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Economic integration and labor market institutions: Worker mobility, earnings risk, and contract structure

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Abstract

This paper investigates the effects of labor market integration, in the form of worker mobility, in a model with long-term labor contracts that lead to wage rigidities and unemployment. Reflecting the interdependence of regional labor markets, we develop a framework where the contract structure is *simultaneously* determined in all regions. It is shown that increased mobility leads to more flexible labor market institutions in which firms can more easily vary the level of employment in response to fluctuations in demand. Economic integration is potentially Pareto-improving but, in the absence of a system of compensation, workers are harmed by greater labor mobility while the owners of firms benefit from higher profits.
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1. Introduction

It has become commonplace for analysts (e.g., Burda and Mertens (1995) or Bertola and Ichino (1995)) to draw a sharp distinction between flexible "US-style" and rigid "European-style" labor market institutions, in which the former are characterized by relatively little regulatory control, high interregional and intersectoral mobility of labor, and wage flexibility, while the latter exhibit strong regulatory constraints, collective bargaining arrangements that limit the ability of firms to adjust employment and wages in the face of changing market conditions, and relatively

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limited intersectoral and interregional mobility of labor.[1] Some of these institutional features are determined as a matter of public policy while others are more "fundamental" in the sense that they depend on underlying "technological" determinants. In this paper, we focus on the cost of migration as a fundamental determinant of labor market institutions, including labor market policies.

Consider, in particular, the impact of imperfectly correlated "external shocks", such as terms of trade shocks (Rodrik, 1998), on the labor markets in a system of regions. If the fundamental costs of migration among regions are low, such as is true among regions within a highly-integrated economy like that of the US, then regions that experience positive shocks would tend to attract labor from those that experience negative shocks. One consequence of this spatial reallocation of labor is that it would tend to moderate regional wage fluctuations, even if public policies in this system are highly conducive to wage flexibility: the supply adjustment that results from workers leaving low-demand regions and moving to high-demand regions limits downward wage movements in the former and upward wage movements in the latter. Suppose, by contrast, that the fundamental costs of migration are high. External shocks would then give rise to large wage fluctuations, in the absence of public policies that constrain wage flexibility: smaller supply adjustments through migration would be associated with larger shocks to regional wage rates. Public policies and institutions that mitigate wage risk (i.e., that create or support wage rigidities) would potentially have much greater appeal in such an environment. If adopted by a system of regions such as the EU countries, imperfectly correlated external shocks would then be expected to produce variations among regions in rates of unemployment, a noteworthy feature of European labor market experience. In short, it may be useful to view some of the institutions that are believed to account for the varying experiences in US and European labor markets, such as the regulations that govern private-sector contracting and bargaining practices, as endogenously dependent upon underlying determinants of worker mobility.

The analysis below presents a model in which regional wage rigidities are endogenously determined in a way that depends upon the degree of labor market integration among regions, characterized as a migration cost parameter. As is typical of most labor-market models, the rigidities in our model generally result in unemployment when there are negative demand shocks. However, unlike models where there is only one regional labor market, our model allows for workers who lose their jobs in one regional economy to move to another region where labor demand is higher; the model thus incorporates not only "layoffs" due to adverse demand shocks but also "turnover", in the form of interregional migration.[2] The degree of wage rigidity, and thus the equilibrium levels of unemployment, migration, and other critical variables, all depend on the migration cost parameter. Comparative statics analysis with respect to this parameter shows how the equilibrium wage rigidities and other equilibrium properties of the entire system of regions depend on the degree of labor market integration.

The paper is organized as follows. Section 2 presents the basic model. Sections 2.1 and 2.2 examine equilibrium "contracts" in a single region, first in the special case where migration costs are prohibitive (the "autarky" case) and then more generally. This lays the foundation for the main

[1] See Nickell (1997, 2003) and Nickell (1999) for recent surveys of labor market institutions and their impact on unemployment.

