity. The equilibrium mass of workers hired by an entrepreneur with managerial talent a is given by[15]

$$l(a) = \frac{2\eta\zeta_2}{(1-\eta)} \frac{a}{a^*}. \tag{17}$$

Aggregating (17) across all entrepreneurs and setting the resulting expression equal to the mass of employed workers in the modern sector $\zeta_2 N_2$ yields

$$N_2 = \frac{2\eta}{(1-\eta)} \frac{\mathbb{E}[a \geqslant a^*]}{a^*}, \tag{18}$$

where $\mathbb{E}[a \geqslant a^*] = \int_{a^*}^{\infty} a g(a) da$ is the expected (average) level of managerial talent in the modern sector. As $\mathbb{E}[a \geqslant a^*]$ declines with a^*,[16] equation (18) implies that the mass of

[14] Note that $\chi_1 = \nu_1/c_1$ represents the probability that a firm fills a vacancy, that is, χ_1 is the hiring rate in the traditional sector. Because each firm receives half of generated revenue, expected profit is $\chi_1/2$. As a result, free-entry condition $\chi_1/2 = \nu_1$ implies $c_1 = 1/2$. Substituting $c_1 = 1/2$ in (14) yields (15).

[15] Observe that $\zeta_2 N_2 = \int_{a^*}^{\infty} l(a) g(a) da$ is the demand for employed workers in the modern sector, where the mass of hired workers by each firm $l(a)$ is given by (8). Using (9), (11), and the no-arbitrage condition $\zeta_1/2 = \zeta_2 c_2$ in equation (8) yields (17).

[16] $d\mathbb{E}[a \geqslant a^*]/da^* = d[\int_{a^*}^{\infty} a g(a) da]/da^* = -a^* g(a^*) < 0$.

workers searching jobs in the modern sector decreases with the managerial talent cutoff a^*. This makes sense: an increase in cutoff level a^* means that the mass of entrepreneurs declines and so does the demand for labor in the modern sector.

The aggregate unemployment rate among workers is defined as the measure of unemployed workers (searching for jobs) in both sectors divided by total labor supply $L = 1$. The unemployment rate in sector i is $U_i = (1 - \zeta_i)N_i$ and therefore the economy-wide unemployment rate $\mathcal{U} = U_1 + U_2$ can be written as

$$\mathcal{U} = (1 - \zeta_1)G(a^*) + (\zeta_1 - \zeta_2)N_2 = (1 - \zeta_1)G(a^*) + \frac{2(\zeta_1 - \zeta_2)\eta\mathbb{E}[a \geqslant a^*]}{(1 - \eta)a^*}, \tag{19}$$

where the sectoral job-finding rates ζ_1 and ζ_2 are given by (15) and (16).

Equation (19) identifies two channels transmitting the effects of trade to aggregate unemployment: the first is the "occupational-choice" channel, captured by $G(a^*)$, which works through the supply of workers seeking jobs; and the second is the "sectoral-reallocation" channel, captured by (18), which operates through the demand for labor in the modern sector. Consider, for example, the effects of a trade-induced increase in the cutoff level of managerial talent a^*. It induces low-talented entrepreneurs to shut-down their firms, enter the labor force as workers and raise the rate of unemployment though an increase in $G(a^*)$. Furthermore, an increase in a^* lowers the demand for labor in the modern sector causing a shift of workers from the modern to the traditional sector. This shift is captured by a reduction in the mass of workers assigned to modern sector N_2. The effect of sectoral worker redistribution on unemployment depends on the ranking of sectoral job-finding rates: an increase in a^* decreases N_2 and aggregate unemployment if and only if the job-finding rate is higher in the destination sector, i.e., $\zeta_1 > \zeta_2$.

In Helpman and Itskhoki (2010), the supply of workers is exogenous, and as a result, aggregate unemployment is affected only through changes in N_2. In other words, their model focuses on the demand-based channel through which trade influences unemployment. In Dinopoulos and Unel (2014), the assumptions of symmetric countries and aggregate Cobb-Douglas preferences imply that sectoral demands for labor are invariant to changes in intraindustry trade; thus more intraindustry trade necessarily increases unemployment by forcing inefficient firms to exit the market and therefore increasing the supply of workers. In contrast, in the present model both channels are present and imply that, in general, the effect of trade on unemployment is ambiguous, as will be shown below.

3.5 Aggregate Income and Hiring Costs

In this subsection we derive expressions for aggregate expenditure and hiring costs. These expressions facilitate the analysis of income distribution and welfare. We start by determining total revenue in each sector expressed in units of the traditional good:

$$Y_1 = \zeta_1 N_1 = \zeta_1 \left[G(a^*) - \frac{2\eta}{(1-\eta)} \frac{\mathbb{E}[a \geqslant a^*]}{a^*} \right], \tag{20a}$$

$$pY_2 = \int_{a^*}^{\infty} py_2(a)g(a)da = \frac{(1+\eta)\zeta_1 N_2}{2\eta} = \frac{(1+\eta)\zeta_1}{(1-\eta)} \frac{\mathbb{E}[a \geqslant a^*]}{a^*}, \tag{20b}$$

where ζ_1 is given by (15).[17]

Aggregate hiring costs in each sector are given by

$$\begin{aligned} C_{1h} &= c_1 \zeta_1 N_1 = \frac{\zeta_1}{2} \left[G(a^*) - \frac{2\eta}{(1-\eta)} \frac{\mathbb{E}[a \geqslant a^*]}{a^*} \right], \\ C_{2h} &= \int_{a^*}^{\infty} c_2 l(a) g(a) da = \frac{\eta \zeta_1}{1-\eta} \frac{\mathbb{E}[a \geqslant a^*]}{a^*}. \end{aligned}$$

The traditional good is also used in formation of managerial capital. Because each entrepreneur uses $\lambda z^2/2a$ units of the traditional good to acquire managerial capital $z(a)$, equation (12) implies that $z^2/2a = \zeta_1 a/(2a^*)$. Integrating this expression across all entrepreneurs yields the aggregate level of resources allocated in the formation of managerial capital, C_z,

$$C_z = \frac{\zeta_1}{2} \frac{\mathbb{E}[a \geqslant a^*]}{a^*}. \tag{21}$$

Thus the total amount of resources used in hiring and formation of organizational capital is given by

$$C = C_{1h} + C_{2h} + C_z = \frac{\zeta_1}{2} \left[G(a^*) + \frac{\mathbb{E}[a \geqslant a^*]}{a^*} \right]. \tag{22}$$

