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Labor market structure and offshoring

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Abstract

We consider a two-country, two-sector model in which a firm's offshoring decision depends on labor market rigidities that impose additional costs on the firm. Firms endogenously choose their organizational form considering their productivity level and organizational costs. The costs generated by labor market frictions play a key role in determining the benefits of each organizational structure, and thus helps determine the conditions under which a firm decides to offshore. There are three different types of equilibria depending on the relative levels of the domestic and foreign labor market costs and the price of the intermediate input. In all equilibria, a relative rise in the domestic labor market cost increases the share of firms that offshore, while decreasing domestic integration. Furthermore, an economy with offshoring has a higher welfare level and a lower unemployment rate than it would under autarky.

JEL CLASSIFICATION

F12; F16; F23; J20; J30

1 | INTRODUCTION

The most pronounced change in international commerce over the past 50 years is the fragmentation of the production process. At the same time that trade barriers were being reduced across the globe, containerization and other changes in technology were greatly lowering transportation costs. These changes have made it easier for firms to produce their products piecemeal in different locations, resulting in greater efficiency and lower consumer prices.[1] Evidence of the changing nature of trade is plentiful. According to the US International Trade Commission, US imports of intermediate goods increased by 48% between 2009 and 2016, while the OECD reports that 59% of all trade in 2010 was in intermediate goods (up from 44% in 2000).

The economy-wide impact of fragmentation depends upon the reasons that firms decide to offshore and the impact that offshoring has on labor market outcomes. One would expect the answers to these questions to depend on the structure of labor markets both home and abroad. For example, a firm might decide to keep production locally sourced if the local government that hosts its main production facility passes new "right to work" legislation, or, a firm might decide to offshore if its national government imposes new labor market restrictions that make it more costly to fire workers. Surprisingly, while the literature on offshoring is large and rapidly growing, only a small amount of attention has been paid to the role that labor market structure might play. This is true in spite of the fact that the differences in labor market structure across the globe are well documented and deemed important enough for the World Bank to develop an index to measure labor market flexibility.[2] Moreover, it has been argued that labor market structure likely plays a role in several other important issues related to international trade. Examples would include playing a role in shaping comparative advantage (Cuñat & Melitz, 2012; Davidson, Martin, & Matusz, 1999; Helpman & Itskhoki, 2010), in determining the distributional consequences of liberalized trade (Davidson et al., 1999; Magee, Davidson, & Matusz, 2005) and in determining how firms shape their organizational structure in response to demand uncertainty (Kohler & Kukharskyy, 2019).

In this paper, we examine the links between labor market structure, both at home and abroad, and a firm's decision to offshore. As is usual, we use "offshoring" to refer to a decision to move any part of the production process abroad. When a firm decides to do this, it has two options. It can forge an arm's-length relationship with intermediate goods suppliers; or it can opt for vertical integration by setting up affiliates overseas. The former is called "foreign outsourcing" and the latter, foreign direct investment (FDI). Our goal is to characterize the firm's choice to produce domestically, outsource or engage in FDI as a function of firm characteristics and labor market structure.

In the following sections, we introduce a two-sector model in which the hiring process in one sector is characterized by search and matching frictions. Specifically, the model of the labor market in that sector is based on Helpman and Itskhoki (2010), in which homogeneous workers search for jobs, while firms are heterogeneous across their productivity levels. In this setting, it is costly for a firm to hire or fire workers, and thus firms consider not only the wage level, but also the labor market cost generated by the frictions. This is important, since one of the primary objectives of offshoring is to lower variable costs. Thus, these additional labor market costs could easily tip the scales for or against domestic production. We assume that offshoring is possible in the search sector, while all output is produced domestically in the frictionless sector.[3] This allows us to capture the notion that some jobs are more easily offshorable than others. Given our framework, we find that a country with a relatively high labor market cost will have more offshoring, and that it will be the high-productivity firms opting to offshore. In contrast, low-productivity firms in the search sector produce their output domestically. Among the offshoring firms, we find that it is the most productive firms that engage in FDI, with the remainder turning to foreign outsourcing. We also characterize other factors that play a role in determining the prominence of foreign outsourcing and FDI in a particular industry, including the complexity of the production process and the degree of worker bargaining power.

In terms of welfare, we find that the ability to offshore results in a weakly higher welfare level when compared to autarky. In autarky, the existence of additional labor market costs causes the monopolistically competitive firms to reduce output and employment, with price increasing accordingly. When offshoring is possible, the price increases are moderated, and welfare is enhanced as some firms choose to offshore.

In terms of labor market outcomes, we find that even though total hiring is higher in autarky, so is the unemployment rate; that is, offshoring lowers the rate of unemployment. These seemingly contradictory results stem from the fact that the unemployment rate depends on not only the total jobs available but also the number of workers searching for jobs in the labor market. When offshoring is possible, workers realize that the number of jobs available in the search sector is lower; and choose to seek employment in the frictionless sector. Our result with respect to unemployment, thus, depends on our assumption that the unemployment rate is higher in the offshorable sector. Had we assumed that frictions were present in both sectors with equilibrium unemployment higher in the non-offshorable sector, this result would be reversed.

Our analysis is intended to complement two stands of the literature on trade and labor markets. The first is the literature that investigates the impact of offshoring when labor markets are imperfect; examples would include Davidson, Matusz, and Shevchenko (2008) and Mitra and Ranjan (2010, 2013) Our analysis differs from existing work in this area in that we allow for foreign outsourcing and FDI, and focus on the firm's choice between the two different production methods.

The second strand of literature that is relevant addresses the issue of why some firms choose to outsource, while others choose FDI. This literature is large, including, for example, Antràs (2003), Grossman and Helpman (2002, 2003), Antràs and Helpman (2004) and Chen (2011). In much of this work, firm decisions depend on tradeoffs between the mixes of fixed and variable costs tied to the different organizational structures, with those fixed and variable costs shaped by a variety of forces. But, almost all of these papers assume frictionless, perfectly competitive labor markets. In our model, the difference in fixed and variables costs across organizational structure are once again key, but they are now tied to labor market structures at home and abroad.

The remainder of this paper is organized as follows. In Section 2, we develop the model and characterize the equilibrium in which offshoring is not possible (which we refer to as "autarky"). In Section 3, we allow for offshoring and calculating the profit levels associated with each organizational choice. We also characterize the different types of equilibria that can emerge. The model is then analyzed in Section 4. Finally, in Section 5, we offer a summary of our analysis with concluding remarks.

2 | THE MODEL

In this section, we present a two-sector model of a closed economy.[4] In one sector firms produce a homogeneous good, while the other sector is characterized by monopolistically competitive firms that produce differentiated products. In the homogeneous-good sector, there are no labor market frictions and all firms produce domestically. The homogeneous good is the numeraire, so that its price is normalized to one.

In the differentiated-goods sector, search and matching frictions exist in the labor market. Firms in this sector can not only produce domestically by using domestic labor but they can also choose to offshore by paying the fixed organizational cost of foreign outsourcing or FDI . As in previous studies, we assume that the fixed organizational cost of FDI is higher than that of foreign outsourcing. Differentiated-goods that are produced by offshoring are consumed in the domestic market. For simplicity, we assume that transportation costs are zero.

2.1 | Preferences

A representative household gets utility from consuming q_0 homogeneous goods and a continuum of differentiated goods,

$$Q = \left[\int_{i \in I} q(i)^{\beta} di \right]^{\frac{1}{\beta}}, \quad 0 < \beta < 1, \tag{1}$$

where $q(i)$ denotes consumption of variety i, I denotes the set of varieties, and β is a measure of the elasticity of substitution between varieties. Total utility is defined as

$$U = q_0 + \frac{1}{\varsigma} Q^{\varsigma}, \quad 0 < \varsigma < \beta.$$

The restriction $\varsigma < \beta$ implies that differentiated goods are better complements to each other than the homogeneous good.

It is well known that CES preferences yield the following demands:

$$q(i) = Q \left(\frac{p(i)}{P} \right)^{-\frac{1}{1-\beta}}. \tag{2}$$

with the price index is defined as

$$P = \left[\int_i p(i)^{-\frac{\beta}{1-\beta}} di \right]^{-\frac{1-\beta}{\beta}}.$$

With total spending E, the representative household maximizes utility by choosing

$$Q = P^{-\frac{1}{1-\varsigma}}, \tag{3}$$

$$q_0 = E - P^{-\frac{\varsigma}{1-\varsigma}}. \tag{4}$$

2.2 | Technology

In the homogeneous-good sector, the marginal product of labor is one. As the market is perfectly competitive, the wage is equal to the price of the homogeneous good, one.