[2] See, e.g., Gottfries (1992), Saint-Paul (1997) and the survey by Bertola (1999) who discuss the importance of turnover and hiring in modeling unemployment. Note that migrants in this model are like "outsiders" in an "insider–outsider" (Lindbeck and Snower, 1988; Leslie, 1992). See, e.g., Decressin and Fatas (1995), Coulombe (2006), and references therein for analyses of migration and unemployment relationships in the US, EU, and Canada.

analysis, beginning in Section 3, which considers the simultaneously-determined equilibrium for a system of imperfectly-integrated regions and the dependence of this system-wide equilibrium on migration costs.[3] The analysis shows that there are two possible types of equilibria, a "mixed" regime (Section 3.1) in which both migration and unemployment are observed, and a "full-employment" regime (Section 3.2) in which all workers that are laid off in regions experiencing adverse shocks migrate to other regions and unemployment completely disappears.

Section 4 explores the welfare implications of increased economic integration, focusing on the effects of reduced migration costs on the distribution of income between workers and the recipients of profit income from firms and on overall economic welfare within the system of jurisdictions. Section 5 summarizes the main results and discusses some policy implications of the analysis.

2. The model

Our objective is to analyze the effects of labor market integration in a system of regions, within each of which workers and firms enter long-term wage and employment "contracts" under conditions of uncertainty. These "contracts" should be viewed as the employment relationships that emerge under a given institutional structure, including not only the bargains between firms and workers, perhaps through collective bargaining agreements or centralized wage-setting negotiations, but also other terms of employment as determined by policies implemented through statutory and administrative policies and regulations (e.g., regarding hiring and firing, minimum wages, workplace health and safety mandates, etc.). In the model, these contracts represent the endogenously-determined institutional structure and outcomes of the labor market. Because these "contracts" are interpreted very broadly to include public policies, their enforcement is not simply a matter of compliance with agreements among private parties, but of adherence to constraints imposed on private parties by regional governments.

The extent of "labor market integration" is parameterized by a variable c which represents the cost incurred by a worker in moving from one region to another. Throughout the paper, we will think of geographic *regions* as a basic unit of analysis. What we call "regions" could, for many purposes, equally be viewed as "sectors"; regional specialization is an important reason why shocks are not perfectly correlated among regions, and geographic and intersectoral mobility are closely linked, in practice. Thus, the variable c which measures labor market integration can be taken to reflect not only the costs of relocation across space but also the costs of movements of labor among sectors.

It is convenient to begin by describing how contracts are determined by the workers and firms in a single jurisdiction in isolation, as would be the case if migration costs are prohibitively high. Once the *autarky* case is analyzed, we can then extend the analysis to incorporate the interactions between labor markets of different jurisdictions as migration costs fall.

2.1. Autarky equilibria

Consider first the case where migration cost c is so high that no migration occurs in equilibrium. This assumption, which corresponds to the closed-economy setup generally used in

[3] This system-wide analysis differs from Ethier (1985), who (to our knowledge) is the only other author to study migration in an economy where at least some workers are subject to endogenous wage rigidities of the type considered here.

previous literature, means that the potential labor force in a given jurisdiction consists only of those individuals who reside there initially, denoted by $\bar{n}$ and assumed for simplicity to be the same for all regions.

We consider a representative firm (sometimes called "the firms" or "employers") in each region that behaves atomistically and that is (or, more precisely, its owners are) assumed to be risk-neutral, while workers are risk-averse. The representative firm competes for workers by offering contracts which specify the firm's state-contingent wage and layoff policies. These contracts offer workers some degree of job security and insurance against wage risk and are enforced by labor market institutions, including public or quasi-public regulatory and organizational structures (labor laws, employment protection regulations, collective bargaining frameworks, unions, etc.). Firms can commit themselves by offering high severance payments in case of lay-offs or by having built up reputation which they can lose in repeated games. Leaving such long-term contracts may be very costly for workers since the worker's remuneration may be in part conditional on the contract duration (cf. Feldstein (1976), Baily (1977)). Contract elements such as seniority-based pay structures, firm pensions, severance payments, and increased job security with job duration (see e.g. Bewley (1999) and the references there) contribute to long-duration employment relationships. Strict enforcement of such commitments may be difficult, but labor market institutions such as union contracts and labor market regulations may mandate benefits for insiders, i.e. existing workers with long-term contracts, that are based on seniority. This further increases the advantages of long-term employment relationships in addition to the insurance they provide.[4]