3.6 Income Distribution and Welfare

Worker income in the traditional sector is $\mathrm{w}_1 = 1/2$ and worker income in the modern sector is $\mathrm{w}_2 = c_2$. Equation (13) indicates that entrepreneurial income is $e_2(a) = \zeta_1 a/(2a^*)$. As a

[17] Equation (7) implies that $py_2(z) = (1+\eta)c_2 l/\eta$, and integrating the latter across all entrepreneurs yields $pY_2 = (1+\eta)c_2\zeta_2 N_2/\eta = (1+\eta)\zeta_1 N_2/2\eta$, where the last equality follows from $\zeta_1/2 = \zeta_2 c_2$. Finally, substituting N_2 from (18) into $(1+\eta)\zeta_1 N_2/2\eta$ yields the last equality in (20b).

result, ex-post personal income distribution is given by

$$e(a) = \begin{cases} 0 & \text{if } a < a^* \text{ and individual is unemployed} \\ 1/2 & \text{if } a < a^* \text{ and individual is employed in sector 1 as worker} \\ c_2 & \text{if } a < a^* \text{ and individual is employed in sector 2 as worker} \\ \zeta_1 a/(2a^*) & \text{if } a \geqslant a^* \text{ and individual is self-employed entrepreneur} \end{cases} \tag{23}$$

where ζ_1 and c_2 are given by (15) and (16), respectively. Integrating across all individuals and using $\zeta_1/2 = \zeta_2 c_2$ yields the following expression for aggregate expenditure:

$$E = \frac{\zeta_1}{2}\left[G(a^*) + \frac{\mathbb{E}[a \geqslant a^*]}{a^*}\right]. \tag{24}$$

Comparing (24) to (22) reveals that $E = Y_1 + pY_2 - C$ and $E = C = (Y_1 + pY_2)/2$, i.e., half of the economy's output is devoted to hiring and managerial capital (investment) costs.

The expression in square brackets in (24) depends solely on the distribution of managerial talent and cutoff level a^*. In addition, observe that aggregate expenditure E increases with hiring rate ζ_1 (and ζ_2) implying that an economy with higher unemployment produces less output and obtains lower welfare. Furthermore, it turns out that aggregate expenditure E is a decreasing, convex function of a^*.[18] Finally (11) implies that the cutoff level of managerial talent a^* is a decreasing, convex function of p. It then follows that aggregate expenditure is an increasing, convex function of p, i.e., $dE/dp > 0$ and $d^2E/dp^2 > 0$.

Lemma 1. *Aggregate expenditure E is a convex, decreasing function of the cutoff level of managerial talent a^*; and a convex, increasing function of relative price p.*

Using (3) and (23), one can readily determine the welfare of each individual. The assumption of identical families allows us to treat aggregate welfare as each family's welfare which equals the sum of individual utilities. Integrating the resulting indirect utility functions across all individuals yields

$$\mathbb{V} = Ep^{-\beta}, \tag{25}$$

where aggregate expenditure E is given by (24).

Because trade affects welfare through changes in the relative price p, it is instructive to analyze the dependence of aggregate welfare on p. An increase in p raises the price index p^β and reduces directly aggregate welfare $\mathbb{V}$ for any level of expenditure. Differentiating (25) with respect to p, using (24) and $da^*/dp = -2a^*/[(1-\eta)p]$ from equation (11), leads to

[18]Differentiating (24) leads to $\frac{dE}{da^*} = -\frac{\zeta_1}{2}\frac{\mathbb{E}[a \geqslant a^*]}{a^{*2}} < 0$ and $\frac{d^2E}{da^{*2}} = \frac{\zeta_1 g(a^*)}{2a^*} + \frac{\zeta_1 \mathbb{E}[a \geqslant a^*]}{a^{*3}} > 0$.

$$\frac{d\mathbb{V}}{dp} = \frac{\beta\zeta_1}{p^{1+\beta}} \left[\left(\frac{2-\beta(1-\eta)}{\beta(1-\eta)} \right) \frac{\mathbb{E}[a \geqslant a^*]}{a^*} - G(a^*) \right], \tag{26}$$

where $a^*$is a decreasing function of p. Where p is small (and therefore a^* is large), the term in brackets is negative; where p is large (and therefore a^* is small), the term in brackets is positive. Thus, aggregate welfare is a U-shaped (not necessarily convex) function of the relative price of modern good p.

Figure 1 plots the welfare function $\mathbb{V}(p)$ under the assumption that the distribution of managerial talent is Pareto $G(a) = 1 - a^{-k}$ where $k > 1$ is the shape parameter.[19] With this distributional assumption, one can show that

$$\mathbb{V} = \frac{\zeta_1}{2} \left[p^{-\beta} + \frac{p^{-\beta+2k/(1-\eta)}}{\varepsilon} \right], \tag{27}$$

where $\varepsilon \equiv (k-1)(\lambda\zeta_1)^k[(1+\eta)c_2^{\eta}]^{2k/(1-\eta)}$. Note that $\mathbb{V}$ is a U-shaped, *convex* function of p as shown in Figure 1. Variable p_A in Figure 1 denotes the autarkic price of the modern good and, as shall be shown shortly, it is always less than the welfare-minimizing price p_m. In addition, the shape of the welfare function ensures that there exists a p' (shown in Figure 1) such that

$$\mathbb{V}(p') = \mathbb{V}(p_A) \qquad \text{and} \qquad p_A < p_m < p'. \tag{28}$$

In words, if the prevailing relative price falls between the autarky price p_A and p', the economy's welfare level is below the autarky welfare level.

Setting equation (26) equal to zero leads to the following expression for the welfare minimizing price p_m :

$$\frac{\mathbb{E}[a \geqslant a_m^*]}{a_m^*} = B_m G(a_m^*), \qquad B_m \equiv \frac{\beta(1-\eta)}{2-\beta(1-\eta)} > 0, \tag{29}$$

where a_m^* is the welfare-minimizing cutoff level of managerial talent.