Following Melitz (2003), each firm in the differentiated-goods sector must pay an fixed cost, f_e, to enter the market. After paying this cost, firms draw their productivity level, θ, from a known common distribution. The production function of a firm with θ is given by

$$q(\theta) = \theta h, \tag{5}$$

where h is the measure of workers the firm hires. Firms can choose to offshore by buying intermediate inputs from foreign intermediate goods suppliers (foreign outsourcing) or hiring foreign labor (FDI) to substitute for domestic labor. In order to produce, firms also pay a fixed production cost, f_d.

Using (2) and (5), we can calculate the price and revenue of a firm with productivity level θ as a function of Q and h:

$$\begin{aligned} p(\theta) &= (\theta h)^{-(1-\beta)} Q^{-(\beta-\varsigma)}, \\ R(\theta) &= (\theta h)^{\beta} Q^{-(\beta-\varsigma)}. \end{aligned} \tag{6}$$

2.3 | The labor market

In this economy, there is a continuum of identical households of measure one. Each household has L units of workers, so that the total labor endowment of this economy is L. Workers can choose to work either in the homogeneous-good sector or in the differentiated-goods sector. A household allocates its labor across the two sectors, with N units of labor allocated to the differentiated-goods sector and the remaining L–N units allocated to the homogeneous-good sector. As the wage in the homogeneous-good sector is equal to one, the average wage from working in the differentiated-goods sector must be one in equilibrium.

The differentiated-goods sector is characterized by labor market frictions; and, as a result, firms face a labor market cost of b whenever it hires a worker. In this setting, firms consider not only the wage level, but also the labor market cost when they decide on the size of their labor force.

The labor market cost, b, can be decomposed into hiring and firing costs. When firms hire workers, they must pay costs associated with opening vacancies. In addition, following Helpman and Itskhoki (2010), we assume that inefficient matching results in the firm firing some recently hired workers. In particular, we assume that after hiring their workforce firms discover that some of their new employees are not a good match for the job and thus fire them. The implication is that firms must hire more than an optimal number of employees.

We assume that the hiring cost, b_h, is a function of labor market tightness, x, as

$$b_h = a x^{\delta}, \quad a > 1 \text{ and } \delta > 0$$

where a represents frictions in the labor market during the hiring process. Higher costs of opening a vacancy or lower efficiency in the matching technology will give us a higher a.

Labor market tightness, x, is defined as

$$x = \frac{H}{(1-\sigma) N},$$

where H is the total hiring in the differentiated-goods sector and σ is the fraction of new hires that will be fired. Since firms anticipate firing a fraction σ of total matches, they hire workers in order to wind up with a workforce of size H.

When firms fire a worker, they bear firing costs of ψ. Under the assumption that we made regarding the firing process, the total labor market cost becomes

$$b = \frac{1}{1-\sigma} \left(b_h + \sigma \psi\right) \tag{7}$$

and the economy-wide unemployment rate is defined as

$$u = \frac{N-H}{L}.$$

Following Stole and Zwiebel (1996a, 1996b), firms engage in a generalized Nash Bargaining procedure over the revenue they create with matches. For simplicity, we assume equal bargaining power for a firm and a worker. As a result, the equilibrium wage as a function of employment is the solution of the following equation:

$$\frac{\partial}{\partial h} \left(R(h) - w(h)\, h\right) = w(h), \tag{8}$$

where $R(h)$ is revenue and h is the number of workers. As an additional worker affects the overall wage level, (8) yields a differential equation in w. With zero outside option for a worker,[5] the bargaining procedure equates the marginal gains from an additional worker to the marginal gains to the worker.

2.4 | Autarky

We now characterize the autarkic equilibrium in which offshoring is not available. In autarky, all firms produce domestically. In contrast, in an equilibrium with offshoring, which is discussed in the next section, offshoring firms produce in the foreign country by using an intermediate input or by hiring foreign labor.[6]

Active firms in the differentiated-goods sector pay a fixed cost, f_d, which is independent of their organizational choice. This fixed cost includes costs associated with headquarter services such as accounting, finance operations, and R&D.

Solving (8) yields

$$w(\theta) = \frac{\beta}{1+\beta}\frac{R(\theta)}{h}. \tag{9}$$

Thus, a firm loses $\frac{\beta}{1+\beta}R(\theta)$ as a result of wage bargaining and faces the following profit-maximization problem:

$$\max \frac{1}{1+\beta}R(\theta) - bh - f_d. \tag{10}$$

The optimal level of hiring is then

$$h_d(\theta) = \left[\frac{\beta}{b(1+\beta)}\right]^{\frac{1}{1-\beta}} Q^{-\frac{\beta-\varsigma}{1-\beta}}\theta^{\frac{\beta}{1-\beta}}. \tag{11}$$

We can now use (9)–(11) to determine the wage and profit level for firms that produce domestically[7]:

$$w(\Theta) = b, \quad \forall\Theta,$$

$$\pi_d(\Theta) = A(Q,\Theta)\, sb^{-\frac{\beta}{1-\beta}} - f_d, \tag{12}$$

where $s \equiv (1+\beta)^{-\frac{1}{1-\beta}} < 1$ and $A(Q,\Theta) \equiv (1-\beta)\,\Theta\beta^{\frac{\beta}{1-\beta}}Q^{-\frac{\beta-\varsigma}{1-\beta}}$. Note that s is a parameter that is positively related to the firm's share of revenue in the wage bargaining. Note also that we are now using a different measure of productivity, $\Theta\left(=\theta^{\frac{\beta}{1-\beta}}\right)$, for simplicity.

As equilibrium conditions depend on the distribution of Θ, we follow what has become standard practice in the literature and assume that Θ follows the Pareto distribution with shape parameter α and minimum value Θ_m.

The zero-profit cut-off condition is given as

$$A(Q,\Theta_d)sb^{-\frac{\beta}{1-\beta}} - f_d = 0. \tag{13}$$

Firms that draw productivity levels above Θ_d will operate in the differentiated-goods sector.

Using our Pareto distribution assumption and the zero-profit cut-off condition, we can now write the free entry condition, which equalizes the entry cost to the average profit level of the differentiated-goods, as

$$\begin{aligned} f_e &= E\left[\pi(\Theta)\right] \\ &= \int_{\Theta_d}^{\infty} f_d \left(\frac{\Theta}{\Theta_d} - 1\right) dG(\Theta) \\ &= \frac{f_d}{\alpha - 1} \left(\frac{\Theta_m}{\Theta_d}\right)^{\alpha}. \end{aligned} \tag{14}$$

Note that (14) gives us the zeroprofit cut-off, Θ_d, as a function of exogenous parameters.

Total output in the differentiated-goods sector is derived as

$$\begin{aligned} Q &= M^{\frac{1}{\beta}} \left[\int_{\Theta_d}^{\infty} q(\Theta)^{\beta} dG(\Theta)\right]^{\frac{1}{\beta}} \\ &= M^{\frac{1}{\beta}} \left[\int_{\Theta_d}^{\infty} \Theta^{1-\beta} h_d^{\beta} dG(\Theta)\right]^{\frac{1}{\beta}}, \end{aligned} \tag{15}$$

where M is the measure of firms in the sector and $q(\Theta) = \Theta^{1-\beta} h_d^{\beta}$ is the output of a firm with productivity level Θ.

Total hiring in the differentiated-goods sector is defined as

$$\begin{aligned} H &= M \times E[h(\Theta)] \\ &= M \int_{\Theta_d}^{\infty} h_d(\Theta) dG(\Theta). \end{aligned} \tag{16}$$

In the labor market, each household divides its labor endowment across the two sectors, and this process equalizes expected wages in both sectors, that is,

$$x(1-\sigma)b = 1. \tag{17}$$

Note that the left-hand side of (17) is the expected wage from choosing the differentiated-goods sector: a worker expects to receive a wage of b when he is hired and is not (subsequently) fired (which happens with probability $x(1-\sigma)$). The right-hand side of (17) is the wage level that a worker could get from the homogeneous-good sector. With $x = \frac{H}{(1-\sigma)N}$, we have

$$\frac{H}{N} = \frac{1}{b} \tag{18}$$

Next, we use (7) and (17) to obtain,

$$b = \frac{1}{1-\sigma}\left(a x^{\delta} + \sigma\psi\right) = \frac{1}{1-\sigma}\left\{a\left[\frac{1}{b(1-\sigma)}\right]^{\delta} + \sigma\psi\right\}. \tag{19}$$

Note that (19) yields b solely as a function of labor market parameters. In other words, b does not depend on other key parameters including f_d, f_e, nor the distributional assumption on Θ. This result is consistent with the result of the closed economy model in Helpman and Itskhoki (2010).