The representative firm in a given region produces output under conditions of multiplicative uncertainty. There are two possible states of the world, a "good" state that occurs with probability ρ and a "bad" state which occurs with the complementary probability. Output (or the value of output) is given by $p_i f(n_i)$, where f is a strictly increasing and concave function of the number of workers employed in state i ($f'>0>f''$) and where p_i is a random variable which may take on either of two values, p_i, $i=1, 2$. As is standard in models of interregional factor mobility, the strict concavity of the production function reflects the presence of immobile and fixed factors of production such as land or natural resources. It implies that firms earn "profits" after covering the costs of hiring labor, but these "profits" should be interpreted as rents (or quasi-rents) accruing to the fixed (or quasi-fixed) factors.[5] Assume that $p_1>p_2$, so that state 1 can be identified as the "good" state and state 2 as the "bad" state.

2.1.1. Partial equilibrium determination of contracts

It is convenient to proceed by supposing that labor "contracts" are determined so as to maximize the profits of firms subject to an expected utility constraint, but it should be kept in mind that contract terms are intended to represent public policies as well as terms that private agents, acting individually within a given institutional setting, are free to negotiate. The setting of policies so as to maximize profits subject to an expected utility constraint is a condensed representation of a process that involves both "private" contracting and "public" policymaking. As will be seen, the final equilibrium of the system is one in which there is no scope for Pareto improvements in contracts, that is, there are no alternative contracts that would produce higher profits for firms for a given expected utility level

[4] Formally, the model below builds upon and extends the well-known implicit contract model originated by Baily (1974), Gordon (1974), and Azariadis (1975); see e.g., Rosen (1985), Taylor (1987) for standard expositions. Agell and Lommerud (1992) highlight the role of institutions – specifically, labor unions – as mechanisms through which wage variability, and thus wage income risk, can be constrained.

[5] Depending on the time horizon of the analysis, capital could also be included among these fixed factors; otherwise, the "profits" of the firm accrue solely to other fixed factors.

for workers (or conversely). Viewed from a political-economy perspective, this means that there are no alternative policies that would secure approval by all groups.[6]

Firms compete ex ante to attract workers, offering contracts which specify the wage w_i to be paid in each state of nature and the number of workers n_i employed in each state. In particular, firms may choose to employ more workers in the good state than in the bad state, and the difference between n_1 and n_2 represents "unemployment" due to layoffs.[7] It is assumed that all workers have an equal likelihood of layoffs in the bad state, i.e., given the contract (w_1, w_2, n_1, n_2), each worker faces an ex ante probability $(n_1-n_2)/n_1$ of being laid off in the bad state. The expected profit of a firm in autarky that offers a contract (w_1, w_2, n_1, n_2) is given by

$$\Pi_A = \rho(p_1 f(n_1) - w_1 n_1) + (1-\rho)(p_2 f(n_2) - w_2 n_2). \tag{1}$$

Worker preferences are represented by a strictly increasing and concave utility function $u(\cdot)$ defined over wage income. If workers are laid off, they may engage in "home production" or leisure, and may also receive cash or in-kind benefits from the government, receiving a reservation level of utility $u(b)$ where b denotes the monetized value of all non-market uses of time. (b may also represent cash and in-kind unemployment benefits but these are not included explicitly so that notation for the financing of public expenditures may be omitted.) Individual firms can hire as many workers as desired ex ante, provided that their contracts offer a level of expected utility that is at least as great as the expected utility that workers can obtain elsewhere, denoted by $\tilde{u}_A$. Although $\tilde{u}$ is treated as fixed by the representative firm, it is an endogenous variable of the model; the determination of its equilibrium value is discussed further below. Thus, the problem facing a firm in formulating an employment contract can be written

$$(P_A) \qquad \max_{<w_1, w_2, n_1, n_2>} \quad \Pi_A$$

subject to

$$\rho u(w_1) + (1-\rho)\frac{n_2}{n_1}u(w_2) + (1-\rho)\frac{n_1-n_2}{n_1}u(b) - \tilde{u}_A \geq 0. \tag{2}$$