Lemma 2. *Aggregate welfare is a U-shaped function of relative price p, and attains its minimum at the cutoff level of managerial talent a_m^* which solves (29).*

[19] In plotting Figure 1, we set $k = 2.5, \beta = 0.75, \eta = 1/3, \lambda = 3, \tau_1 = 0.65, \tau_2 = 0.55$, and $\gamma = 1$. To enhance the presentation, Figure 1 plots welfare $\mathbb{V}(p)$ over $p \in [0.9, 1.25]$.

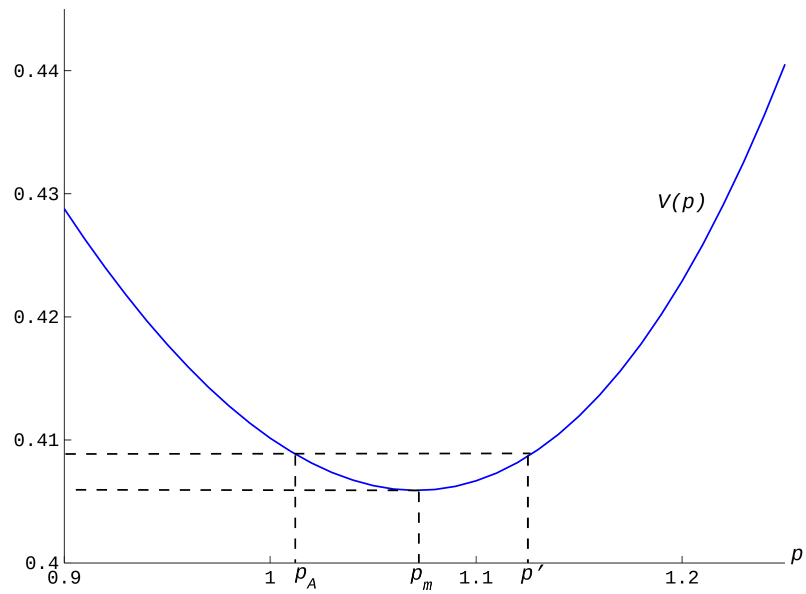

Figure 1: The welfare function

3.7 Closed-Economy Equilibrium

In the closed-economy equilibrium, $Q_1 = Y_1 - C$ and $Q_2 = Y_2$, where Q_i is aggregate quantity consumed of good i. Substituting these expressions in $Q_1/pQ_2 = (1-\beta)/\beta$ from equation (2) implies

$$\frac{\mathbb{E}[a \geqslant a^*]}{a^*} = BG(a^*), \qquad B \equiv \frac{\beta(1-\eta)}{2(1+\eta) - \beta(1-\eta)}. \tag{30}$$

The left-hand side (LHS) is a decreasing function of managerial talent cutoff a^*[20], whereas the right-hand side (RHS) is an increasing function of a^*. As a result, equation (30) determines the unique closed-economy equilibrium cutoff level of managerial talent a^*. Because $0 < B < 1$, the equilibrium cutoff level ensures that both goods are produced, i.e., $N_i > 0$ for $i = 1, 2$.[21]

The equilibrium cutoff level of managerial talent a^* does not depend on parameters

[20] $d\mathbb{E}[a \geqslant a^*]/da^* = d\left[\int_{a^*}^{\infty} ag(a)da\right]/da^* = -a^* g(a^*) < 0$.

[21] Equation (30) can be written as $N_2/G(a^*) = 2\eta\mathbb{E}[a \geqslant a^*]/[(1-\eta)a^* G(a^*)] = 2\eta B/(1-\eta) < 1$ implying that the fraction of workers assigned to the modern sector is strictly positive and strictly less than one. This result combined with the supply of workers $G(a^*) = N_1 + N_2$ implies $N_i > 0$, i.e. the closed-economy equilibrium is characterized by incomplete specialization of production.

capturing labor-market rigidities such as hiring, vacancy-posting, and managerial-capital costs. This feature facilitates the analysis of comparative advantage.

Lemma 3. *The unique closed-economy equilibrium cutoff level of managerial talent* a^* *exists and satisfies equation (30).*

Once the closed-economy cutoff level of managerial talent is determined, one can easily determine the model's remaining endogenous variables.[22] In particular, note that the autarky price of modern good p_A can be written as a function of a^* from (11)

$$p_A = (1+\eta)c_2^{\eta}\left[\frac{\lambda\zeta_1}{a^*}\right]^{\frac{1-\eta}{2}}, \tag{31}$$

where ζ_1 and c_2 are given by (15) and (16).

A comparison of (29) to (30) reveals that $a_m^* < a^*$ because $B_m > B$ for any $0 < \eta < 1$ and $0 < \beta < 1$. This implies that $p_A < p_m$, i.e., aggregate welfare is not minimized at the autarky price. This property has implications for the welfare effects of trade and deserves a few remarks. In the absence of labor-market frictions, welfare is a U–shaped function of relative price p and lies above the welfare curve presented in Figure 1. In other words, eliminating labor-market frictions increases welfare at any relative price p. In this case, welfare attains its minimum again at p_m. In addition, the autarky price under no labor-market frictions is identical to p_m, i.e. welfare is minimized at autarky.[23]

Introducing labor-market frictions generates hiring costs expressed in units of the traditional good. Since hiring costs are modeled as a final and intermediate product, their presence requires further reduction in output of the traditional good available for consumption. As a result, for any relative price p, the relative supply of modern good (Q_2/Q_1) is

[22] First, substituting the cutoff talent level a^* in (23) and (24) pins down the distribution of personal income and aggregate income, respectively. Second, substituting a^* into (12) yields the equilibrium cutoff level of managerial capital $z^* = (a^*\zeta_1/\lambda)^{1/2}$, where ζ_1 is exogenous and given by (15). Third, equations (16) determine the job-finding rate ζ_2 and hiring cost per worker c_2, respectively. Fourth, substituting c_2 into (11) yields the relative price of good 2 p; and substituting p into (25) determines aggregate welfare. Using equilibrium condition (30) in (19) determines the closed-economy unemployment rate.