Finally, with b and Θ_d in hand, we can solve for Q in the zero-profit cut-off condition in (13) and H, M, and N can be obtained from (15), (16), and (18). Note that the zero-profit cut-off, Θ_d does not depend on b. This means that when labor market inefficiencies increase, the profit level of firms in the differentiated-goods sector do not change. In other words, changes in b are completely offset by changes in the quantity index in the differentiated-goods sector, Q, so that the profit level of an individual firm remains the same. Firms use their monopolistic power over the market when hiring labor gets more costly.

3 | OFFSHORING

In this section, we explore the model when offshoring is available. In this case, firms have two more organizational choices: foreign outsourcing and FDI. When firms choose foreign outsourcing, they produce using an intermediate input purchased from foreign suppliers.[8] When they choose FDI, firms produce abroad using foreign labor.

For both offshoring choices, firms bear an additional fixed organizational cost. We assume that the fixed cost of FDI is greater than the fixed cost of foreign outsourcing:

$$f_f > f_u > 0. \tag{20}$$

This assumption implies that fixed costs are the highest under FDI and the lowest under domestic production.

In the case of foreign outsourcing, firms buy intermediate goods from foreign suppliers to substitute for domestic labor. Doing so allows the firm avoid bargaining with the labor it would hire otherwise. If we use p_u to denote the unit price of the intermediate good, then the problem that a firm that opts for foreign outsourcing faces is

$$\max R(\Theta) - p_u h - f_d - f_u$$

and the resulting level of hiring and profit becomes

$$\begin{aligned} h_u(\Theta) &= \left(\frac{\beta}{p_u}\right)^{\frac{1}{1-\beta}} Q^{-\frac{\beta-\varsigma}{1-\beta}} \Theta \\ \pi_u(\Theta) &= A(Q,\Theta) p_u^{-\frac{\beta}{1-\beta}} - f_d - f_u. \end{aligned} \tag{21}$$

Alternatively, a firm can hire foreign labor by engaging in FDI. Like the domestic labor market, there are frictions in the foreign labor market, and firms incur a cost of b_f whenever they hire foreign workers.[9]

We assume that a firm engaging in FDI faces the same bargaining procedure as in (8), so that

$$\frac{\partial}{\partial h}\left[R(\Theta) - w_f(\Theta)\, h\right] = w_f(\Theta),$$

and the resulting foreign wage level becomes

$$w_f(\Theta) = \frac{\beta}{1+\beta}\frac{R(\Theta)}{h}.$$

Note that the result of wage bargaining is the same as in (9).

A firm opting for FDI solves the same problem as it would with domestic production, except that it now faces the foreign labor market cost of b_f and a higher fixed organizational cost of $f_d + f_f$. Thus, optimal hiring level under FDI takes the same form in (11)

$$h_f(\Theta) = \left[\frac{\beta}{b_f(1+\beta)}\right]^{\frac{1}{1-\beta}} Q^{-\frac{\beta-\varsigma}{1-\beta}}\Theta.$$

With the optimal hiring level, we can now derive the following wage and profit level associated with FDI:

$$w_f(\Theta) = b_f, \quad \forall\Theta,$$
$$\pi_f(\Theta) = A(Q,\Theta)sb_f^{-\frac{\beta}{1-\beta}} - f_d - f_f.$$

3.1 | Types of offshoring equilibria

With firms differing in productivity and three different organizational structures, there are several different organizational types across firms that may emerge in equilibrium. Although it is theoretically possible to have equilibria with all firms selecting foreign outsourcing or all firms selecting FDI, we consider these to be extreme cases and focus instead on three types of equilibria which we refer to as Type 1, Type 2, or Type 3. A Type 1 equilibrium includes domestic production and foreign outsourcing, so that no firm engages in FDI. A Type 2 equilibrium includes domestic production and FDI, so that no firm uses foreign outsourcing. And a Type 3 equilibrium includes all three choices.

Assuming that fixed costs are higher with offshoring than they are under domestic production, the type of equilibrium depends on relative size of the variable costs associated with the different organizational structures. From the profit functions that we derived above, we can extract the variable profits for each of the three choices as a function of the firm's productivity level:

$$\begin{aligned}
\frac{\pi_f(\Theta)+f_d+f_f}{\pi_d(\Theta)+f_d} &= \left(\frac{b}{b_f}\right)^{\frac{\beta}{1-\beta}}, \\
\frac{\pi_u(\Theta)+f_d+f_u}{\pi_d(\Theta)+f_d} &= \left(\frac{b}{s^{\frac{1-\beta}{\beta}}p_u}\right)^{\frac{\beta}{1-\beta}}, \\
\frac{\pi_f(\Theta)+f_d+f_f}{\pi_u(\Theta)+f_d+f_u} &= \left(\frac{s^{\frac{1-\beta}{\beta}}p_u}{b_f}\right)^{\frac{\beta}{1-\beta}}.
\end{aligned} \tag{22}$$

From (22), the ranking of these three terms depends on the relative sizes of b, $s^{\frac{1-\beta}{\beta}}p_u$, and b_f. To have an equilibrium in which some firms decide to offshore, we must have $\min\left(s^{\frac{1-\beta}{\beta}}p_u, b_f\right) < b$. This condition simply states that either foreign outsourcing or FDI has a lower variable cost than domestic production. If this condition is not met, then domestic production entails the lowest fixed cost and the lowest variable cost, so that offshoring is never optimal. In this case, we get an outcome identical to the autarkic equilibrium described in Section 2.

Since the fixed cost of FDI is greater than that of the foreign outsourcing, we get a Type 1 equilibrium if $s^{\frac{1-\beta}{\beta}} p_u \leq b_f$. In this case, foreign outsourcing dominates FDI since it has lower fixed costs and lower variable costs.

Type 2 and Type 3 emerge when the inequality is reversed: $s^{\frac{1-\beta}{\beta}} p_u > b_f$. When this is the case, FDI has lower variable costs than foreign outsourcing. If the fixed cost associated with foreign outsourcing is too high, we get an equilibrium in which no firms chooses foreign outsourcing (a Type 2 equilibrium). But, if the fixed cost from foreign outsourcing is sufficiently low, we get both types of offshoring in equilibrium.

The three types of equilibria are depicted in Figure 1. There are three productivity cut-offs that help to characterize the equilibria. In all three types, Θ_d is the zero-profit cut-off, so that a firm with Θ_d earns no profit. For Type 1 and Type 3 equilibria, Θ_u is the productivity level which makes a firm indifferent between domestic production and foreign outsourcing. Similarly, in Type 2 and Type 3 equilibria, Θ_f is the productivity level which makes a firm indifferent between FDI and domestic production (in a Type 2 equilibrium) or the foreign outsourcing (in a Type 3 equilibrium).