Letting $\mathcal{L}_A(n_1, n_2, w_1, w_2, \lambda_A)$ represent the Lagrangian for (P_A) where λ_A is the Lagrange multiplier associated with the expected-utility constraint (2), the first-order conditions characterizing the profit-maximizing choice of wages in each period are

$$\frac{\partial \mathcal{L}_A}{\partial w_1} = -\rho n_1 + \lambda_A \rho u'(w_1) = 0 \tag{3a}$$

$$\frac{\partial \mathcal{L}_A}{\partial w_2} = -(1-\rho)n_2 + \lambda_A(1-\rho)\frac{n_2}{n_1}u'(w_2) = 0. \tag{3b}$$

[6] In order to maintain a sharp focus on labor market institutions, the analysis does not examine the endogenous determination of explicitly redistributive policies, such as the taxation of land rents in order to finance transfer payments to workers.

[7] Since any state-contingent reductions in employment are contracted in advance, it can be argued that "unemployment" in this framework is not involuntary in an ex ante sense. One can view layoffs as simply "turnover" or "separations." Within the context of the present analysis, these terms can be viewed as equivalent. Notice that in the present framework the number of separations in the bad state may be smaller than it would be in a Walrasian labor market. This "over-employment" result depends on the symmetric information assumption applied here. Hart (1981) and Grossman and Hart (1981, 1983) have shown, however, that with asymmetric information there will be more unemployment with implicit contracts than in a Walrasian labor market because laying off workers is the only way for firms to signal workers that the firm is in a bad state of the world.

Using these equations to eliminate λ_A, [8] it follows that

$$u'(w_1) = u'(w_2) \quad \Leftrightarrow \quad w_1 = w_2,$$

that is, the wage rate is *state-invariant* under an equilibrium contract. Henceforth, this state-invariant wage is denoted by w.

The first-order conditions for the choice of employment levels in each state are

$$\frac{\partial \mathcal{L}_A}{\partial n_1} = \rho(p_1 f'(n_1) - w) - \lambda_A\left((1-\rho)\frac{n_2}{n_1^2}u(w) - (1-\rho)\frac{n_2}{n_1^2}u(b)\right) = 0 \tag{3c}$$

$$\frac{\partial \mathcal{L}_A}{\partial n_2} = (1-\rho)(p_2 f'(n_2) - w) + \lambda_A\left((1-\rho)\frac{1}{n_1}u(w) - (1-\rho)\frac{1}{n_1}u(b)\right) = 0. \tag{3d}$$

Using Eq. (3a) to eliminate λ_A in Eq. (3c), we obtain

$$\rho n_1(p_1 f'(n_1) - w) = (1-\rho)n_2\left(\frac{u(w) - u(b)}{u'(w)}\right) > 0. \tag{4a}$$

As the right-hand side is positive, the left-hand side can be interpreted as an insurance premium that workers pay to the firm in the good state in order to obtain insurance against income risk (see, e.g., Taylor (1987), p. 13). Furthermore, eliminating λ_A from Eq. (3d) yields

$$p_2 f'(n_2) - w = -\frac{u(w) - u(b)}{u'(w)} < 0. \tag{4b}$$

Thus, the marginal product of labor in the bad state is less than the wage rate. As is well-known, there are reasonable conditions under which $n_1 > n_2$, implying that firms lay off workers in the bad state.[9]

2.1.2. Regional equilibrium in autarky

The analysis thus far has examined the contract that firms offer to workers given that they engage in ex ante competition for labor and must offer contracts that provide at least a specified level of expected utility, $\tilde{u}_A$. Individual competitive firms act as though they can hire as many workers as they wish, subject to this constraint. However, ex ante equilibrium in the labor market of an autarkic jurisdiction requires that there be no excess demand for labor, i.e., $n_1 \leq \bar{n}$. Intuitively, if $\tilde{u}_A$, the level of utility that firms must offer workers, is sufficiently low, wages and layoff policies will be sufficiently profitable to firms that they would wish to hire more workers than are available in the labor force, i.e., $n_1 > \bar{n}$, and in this case firms will find it advantageous to offer somewhat more attractive contracts to workers. As this competition for workers proceeds, the level of utility that workers can obtain in the labor market rises, and as $\tilde{u}_A$ goes up, the number of workers that firms wish to hire will fall. As shown in Appendix A, comparative statics analysis confirms that $\partial n_1/\partial \tilde{u}_A < 0$. Conversely, if $\tilde{u}_A$ is "too high," there will be excess supply in the labor

[8] It is easily verified that that the expected utility constraint (2) is always binding at a solution to (P_A) so that $\lambda_A > 0$.