[23] Details of the analysis with no labor-market frictions are available upon request. In this case, aggregate expenditure is given by $E = G(a^*) + \mathbb{E}[a \geqslant a^*]/a^*$, where $a^* = 2\lambda/p^{2/(1-\eta)}$. Differentiating $\mathbb{V} = p^{-\beta}E$ with respect to p and using $da^*/dp = -a^*/(1-\eta)p$ yields

$$\frac{d\mathbb{V}}{dp} = \frac{\beta}{p^{1+\beta}}\left[\left(\frac{2-\beta(1-\eta)}{\beta(1-\eta)}\right)\frac{\mathbb{E}[a \geqslant a^*]}{a^*} - G(a^*)\right].$$

Thus, as in the presence of labor-market frictions, welfare is U–shaped and attains its minimum at $p = p_m$.

higher in the presence of hiring costs. The resulting relative excess supply of modern good puts downward pressure on autarky price. Therefore, the presence of hiring costs requires a lower autarky price than the welfare-minimizing price ($p_A < p_m$).

4 Open Economy

In this section, we extend our framework to analyze the nexus of trade, unemployment, inequality, and welfare. First, we analyze a small, open economy (SOE) taking its terms of trade (relative price of modern good) as given; and second, we employ a two-country framework where the terms of trade is endogenously determined.

4.1 A Small Open Economy

Consider a small open economy trading with the rest of the word at a fixed relative price of modern good denoted by p_T. Following the standard practice, we assume balanced trade implying that the value of net exports must be equal to zero:

$$Y_1 - Q_1 - C + p_T(Y_2 - Q_2) = 0,$$

where Y_i is quantity supplied and Q_i is quantity demanded for good i.[24]

Substituting the international price p_T in equation (11) provides the equilibrium level of managerial talent

$$a_T^* = \lambda\zeta_1 \left[\frac{(1+\eta)c_2^\eta}{p_T}\right]^{\frac{2}{1-\eta}}. \tag{32}$$

where ζ_1 and c_2 are given by (15) and (16). Once a_T^* is determined, we can readily solve for all remaining endogenous variables. If the economy produces both goods, then there must be an upper bound, denoted by $p_T^{\max}$, on the relative price of modern good.[25]

[24] The balanced-trade condition can be written as $E = Y_1 + p_T Y_2 - C = Q_1 + p_T Q_2$, where aggregate expenditure E is given by (24). In words, the value of aggregate expenditure (income) must equal the value of aggregate production net of intermediate inputs (hiring and managerial-capital costs).

[25] Equation (32) states that a_T^* is monotonically decreasing with p_T from infinity to zero. As the relative price of good 2 increases and the cutoff level of managerial talent declines, the modern sector expands because more individuals become self-employed entrepreneurs and more workers find employment in the modern sector. This process is reflected in the corresponding increase in the fraction of workers assigned to the modern sector $N_2/G(a_T^*) \leqslant 1$. Note that $N_2/G(a_T^*) = 2\eta\mathbb{E}[a \geqslant a_T^*]/[(1-\eta)a_T^* G(a_T^*)]$ declines monotonically in a_T^*, and approaches unity for a sufficiently small value $a_T^* = a_{\min}^*$. For example, if the distribution of managerial talent is Pareto $G(a) = 1 - a^{-k}$, where $k > 1$ is the shape parameter, then the share of workers in sector 2 is given by $N_2/G(a_T^*) = 2\eta k/[(1-\eta)(k-1)(a_T^{*k}-1)]$. As a result, $a_{\min}^* = [1+2\eta k/(1-\eta)(k-1)]^{1/k} > 1$. Replacing a_T^* in (32) with $a_{\min}^*$ yields $p_T^{\max}$.

The pattern of intersectoral trade depends on several factors that govern the relationship between the closed-economy equilibrium price p_A, which is given by (31), and the international price p_T : where $p_A = p_T$, there is no trade; where $0 < p_T < p_A$, the economy exports the traditional good; and where $p_A < p_T < p_T^{\max}$, the economy exports the modern good.

What is the impact of a move from autarky to free trade on income distribution, unemployment, and welfare? In the present model the impact of trade is heavily influenced by the pattern of trade which in turn depends on comparative advantage. Without loss of generality, we assume that $p_A < p_T < p_T^{\max}$ so that the economy exports the modern good. Since an increase in the relative price of modern good from p_A to p_T lowers the managerial talent cutoff from a^* to a_T^*, a move from autarky to free trade increases the mass of entrepreneurs and lowers the supply of workers. Equation (12) implies that trade increases each entrepreneur's managerial capital z and firm-level productivity. In sum, trade increases the extensive and intensive margins of managerial capital and raises firm productivity, profits, and entrepreneurial income.

The income distribution equation (23) implies that a decrease in cutoff level from a^* to a_T^* raises entrepreneurial income while leaving worker income unaffected. Thus, trade increases income inequality between entrepreneurs and employed workers. In addition, because aggregate expenditure is inversely related to the managerial cutoff level, trade increases aggregate expenditure E.

Equation (19) implies that a move from autarky to free trade decreases the rate of aggregate unemployment if the job-finding rate in the modern sector exceeds the one in the traditional sector (i.e., $\zeta_2 > \zeta_1$). In other words, the rate of unemployment decreases if labor-market frictions in the traditional sector are more severe than those in the modern sector.

Intuitively, a move from autarky to free trade in this case induces more individuals to become self-employed entrepreneurs, reduces the supply of workers, and lowers the rate of unemployment. However, the accompanied increase in relative price of the modern good, induces a shift of workers from the traditional to the modern sector and reduces unemployment if the latter has higher job-finding rate.

We must emphasize that inequality $\zeta_2 > \zeta_1$ constitutes a sufficient (but not necessary) condition for trade to have a negative impact on unemployment.[26] This feature differentiates

[26] Under the assumption of a Pareto distribution of managerial talent $G(a) = 1 - a^{-k}$, one can readily derive a sufficient and necessary condition for trade to reduce unemployment in our model. In this case, unemployment is given by $\mathcal{U} = 1 - \zeta_1 - \nu(a^*)^{-k}$, where $\nu \equiv 1 - \zeta_1 - \frac{2(\zeta_1 - \zeta_2)\eta k}{(1-\eta)(1-k)}$. Consequently, trade reduces

the present model from Helpman and Itskhoki (2010) and Dinopoulos and Unel (2014). Consider, for instance, the case of no sectoral differences in labor market frictions (that is, $\zeta_2 = \zeta_1$) where inter-industry trade reduces unemployment in the present model. In the model proposed by Helpman and Itskhoki (2010), if $\zeta_2 = \zeta_1$ then intraindustry trade does not affect unemployment; whereas in Dinopoulos and Unel (2014), intraindustry trade increases unemployment independently of job-finding rates. These differences stem from the presence of two channels which transmit the impact of trade on unemployment in the present model: the occupational choice channel which creates and destroys jobs in the traditional sector as trade changes the supply of workers; and the demand-based channel which captures sectoral worker reallocation movements. Dinopoulos and Unel (2014) highlight the former channel, whereas Helpman and Itskhoki (2010) focus on the second one.