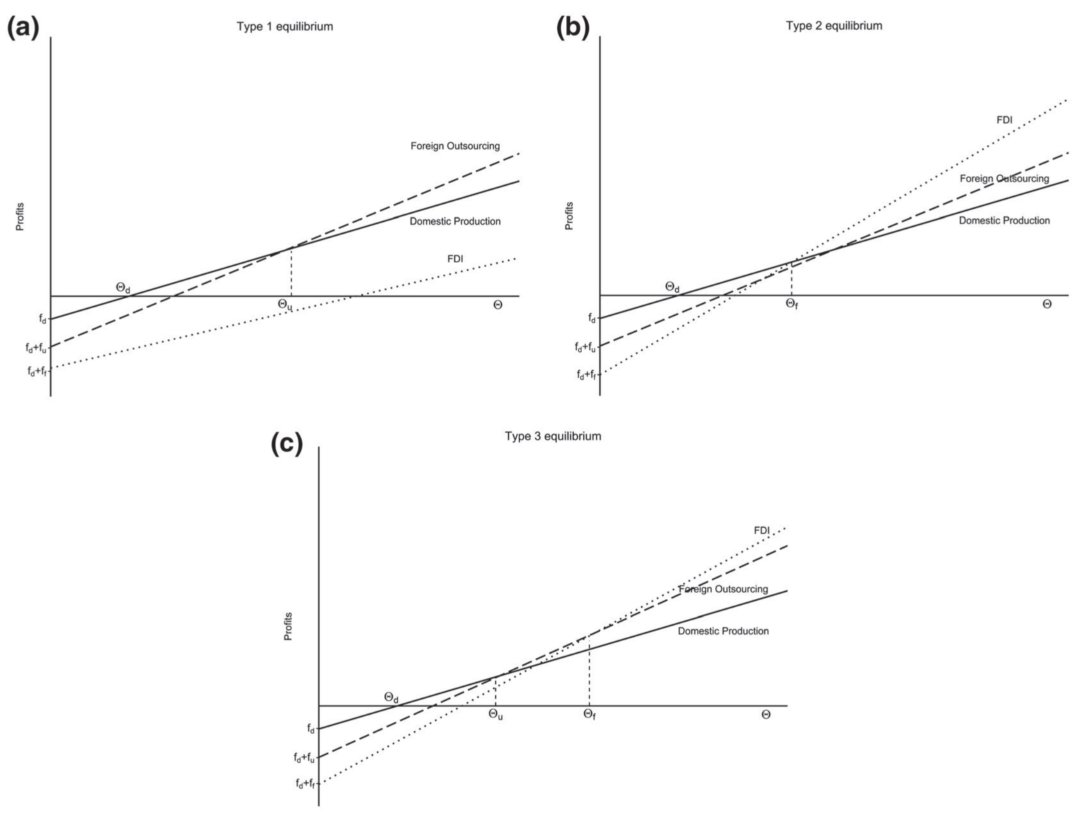

FIGURE 1 Three types of Equilibria

In a Type 1 equilibrium, firms with $\Theta \geq \Theta_u$ choose the foreign outsourcing while firms with $\Theta \in [\Theta_d, \Theta_u)$ choose domestic production. FDI is not chosen since, as noted above, it is dominated by foreign outsourcing. In a Type 2 equilibrium, FDI always dominates foreign outsourcing. In this case, firms with $\Theta \geq \Theta_f$ choose FDI, while firms with $\Theta \in [\Theta_d, \Theta_f)$ choose domestic production.

In a Type 3 equilibrium, we have both foreign outsourcing and FDI. Firms with $\Theta \in [\Theta_d, \Theta_u)$ produce domestically, firms with $\Theta \in [\Theta_u, \Theta_f)$ opt for foreign outsourcing, and firms with $\Theta \geq \Theta_f$ use FDI. Note that in all three types of equilibria, it is the least productive firms that produce domestically since their productivity level is not high enough to allow them to cover the fixed cost of offshoring.

We are now in position to describe how an industry's production configuration depends on the structure of its local labor market. So, let's assume that in one country b is sufficiently low so that it satisfies $b < \min\left(s^{\frac{1-\beta}{\beta}}, b_f\right)$. From above, we know that in this case all firms in the country's search sector will produce domestically since that option has the lowest fixed cost and the lowest variable cost. Now, suppose that another country has a higher value of b, perhaps because its government tries to protect jobs by imposing firing costs on firms that try to shrink their labor force. A higher value for b translates into increased benefits from offshoring. And, if the inequality above is reversed, some firms in this country's search sector would find it optimal to offshore. The type of offshoring that will be observed depends on the relative values of $s^{\frac{1-\beta}{\beta}} p_u$ and b_f. If, for example, $s^{\frac{1-\beta}{\beta}} p_u < b_f$, which happens when the cost of buying the intermediate good from a foreign supplier is sufficiently low (or dealing with the foreign labor market is sufficiently costly), then the only type of offshoring that will be observed is foreign outsourcing. In other words, this country's search sector will be characterized by a Type 1 equilibrium. FDI is never observed because it has higher fixed and variables costs when compared to foreign outsourcing.

If $s^{\frac{1-\beta}{\beta}} p_u > b_f$, things are slightly more complicated because the variable costs from FDI are lower than those associated with foreign outsourcing. It then becomes necessary to compare the savings in fixed costs that foreign outsourcing yields relative to FDI. In short, if f_u is sufficiently high, the variable cost savings from FDI will always dominate and foreign outsourcing will never be observed. In this case, the search sector will be characterized by a Type 2 equilibrium. However, if f_u is sufficiently low, equilibrium will be of Type 3. Note that in all three cases, a higher value of b leads to more offshoring.

3.2 | Type 3 equilibria

Since Type 3 equilibria are the most interesting in that all three organizational structures co-exist, we close this section by exploring their properties in greater detail. In particular, we solve for the critical productivity cut-offs and then provide explicit conditions under which such equilibria exist. We then close this section by providing the general equilibrium conditions for the economy as a whole when Type 3 equilibria are relevant.

As in the autarky, there is a zero-profit cut-off productivity, Θ_d, at which a firm breaks even. There are two more productivity cut-offs, Θ_u and Θ_f, that are defined by the intersections of the different profit equations:

$$A(Q, \Theta_d) s b^{-\frac{\beta}{1-\beta}} = f_d, \tag{23a}$$

$$A(Q, \Theta_u) s b^{-\frac{\beta}{1-\beta}} - f_d = A(Q, \Theta_u) p_u^{-\frac{\beta}{1-\beta}} - f_d - f_u \tag{23b}$$

$$A(Q,\Theta_f)p_u^{-\frac{\beta}{1-\beta}}-f_d-f_u=A(Q,\Theta_f)sb_f^{-\frac{\beta}{1-\beta}}-f_d-f_f. \tag{23c}$$

We can use (23a) to solve for the zero-profit cut-off Θ_d, and then (23b), which equates the profit from domestic production with that from foreign outsourcing, pins down Θ_u. Finally, (23c) determines the productivity level Θ_f which equates the profits from foreign outsourcing and FDI.

To solve for these values, it is useful to express Θ_u and Θ_f in terms of Θ_d. From (23b) and (23c) we obtain

$$\Theta_u=k_1\Theta_d \quad \text{where } k_1=\frac{f_u}{f_d}\left[s^{-1}\left(\frac{b}{p_u}\right)^{\frac{\beta}{1-\beta}}-1\right]^{-1} \tag{24}$$

$$\Theta_f=k_2\Theta_d \quad \text{where } k_2=\frac{f_f-f_u}{f_d}\left[\left(\frac{b}{b_f}\right)^{\frac{\beta}{1-\beta}}-s^{-1}\left(\frac{b}{p_u}\right)^{\frac{\beta}{1-\beta}}\right]^{-1}. \tag{25}$$

To have a Type 3 equilibrium, b_f must be low enough that firms can cover the high fixed costs from FDI. Likewise, the unit price of an intermediate good, p_u, must be low enough that firms can cover the fixed cost of foreign outsourcing, but it cannot not be so low that it would dominate FDI.

Lemma 1 *Sufficient conditions to have Type 3 equilibrium are*

1. $b > s^{\frac{1-\beta}{\beta}} p_u > b_f$
2. $k_2 > k_1 > 1$

Proof The first condition is derived from the slope condition, $A(Q,\Theta)sb_f^{-\frac{\beta}{1-\beta}}/\Theta > A(Q,\Theta)p_u^{-\frac{\beta}{1-\beta}}/\Theta > A(Q,\Theta)sb^{-\frac{\beta}{1-\beta}}/\Theta$, and the second condition is derived from $\Theta_f > \Theta_u > \Theta_d$. □

The first condition of Lemma 1 implies that the variable benefits from FDI are the largest, while the second condition restricts the variable gains from FDI, so that we can have both domestic production and foreign outsourcing in equilibrium. If conditions in Lemma 1 are met, then we have the following characterization for firms in any Type 3 equilibrium.

Proposition 1 *In any Type 3 equilibrium, a firm with productivity Θ*

1. exit if $\Theta < \Theta_d$
2. produce domestically if $\Theta \in [\Theta_d, \Theta_u)$
3. opt for foreign outsourcing if $\Theta \in [\Theta_u, \Theta_f)$
4. produce via FDI if $\Theta \geq \Theta_f$

Proposition 1 tells us that a firm decides on its organizational form by comparing its realized productivity level with three productivity cut-offs. It is interesting to note that this outcome is similar to the segregation result for the headquarter intensive sector in Antràs and Helpman (2004). Although both papers employ the same assumption on concerning the relative sizes of fixed organizational costs, the fundamental source of the result if different. In Antràs and Helpman (2004), a tradeoff between ownership advantages from FDI and better incentive in outsourcing drives the results. In our model, it is the relative labor market conditions at home and abroad, along with the price of intermediate goods, that determine the productivity cut-offs.

