Labor Standards and International Trade in a Search-Matching Model*

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Abstract

In order to shed some theoretical light on the impact of labor standards on trade competitiveness, we develop an international trade model with search-matching frictions. The traditional sector is labor-intensive, while the modern sector is capital-intensive, and exhibits search frictions in its labor market. We assume that workers in the domestic country have a stronger bargaining power than their foreign counterparts. We show that the domestic country can have a comparative advantage in the modern sector. This result may explain why some empirical papers obtain a positive correlation between stronger labor standards and higher manufacturing exports. We also show that stronger labor standards may make a country more attractive to capital.

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1 Introduction

It is widely acknowledged that better labor standards should be promoted in developing countries. In particular, it is often argued that freedom of association and collective bargaining (FACB) rights should be strongly enforced. The main motivation for such statements is that FACB rights are classified as "civic rights" for workers. As a result, they are linked to civil liberties and democracy, and they have a value *per se*.[1]

On the other hand, some have raised concerns on the potential adverse impact of FACB rights enforcement on the economic competitiveness of developing countries. If the modern sector of a developing country becomes heavily unionized, so the argument goes, it seems reasonable to assume that wages should be pushed up. This should erode the competitiveness of manufacturing firms, and therefore reduce the size of the modern sector, thereby slowing down the development process. Besides, foreigners would then be reluctant to invest their capital in this country, which would imply a decrease in inward FDI flows. If this point is taken seriously, the enforcement of FACB rights may have an even more negative impact on economics development.

In a nutshell, the conventional wisdom seems to be that there is tradeoff between stronger FACB rights and economic development. Yet, empirical studies provide mixed evidences. Rodrik (1996), Busse (2001) and Flanagan (2003) find no statistically significant evidence that the ratification of ILO standards affects exports. Using the OECD FACB index, Busse (2001) and Belser (2001) obtain that stronger FACB rights affect trade negatively. In a recent paper, Kucera and Sarna (2006) use a trade gravity model to assess the impact of FACB rights on exports, using their own indicators for FACB rights enforcement. They find a statistically significant relationship between stronger FACB rights and higher manufacturing exports. They also argue that the previous studies are questionable, because their authors did not include regional dummies in their regressions. In particular, they claim that the negative relationship between FACB rights and manufacturing exports in these studies was essentially driven by the Asian continent. Once regional dummies are included, this negative relationship disappears, and actually becomes positive.

In this paper, we provide a theoretical argument to explain how stronger FACB rights can be associated with higher manufacturing exports. Broadly speaking, we argue that the conventional wisdom, according to which stronger FACB rights should reduce manufacturing exports, is based on an absolute advantage reasoning, not on a comparative advantage one. We show that a comparative advantage reasoning can reconcile Kucera

[1] See, for instance, ILO (2004), paragraph 242: "Labour market institutions, including appropriate legal frameworks, freedom of association, and institutions for dialogue and bargaining are also essential in order to protect the fundamental rights of workers, provide social protection and promote sound industrial relations."

and Sarna (2006)'s finding with the theory.

To make this point, we develop a two-country, two-sector, two-factor model, with perfectly competitive goods markets. Both countries, H and F, are endowed with a fixed stock of labor, L, and a fixed stock of capital, K. The first sector, which we label as sector T, operates under constant returns to scale. Its production technology uses only labor, and there are no search frictions in its labor market: a worker can find a job instantaneously in this sector, and labor receives its marginal product. The second sector, sector M, uses both capital and labor under constant returns to scale. Its labor market features search and matching frictions *à la* Pissarides (1985). It takes time for a worker to find a corresponding unit of capital, and vice versa. We interpret sector T as a traditional, agricultural and labor-intensive sector with little labor market frictions, while sector M is a modern, manufacturing and capital-intensive sector, in which information asymmetries cause important delays in the formation of employer-worker pairs.

In the modern sector, after a unit of capital and an unemployed worker have met, ex post bargaining takes place so as to share the surplus. We denote by β the share of the surplus that a worker receives after a match has been formed in the home country. Similarly, β^* denotes workers's bargaining power in the foreign country. We assume that $\beta > \beta^*$, namely, workers in the home country receive a larger fraction of the surplus than their foreign counterparts. The home country should be interpreted as a country where FACB rights are better enforced than in the foreign one. It is easier for domestic workers to organize and bargain collectively, and they can therefore claim for a a higher share of the surplus. Other than that, the two countries are perfectly symmetric, in terms of endowments, and production and matching technologies.

As is standard in the trade literature, we start by computing the unique autarkic equilibrium. Doing comparative statics on β, the proxy for FACB rights, we show that the relative price of good M is lower in the high FACB rights country. As a result, this country has a comparative advantage in the modern, manufacturing sector. This counterintuitive result comes from the presence of search and matching frictions. When workers have higher bargaining power, they anticipate that they will be able to get a higher share of the surplus in the modern sector once they find a job. This attracts more workers into the unionized sector, which diminishes the relative scarcity of good M, and hence, its autarkic relative price.

After having found the comparative advantages, it is immediate to derive the patterns of trade. After trade liberalizes, the relative price of good M in the high FACB rights country increases. Thus, this country becomes a net exporter of good M in equilibrium, and the size of its modern sector grows following trade liberalization. Hence, the presence of search-matching frictions in the modern sector may explain why the empirical results on the impact of FACB rights on manufacturing trade are so inconclusive.

We then check whether Stolper-Samuelson results still hold in the presence of search frictions. In a frictionless environment, we would expect capital to gain and labor to lose in real terms, as production is moved from the labor-intensive sector to the capital-intensive one. We show that this is indeed true for *searching* factors. However, this may not hold for matched labor: it may well be that a worker employed in the unionized sector *before* trade liberalization gains from trade.

Our result on the impact of FACB rights on a country's comparative advantage was derived by making two important assumptions. First, the production technology in the modern sector is one-to-one: to produce one unit of the modern good, one unit of capital and one unit of labor are needed. Second, there is a fixed stock of capital in both countries. These assumptions imply in particular that the supply of capital in the modern sector, and hence the demand for labor in this sector, do not depend on the bargained wage. Therefore, in our baseline model, the standard labor cost effect is not present. To show the robustness of our results, we assume that a capitalist has to incur a search cost as long as it has not found a worker. This assumption is standard in the search-matching literature, and it implies that the supply of jobs in the modern sector does depend on the bargained wage through the classical job creation condition. Under this assumption, we show that the home country still has a comparative advantage in the modern sector, as long as its workers's bargaining power is not too strong.

At the end of the paper, we allow for international capital migrations. This enables us to shed some light on the impact of labor standards on a country's attractiveness to foreign capital. We exhibit the trade-off faced by capitalists when deciding in which country to locate. On the one hand, producing in the home country allows to attract more workers, which lowers the labor market tightness. On the other hand, producing abroad allows to get a larger share of the surplus. We show that the first effect dominates when the domestic workers' bargaining power is not too high. In this case, the home country receives inward capital flows. In other words, stronger labor standards can paradoxically attract some capital, provided that they are not too strong.

This article is related to several strands of the literature. We rely strongly on the traditional trade theory, i.e., trade models of comparative advantages under perfect competition and constant returns to scale; see Jones (1965) and Dixit and Norman (1980). We also ground heavily on the search and matching literature; see Pissarides (1985), Pissarides (2000) and Rogerson, Shimer, and Wright (2005) for a survey.

Our paper is also related to a series of recent articles on the interactions between international trade and the labor market. In Davidson, Martin, and Matusz (1999), differences in terms of matchings technologies across countries determine countries' comparative advantages, and hence, the patterns of trade.[2] Cuñat and Melitz (2007) modify the model of Dornbusch, Fischer, and Samuelson (1977) by allowing for differences in terms of labor market flexibility across countries. They show that countries with higher labor market flexibility tend to have a comparative advantage in high-turnover sectors. Janiak (2007), Helpman and Itskhoki (2007) and Felbermayr, Prat, and Schmerer (2008) merge the Melitz (2003) and the Pissarides (2000) models to assess the impact of trade liberalization on unemployment. None of these papers derive the impact of bargaining power differentials on the patterns of trade.

The remainder of the paper is organized as follows. In section 2, we present our model. The autarkic equilibrium is exhibited in section 3. This allows us to derive comparative advantages and to solve for the free trade equilibrium in section 4. In section 5, we show the robustness of our results to search costs and elastic labor demand. Section 6 solves the model under international capital mobility. Section 7 concludes.