Finally, although trade increases the aggregate expenditure E, its impact on aggregate welfare is ambiguous. As shown in Figure 1, where the price of modern good p_T is greater than p', a move from autarky to free trade improves welfare; and where $p_A < p_T < p'$, trade reduces welfare.[27]

The possibility that trade can reduce welfare is not present in the recent studies (e.g., Helpman and Itskhoki (2010), Helpman et al. (2010), and Dinopoulos and Unel (2014)). These studies assume that the modern sector is characterized by monopolistic competition and horizontal product differentiation. As a result, trade increases the mass of varieties available for consumption and therefore raises welfare despite the presence of labor market frictions and unemployment. In contrast, the present model assumes that the modern good is produced under perfect competition and therefore interindustry trade can lead to a welfare loss by changing firm productivity and by increasing the level of hiring costs. In other words, in Melitz (2003) type models of intraindustry trade, the welfare improving effect of more consumed varieties, caused by more intraindustry trade, dominates the welfare losses created by trade-induced resource misallocation in economies with labor-market frictions. The following proposition summarizes the effects of trade on a SOE exporting the modern good.

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unemployment if and only if $\nu > 0$. In other words, the shape parameter of the Pareto distribution k and the span of control parameter η affect the impact of trade on unemployment. Specifically, even in the case where $\zeta_1 - \zeta_2 > 0$, as η approaches zero and the production technology becomes less labor intensive, trade reduces unemployment.

[27] We assume that $p_T > p_A$. On the other hand, if $p_T < p_A$ so that the economy imports the modern good, trade is always welfare improving, as Figure 1 shows.

Proposition 1. *Consider a small open economy producing both goods with comparative advantage in the modern good ($p_A < p_T$). A move from autarky to free-trade:*

a. increases the supply of entrepreneurs and firm productivity by inducing each entrepreneur to acquire more managerial capital;

b. raises income inequality between entrepreneurs and employed workers;

c. lowers aggregate unemployment if the modern good exhibits lower labor-market frictions than the traditional good, that is $\zeta_2 > \zeta_1$;

d. has ambiguous welfare effects: it reduces welfare if $p_T < p'$, and increases welfare if $p_T > p'$.

Structural unemployment carries its own economic and political significance and raises the question of whether job-creating policies affect the economy differently than a move from autarky to free trade. We thus analyze the impact of a few job-creating (as opposed to job-destroying) policies under the maintained assumption that the modern sector exhibits lower labor-market frictions. This assumption implies lower labor-market tightness and therefore higher job-finding rate in the modern sector ($\tau_2 < \tau_1$ and $\zeta_2 > \zeta_1$). Other cases could be readily examined, but are not presented here based on space considerations. The analysis of job-creating policies is facilitated by writing equation (32) as

$$a_T^* = b\lambda\tau_1^{-\frac{1}{1-\gamma}-\rho}\tau_2^{\rho}p_T^{-\frac{2}{1-\eta}}, \tag{33}$$

where $b = 2^{-1/\gamma-2\eta/(1-\eta)}(1+\eta)^{2/1-\eta} > 0$ and $\rho = 2\eta/(1+\gamma)(1-\eta)$ are policy-invariant, inconsequential parameters.

The first exercise consists of a marginal reduction in the costs of managerial capital λ. A reduction in λ captures, albeit in a reduced form, the effects of two classes of policies: those promoting firm entry such as better business climate, simpler bureaucratic processes, and better credit availability to new firms; and policies promoting firm efficiency of established firms such as on-the-job training for managers, lower costs of managerial capital acquisition, and educational policies enhancing entrepreneurship.

A reduction in λ induces more individuals to become entrepreneurs; leads to a reduction in the cutoff level a_T^*, according to (33); lowers unemployment; increases GDP which is directly proportional to aggregate expenditure E; and worsens the income distribution as entrepreneurs acquire more managerial capital, enhance firm productivity and profits, and thus receive higher earnings. As p_T does not change and E increases, a reduction in λ raises welfare, according to equation (25).

Another job-creating policy consists of subsidizing the costs of job vacancies in the modern sector. This policy generates lower labor-market tightness τ_2, lower hiring costs c_2, and higher job-finding rate ζ_2. A decrease in labor-market tightness τ_2 leads to a reduction in the cutoff level of managerial talent a_T^*, according to (33). Consequently, more individuals switch from being workers to entrepreneurs, firm productivity rises, and aggregate expenditure E increases. The rise in firm productivity increases firm profits and entrepreneurial income. The latter contributes to a rise in income inequality.

Because $\mathrm{w}_2 = c_2$, a reduction in job-vacancy costs reduces ex-post worker income in the modern sector and leads to two consequences: first, income inequality between entrepreneurs and workers in the modern sector increases more than the increase in income inequality when λ falls; second, income inequality between workers in the traditional and modern sectors increases as well. Under our maintained assumption $\zeta_2 > \zeta_1$, an increase in ζ_2 coupled with a reduction in a_T^* result in lower unemployment, according to (19). As a result, lowering vacancy costs in the modern sector raises aggregate expenditure (which is proportional to GDP) and reduces unemployment. Finally, a reduction in τ_2 leads to lower hiring costs c_2 and higher welfare according to (24) and (25).