We are now in a position to describe how to solve for the general equilibrium outcome when offshoring is possible and all three organizational structures are present. First, we note that (24) and (25) allow us to express the profit functions in terms of productivity cut-offs. We have

$$\pi_d(\Theta) = f_d \frac{\Theta}{\Theta_d} - f_d,$$

$$\pi_u(\Theta) = \left(f_u + k_1 f_d\right) \frac{\Theta}{k_1 \Theta_d} - f_d - f_u,$$

$$\pi_f(\Theta) = \left[k_2 f_d + \left(\frac{k_2 - k_1}{k_1}\right) f_u + f_f\right] \frac{\Theta}{k_2 \Theta_d} - f_d - f_f.$$

Substituting these values into the free entry condition and applying the Pareto distribution assumption yields

$$f_e = \frac{\left(k_1 k_2\right)^{-\alpha} \left[\left(f_f - f_u\right) k_1^{\alpha} + \left(f_u + f_d k_1^{\alpha}\right) k_2^{\alpha}\right]}{\alpha - 1} \left(\frac{\Theta_m}{\Theta_d}\right)^{\alpha},$$

where the right-hand side of the last expression is decreasing in Θ_d.

The labor market and the average wage conditions are

$$x(1-\sigma)\bar{w} = 1 \tag{26}$$

and

$$\overline{w} = \frac{M}{H} \int_{\Theta_d}^{\Theta_u} w(\Theta) h_d(\Theta) \, dG(\Theta) = \frac{bM}{H} \int_{\Theta_d}^{\Theta_u} h_d(\Theta) \, dG(\Theta). \tag{27}$$

The second equality of the average wage condition 27) holds because all domestic workers earn the same wage, b.

Total hiring, H, and total output in the differentiated-goods sector, Q, are defined as

$$H = M \int_{\Theta_d}^{\Theta_u} h_d(\Theta) \, dG(\Theta) \tag{28}$$

and

$$Q = M^{\frac{1}{\beta}} \left[\int_{\Theta_d}^{\Theta_u} q_d(\Theta)^{\beta} \, dG(\Theta) + \int_{\Theta_u}^{\Theta_f} q_u(\Theta)^{\beta} \, dG(\Theta) + \int_{\Theta_f}^{\infty} q_f(\Theta)^{\beta} \, dG(\Theta)\right]^{\frac{1}{\beta}}, \tag{29}$$

where $q_j(\Theta) = \Theta^{\frac{1-\beta}{\beta}} h_j$ for $j = d$, u, and f.

Combining (26)–(28), we get

$$\frac{H}{N} = \frac{1}{b}. \tag{30}$$

Using (30) and (7), we obtain get the following equation that determines the labor market cost:

$$b = \frac{1}{1-\sigma}\left(ax^{\delta} + \sigma\psi\right) = \frac{1}{1-\sigma}\left\{a\left[\frac{1}{b(1-\sigma)}\right]^{\delta} + \sigma\psi\right\}. \tag{31}$$

Note that we can calculate b from (31) as a function of labor market parameters.

Since the labor market cost is determined solely by exogenous labor market parameters, we can calculate Θ_d from (26). As the right-hand side of (26) is decreasing in Θ_d, under the conditions of Lemma 1, there exists a unique equilibrium value for Θ_d for any given level of b. This then allows us to calculate total output in the differentiated-goods sector using the zero-profit condition:

$$\frac{1-\beta}{1+\beta}\left[\frac{\beta}{b(1+\beta)}\right]^{\frac{\beta}{1-\beta}} Q^{-\frac{\beta-\zeta}{1-\beta}}\Theta_d = f_d. \tag{32}$$

Finally, with Θ_d and Q, we can solve for M, N, and H using, (28)–(30), while Θ_u and Θ_f can be obtained from (24) and (25).

4 | ANALYSIS

In this section, we analyze the model in several different ways. First, we examine the key factors that govern the tradeoffs between foreign outsourcing and FDI. This allows us to make predictions about the types of countries that firms are likely to select for their investments when engaging in FDI and the types of production processes that are most likely to be fragmented by foreign outsourcing. Second, we examine how changes in domestic labor market conditions impact firm choices with respect to organizational structure. Third, we explore the implications of unequal bargaining power for labor across countries. Finally we analyze how offshoring affects the economy in terms of production, social welfare, and unemployment.

4.1 | Tradeoffs between foreign outsourcing and FDI

From (22), the tradeoff between foreign outsourcing and FDI depends on relative sizes of variable profits and fixed costs associated with the two choices. Since the fixed cost of FDI is greater, the variable profits of FDI must also be greater for FDI to occur in equilibrium. This result is similar to those found in previous studies (Antràs, 2003; Antràs & Helpman, 2004; Chen, 2011; Grossman & Helpman, 2002, 2003) that explore the reasons to lead some firms to choose foreign outsourcing while others select FDI. However, in our model, the key factors that drives the tradeoffs are tied to labor market structures.

In Section 3, we derived the necessary condition to have FDI in equilibrium: $b_f < s^{\frac{1-\beta}{\beta}} p_u$. Thus, a key factor in determining the prominence of FDI is the labor market cost generated from search and matching inefficiencies in the foreign labor market. When the foreign labor market is efficient, the variable gains from vertical integration are large. Not surprisingly, firms that choose FDI are likely to invest in countries that have efficient labor markets and low labor market costs. Based on the World Bank's measure of labor market flexibility, countries with medium/high GDP and high labor market flexibility (above 90 on a 100-point scale) would include Slovakia, Malaysia, Canada, United States, Singapore, Hong Kong and New Zealand (see Cuñat & Melitz, 2012).[10]

The second factor that affect a firm's decision is captured by the term $s^{\frac{1-\beta}{\beta}} = (1+\beta)^{\frac{1}{\beta}}$. The presence of this term reflects the fact that foreign outsourcing entails replacing workers with intermediate goods, thereby allowing the firm to avoid bargaining with labor. Thus, this term captures an additional benefit of choosing foreign outsourcing over FDI. Intuitively, firms gain more from avoiding bargaining in industries and countries in which labor has the ability to capture a greater share of revenue during the bargaining process. This result is summarized below.

Proposition 2 *Foreign outsourcing allows a firm to avoid bargaining with labor. This secondary benefit increases as workers have more share in the wage bargaining process.*

Proof We can easily show that the term $s^{\frac{1-\beta}{\beta}} = (1+\beta)^{\frac{1}{\beta}}$ is a decreasing function of β in $0 < \beta < 1$. We also know that worker's share in the wage bargaining, $\frac{\beta}{1+\beta}R(\Theta)$, increases in β. Thus, when worker's share in the wage bargaining increases, relative profits of foreign outsourcing increases. □

It is worth noting that it is a stylized fact that over the past 50 years labor's bargaining power has eroded both in the United States and abroad (for an excellent discussion of the causes and consequences, see Krueger, 2018). Proposition 2 suggests that one implication of this is that over that period the incentives faced by offshoring firms have tilted away from foreign outsourcing towards FDI.

The last factor that affects the tradeoff between foreign outsourcing and FDI is the price of the intermediate input, p_u. Intuitively, the level of p_u should depend on the nature of the firm's technology. If a firm uses unique technology, it will be very costly to buy an intermediate good and adjust it to fit into the production process. In such a case, the firm would be better off with vertical integration, instead of an arm's-length relationship with a foreign supplier. In contrast, if the technology is a generic one, it will be profitable to choose foreign outsourcing. One might conjecture that the degree of specialization of a firm's technology might be tied to the degree of produce differentiation in an industry. If this is the case, our model would suggest that we should expect to see greater reliance on foreign outsourcing in industries with little or no product differentiation.

4.2 | Domestic labor market inefficiencies and firm decisions

In this subsection, we investigate the link between our measure of the domestic labor market cost, b, and the nature of Type 3 equilibria. First, we derive an analytic solution for Θ_d from (26):

$$\Theta_d = \left[\frac{f_d + k_1^{-\alpha} f_u + k_2^{-\alpha}\left(f_f - f_u\right)}{f_e(\alpha-1)}\right]^{1/\alpha} \Theta_m. \tag{33}$$

We also have Θ_u and Θ_f from (24) and (25). In Appendix A, we use these three equations to show that Θ_d is a increasing in b while the other two offshoring cut-offs are decreasing in b. It is important to note that the result contrasts with what we found in Section 2 when discussing autarky. In autarky, Θ_d is independent of the labor market structure, so that firms that face higher domestic labor market inefficiencies reduce production and increase the price level in a manner that leaves the profit level unchanged.