2 The Model

There are two countries, H (home) and F (foreign), two sectors, T and M and two production factors, capital K and labor L. In the following, "starred" variables denote the foreign country's variables.

Endowments Both countries are exogenously endowed with L units of capital and K units of labor. We assume that capital and labor cannot migrate across countries. In Section 6, we allow some capitalists to send their capital abroad.

Preferences As is standard in a search-matching framework, consumers are risk neutral, and their rate of time preference is equal to the constant r. This implies that workers and capitalists maximize their present discounted value of income. In such a framework, international lending and borrowing will never happen, and trade will be balanced at each period of time.

In line with the international trade literature, consumers all have the same preferences, which are assumed to be strictly quasi-concave, twice continuously differentiable with positive partial derivatives, and homothetic. Denoting by C_M and C_T the consumption of goods M and T respectively, we also assume that consumers' utility function, denoted by $\phi(C_M, C_T)$ satisfies: $\phi(0, X) = \phi(X, 0) = 0$, $\lim_{C_i \to 0} \frac{\partial \phi}{\partial C_i} = +\infty$, $\lim_{C_i \to +\infty} \frac{\partial \phi}{\partial C_i} = 0$ and $\lim_{C_i \to +\infty} \phi = 0$, for $C_j \neq O$ and $i \neq j$ in $\{M, T\}$. In particular, the relative demand function can be written as $\frac{C_M}{C_T} = D(\frac{P_M}{P_T})$, where $D(.)$ is downward-sloping.

[2]See also Davidson, Martin, and Matusz (1987, 1988, 1991) and Hosios (1990a) for similar two-sector models.

Technologies Sector T is the traditional sector. Firms in T operate under constant returns to scale and perfect competition. The production technology transforms one unit of labor into one unit of good T. We assume away any kind of technology differences across country. In the following, good T will be taken as the numeraire, so that $P_T = 1$.

In manufacturing sector M, some capital is needed in the production process. We assume the following fixed-proportions technology: One unit of capital together with one unit of labor allow for the production of 1 unit of good M. Once again, in order to focus on the impact of labor market imperfections, we consider that both countries have access to the same technology.

Markets As we said before, the goods markets are perfectly competitive.

Workers face the following choice. They can either be employed instantaneously in sector T and earn wage w_T. With the constant returns to scale assumption, we immediately get that $w_T = P_T = 1$. Or they can look for a unit of capital in sector M; If they do so, they go through an unemployment spell before finding a match.

More precisely, if N_U is the number of workers looking for a job in sector M, and N_V is the number of units of idle capital, we assume that $\mu(N_U, N_V)dt$ jobs are created between time t and time $t + dt$. As usual, we assume that the matching function is concave, homogenous of degree 1, twice continuously differentiable, has positive partial derivatives, and satisfies $\lim_{N_i \to 0} \mu = 0$ and $\lim_{N_i \to +\infty} \mu = +\infty$ for $i = U, V$.

We make all the usual assumptions regarding the matching function: constant returns to scale, concavity and positiveness of partial derivatives. As usual, we can then define parameter $\theta = \frac{N_V}{N_U}$ as the labor market tightness. The instantaneous probability for a unit of idle capital to find a worker is then equal to $\mu\left(\frac{N_U}{N_V}, 1\right) = \mu(\theta^{-1}, 1) \equiv q(\theta)$, with $q'(.) < 0$. Similarly, an unemployed worker finds a job at rate $\theta q(\theta)$, with $\frac{d(\theta q(\theta))}{d\theta} > 0$. To allow for the existence of steady state unemployment, we assume that matches are destroyed at rate $\delta > 0$. For the sake of simplicity, we assume away any form of search costs, unemployment benefits or domestic production. This implies that each unit of capital will either be employed or looking for a worker in equilibrium.[3] In line with most of the search and matching literature, we do not allow for on-the-job search either.

The assumptions we make on the two sectors may seem rather extreme, but they are made to capture the following idea. Sector T should be seen as a traditional, labor-intensive sector, in which search-matching frictions are small, namely, it does not take too long to find a job in this sector. On the other hand, sector M should be thought of as a modern, capital-intensive sector, in which information asymmetries about the quality of workers and firms imply important delays in the formation of matches.

[3]We relax this assumption in Section 5.

Ex post bargaining and FACB rights Once a worker and a unit of capital have met, ex post Nash bargaining occurs so as to share the surplus created by the match. We assume that workers in the domestic country have more bargaining power than in the foreign one, i.e., $\beta > \beta^*$. Domestic workers are able to capture a larger share of the surplus, because FACB rights are better enforced in country H. Notice that this is the only difference between countries in this economy, hence, the only potential source of comparative advantages. In the absence of increasing returns to scale and imperfect competition, this difference in FACB rights is the only reason why trade will occur in equilibrium.

Equilibrium We focus on steady-state equilibria and ignore the transitional dynamics.

3 Self-Sufficiency Equilibrium

In this section, we assume that the emergence of trade is precluded. This will allow us to derive autarkic relative prices, hence comparative advantages. To do so, we proceed as follows. First, we find a non-arbitrage condition on the labor market, which gives us the relative price of goods for any level of the labor market tightness. Then, using factor markets clearing conditions together with the Beveridge curve, we get the quantities produced for both goods as functions of θ. Combining these relations with the non-arbitrage condition, we get an upward-sloping relative supply curve, which intersects the relative demand curve once, and only once, yielding a unique equilibrium. In the following, we focus on domestic country variables but, as should be obvious, the same reasoning could be made in the foreign country.

Non-arbitrage condition on the labor market To begin with, let us write the value functions of workers in sector M. We denote by U the present discounted value of looking for a job in sector M, and $W(w)$ the value of being employed at wage w in sector M. We have the following Bellman equations:[4]

$$rU = \theta q(\theta)\left(W - U\right), \tag{1}$$

$$rW(w) = w + \delta\left(U - W(w)\right). \tag{2}$$

Similarly, we define value functions for units of capital. V denotes the present discounted value of being idle, while $J(w)$ denotes the value of being matched with a worker, paid at

[4] Since we have chosen to rule out the transitional dynamics, we can ignore the time derivatives of the value functions.

wage w. The Bellman equations are given by:

$$rV = q(\theta)(J - V), \tag{3}$$

$$rJ(w) = P_M - w + \delta(V - J(w)). \tag{4}$$

Once a match is realized, wage bargaining takes place and the surplus is shared. If the negotiation breaks, the worker goes back to unemployment and earns U, while the capital owner earns the value of being idle V. If it succeeds, the latter earns $W(w)$, while the former gets $J(w)$. Formally, the wage is chosen so as to maximize the following Nash product:[5]

$$(W(w) - U)^{\beta}(J(w) - V)^{1-\beta}.$$

As is well known, this implies that the worker gets a share β of the match surplus: $W(w) - U = \beta(J(w) + W(w) - V - U)$. After some algebra, we obtain the bargained wage as a function of the price of good M and the labor market tightness:

$$w = \frac{\beta(r + \delta + \theta q(\theta))}{(1-\beta)(r + \delta + q(\theta)) + \beta(r + \delta + \theta q(\theta))} P_M. \tag{5}$$

The above expression is obviously increasing in θ. Intuitively, as the labor market tightness increases, the probability for an unemployed worker to receive a job offer goes up, whereas the probability for an idle capitalist to find a worker goes down. This increases the workers' outside option and decreases the capitalists' one, which leads to a higher bargained wage.

This value can be plugged into the expression of U to get the value of being unemployed:

$$rU = \frac{\beta\theta q(\theta)}{(1-\beta)(r + \delta + q(\theta)) + \beta(r + \delta + \theta q(\theta))} P_M.$$

In equilibrium, workers have to be indifferent between working in sector T at wage $w_T = 1$ and being unemployed in sector M. Since agents are risk neutral, the present discounted value of the expected income flows have to be equalized across sectors. In other words, rU has to be equal to 1. Straightforward computations yield the non-arbitrage condition:

$$P_M = \frac{(1-\beta)(r + \delta + q(\theta)) + \beta(r + \delta + \theta q(\theta))}{\beta\theta q(\theta)}. \tag{6}$$

Hence, the relative price of good M is a decreasing function of the labor market tightness θ. This relation is rather intuitive. As the relative price of good M increases, the total surplus from a match in the modern sector increases, and some of this increase is passed

[5] We are aware of Hall and Milgrom (2005)'s criticism. In such a framework, the outcome of the negotiation depends heavily on non-credible threats, which is inconsistent with Binmore, Rubinstein, and Wolinsky (1986)'s theory of sequential bargaining. We choose to keep on using Pissarides (2000)'s framework anyway, since it is still widely accepted in the literature.

through to workers through wage bargaining. This induces some workers to move from sector T to sector M, which lowers the labor market tightness, since the stock of capital is fixed.