Proposition 2. *Consider a small open economy where the modern sector exhibits lower labor-market frictions (i.e., $\zeta_2 > \zeta_1$). Independently of the trade pattern, a job-creating policy lowering the costs of managerial capital λ or reducing frictions in the modern sector (τ_2) by subsidizing job vacancies:*

a. *increases the supply of entrepreneurs and firm productivity by inducing each entrepreneur to acquire more managerial capital;*

b. *raises income inequality between entrepreneurs and employed workers;*

c. *increases aggregate expenditure and GDP;*

d. *lowers aggregate unemployment;*

e. *raises aggregate welfare.*

4.2 A Two-Country Global Economy

In this section, we analyze a world economy consisting of two trading countries, Home and Foreign. Following standard practice, we assume that preferences and production functions are identical between countries. We use the two-country framework to analyze how cross-country differences in labor market rigidities and costs of managerial capital determine the pattern of trade. In addition, we investigate how unilateral job-creating policies affect each economy.

Equilibrium condition (30) implies that the managerial talent cutoff levels in autarky do not depend on labor-market frictions and costs of managerial capital; as a result, Home and Foreign have the same managerial talent cutoffs (i.e. $a^*_{AH} = a^*_{AF} = a^*_A$). Equation (31) indicates that Home, despite having the same managerial talent cutoff level as Foreign, produces the modern good cheaper in autarky (i.e., $p_{AH} < p_{AF}$) if the following inequality holds

$$f_H \equiv \tau_{1H}^{-\delta}\tau_{2H}^{\frac{\eta}{1+\gamma}}\lambda_H^{\frac{1-\eta}{2}} < \tau_{1F}^{-\delta}\tau_{2F}^{\frac{\eta}{1+\gamma}}\lambda_F^{\frac{1-\eta}{2}} \equiv f_F, \tag{34}$$

where $\delta = \eta/(1+\gamma) + (1-\eta)/(2\gamma) > 0$ is an inconsequential constant. Parameter f_j ($j = H, F$) captures country j's relative cost advantage in production of modern good which is reflected on its autarky price. Thus, ceteris paribus, each country exports the good with lower relative labor-market frictions captured by term $\tau_2^{\eta/(1+\gamma)}/\tau_1^{\delta}$ and/or lower relative costs of managerial capital captured by λ_H/λ_F. Without loss of generality, in what follows we assume that inequality (34) holds so that Home exports the modern good.

4.2.1 Equilibrium in the Global Economy

As in the small open economy (SOE) case, balanced trade implies $Y_{1j} - C_j + p_T Y_{2j} = Q_{1j} + p_T Q_{2j} = E_j$, where Q_{ij} is the total quantity of good i consumed in country j; C_j is the total cost of hiring workers and managerial capital in country j (measured in terms of good 1); p_T is the common free-trade price of good 2; and E_j is aggregate expenditure given by (24).

In equilibrium, global demand for each good must equal its net global supply

$$Q_{1H} + Q_{1F} = Y_{1H} - C_H + Y_{1F} - C_F, \tag{35a}$$

$$Q_{2H} + Q_{2F} = Y_{2H} + Y_{2F}. \tag{35b}$$

Substituting $Q_{2j} = \beta E_j$ from (2) and Y_{2j} from (20b) into market-clearing condition (35b) yields

$$\sum_{j=H,F} \frac{\mathbb{E}[a \geqslant a_j^*]}{a_j^*} = B \sum_{j=H,F} G(a_j^*), \tag{36}$$

where B is given by (30). Equation (36) constitutes a generalization of the closed-economy equilibrium condition (30). Since the cutoff level a_j^* is a decreasing function of p, as indicated by equation (11), the LHS of (36) increases with p, whereas the RHS decreases with p. Thus, the above condition yields unique solution to the equilibrium relative price of modern good p_T in the world market. Substituting p_T in equation (11) leads to the unique managerial ability cutoff a_j^* for each country. In addition, inequality (34) ensures that $a_H^* < a_F^*$, that is, more individuals choose to become entrepreneurs in Home.

Lemma 4. *Suppose that $f_H < f_F$ holds so that the relative price of modern good is lower in Home than in Foreign. Then there exists a solution (a_H^*, a_F^*) satisfying equilibrium condition (36) which is unique and implies that $a_H^* < a_F^*$.*

A move from autarky to free trade operates through changes in the relative price of modern good, which increases in Home and decreases in Foreign. The effects of a change in relative price were analyzed in Section 4.1 and will not be repeated here.

The presence of labor-market distortions combined with perfectly competitive product markets lead to an ambiguous effect of trade on Home welfare. Figure 2 illustrates this ambiguity and the possibility of Home welfare loss from trade. Specifically, for each ratio of autarky prices p_{AF}/p_{AH} the graph illustrates the percentage change in Home welfare associated with a move from autarky to trade.[28] The autarky price ratio is greater than one, as we assume that Home has a comparative advantage in the production of modern good.

Figure 2 shows that Home can lose or gain from trade. For example, point A illustrates the case where the autarky price in Foreign is 20 percent higher than the autarky price in Home ($p_{AF}/p_{AH} = 1.2$). In this case, moving from autarky to free trade *decreases* Home welfare by 0.3 percent. Point B illustrates the case $p_{AF}/p_{AH} = 1.4$ where a move from autarky to free trade does not change Home welfare. Finally, Point C shows the case

[28]Figure 2 is created under the assumption that the distribution of managerial ability is Pareto, and we set $k = 2.5, \beta = 0.75, \eta = 1/3, \lambda_H = 3, \tau_{1H} = \tau_{1F} = 0.65, \tau_{2H} = \tau_{2F} = 0.55$, and $\gamma = 1$. These parameter values are the same as those used to construct Figure 1. These parameter restrictions imply $p_{AF}/p_{AH} = (\lambda_F/\lambda_H)^{(1-\eta)/2}$ (see equation (34)); as a result, we chose $\lambda_F \in [3, 24]$ so that $p_{AF}/p_{AH} \in [1, 2]$.