When offshoring is available, firms that offshore are not affected by changes in b because they do not hire domestic labor. Because of this, changes in Q will no longer be able to fully absorb the effects of the changes in b. Higher values of b will reduce the profits earned by firms that produce domestically, resulting in fewer active low-productivity firms. That is, an increase in b pushes up Θ_d, and thus the average productivity level rises. The reduction in profits earned by low-productivity firms also means that the relative gains from offshoring increase, so that an economy with a less efficient labor market should have more offshoring firms. The impacts on Θ_u and Θ_f follow naturally. First since firms that produce domestically see their profits fall, the highest productivity domestic producers switch and start to use foreign outsourcing. This leads to a reduction in Θ_u. In addition, since we know that a change in b does not affect the relative attractiveness of foreign outsourcing versus FDI, Θ_f must decrease as well. We summarize these findings in the following proposition.

Proposition 3 *In Type 3 equilibria, Θ_d is increasing in* b *while Θ_u and Θ_f are decreasing in* b. *In addition, higher domestic labor market costs result in a higher level of average productivity in the differentiated-goods sector.*

Proof In Appendix A □

4.3 | Asymmetric bargaining power

Up to this point, we have assumed that worker bargaining power is the same in all countries and that it is equal to firm bargaining power. We now extend our analysis by assuming that worker and firm bargaining power differ in the foreign country. This allows us to examine a case in which a firm located in the United States is considering engaging in FDI in Western Europe, where worker bargaining power usually exceeds that in the United States or, alternatively, in China, where worker bargaining power is quite low.

If we use μ to denote the relative bargaining power of firms in the foreign labor market then the bargaining process yields

$$w(\Theta) = \frac{\beta}{\mu+\beta}\frac{R(\Theta)}{h}. \tag{34}$$

As a result, the profit-maximization problem that FDI firms face is

$$\max \frac{\mu}{\mu+\beta}R(\Theta) - b_f h - f_d - f_f. \tag{35}$$

From (35), we get the optimal level of hiring:

$$h_f(\Theta) = \left(\frac{\mu\beta}{b_f(\mu+\beta)}\right)^{\frac{1}{1-\beta}} Q^{-\frac{\beta-\zeta}{1-\beta}}\Theta. \tag{36}$$

And, from (36), we can derive the wage and profit level for FDI:

$$w_f(\Theta) = b_f/\mu, \quad \forall\Theta,$$
$$\pi_f(\Theta) = A(Q,\Theta)s(\mu)b_f^{-\frac{\beta}{1-\beta}} - f_d - f_f,$$

where $s(\mu) \equiv \left(\frac{\mu}{\mu+\beta}\right)^{\frac{1}{1-\beta}}$. Note that $s'(\mu) > 0$.

To see how the productivity cut-offs vary with μ, it is convenient to express Θ_u and Θ_f in terms of Θ_d by examining the ratios $\frac{\Theta_u}{\Theta_d}$ and $\frac{\Theta_f}{\Theta_d}$. Since the payoffs from domestic production and foreign outsourcing do not depend on μ, $\frac{\Theta_u}{\Theta_d}$ is still given by k_1, as defined in (24). For the remaining ratio we have

$$\frac{\Theta_f}{\Theta_d} = k_2(\mu) \tag{37}$$

where $k_2(\mu) = \frac{f_f - f_u}{f_d}\left[\frac{s(\mu)}{s}\left(\frac{b}{b_f}\right)^{\frac{\beta}{1-\beta}} - \frac{1}{s}\left(\frac{b}{p_u}\right)^{\frac{\beta}{1-\beta}}\right]^{-1}$. Note that $k_2'(\mu) < 0$. We can also use k_1 and $k_2(\mu)$ to express the zero-profit cut-off, Θ_d, as a function of foreign firm bargaining power, μ. We have

$$\Theta_d = \left[\frac{f_d + k_1^{-\alpha} f_u + k_2(\mu)^{-\alpha}\left(f_f - f_u\right)}{f_e(\alpha-1)}\right]^{1/\alpha}\Theta_m. \tag{38}$$

It is straightforward to use (37) and (38) to show that Θ_d is positively related to μ.[11] Moreover, since k_1 is independent of μ, (24) implies that if Θ_d is positively related to μ then so must be Θ_u. Using (37) to write $\Theta_f = k_2(\mu)\Theta_d$ and differentiating allows us to show that Θ_f is decreasing in μ. Finally, (32) indicates that Q is positively related to Θ_d, and thus, when μ increases, Q must also increases.

The intuition behind these results is straightforward. As firm bargaining power in foreign labor markets increase (μ rises), the benefit from choosing FDI increase while benefits from the other two organizational choices are unchanged. This results in more firms choosing FDI over foreign outsourcing, which implies that Θ_f must be lower. This process triggers an increase in production, and thus more competition in the differentiated-goods market (Q increases). The increased competition leads to exit by the least productive firms exit (Θ_d increases), and fewer firms are able to afford the fixed cost of choosing foreign outsourcing (Θ_u increases). In addition, since the indirect utility function is given by $V = E + \frac{1-\zeta}{\zeta}Q^{\zeta}$, welfare must improve when there is a better FDI option. These are summarized in the following proposition.

Proposition 4 *An increase in the bargaining power of firms in foreign markets will lead to exit of the least productive firms in the differentiated-goods sector. It will also lead to more firms choosing FDI and a higher level of domestic welfare.*

4.4 | Economic implications of offshoring

Our model predicts how organizational decisions will be made by heterogeneous firms when two offshoring options are available. We now investigate the economic implications of offshoring by comparing the autarkic and offshoring equilibria.

As shown in Section 2, an increase in domestic labor market inefficiencies does not alter Θ_d in the autarkic equilibrium because firms completely offset all the effects from changes in b by reducing the quantity produced. As indirect utility is positively related to Q, this implies that the welfare level in the autarkic equilibrium decreases accordingly.

In order to compare the welfare levels in autarkic and offshoring equilibria, we examine the zero-profit cut-off conditions for the two cases. From the zero-profit conditions (32) we have

$$Q_A^{-\frac{\beta-\zeta}{1-\beta}} = \frac{1+\beta}{1-\beta}\left[\frac{b(1+\beta)}{\beta}\right]^{\frac{\beta}{1-\beta}} \frac{f_d}{\Theta_{d,A}},$$
$$Q_O^{-\frac{\beta-\zeta}{1-\beta}} = \frac{1+\beta}{1-\beta}\left[\frac{b(1+\beta)}{\beta}\right]^{\frac{\beta}{1-\beta}} \frac{f_d}{\Theta_{d,O}},$$

where the subscript A denotes autarky and the subscript O refers to the offshoring equilibrium. Dividing yields

$$\left(\frac{Q_O}{Q_A}\right)^{-\frac{\beta-\zeta}{1-\beta}} = \frac{\Theta_{d,A}}{\Theta_{d,O}}. \tag{39}$$

Because firms exit when labor market inefficiencies increase in the offshoring equilibria while the cut-offs remain unchanged under autarky, the right-hand side of (39) is smaller than one; and thus Q_O exceeds Q_A.

Panel (a) and panel (b) in Figure 2 show simulation results that indicate how Θ_d and Q change as b varies. In panel (a), the zero-profit cut-off under autarky does not change while the corresponding