Equilibrium on the factors markets In the following, we fix the relative price of good M. We have seen that this yields a unique value for the labor market tightness. First, let us write the factor markets clearing conditions (remembering the fact that $N_V = \theta N_U$):

$$\begin{aligned} K &= X_M + \theta N_U, \\ L &= X_T + X_M + N_U, \end{aligned}$$

where X_i denotes the production in sector i.

Since we have chosen to focus on steady states, we can use the Beveridge curve: $\delta M = N_U \theta q(\theta)$, which basically states that destroyed jobs have to be replaced by newly created ones in equilibrium. We have thus 3 equations, 3 unknowns, with θ as a parameter. This system has a unique solution:

$$N_U = \frac{\delta}{\delta + q(\theta)} \frac{1}{\theta} K, \tag{7}$$

$$X_T = L - \frac{\delta + \theta q(\theta)}{\delta + q(\theta)} \frac{1}{\theta} K, \tag{8}$$

$$X_M = \frac{q(\theta)}{\delta + q(\theta)} K. \tag{9}$$

One sees immediately that X_M is a decreasing function of θ. Intuitively, as θ gets higher, there are less workers looking for a job in sector M. That also means that there are less workers actually employed in sector M, hence less production. A similar reasoning can be made to show that the production of sector T increases as labor market tightness rises.[6] Therefore, the ratio $\frac{X_M}{X_T}$ is a decreasing function of θ.

Relative supply curve and autarkic equilibrium Let us now summarize. The price P_M uniquely determines the labor market tightness through the non-arbitrage condition on the labor market. This value of θ then uniquely determines the relative supply of goods through the factor markets clearing conditions and the Beveridge curve. We have

[6] The partial derivative of T with respect to θ is given by:

$$\frac{\partial X_T}{\partial \theta} = \frac{K\delta}{\theta^2 \left(\delta + q(\theta)\right)^2} \left\{ \delta + (\theta q(\theta))' - \theta^2 q'(\theta) \right\},$$

which is positive thanks to the assumptions we have made on the matching function.

just exhibited the relative supply curve. Let us check that it is positively sloped:

$$\frac{\partial P_M}{\partial X_M/X_T} = \frac{\partial P_M}{\partial \theta}\frac{\partial \theta}{\partial X_M/X_T}.$$

Both terms in the right-hand side product are strictly negative, therefore, the relative supply curve is upward sloping. On the consumers side, we assumed that the relative demand function was downward sloping. These two curves intersect each other once, and only once. That result is summarized in the following proposition:

Proposition 1. *The autarkic equilibrium exists, and it is unique.*

Proof. Immediate. □

4 Free Trade Equilibrium

We now consider the polar case in which all barriers to trade have been removed. As usual in a trade model with perfect competition, we first compare the autarkic relative prices of the two countries, which will give us the comparative advantages, hence, the patterns of trade. We then evaluate the impact of trade openness on the domestic country's endogenous variables.

4.1 Comparative Advantages and Free trade Equilibrium

Comparative advantages As we said before, the only difference between the two countries is the enforcement of FACB rights. Therefore, to exhibit each country's comparative advantage, we have to investigate the impact on the autarkic price of an increase in β. Obviously, a change in β will not affect the relative demand curve. Hence, the only channel through which the relative autarkic price can be affected is the supply curve.

Fix the ratio $\frac{X_M}{X_T}$. We know that this uniquely determines a value of θ, which does not depend on β (see equations (8) and (9)). Using the non-arbitrage condition on the labor market, we can now compute the partial derivative of the price ratio with respect to β, taking the value of θ as given. We get:

$$\frac{\partial P_M}{\partial \beta} = -\frac{1}{\beta^2}\frac{r+\delta+q(\theta)}{\theta q(\theta)}, \tag{10}$$

which is strictly negative. For a given ratio $\frac{X_M}{X_T}$, P_M is lower when β is larger. In other words, as β rises, the relative supply curve shifts downwards. The relative price of good M has then to decrease to restore equilibrium on the goods markets, as can be seen in Figure 1. Therefore, the relative price of good M is a decreasing function of workers' bargaining power β. Since, by assumption, $\beta > \beta^*$, the autarkic relative price of good M is lower in the domestic country. We can now state the following proposition:

Proposition 2. *The higher FACB rights country has a comparative advantage in good M.*

Proof. Immediate. □

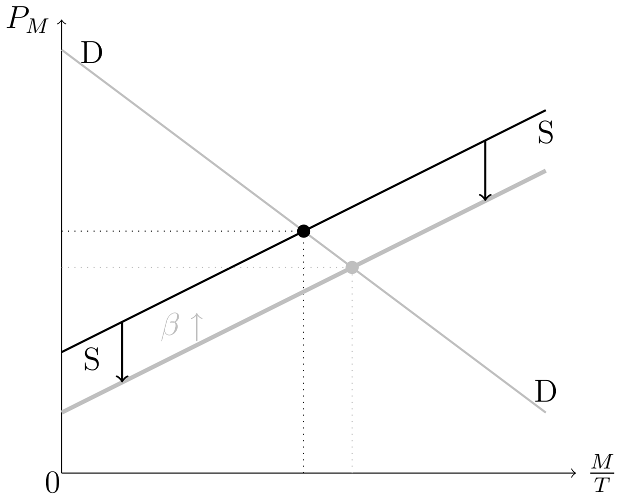

Figure 1: Comparative advantages

This result may sound a bit counterintuitive: after all, since domestic workers have more rights, the labor cost should be higher in the domestic country, imposing an upward pressure on the price of good M. The latter reasoning does not take into account the presence of search and matching frictions. If workers have weak FACB rights, they are reluctant to start searching in sector M, since they anticipate that they will not be able to bargain a high wage. This tends to increase the relative scarcity of good M, hence its relative price. To put it another way, in this economy, a high bargaining power provides a strong incentive for workers to look for a job in M, which makes good M cheaper.

Free trade equilibrium In the following, superscript a stands for autarkic variables, while superscript ft stands for free trade variables. We can now characterize the free trade equilibrium.

As usual in trade theory, the free trade price P_M^{ft} has to lie between both autarkic prices. Indeed, if it were above P_M^{a*}, both countries would want to be net exporters of good M. Similarly, if it were below P_M^a, they would both want to export good T. That being said, we can derive the equilibrium patterns of trade: the domestic country will be net exporter of good M, while the foreign country will be net exporter of good T. The following proposition summarizes these results:

Proposition 3. *Assume that both countries engage in free trade. Then there exists a unique equilibrium, such that:*

- P_M^{ft} *lies between* P_M^a *and* P_M^{a*}*,*
- *country* H *exports good* M *while country* F *exports good* T*.*

Proof. See Appendix A.1. □

Paradoxically, the size of the modern sector in the domestic country ends up increasing under free trade. Put differently, stronger FACB rights can accelerate the development process by shifting labor from the traditional sector to the modern sector. Once again, this is due to the fact that the prospect to bargain high wages attracts many domestic workers in the modern sector. Therefore, for any level of the relative price, the domestic country produces larger quantities of good M than the foreign one.

4.2 Hat Calculus

We now investigate the way endogenous domestic variables are affected while moving from autarky to free trade. The results we derive here are similar to those of Davidson, Martin, and Matusz (1999). However, in their model, the comparative advantages come from differences in terms of matching technologies, while they are linked to FACB rights differentials in our model.

Comparing the values of these variables at price P_M^{ft} with their values at price P_M^a would be a bit messy. So, in line with the trade literature, we investigate the impact of a small increase in P_M: $dP_M > 0$. This will give us the direction of change when moving from autarky to free trade. In the following, hatted variables denote percentage changes: $\hat{x} \equiv \frac{dx}{x}$.