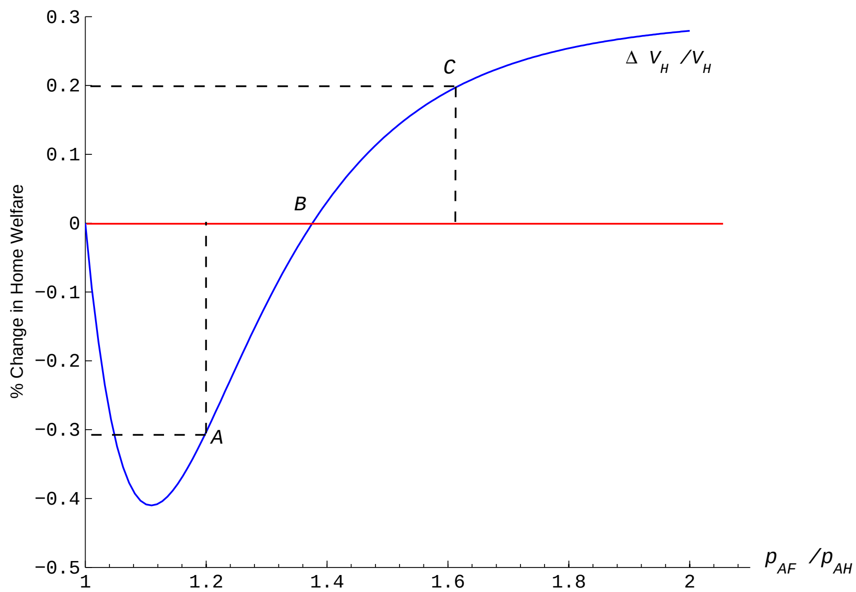

Figure 2: Changes in Home welfare

$p_{AF}/p_{AH} = 1.6$ where a move from autarky to free trade increases Home welfare by 0.2 percent. In all these cases Foreign welfare increases substantially. Point A corresponds to a 4.5 percent increase in Foreign welfare, point B to a 12.5 percent welfare increase, and point C to a 24 percent increase, respectively. Thus in the presence of labor-market frictions and endogenous firm productivity interindustry trade can generate substantial welfare gains.

The finding, that trade may reduce welfare in one country, differs from one of the main results obtained by Helpman and Itskhoki (2010), Helpman et al. (2010), and Dinopoulos and Unel (2014). These studies find that trade improves welfare in both countries despite the presence of equilibrium unemployment. As explained earlier, intraindustry trade in these models increases the measure of varieties consumed leading to substantial additional gains. These additional welfare gains are absent from the present model and thus trade may reduce welfare.

What are the main features of a two-country global economy with labor-market frictions and free inter-industry trade? How do personal income distribution, unemployment, and welfare differ across the two countries? To enhance the presentation, we assume that both countries have the same labor-market frictions in the traditional sector and that Home exhibits lower labor-market frictions in the modern sector. We also assume that Home exhibits lower costs of managerial capital. Roughly speaking, Home represents an advanced country (North) with more flexible labor markets and lower or equal costs of managerial capital. The following lemma states the technical restrictions implied by these assumptions.

Assumption 1. $\tau_{1H} = \tau_{1F} = \tau_1,\ \tau_{2H} < \tau_{2F} < \tau_1,$ *and* $\lambda_H \leqslant \lambda_F$.

Under Assumption 1, equation (12) implies that each entrepreneur in Home acquires more managerial capital than her foreign counterpart. Equation (34) implies $f_H < f_F$ and therefore Home exports the modern good. According to equation (13), each Home entrepreneur invests more in managerial capital leading to higher firm productivity, and earns more, that is, $e_H(a) > e_F(a)$. Thus, Home exhibits higher income inequality between entrepreneurs and workers. In addition, using $\zeta_{1H} = \zeta_{1F}$ and $a_H^* < a_F^*$, equation (24) implies that Home has higher aggregate spending and GDP than Foreign ($E_H > E_F$). Using (19), it can be readily shown that unemployment is lower in Home. Finally, substituting $E_H > E_F$ into welfare function (25) yields $\mathbb{V}_H > \mathbb{V}_F$. In sum, Home (North) has higher GDP, higher welfare, lower unemployment, more entrepreneurs, and higher inequality than Foreign (South). The following proposition summarizes these results.

Proposition 3. *Consider two freely trading countries Home and Foreign as described. Under Assumption 1:*

a. entrepreneurs acquire more managerial capital leading to higher firm-level productivity in Home;

b. income inequality between entrepreneurs and workers is greater in Home;

c. Home has higher expenditure and GDP;

d. Home has lower unemployment;

e. and Home achieves higher welfare.

We next investigate how a unilateral job-creating policy affects cross-country differences in income distribution, unemployment, and welfare. We consider two cases: a reduction in the cost of managerial capital λ;[29] and a reduction in labor-market rigidities in the modern sector τ_2. A reduction in λ_j or τ_j lowers f_j. In what follows, without loss of generality, we

[29] This exercise complements Unel (2013b) who investigates the impact of a unilateral change in the cost of forming human capital on inequality and welfare in each country in the absence of labor-market frictions.

assume that a reduction in these parameters is not substantial so that condition (34) still holds, i.e. $f_H < f_F$. The following lemma summarizes the impact of such policies on the equilibrium talent cutoff a_j^* in each country (see Appendix A for the proof).[30]

Lemma 5. *Consider two freely trading countries Home and Foreign as described. A unilateral job-creating policy adopted by Home (in the form of a reduction in λ_H or τ_{2H}) decreases the equilibrium managerial talent cutoff level a_H^* in Home, while increasing the corresponding cutoff level a_F^* in Foreign. In addition, it reduces the world relative price of the modern good p_T.*

Armed with these results, analyzing the impact of a unilateral job-creating policies is similar to the analysis in Section 4.1, and will not be repeated here. As Appendix B elaborates, a unilateral job-creating policy lowers the free-trade price p_T and improves welfare in both countries.

Finally, we analyze how such unilateral job-creating policies affect national income distribution, unemployment, and welfare. Under Assumption 1, Home has more managerial capital than Foreign in the initial equilibrium. Equation (12) implies that unilateral job-creating policies in the form of lower λ_H or τ_{2H} widen the managerial-capital gap across countries. In addition, equation (12) ensures that the cross-country income inequality between entrepreneurs and workers rises. As Home has higher initial expenditure and GDP, equation (24) implies that these policies increase the aggregate spending and GDP gap between the two countries. Furthermore, using equation (19), it can be shown that such policies create more jobs in Home and destroy jobs in Foreign thus leading to a divergence in national unemployment rates.

In sum, although unilateral job-creating policies improve welfare in both countries they exhibit "beggar-thy-neighbor" features: they reduce unemployment, raise firm productivity, and enhance entrepreneurship and firm formation in Home; while they raise unemployment, reduce firm productivity, and discourage entrepreneurship and firm formation abroad.