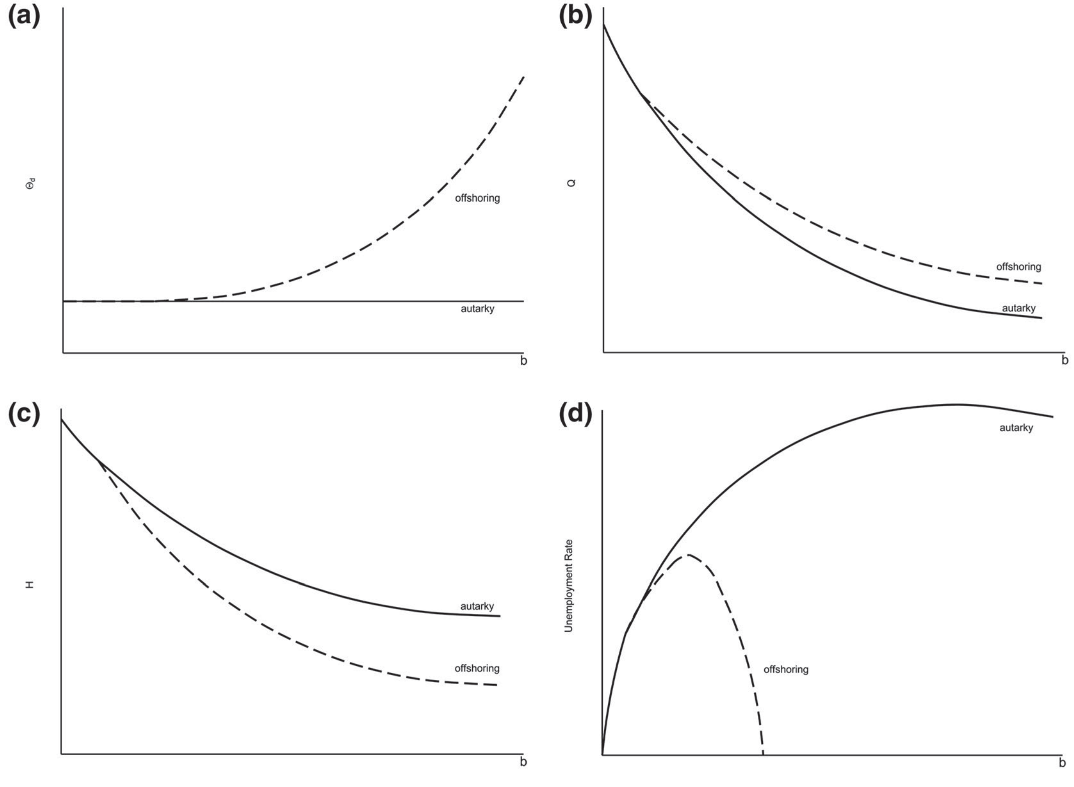

FIGURE 2 Autarky versus offshoring

cut-off under offshoring increases with b. The results displayed in panel (b) indicate that the impact of an increase in b on Q is larger under autarky than it is when offshoring is possible. The implication of panel (b) is that offshoring is more valuable to economies that have very inefficient domestic labor markets. We summarize these results in the following proposition.

Proposition 5 *Welfare is higher when offshoring is possible than it is under autarky. In addition, the difference between the two welfare levels is increasing in* b.

We now turn to question of how offshoring affects the hiring level of domestic workers and the economy-wide unemployment rate. From (39) and (11), we have

$$\frac{h_O(\Theta)}{h_A(\Theta)} = \left(\frac{Q_O}{Q_A}\right)^{-\frac{\beta-\zeta}{1-\beta}}. \tag{40}$$

As $Q_O > Q_A$, the hiring level of individual firms under autarky exceeds the hiring rate when offshoring is possible. Moreover, if we apply our Pareto assumption, the number of firms that choose domestic production is greater in autarky. Thus, we can conclude that the total hiring, H, is smaller in an offshoring equilibrium. Panel (c) of Figure 2 shows how H varies with b.

The economy-wide unemployment rate is defined as

$$u = (N - H)/L = (b - 1)H/L, \tag{41}$$

where the second equality holds due to (30). From (41), the unemployment rate equals zero when $b = 1$. When b goes to infinity, H approaches zero and the unemployment rate drops to zero as well. Thus, as b increases, we expect a bell-shaped unemployment rate curve.

The bell-shaped unemployment rate curve is driven by labor movement across the two sectors. As b increases, more workers enter the differentiated-goods sector, since a higher value for b results in a higher wage level. However, as total hiring, H, decreases at the same time, workers realize that the probability of getting a job in the differentiated-goods sector falls and this reduces the incentive to move to the differentiated-goods sector. Even though this latter effect hinders workers from entering the differentiated-goods sector in both the offshoring equilibrium and under autarky, the impact is lower under autarky. In the offshoring equilibrium, increased labor market inefficiencies result in more offshoring firms, and thus the adjustment in H is more dramatic than it is under autarky. With a reduced hiring rate in the differentiated-goods sector, more workers choose the homogeneous sector, and thus the unemployment rate in the offshoring equilibrium becomes lower than it would be under autarky. Analytically, this result follows from the fact that the autarkic value for H exceeds what is would be with offshoring, and (41) tells us that for a given level of b, a higher value for H leads to a higher unemployment rate. This relationship is depicted in panel (d) of Figure 2.

Our prediction with respect to the unemployment rate depends on our assumption that the labor market in the non-offshorable sector is frictionless. This assumption implies the reduction in total hiring that occurs in the offshorable sector can be absorbed by the other sector. This result is similar to Mitra and Ranjan's (2010) finding that offshoring decreases the economy-wide unemployment rate in the presence of perfect inter-sectoral mobility. In both settings, the impact of offshoring on the unemployment rate depends on whether the expanding sector can partly absorb the negative effects of offshoring on unemployment.

Proposition 6 *When offshoring is possible, the total hiring rate in the differentiated-goods sector and the economy-wide unemployment rate are both lower than they would be under autarky.*

5 | CONCLUSION

Fragmentation of the production process has changed the nature of international trade over the past 50 years. Not surprisingly, this has led to a large literatures targeted at both determining key aspects that enter into a firm's decision to offshore and assessing the impact of offshoring on key economic variables such as social welfare and unemployment. In this paper, we have focused on a feature of every modern economy that has received only a modicum of attention, the structure of labor markets both at home and abroad. We have developed a two-sector heterogeneous-firm model, based largely on Helpman and Itskhoki (2010), in which the labor market in offshorable sector is characterized by search and matching frictions. We have also assumed that countries differ in the degree of labor market inefficiencies and investigated how those inefficiencies shape industry structure when firms have the options of producing domestically, engaging in FDI, or substituting for domestic labor via foreign outsourcing.

In this setting, we show that it is the most productive firms that choose to offshore, with the least productive active firms producing domestically. Within the set of offshoring firms, we find that it is the most productive firms that engage in FDI with the remainder turning to foreign outsourcing. As in previous literatures, these decisions are driven by tradeoffs between the fixed and variable costs associated with the different production methods. It is also worth noting that while our segregation result mirrors findings from previous studies (e.g. Antràs & Helpman, 2004 or Helpman, Melitz, & Yeaple, 2004), it is driven by labor market considerations that differ substantially from the forces that drove those earlier outcomes.

Comparing across countries, we find that countries with less efficient labor markets will be characterized by more offshoring. Greater labor market inefficiencies also induce more exit of the least productive firms, and thus trigger an increase in the average productivity level within the industry. In terms of social welfare, we find that the welfare when offshoring is an option exceeds what would be achieved under autarky. Finally, we find total hiring and the unemployment rate are both lower in an equilibrium with offshoring than they would be under autarky (this last result depends on our assumption that the unemployment rate is higher in the offshorable sector). The implication is that although offshoring reduces total hiring in the offshorable sector, it aids the economy by lowering the overall unemployment rate and increasing welfare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] Fragmentation has costs as well, leading to disruption in labor markets. The offshoring of production by domestic firms leads to job dislocation at home and estimates are that the personal cost of worker dislocation can be quite high. Policymakers have been slow to respond to the new challenges that have arisen as a result, leading to intense policy

debates about the appropriate responses. Academically, some have called for thoughtful reconsideration of the way that economists think about the gains and losses from globalization (see, for example, Rodrik, 1998, 2011 and/or Blinder, 2006).

[2] The measures for a variety of countries can be found in Cuñat and Melitz (2012), along with further discussion. See also Kohler and Kukharskyy (2019) for a related approach that relies on the World Bank's Doing Business database to measure labor rigidity.

[3] Depending on the context, we name the search/frictionless sectors differently: differentiated-goods/homogeneous-good sectors or offshorable/non-offshorable sectors.

[4] Note that our focus is vertical FDI (as opposed to horizontal FDI). As discussed in Antràs and Yeaple (2014), it is useful to assume zero transportation costs to shut down the horizontal incentive for FDI. If we introduce exports into this model, it would complicate the analysis without altering any of our main results (exports would simply increase the market size that firms face).

[5] Once a worker enters the differentiated-goods sector, he cannot go back to the homogeneous-good sector.

[6] In this closed economy, all products in the offshoring equilibria are transported back to the domestic market and consumed. The transportation cost of final products are assumed to be zero for simplicity.

[7] In more general settings where the bargaining power of two parties are not equal, the wage level is proportional to the labor market cost. Specifically, with a relative bargaining power of firms μ, we get $w(\theta) = b/\mu$.