Impact on equilibrium quantities Using the non-arbitrage condition, one immediately sees that $\hat{\theta}$ is strictly negative when $\hat{P}_M$ is strictly positive. When P_M increases, it becomes more interesting to look for a job in sector M, since the surplus to be shared after a match increases. Some workers move from T to M, which lowers the labor market tightness. This reallocation process stops when the adverse impact on the bargained wage becomes large enough.

Obviously, when $\hat{\theta} < 0$, the domestic country produces less good T and more good M, as can be seen by combining equations (8) and (9) with $\hat{\theta} < 0$.

This decrease in the labor market tightness has an adverse impact on unemployment ($\hat{N}_U > 0$): as more workers look for a job in the high unemployment sector, the unemployment rate increases. In this model, international trade, combined with labor market imperfections can indeed have an important impact on unemployment.

Stolper-Samuelson effects We now analyze the impact of trade integration on real factor returns. In a standard trade model *à la* Jones (1965), we would just need to look at factor prices. In our framework with search and matching frictions, we have to distinguish three types of Stolper-Samuelson effects: the impact on factor prices, the impact on returns to searching factors and the impact on returns to matched factors. The following proposition lists the results, and summarizes the impacts on equilibrium quantities:

Proposition 4. *Consider an increase in the relative price of good M: $\hat{P}_M > 0$. Then,*

- *Unemployment increases, sector M grows and sector T shrinks: $\hat{N}_U > 0$, $\hat{X}_M > 0$, and $\hat{X}_T < 0$;*
- $0 < \hat{w} < \hat{P_M}$*, i.e., the impact on the real wage in sector M is ambiguous;*
- $0 = r\hat{U} < \hat{P_M}$*, i.e., sector T workers and unemployed workers unambiguously lose;*
- $0 < r\hat{W} < \hat{P_M}$*, i.e., the impact on the well-being of matched workers is ambiguous;*
- $0 < \hat{P_M} < r\hat{V}$*, i.e., idle capital unambiguously wins;*
- $0 < \hat{P_M} < \hat{rJ}$*, i.e., employed capital unambiguously wins.*

Proof. See Appendix A.2. □

First, consider the impact of trade integration on wages in sector M. As trade liberalizes, the price of good M rises in the domestic country. The first effect is to increase the bargained wage, since the surplus from a match goes up. This attracts more workers into the modern sector, which has a negative impact on the bargained wage. At the end of the day, the wage increases, but it increases less than P_M. Consequently, it is impossible to tell unambiguously whether the real bargained wage increases. This is an important departure with respect to the Stolper-Samuelson theorem. In a frictionless environment, this theorem would state that, since the comparative advantage sector is relatively more capital-intensive, workers should be made worse off by trade integration.

However, Proposition 4 states that the Stolper-Samuelson applies for searching factor. First of all, the value of being unemployed is pinned down by the non-arbitrage condition. The expected income flow has to be equal to 1, which by assumption increases less than P_M: Unemployed workers unambiguously lose. Idle capital clearly wins for three reasons. First, the price of the good it produces increases. Second, the bargaining position of capital is strengthened by the decrease in labor market tightness. Last, the probability for a unit of capital to find a match increases. We can now restate the Stolper-Samuelson theorem in our search-and-matching framework: $r\hat{U} = 0 < \hat{P_M} < r\hat{V}$.

The behavior of the return to matched labor is ambiguous. We see from Proposition 4 that the real value of an employed worker can either increase or decrease. Indeed, we have seen that the real bargained wage may go up. There is now a second (discounted) impact: employed workers anticipate that, when they will be laid off, they will have more difficulties to find another job, because of the decrease in the labor market tightness. The impact on matched capital is clear-cut: It benefits from an improvement in its outside option and from a higher total surplus. As pointed out by Davidson, Martin, and Matusz (1999), these results on matched factors are reminiscent of the Ricardo-Viner specific factor model: employed factors are somewhat attached to their sector, so they are partially affected by an increase in the profitability of their sector.

5 Elastic Labor Demand

With the model presented before, we have seen that stronger FACB rights can give a comparative advantage in the modern good, when search frictions in the modern sector are taken into account. To make this point, we have voluntarily ignored the standard labor demand effect, by assuming that the supply of capital in the modern sector is perfectly inelastic. In the following, we claim that the above results are robust to the introduction of a labor cost effect.

The simplest way to introduce this effect is to assume that it is costly for capitalists to look for a worker. More precisely, we assume that a capitalist opening a vacancy incurs a utility loss c per unit of time, as long as it has not found a worker. This assumption is common in the search-matching literature. In this model, it will enable us to have an endogenous rate of vacancy creations, as long as the stock of capital is sufficiently high, which we assume in the following.[7]

The only value function which is affected by this new assumption is the value of a searching unit of capital (equation (3) in the previous model), since we now have to take into account the presence of a search cost. All the value functions are expressed in units of the numeraire good, while the search cost is expressed in units of utility. Therefore, to plug the search cost in the value of a vacancy, we need to rewrite the search cost in terms of the numeraire. This is done by multiplying c by $\tilde{P}(P_M)$, the consumers price index.[8]

[7] If the stock of capital is too low, all capitalists choose to post vacancies, and we are back to the model developed in section 2.

[8] $\tilde{P}(P_M)$ is well-defined and depends only on P_M, since consumers have the same homothetic preferences.

We obtain the following expression:

$$rV = -\tilde{P}(P_M)c + q(\theta)(J - V) \tag{11}$$

Since vacancies can be created freely, and with our assumption that the stock of capital is sufficiently large (see footnote 7), we can write the free entry condition: $V = 0$. Plugging this into equations (4) and (11), we obtain the job creation condition:

$$(r + \delta)\frac{\tilde{P}(P_M)c}{q(\theta)} = P_M - w. \tag{12}$$

As before, when a capitalist and a worker are matched, they bargain other the wage so as to share the surplus. Maximizing the Nash product, and using the job creation condition, we get $w = \beta(P_M + \theta\tilde{P}(P_M)c)$. Notice that higher vacancy costs strengthen the bargaining position of workers, thereby allowing them to obtain a higher share of the surplus. Plugging the wage expression into the job creation condition, we get:

$$\frac{P_M}{\tilde{P}(P_M)c} = \frac{r + \delta + \beta\theta q(\theta)}{(1-\beta)q(\theta)}. \tag{13}$$

Finally, as before, we can plug the wage expression into the non-arbitrage condition $rU = 1$ to get:

$$\frac{\theta q(\theta)}{r + \delta + \theta q(\theta)}\beta(P_M + \theta\tilde{P}(P_M)c) = 1. \tag{14}$$

In the following proposition, we claim that the job creation condition (13) and the non-arbitrage condition (14) define a unique autarkic equilibrium:

Proposition 5. *There exists a unique pair (P_M, θ) that satisfies conditions (13) and (14): the autarkic equilibrium exists, and it is unique.*

Proof. See Appendix A.3. □

Now that we have proven the uniqueness of the autarkic equilibrium, we can perform some comparative statics to investigate the impact of FACB rights on a country's comparative advantage. As before, denote by $P_M^a(\beta)$ (resp., $\theta^a(\beta)$) the autarkic relative price (resp., labor market tightness) of a country when workers' bargaining power is β. Define also $\eta(\theta) = -\frac{d\log(q(\theta))}{d\log\theta}$, the elasticity of the workers' arrival rate $q(\theta)$ with respect to θ. The following lemma states that the impact of FACB rights on comparative advantages is closely linked to the function $\eta(.)$:

Lemma 1. $\frac{dP_M^a}{d\beta}$ *has the same sign as $\beta - \eta(\theta^a(\beta))$.*

Proof. See Appendix A.4. □

This result is reminiscent of the Hosios (1990b) condition, which traditionally relates the efficiency of the decentralized equilibrium of a one-sector search-matching model to the difference between workers's bargaining power and the elasticity of workers' arrival rate.

In our model, an increase in workers' bargaining power entails two effects. On the one hand, workers internalize the fact that they will obtain higher wages in the modern sector, which induces them to move into the modern sector. Everything else equal, this should trigger a decrease in P_M and a decrease in θ, so as to keep workers indifferent between the traditional sector and the modern sector. On the other hand, capitalists anticipate that they will earn lower margins on the sale of the modern good, therefore, they post fewer vacancies. Everything else equal, P_M should then increase, while θ should decrease for the job creation condition to hold. Lemma 1 tells us that the first effect dominates, provided that $\beta < \eta(\theta)$. Put differently, workers' bargaining strength has to be sufficiently low, and the elasticity of workers' arrival rate has to be sufficiently high, for an increase in β to lower the autarkic relative price.