Proposition 4. *Consider two freely trading countries Home and Foreign as described. Under Assumption 1, unilateral job-creating policies in the form of lower λ_H or τ_{2H} implemented by Home:*

[30]In Lemma 5, we consider a unilateral job-creating policy adopted by Home. A unilateral job-creating policy adopted by Foreign, on the other hand, decreases a_F^* while increasing a_H^*.

a. widen the initial unemployment gap between Home and Foreign by reducing unemployment in Home and increasing it in Foreign;

b. lead to divergence in managerial capital and firm productivity between Home and Foreign;

c. lead to divergence in cross-country income inequality between entrepreneurs and workers;

d. and raise welfare in both countries.

5 Concluding Remarks

We developed a simple and tractable theory featuring the complex interactions among interindustry trade, personal income distribution, firm-level productivity, unemployment, and welfare. The key features of the theory consist of individuals differing in managerial talent and choosing optimally their occupation, perfectly competitive product markets generating interindustry trade, and labor-market frictions leading to equilibrium unemployment.

The assumption of perfectly competitive product markets provides considerable analytical mileage. It permits the use of a small-open-economy framework to analyze the effects of more trade and job-creating policies stemming from reductions in managerial-capital costs and job-vacancy subsidies. Job-creating policies generally lead to lower unemployment, higher GDP, higher aggregate welfare, and higher income inequality.

The theory permits the analysis of managerial capital and labor-market frictions as determinants of comparative advantage in a two-country global economy. We find that, ceteris paribus, a country exports the good exhibiting lower labor-market frictions and/or lower costs of managerial capital. We also find that a country with lower costs of managerial capital and more flexible labor markets exhibits lower unemployment, higher GDP, higher firm-level productivity, and worse income distribution than its trading partner. Finally, we establish that, starting at the free-trade equilibrium described above, unilateral job-creating policies improve national and global welfare; and lead to divergence in firm-productivity, income distribution, and unemployment between the two countries.

The proposed theory can be extended along several directions. One can analyze the case where entrepreneurs face the prospect of search-based unemployment. The assumption that worker productivity is independent of worker ability is restrictive and can be substituted by one where worker productivity increases with ability. One can also introduce another factor of production, such as capital, to analyze the role of factor endowments in conjunction with labor-market frictions as determinants of comparative advantage. These topics constitute fruitful areas for future research.

Appendix

A. Proof of Lemma 5

Note that a reduction in τ_j implies a reduction c_j, and thus we hereafter assume a reduction in c_{2j}. Let x_H denote λ_H or c_{2H}. Totally differentiating (36) with respect to x_H yields

$$\sum_j \Gamma_j \frac{da_j^*}{dx_H} = 0, \qquad \Gamma_j = (1+B)g(a_j^*) + \frac{\mathbb{E}[a \geqslant a_j^*]}{a_j^{*2}}. \tag{37}$$

where B is given by (30).

Differentiating (11) with respect to λ_H and c_{2H} yields

$$\frac{da_H^*}{d\lambda_H} = \frac{a_H^*}{\lambda_H} - \frac{2a_H^*}{(1-\eta)p_T}\frac{dp_T}{d\lambda_H}, \qquad \frac{da_F^*}{d\lambda_H} = -\frac{2a_F^*}{(1-\eta)p_T}\frac{dp_T}{d\lambda_H} \tag{38a}$$

$$\frac{da_H^*}{dc_{2H}} = \frac{2\eta a_H^*}{(1-\eta)c_{2H}} - \frac{2a_H^*}{(1-\eta)p_T}\frac{dp_T}{dc_{2H}}, \qquad \frac{da_F^*}{dc_{2H}} = -\frac{2a_F^*}{(1-\eta)p_T}\frac{dp_T}{dc_{2H}}, \tag{38b}$$

where p_T is the world relative price of good 2. Substituting these into (37) yields

$$\frac{dp_T}{d\lambda_H} = \frac{(1-\eta)\Gamma_H a_H^* p_T}{2\lambda_H \sum_j \Gamma_j a_j^*} > 0, \tag{39a}$$

$$\frac{dp_T}{dc_{2H}} = \frac{\eta \Gamma_H a_H^* p_T}{c_{2H} \sum_j \Gamma_j a_j^*} > 0. \tag{39b}$$

The first equations in (38a) and (38b) imply $da_F^*/dx_H < 0$ for $x_H = \lambda_H, c_{2H}$. Finally, substituting (39a) and (39b) into the the second equations in (38a) and (38b) yields

$$\frac{da_H^*}{d\lambda_H} = \frac{a_F^* a_H^* \Gamma_F}{\lambda_H \sum_j \Gamma_j a_j^*} > 0, \qquad \frac{da_H^*}{dc_{2H}} = \frac{2\eta a_F^* a_H^* \Gamma_F}{(1-\eta)c_{2H} \sum_j \Gamma_j a_j^*} > 0. \tag{40}$$

B. Welfare Effects of Unilateral Job-Creating Policies

Differentiating $\mathbb{V}_j = p_T^{-\beta} E_j$ with respect to $x_H = \{\lambda_H, c_{2H}\}$ and using equations (38), (39), and (40) yields

$$\frac{d\mathbb{V}_H}{dx_H} = -\frac{\beta\zeta_1}{2p_T^{1+\beta}} \left[G(a_H^*) + \left(1 + \frac{2a_F^*\Gamma_F}{\beta(1-\eta)a_H^*\Gamma_H}\right) \frac{\mathbb{E}[a \geqslant a_H^*]}{a_H^*} \right] \frac{dp_T}{dx_H} < 0, \tag{41a}$$

$$\frac{d\mathbb{V}_F}{dx_H} = -\frac{\beta\zeta_1}{2p_T^{1+\beta}} \left[G(a_F^*) - \frac{\mathbb{E}[a \geqslant a_F^*]}{B_m a_F^*} \right] \frac{dp_T}{dx_H} < 0, \tag{41b}$$

where B_m is given by (29). Using $a_F^* > a_{AF}^*$ and $B_m > B$ implies that the expression in the square brackets in (41b) is positive. This, combined with $dp_T/dx_H > 0$, implies that $d\mathbb{V}_F/dx_H < 0$ for $x_H = \{\lambda_H, c_{2H}\}$.

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