[8] Domestic outsourcing is excluded in this model as it would not be chosen under a reasonable parametric assumption that makes using a domestic intermediate good more costly than producing with domestic labor. With foreign outsourcing, the search and matching cost that a domestic firm faces is generally higher than a foreign supplier that produces the intermediate goods. This is because foreign suppliers are assumed to have relative strength in dealing with the foreign labor market as they have more information about its labor market structure. Thus, foreign outsourcing can be optimal for some firms. In contrast, in the domestic labor market the labor market cost that a domestic firm faces would be the same regardless of its choice over two organizational forms, domestic outsourcing and domestic production(domestic integration).

[9] This cost is generated by the imperfections in the foreign labor market and restrictions placed on hiring by the foreign government. For simplicity, we can assume that the labor market structure in the foreign country is similar to that in the domestic market but with different parameters so that, as in (7), $b_f = \frac{1}{1-\sigma_f}\left(a_f x_f^{\delta} + \sigma_f \psi_f\right)$.

[10] It is also worth noting that of the ten countries that attracted the most FDI in 2017 (United States, China, Hong Kong, Brazil, Singapore, the Netherlands, France, Australia, Switzerland and India based on United Nations data), five had very high scores for labor market flexibility. On a 100-point scale, these were: United States (97), Hong Kong (100), Singapore (100), Australia (83), and Switzerland (83). Only 2 of the 10 had very low scores, Brazil (28) and France (34), suggesting that there may be other reasons that countries find Brazil and France to be attractive targets for investment.

[11] From (37) we know that $k_2'(\mu) < 0$ and from (38) we see that Θ_d is decreasing in $k_2(\mu)$, yielding the desired result.

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APPENDIX A

A PROOF OF PROPOSITION 3

A1 | A positive relationship between Θ_d and b

The zero-profit cut-off is related to b through k_1 and k_2: $\Theta_d = \left[\frac{f_d + k_1^{-\alpha} f_u + k_2^{-\alpha}(f_f - f_u)}{f_e(\alpha-1)}\right]^{1/\alpha} \Theta_m$. Thus, the sign of $\frac{\partial \Theta_d}{\partial b}$ can be expressed as

$$\frac{d\Theta_d}{db} = \frac{\partial \Theta_d}{\partial k_1}\frac{dk_1}{db} + \frac{\partial \Theta_d}{\partial k_2}\frac{dk_2}{db}.$$

Before we decide the sign of the four parts, it is convenient to define R_1 and R_2 as

$$R_1 = s^{-1}\left(\frac{b}{p_u}\right)^{\frac{\beta}{1-\beta}} \tag{A1}$$

$$R_2 = \left(\frac{b}{b_f}\right)^{\frac{\beta}{1-\beta}}. \tag{A2}$$

Note that $R_2 > R_1$ in Type 3 equilibrium.

And we get the signs of the four parts:

$$\begin{aligned}
\frac{dk_1}{db} &= -\frac{f_u}{f_d(R_1-1)^2}\frac{dR_1}{db} < 0 \\
\frac{dk_2}{db} &= -\frac{f_f-f_u}{f_d}\left(\frac{1}{R_2-R_1}\right)^2\left[\frac{\beta\left(R_2-R_1\right)}{(1-\beta)\,b}\right] < 0 \\
\frac{\partial\Theta_d}{\partial k_1} &= -\left[\frac{f_d+k_1^{-\alpha}f_u+k_2^{-\alpha}\left(f_f-f_u\right)}{f_e(\alpha-1)}\right]^{1/\alpha-1}\Theta_m\frac{f_u}{f_e\,(\alpha-1)}k_1^{-\alpha-1} < 0 \\
\frac{\partial\Theta_d}{\partial k_2} &= -\left[\frac{f_d+k_1^{-\alpha}f_u+k_2^{-\alpha}\left(f_f-f_u\right)}{f_e(\alpha-1)}\right]^{1/\alpha-1}\Theta_m\frac{f_f-f_u}{f_e\,(\alpha-1)}k_2^{-\alpha-1} < 0.
\end{aligned}$$

Because the signs of the four terms are all negative, we verify $\frac{d\Theta_d}{db} > 0$.

A2 | Negative relationships between offshoring cut-offs and *b*

Now, we have to check how two cut-offs react to changes in the labor market cost in Type 3 equilibrium. We begin with $\Theta_u = k_1\Theta_d$:

$$\frac{d\Theta_u}{db} = \frac{d(k_1\Theta_d)}{db} = k_1\frac{d\Theta_d}{db} + \Theta_d\frac{dk_1}{db}. \tag{A3}$$

Before we calculate parts of (A3), we define $B \equiv \frac{f_d+k_1^{-\alpha}f_u+k_2^{-\alpha}\left(f_f-f_u\right)}{f_e(\alpha-1)}$ and $C \equiv \Theta_m\frac{1}{f_ef_d(\alpha-1)}\frac{\beta}{b(1-\beta)}$. Then, we get

$$\begin{aligned}
\frac{d\Theta_d}{db} &= B^{\frac{1}{\alpha}-1}C\left[\frac{R_1}{\left(R_1-1\right)^2}f_u^2k_1^{-\alpha-1} + \frac{\left(f_f-f_u\right)^2}{R_2-R_1}k_2^{-\alpha-1}\right] \\
\frac{dk_1}{db} &= -\frac{\beta}{b\,(1-\beta)}\frac{f_u}{f_d}\frac{R_1}{\left(R_1-1\right)^2}.
\end{aligned} \tag{A4}$$

If we plug (A4) into (A3), we get

$$
\begin{aligned}
\frac{d\Theta_u}{db} &= B^{\frac{1}{\alpha}-1}C\left[\frac{R_1}{(R_1-1)^2}f_u^2k_1^{-\alpha}+\frac{(f_f-f_u)^2}{R_2-R_1}k_1k_2^{-\alpha-1}\right] \\
&\quad -B^{\frac{1}{\alpha}-1}C\left\{\frac{R_1}{(R_1-1)^2}f_u\left[f_d+f_uk_1^{-\alpha}+(f_f-f_u)\,k_2^{-\alpha}\right]\right\} \\
&= B^{\frac{1}{\alpha}-1}C\left[\frac{(f_f-f_u)^2}{R_2-R_1}k_1k_2^{-\alpha-1}-\frac{R_1}{(R_1-1)^2}f_u\,(f_f-f_u)\,k_2^{-\alpha}-\frac{R_1f_df_u}{(R_1-1)^2}\right] \\
&= B^{\frac{1}{\alpha}-1}C\left[-f_d^{\alpha}f_u\,(f_f-f_u)^{-\alpha+1}\frac{(R_2-R_1)^{\alpha}}{(R_1-1)^2}-\frac{R_1f_df_u}{(R_1-1)^2}\right].
\end{aligned}
$$

Because $R_2 > R_1$ and $f_f > f_u$, $\frac{d\Theta_u}{db} < 0$.

Similarly, we can simplify $\frac{d\Theta_f}{db}$ as

$$
\begin{aligned}
\frac{d\Theta_f}{db} &= \frac{d(k_2\Theta_d)}{db} = k_2\frac{d\Theta_d}{db}+\Theta_d\frac{dk_2}{db} \\
&= B^{\frac{1}{\alpha}-1}C\left[\frac{R_1}{(R_1-1)^2}f_u^2k_1^{-\alpha-1}k_2+\frac{(f_f-f_u)^2}{R_2-R_1}k_2^{-\alpha}\right] \\
&\quad -B^{\frac{1}{\alpha}-1}C\left\{\frac{f_f-f_u}{(R_2-R_1)}\left[f_d+k_1^{-\alpha}f_u+k_2^{-\alpha}\,(f_f-f_u)\right]\right\} \\
&= B^{\frac{1}{\alpha}-1}C\left[\frac{R_1}{(R_1-1)^2}f_u^2k_1^{-\alpha-1}k_2-\frac{f_u\,(f_f-f_u)}{(R_2-R_1)}k_1^{-\alpha}-\frac{f_d\,(f_f-f_u)}{(R_2-R_1)}\right] \\
&= B^{\frac{1}{\alpha}-1}C\frac{f_d\,(f_f-f_u)}{R_2-R_1}\left[\left(\frac{f_u}{f_d}\frac{1}{R_1-1}\right)^{1-\alpha}-1\right].
\end{aligned}
$$

Because $\alpha > 1$ and $\frac{f_u}{f_d}\frac{1}{R_1-1}$ is greater than one, we get $\left(\frac{f_u}{f_d}\frac{1}{R_1-1}\right)^{1-\alpha} < 1$. Thus, we get $\frac{d\Theta_f}{db} < 0$.