To grasp the intuition, consider that $\eta(\theta)$ is high. Then, $q(\theta)$, the rate at which capitalists meet workers, increases a lot when θ decreases. This implies that a small decrease in θ is sufficient to restore the job creation condition, following an increase in β. By contrast, $\theta q(\theta)$, the rate at which workers receive job offers, is barely affected by a change in θ. Therefore, following an increase in workers' bargaining strength, θ and P_M have to decrease a lot to restore workers' indifference between the two sectors. To summarize, when $\eta(\theta)$ is high, most of the change in P_M and θ comes from the workers' side, not from the capitalists' side. In this case, the labor supply effect, identified in the previous sections, dominates, and an increase in β triggers a decrease in the autarkic relative price. Conversely, if $\eta(\theta)$ is high, most of the change in P_M comes from the capitalists' side, and an increase in β raises the autarkic relative price of good M.

Consider now that parameter β is high. Then, workers receive most of the surplus from a match. In particular, workers are much more affected than capitalists by a change in matches' surplus. For instance, when P_M decreases, most of this decrease is reflected in the workers' payoffs, not in the capitalists'. Following an increase in β, the labor supply effect triggers a small decrease in P_M through the non-arbitrage condition, whereas the labor cost effect generates an important increase in P_M. At the end of the day, P_M increases. Conversely, when β is low, capitalists are more affected than workers by a change in the surplus from a match, and therefore, an increase in β lowers P_M.

Notice that the above discussion only tells us that, starting from a situation in which $\beta < \eta(\theta)$, an increase in β lowers the autarkic relative price. However, we cannot say that, for instance, if β is initially small, then an increase in β decreases $P_M^a(\beta)$, since θ is an endogenous variable. To perform this kind of comparative statics exercise, we assume that the matching function is Cobb-Douglas, a specification that is commonly used in the search-matching literature. We obtain the following proposition:

Proposition 6. *Assume that the matching function is Cobb-Douglas:* $\mu(N_U, N_V) = N_U^{\eta} N_V^{1-\eta}$.
Then, $P_M^a(\beta)$ *is U-shaped, reaches its minimum for* $\beta = \eta$*, and goes to* $+\infty$ *as* β *goes to* 0 *or* 1.
Besides, if $\beta^* < \eta$*, then, there exists* $\bar{\beta} \in (\eta, 1)$ *such that:*

- *If* $\beta^* < \beta < \bar{\beta}$*, then,* $P_M^a(\beta) < P_M^a(\beta^*)$*, and the domestic country has a comparative advantage in the modern good.*
- *If* $\beta > \bar{\beta}$*, then,* $P_M^a(\beta) > P_M^a(\beta^*)$*, and the domestic country has a comparative advantage in the traditional good.*

If $\beta^* > \eta$*, then, the domestic country has a comparative advantage in the traditional good.*

Proof. See Appendix A.5. □

Figure 2 offers a graphical representation of Proposition 6. As explained before, an increase in workers' bargaining power entails two effects. On the one hand, it induces workers to migrate into the modern sector, which tends to lower the autarkic relative. On the other hand, it increases the labor cost, which induces capitalists to create fewer modern jobs, thereby raising the autarkic relative price. With a Cobb-Douglas matching function, the labor supply effect dominates the labor cost effect, provided that $\beta < \eta$.

If the domestic and foreign workers' bargaining powers are not too high, namely, if $\beta^* < \eta$ and $\beta^* < \beta < \bar{\beta}$, the domestic country can therefore have a comparative advantage in the manufacturing sector. Again, this may explain why negative relationships between FACB rights and manufacturing exports are so hard to obtain in cross-country regressions: this negative relationship is not a prediction of our model. If anything, this relationship should be hump-shaped.

6 Capital Mobility

We now investigate the impact of capital markets liberalization. To do so, we come back to the model developed in Section 2, namely, there are no search costs. We assume that, in both countries, a fraction $0 < \kappa < 1$ of capitalists can send its units of capital abroad. In this case, these units of capital can be matched with some foreign workers, and production

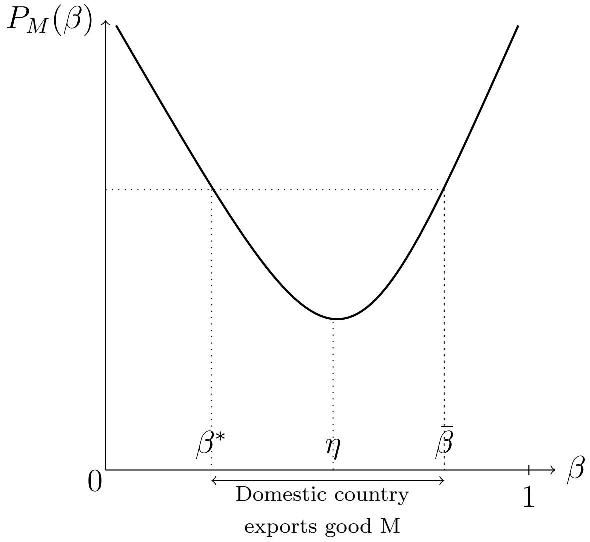

Figure 2: Comparative advantages, elastic labor supply

still takes place on a one-to-one basis. Denoting by K^W the world supply of capital, this implies that K, the number of units of capital invested in country H, varies between $\frac{K^W}{2}(1-\kappa)$ and $\frac{K^W}{2}(1+\kappa)$.

We make the following assumption:

Assumption 1. *Fix $K \in [\frac{K^W}{2}(1-\kappa), \frac{K^W}{2}(1+\kappa)]$. Then, in the unique stationary equilibrium of the economy, no country specializes in sector M.*

Assumption 1 means that, if the number of units of capital in country H is exogenously set to K, no specialization occurs. This assumption is satisfied, provided that the two countries are not too different in terms of bargaining power, or that κ is not too large, or that the relative inverse demand curve is not too steep. At the end of this section, we discuss how our results would be affected if Assumption 1 did not hold.

We obtain the following proposition:

Proposition 7. *Assume that Assumption 1 holds, and that the matching function is Cobb-Douglas. If $\beta^* < \eta$, then there exists $\bar{\beta} > \beta^*$ such that:*

- *If $\beta^* < \beta < \bar{\beta}$, then, in the unique stationary equilibrium, the home country attracts foreign capital: $K = \frac{K^W}{2}(1+\kappa)$.*
- *If $\beta = \bar{\beta}$, then, any $K \in [\frac{K^W}{2}(1-\kappa), \frac{K^W}{2}(1+\kappa)]$ can be sustained in a stationary equilibrium.*
- *If $\beta > \bar{\beta}$, then, in the unique stationary equilibrium, the foreign country receives domestic capital: $K = \frac{K^W}{2}(1-\kappa)$.*

If $\beta^* \geq \eta$, then, in the unique stationary equilibrium, the foreign country receives domestic capital: $K = \frac{K^W}{2}(1-\kappa)$.

Proof. See Appendix A.6. □

The intuition behind Proposition 7 is clear. On the one hand, domestic workers in sector M get a larger share of the surplus from a match thanks to their higher bargaining power, which should induce domestic capital to relocate abroad. On the other hand, the foreign country has a tighter labor market, since sector M is less attractive to labor. In the limit case in which β would be equal to 1, a unit of capital located in the home country would not earn any profits, and capitalists would prefer investing in the foreign country. Similarly, in the limit case in which β^* approaches 0, foreign capitalists would not be able to attract any workers in their sector, since workers would anticipate that they would not be able to get a positive surplus. In this case, capitalists would prefer investing in the home country, in spite of its stronger FACB rights, to actually get a chance to hire some workers. This explains that, in this search and matching framework, a country with stronger labor standards can paradoxically attract capital.

To obtain Proposition 7, we have made two assumptions. First, we have assumed that $\kappa < 1$: not all capitalists have the ability to send their capital abroad. This assumption is helpful to prove the existence, or non-existence, of corner equilibria. When $\kappa < 1$, in a corner equilibrium, there is some capital in both countries, and therefore, rV and rV^* exist, and are easy to compare. By contrast, if $\kappa = 1$, in a corner equilibrium, one of the two countries has no longer a modern sector. To check whether this is indeed in an equilibrium, we would then need to compute the value of a unit of capital which would be invested in this country, thereby creating a modern sector. To do so, we would need to analyze the transitional dynamics of this economy, which, in this model, would be a challenge. This is the reason why we need $\kappa < 1$ to obtain Proposition 7. However, since κ can be made arbitrarily close to 1, this is mainly a technical assumption.

We also need Assumption 1 to obtain our result. To see why, assume that $\beta^* < \beta < \bar{\beta}$, as in the first bullet point of Proposition 7, and consider first that no country had specialized in the modern sector prior to capital markets liberalization. Then, we claim that there is still a stationary equilibrium, in which country H receives some foreign capital. To see this, start from $K = \frac{K^W}{2}$, and increase K. Then, several things may occur. First, if no country specializes in sector M as K increases from $\frac{K^W}{2}$ to $\frac{K^W}{2}(1+\kappa)$, we know from the proof of Proposition 7, that there is no stationary equilibrium with $K \in [\frac{K^W}{2}, \frac{K^W}{2}(1+\kappa))$ and that there is a stationary equilibrium for $K = \frac{K^W}{2}(1+\kappa)$.

Second, if the foreign country specializes in sector M for $K \in (\frac{K^W}{2}, \frac{K^W}{2}(1+\kappa))$, it can be shown that there is no stationary equilibrium with this value of K. Indeed, if such an equilibrium existed, θ^*, the labor market tightness in the foreign country, would be higher than the value which satisfies the non-arbitrage condition. This would make the foreign country less attractive to capital. But we know from the proof of Proposition 7 that $rV > rV^*$ when the non-arbitrage condition holds. Therefore, we would still have $rV > rV^*$, which contradicts the assumption that K sustains a stationary equilibrium. Now, if country F specializes in sector M for $K = \frac{K^W}{2}(1+\kappa)$, we can use this reasoning to show that $rV > rV^*$, which implies that there is still a corner stationary equilibrium with $K = \frac{K^W}{2}(1+\kappa)$.

Last, consider that country H specializes in M for $K \in (\frac{K^W}{2}, \frac{K^W}{2}(1+\kappa))$, and denote by $\underline{K}$ the smallest K such that specialization occurs. By continuity, there cannot exist a stationary equilibrium with $K = \underline{K}$, since we know from the proof of Proposition 7 that rV would be strictly larger than rV^*. However, as K becomes larger, rV and rV^* may become equal, and we could then obtain a stationary equilibrium, in which country H receives some foreign capital, and specializes in sector M. If, on the other hand, rV and rV^* do not become equal, then, as in Proposition 7, there exists a corner stationary equilibrium with $K = \frac{K^W}{2}(1+\kappa)$.

To summarize, if we allow countries to specialize for somme values of K ($\neq \frac{K^W}{2}$), when $\beta^* < \beta < \bar{\beta}$, there still exists an equilibrium, in which the home country attracts some foreign capital. However, another equilibrium may exist. To see this, start from $K = \frac{K^W}{2}$, and let us lower K: capital shifts to a country that produces the modern good relatively less efficiently. This implies that P^M rises. If this general equilibrium effect is sufficiently important, this may induce the home country to specialize in the modern sector, in spite of his losing capital. As in the previous paragraph, this would make the home country less attractive to capital (relative to the situation in which the labor market tightness would be determined by the non-arbitrage condition). If this effect is strong enough, rV may become equal to rV^* for a small enough value of K, and we would then obtain an equilibrium in which the foreign country receives some capital, whereas the home country specializes in the modern sector. We have not been able to exhibit such equilibria, but there does not seem to be an obvious way to rule them out.

Last, if country H was already specialized in sector M before capital markets liberalization, the analysis becomes quite tedious, and we cannot even prove the existence of an equilibrium in which the home country receives some foreign capital.

Let us summarize this discussion. If Assumption 1 is slightly relaxed, namely, if some country specializes in sector M for some values of $K \neq \frac{K^W}{2}$, then, there still exists an equilibrium in which the home country attracts some foreign capital when $\beta^* < \beta < \bar{\beta}$, but this equilibrium may not be unique. If Assumption 1 is strongly relaxed, i.e., if some country specializes in sector M for $K = \frac{K^W}{2}$, the existence of an equilibrium in which country H receives some foreign capital is no longer guaranteed.

7 Conclusion

In this paper, we have built an international trade model with search-matching frictions to assess the impact of freedom of association and collective bargaining rights on manufacturing trade. In a simple model, we have shown that stronger FACB rights induce workers to migrate from the traditional sector into the modern sector, which tends to lower the autarkic relative price of the manufacturing good. Therefore, a country with stronger FACB rights has a comparative advantage in the modern sector. In a more elaborate version of the model, in which firms have to incur search costs when their positions are vacant, we have seen that this result remains valid, provided that workers' bargaining strength is not too strong. This implies that we should not expect to obtain a negative relationship between FACB rights and manufacturing exports in cross-country regressions. If anything, this relationship seems to be hump-shaped, as depicted on Figure 2: it would be worth testing this prediction empirically. We have also shown that stronger FACB rights can attract some foreign capital. Therefore, there is not necessarily a tradeoff between labor standards on the one hand, and manufacturing exports, foreign direct investment and economic development on the other hand.

A Appendix

A.1 Proof of Proposition 3

Proof. We first prove the existence, and then the uniqueness of the free trade equilibrium. Denote by $m_M(P) = C_M(P) - X_M(P)$ the domestic demand for import of good M when the international relative price is equal to P.

The representative consumer's budget constraint is given by: $PC_M(P) + C_T(P) = PX_M(P) + X_T(P)$, which can be rewritten as $PC_M(P)(1 + \frac{1}{PD(P)}) = PX_M(P) + X_T(P)$, given the homothetic preferences assumption. It follows that the demand for export is:

$$m_M(P) = \frac{1}{1 + PD(P)} \left(D(P)X_T(P) - X_M(P) \right).$$

By definition of the autarkic equilibrium price, and by continuity of the above function, we know that $m_M(P) < 0$ iff $P > P_M^a$, $m_M(P) > 0$ iff $P > P_M^a$, and $m_M(P) = 0$ iff $P = P_M^a$. The same results hold for the foreign country, when replacing m_M by m_M^* and P_M^a by P_M^{a*}.

Let us now define $m_M^W(P) = m_M(P) + m_M^*(P)$ the world excess demand for good M. Then we know that $m_M^W(P)$ is strictly positive for $P > P_M^{a*}$, and strictly negative for $P < P_M^a$. By continuity, there exists at least one $p \in]P_M^a, P_M^{a*}[$ such that $m_M^W(p) = 0$. If the international price is equal to such a P, the market for good M clears. By Walras' law, the market for good T clears as well. The existence of the free trade equilibrium is proven.

After some straightforward computations, one can prove that:

$$(1 + PD(P))m_M^W(P) = D(P)\left[X_T(P) + X_T^*(P)\right] - \left[X_M(P) + X_M^*(P)\right].$$

The second term on the right-hand side is strictly decreasing in P (see equations (6) and (8)). By assumption, $D(.)$ is downward sloping; and $[X_T(.) + X_T^*(.)]$ is strictly decreasing. Therefore, the right-hand side of the above equation is strictly decreasing. There exists only one value of P which cancels it. □

A.2 Proof of Proposition 4

Proof. Consider first the impact on the bargained wage. Its expression as a function of P_M is given by equation 5, which we log-differentiate. We get:

$$\hat{w} = d\log\left\{\frac{\beta}{1 + \frac{1-\beta}{\beta}\frac{r+\delta+q(\theta)}{r+\delta+\theta q(\theta)}}\right\} + \hat{P_M}.$$

The first term on the left-hand side is clearly negative, since $\hat{\theta} < 0$, therefore, $\hat{w} < \hat{P_M}$. Plugging the non-arbitrage condition to get rid of the P_M term, and log-differentiating, we obtain:

$$\hat{w} = d\log\left\{\frac{r + \delta + \theta q(\theta)}{\theta q(\theta)}\right\} > 0.$$

Therefore, $0 < \hat{w} < \hat{P_M}$. In other words, the real wage can either increase or decrease, depending on the shape of the utility function. The standard Stolper-Samuelson theorem does not apply here.

Consider now the value of being unemployed. We know, from the non-arbitrage condition that $rU = 1$, so $r\hat{U} = 0 < \hat{P_M}$: Unemployed workers unambiguously lose, when moving from autarky to free trade.

We can easily show that the value of being employed in sector M is given by: $rW = \frac{r+\theta q(\theta)}{\theta q(\theta)}$. The ratio on the right-hand side is decreasing in θ, therefore, $r\hat{W} > 0$. Once again, we rewrite rW as a function of P_M: $rW = \frac{\beta(r+\theta q(\theta))}{(1-\beta)(r+\delta+q(\theta))+\beta(r+\delta+\theta q(\theta))}P_M$. Since the ratio on the right-hand side is increasing in θ, we deduce that $r\hat{W} < \hat{P_M}$.

After some algebra, the value of an idle unit of capital is obtained as:

$$rV = \frac{1-\beta}{\frac{r+\delta}{q(\theta)} + (1-\beta) + \beta\theta} P_M.$$

The ratio on the right-hand side is decreasing in θ, so $\hat{rV} > \hat{P_M} > 0$.

Similarly, the value of an employed unit of capital is equal to

$$rJ = \frac{(1-\beta)(r+q(\theta))}{(1-\beta)(r+\delta+q(\theta)) + \beta(r+\delta+\theta q(\theta))} P_M,$$

which is decreasing in θ, so $\hat{rJ} > \hat{P_M} > 0$.

□

A.3 Proof of Proposition 5

Proof. The job creation condition can be rewritten as:

$$\frac{P_M}{\tilde{P}(P_M)c} = \frac{r+\delta+\theta q(\theta)}{(1-\beta)q(\theta)} - \theta. \tag{15}$$

Plugging the non-arbitrage condition into this expression, and rearranging terms, we obtain:

$$\theta\beta\tilde{P}(P_M)c = 1-\beta. \tag{16}$$

Besides, the job creation condition can be rewritten as:

$$\frac{P_M}{\tilde{P}(P_M)c} = \frac{1}{1-\beta}\left(\frac{r+\delta}{q(\theta)} + \beta\theta\right). \tag{17}$$

Now, we want to show that there exists a unique pair (P_M, θ) that satisfies conditions (16) and (17).

The proof proceeds in three steps. First, we derive some useful properties for the behavior of the price index. Second, we show that condition (16) defines a strictly decreasing relation between θ and P_M. Last, we show that condition (17) defines a strictly increasing relation between θ and P_M.

Price index behavior: Let us solve the problem of a consumer with preferences $\phi(.,.)$ and income I. The first order condition yields

$$\frac{\phi_M(\frac{c_M}{c_T},1)}{\phi_T(\frac{c_M}{c_T},1)} = P_M, \tag{18}$$

where ϕ_j denotes the partial derivative of ϕ with respect to c_j. This defines a unique ratio $\frac{c_M}{c_T} \equiv \psi(P_M)$. With the assumptions we made on ϕ, ψ is such that $d\psi/dP_m < 0$,

$\lim_{+\infty} \psi = 0$ and $\lim_0 \psi = +\infty$.

Combining this with the budget constraint, we get $c_T = I/(1 + \psi(P_M)P_M)$ and $c_M = \psi(P_M)c_T$. Plugging this into the utility function, and using the fact that preferences are homothetic, we obtain that the consumer receives indirect utility $I\frac{\phi(\psi(P_M),1)}{1+P_M\psi(P_M)}$. Therefore, the price index is $\tilde{P}(P_M) = \frac{1+P_M\psi(P_M)}{\phi(\psi(P_M),1)}$. Therefore, by definition of ψ,

$$\tilde{P}(P_M) = \frac{\phi_T(\psi, 1) + \psi\phi_M(\psi, 1)}{\phi(\psi, 1)} \frac{1}{\phi_T(\psi, 1)}, \tag{19}$$

where we omitted variable P_M for simplicity. Since ϕ is homogenous of degree 1, we can apply Euler's theorem to get $\tilde{P}(P_M) = \frac{1}{\phi_T(1,\psi^{-1})}$. Given our assumptions on the utility function, this implies that $\tilde{P}$ is continuously differentiable and strictly increasing in P_M, and goes to 0 (resp., to ∞) as P_M goes to 0 (resp., to ∞).

Similarly, by definition of ψ, $\frac{P_M}{\tilde{P}(P_M)} = \phi_M(\psi, 1)$. Therefore, the ratio $\frac{P_M}{\tilde{P}(P_M)}$ is continuously differentiable and strictly increasing in P_M, and goes to 0 (resp., to ∞) as P_M goes to 0 (resp., to ∞).

Equation (16): This condition defines a strictly decreasing and continuous relation between θ and $\tilde{P}$, with $\lim_{\theta\to 0} \tilde{P} = +\infty$ and $\lim_{\theta\to+\infty} \tilde{P} = 0$. Given the behavior of the price index, this also defines a strictly decreasing and continuous relation between θ and P_M, with $\lim_{\theta\to 0} P_M = +\infty$ and $\lim_{\theta\to+\infty} P_M = 0$.

Equation (17): This condition defines a strictly increasing and continuous relation between θ and $P_M/\tilde{P}(P_M)$, with $\lim_{\theta\to 0} P_M/\tilde{P}(P_M) = 0$ and $\lim_{\theta\to+\infty} P_M/\tilde{P}(P_M) = +\infty$. Given the behavior of the price index, this also defines a strictly increasing and continuous relation between θ and P_M, with $\lim_{\theta\to 0} P_M = 0$ and $\lim_{\theta\to+\infty} P_M = +\infty$.

Therefore, the curves defined by conditions (16) and (17) intersect once, and only once: this defines a unique equilibrium pair (P_M, θ). Equilibrium quantities can then be readily determined by using the labor market clearing condition, the Beveridge curve and consumers' relative demand.

□

A.4 Proof of Lemma 1

Proof. Plugging condition (16) into condition (17), we get:

$$\beta P_M = \beta + \frac{r + \delta}{\theta q(\theta)}. \tag{20}$$

To obtain the impact of β on the autarkic relative price, we totally differentiate equations (16) and (20). We get:

$$d\beta(1+\theta\tilde{P}(P_M)c) + \beta\theta c\tilde{P}'(P_M)dP_M + \beta\tilde{P}(P_M)cd\theta = 0$$
$$d\beta(P_M - 1) + \beta dP_M = -\frac{r+\delta}{(\theta q(\theta))^2}(\theta q(\theta))'d\theta.$$

Taking the value of $d\beta$ from the latter equation, and plugging it into the latter one, we get:

$$\frac{d\beta}{\beta}\left(\beta(P_M-1) - \frac{r+\delta}{\theta q(\theta)}\frac{(\theta q(\theta))'}{\theta q(\theta)}\frac{1+\theta\tilde{P}c}{\tilde{P}c}\right) = dP_M\left(-\beta + \frac{r+\delta}{\theta q(\theta)}\frac{(\theta q(\theta))'}{\theta q(\theta)}\theta\frac{\tilde{P}'}{\tilde{P}}\right). \quad (21)$$

Notice that, $d\log(\theta q(\theta))/d\log\theta = 1-\eta(\theta)$. Therefore, $(\theta q(\theta))'/(\theta q(\theta)) = (1-\eta(\theta))/\theta$.

Now, let us inspect the left-hand side of equation (21), which we denote by LHS. Using condition (16), it can be simplified into

$$\begin{aligned} LHS &= \frac{1}{\beta}\frac{r+\delta}{\theta q(\theta)}\left(1 - \frac{1-\eta(\theta)}{\theta}(\theta + \frac{1}{\tilde{P}c})\right), \\ &= \frac{1}{\beta}\frac{r+\delta}{\theta q(\theta)}\left(1 - \frac{1-\eta(\theta)}{\theta}(\theta + \frac{\beta}{1-\beta}\theta)\right) \text{ using 16}, \\ &= \frac{1}{\beta}\frac{r+\delta}{\theta q(\theta)}\frac{\eta(\theta)-\beta}{1-\beta}. \end{aligned}$$

Therefore, the left-hand side of equation (21) is positive if and only if $\beta < \eta(\theta)$.

Now, let us inspect the right-hand side of equation (21), which we denote by RHS. Using equation (20), it can be simplified into

$$\begin{aligned} RHS &= \beta\left((P_M-1)(1-\eta(\theta))\frac{\tilde{P}'}{\tilde{P}} - 1\right), \\ &= \beta\left(\frac{P_M-1}{P_M}\frac{d\log(\tilde{P})}{d\log(P_M)}(1-\eta(\theta)) - 1\right). \end{aligned}$$

Since $1-\eta(\theta) < 1$ and $(P_M-1)/P_M < 1$, all we need to do is show that $d\log(\tilde{P})/d\log(P_M) < 1$. Using the notations introduced in the proof of Proposition 5, we have:

$$\begin{aligned} \frac{d\log(\tilde{P})}{d\log(P_M)} &= \frac{P_M}{\tilde{P}}\frac{d\tilde{P}}{d\psi}\frac{d\psi}{dP_M} \\ &= \phi_M(\psi,1)\frac{-\phi_{MT}(\psi,1)}{\phi_T^2(\psi,1)}\frac{d\psi}{dP_M}. \end{aligned}$$

By definition of ψ,

$$\frac{d\psi}{dP_M} = \frac{\phi_T^2}{\phi_{MM}\phi_T - \phi_M\phi_{MT}}.$$

Therefore,

$$\frac{d\log(\tilde{P})}{d\log(P_M)} = \frac{1}{1 + \frac{(-\phi_{MM}\phi_T)}{\phi_{MT}\phi_M}}.$$

Since ϕ_M is homogenous of degree 0, $\psi\phi_{MM}(\psi, 1) + 1\phi_{MT}(\psi, 1) = 0$. As a result,

$$\frac{d\log(\tilde{P})}{d\log(P_M)} = \frac{1}{1 + \frac{\phi_T}{\psi\phi_M}} < 1.$$

This concludes the proof □

A.5 Proof of Proposition 6

Proof. If the matching function is Cobb-Douglas, then, $q(\theta) = \theta^{-\eta}$, and $\eta(\theta) = \eta$ for all θ. Lemma 1 enables us to conclude that $P_M^a(.)$ is indeed U-shaped.

Since $P_M^a(.)$ is monotone on the interval $(0, \eta)$ (resp., $(\eta, 1)$), it has a limit in 0 (resp., 1).

Assume by contradiction that $\lim_{\beta\to 0} P_M^a(\beta) = l$ is finite. Clearly, $l > 0$. Equation (16) implies that $\lim_{\beta\to 0} \theta^a(\beta) = +\infty$ and $\lim_{\beta\to 0}(\beta\theta^a(\beta)) = \frac{1}{\tilde{P}(l)c}$. Since equation (20) can be rewritten as

$$P_M = 1 + \frac{r + \delta}{\beta\theta q(\theta)},$$

this implies that $\lim_{\beta\to 0} P_M^a(\beta) = +\infty$, which is a contradiction.

Similarly, assume by contradiction that $\lim_{\beta\to 1} P_M^a(\beta) = l$ is finite. Again, l cannot be zero. Therefore, from equation (16), $\lim_{\beta\to 1} \theta^a(\beta) = 1$, and, from equation (20), $\lim_{\beta\to 1} P_M^a(\beta) = +\infty$: a contradiction.

The remainder of the proposition follows readily from the fact that $P_M^a(.)$ is U-shaped, reaches its minimum for $\beta = \eta$ and goes to ∞ as β goes to 0 or 1. □

A.6 Proof of Proposition 7

Proof. Assume first that there exists a stationary equilibrium with $K \in (\frac{K^W}{2}(1-\kappa), \frac{K^W}{2}(1+\kappa))$. Then, by Assumption 1, no country specializes in the modern sector. No country specializes in the traditional sector either, since, for a given P_M, there always exists a θ such that the non-arbitrage condition (6) holds.

Using the non-arbitrage condition in both countries, we get:

$$\frac{r + \delta}{\beta\theta q(\theta)} + \frac{1 - \beta}{\beta\theta} = \frac{r + \delta}{\beta^*\theta^* q(\theta^*)} + \frac{1 - \beta^*}{\beta^*\theta^*}. \tag{22}$$

Solving for the value of an idle unit of capital, we get: $rV = \frac{1-\beta}{\beta}\frac{1}{\theta}$ and $rV^* = \frac{1-\beta^*}{\beta^*}\frac{1}{\theta^*}$. Since we have assumed that this stationary equilibrium is interior ($K \in (\frac{K^W}{2}(1-\kappa), \frac{K^W}{2}(1+\kappa))$), these two values have to be the same; otherwise there exists a capitalist who has the ability to send its capital abroad, and who actually wants to do so. Therefore,

$$\frac{1-\beta}{\beta}\frac{1}{\theta} = \frac{1-\beta^*}{\beta^*}\frac{1}{\theta^*}. \tag{23}$$

Combining equations (22) and (23), we obtain $\beta\theta q(\theta) = \beta^*\theta^* q(\theta^*)$. Assuming that the matching function is Cobb-Douglas, this implies that $\frac{\theta}{\theta^*} = \left(\frac{\beta^*}{\beta}\right)^{\frac{1}{1-\eta}}$. Plugging this into equation (23) and rearranging terms, we obtain:

$$(1-\beta)^{1-\eta}\beta^{\eta} = (1-\beta^*)^{1-\eta}\beta^{*\eta}. \tag{24}$$

Therefore, for an interior stationary equilibrium to exist, β and β^* have to satisfy equation (24) and $\beta > \beta^*$. Function $f : \beta \in [0,1] \mapsto (1-\beta)^{1-\eta}\beta^{\eta}$ is hump-shaped, satisfies $f(0) = f(1) = 0$, and reaches its unique maximum for $\beta = \eta$. Therefore,

- If $\beta^* \geq \eta$, then the system $\{f(\beta) = f(\beta^*),\ \beta > \beta^*\}$ has no solution, and therefore, there is no interior equilibrium.
- If $\beta^* < \eta$, then, there exists a unique $\bar{\beta} > \eta$ such that $f(\bar{\beta}) = f(\beta^*)$.
  - If $\beta = \bar{\beta}$, then, any $K \in (\frac{K^W}{2}(1-\kappa), \frac{K^W}{2}(1+\kappa))$ provides a unique pair (θ, θ^*), which satisfies equations (22) and (23). By continuity, this implies that any $K \in [\frac{K^W}{2}(1-\kappa), \frac{K^W}{2}(1+\kappa)]$ can be sustained in a stationary equilibrium. This is the second bullet-point of the proposition.
  - If $\beta \neq \bar{\beta}$, then, there is no interior equilibrium.

Assume now that there exists a corner stationary equilibrium, such that $K = \frac{K^W}{2}(1+\kappa)$. Again, no country specializes, and therefore, the non-arbitrage condition has to hold in both countries. This implies equation (22). We also need to have $rV \geq rV^*$, otherwise, a capitalist owning a mobile unit of capital would prefer to invest it in the foreign country:

$$\frac{1-\beta}{\beta}\frac{1}{\theta} \geq \frac{1-\beta^*}{\beta^*}\frac{1}{\theta^*}. \tag{25}$$

Plugging this into the non-arbitrage condition, we get: $\beta^*\theta^{*1-\eta} \leq \beta\theta^{1-\eta}$. This inequality and inequality (25) imply that $f(\beta) \geq f(\beta^*)$. Therefore, if $\beta^* \geq \eta$, or if $\beta > \bar{\beta}$, then, $rV^* > rV$, and there is no stationary equilibrium such that $K = \frac{K^W}{2}(1+\kappa)$.[9]

[9]Notice that, to obtain inequality $rV^* > rV$, we did not need to use the fact that $K = \frac{K^W}{2}(1+\kappa)$. This will be useful to conclude the proof.

By the same token, we obtain that, if $\beta^* < \eta$ and $\beta < \bar{\beta}$, then, $rV > rV^*$, and there is no stationary equilibrium such that $K = \frac{K^W}{2}(1-\kappa)$.

We can now conclude:

- If $\beta^* < \eta$ and $\beta < \bar{\beta}$, then, $rV > rV^*$, and therefore, there is a stationary equilibrium with $K = \frac{K^W}{2}(1+\kappa)$. Besides, we have just shown that there are no other equilibria. This is the first bullet point of the proposition.

- If $\beta^* \geq \eta$, or $\beta > \bar{\beta}$, then, $rV^* > rV$, and there is a stationary equilibrium with $K = \frac{K^W}{2}(1-\kappa)$. This is the last bullet point, and the last sentence of the proposition.

□

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