[9] Specifically (see Taylor (1987, p. 16)), $n_1 > n_2$ if $(w - p_2 f'(n_1)) > (u(w) - u(b))/u'(w)$. Note that unemployment can only occur if $p_2 f'(n_1) < b$, which we assume throughout. If b were smaller than $p_2 f'(n_1)$, then laid-off workers would underbid incumbent workers for jobs in the bad state and firms would hire them instead, firing incumbent workers and thus reneging on the employment protection given in the long-term contract.

market. Firms will be able to hire as many workers as desired while offering somewhat less attractive contracts, causing $\tilde{u}_A$ to fall and n_1 to rise. The reservation utility level obtained by unemployed workers, $u(b)$, puts a lower bound on the value of $\tilde{u}_A$, however, and it is possible that $n_1<\bar{n}$ when $\tilde{u}_A=u(b)$, in which case there is ex ante excess supply of labor in equilibrium. Throughout the analysis, we assume that this is not the case, so that $\tilde{u}_A>u(b)$ and $n_1=\bar{n}$ in equilibrium.[10]

2.2. Equilibria for a single open jurisdiction

Now consider the case where migration costs c are sufficiently low that workers may move from one region to another. For the sake of analytical simplicity, suppose that there are many jurisdictions which initially contain identical numbers of workers $\bar{n}$ and whose firms have identical technologies, as represented by the production function f. Output in each jurisdiction is characterized by multiplicative uncertainty of the form described above, and the random variable p_i is independently and identically distributed across all regions.[11] With many jurisdictions, by the law of large numbers, the proportion of jurisdictions experiencing favorable technological realizations ($p_i=p_1$) is equal to ρ while the proportion $(1-\rho)$ experience an unfavorable realization p_2. Migration occurs when firms in regions experiencing favorable technology shocks are able to attract workers who have been laid off from jobs in regions experiencing unfavorable shocks. Migrant workers are assumed to participate in a spot labor market in regions where firms are hiring additional labor, rather than entering into new long-term contracts, reflecting their more transient and less-established relationships with employers.[12] This spot market is assumed to operate under conditions of perfect competition, so that new (migrant) workers are paid according to their marginal products; assuming that migration costs are independent of the origin or destination of migrants, arbitrage in the market for migrant workers means that all will earn the same wage in equilibrium, denoted by w^*.

In the case of autarky, the marginal product of labor in favorable states of nature is equal to $p_1 f'(\bar{n})$. This places an upper bound $w^*_{\max}$ on the spot wage; if migration actually occurs, the amount of employment in jurisdictions experiencing favorable shocks will exceed $\bar{n}$ and w^* will thus be less than $w^*_{\max}$. It is clear, therefore, that no migration can occur if $c>p_1 f'(\bar{n})-b$ since workers can always receive b as a minimum when laid off, and the spot wage must thus be at least equal to $b+c$ before any migration occurs.

While $c \le p_1 f'(\bar{n})-b=w^*_{\max}-b\equiv c^*$ is a necessary condition for any migration to take place, the precise amount of migration that occurs depends on the nature of the contracts that are established between workers and firms and, in particular, on the number of workers laid off by firms experiencing unfavorable shocks. In turn, however, the conditions of the equilibrium contract may depend on the feasibility and cost of migration; in particular, workers may willingly accept contracts with higher levels of layoffs if migration provides good job opportunities when

[10] More generally, ex ante equilibrium in the labor market is characterized by the complementary-slackness type condition $(\tilde{u}_A-u(b))(\bar{n}-n_1)=0$.

[11] The assumption of iid risks is made for analytical simplicity; the general message of the analysis with partially-correlated risks would be similar, but less transparent. A referee has observed that the degree of correlation of risks among regions might depend on the degree to which they are integrated (e.g., they might have more similar industrial structures, trade patterns, etc.). To avoid over-burdening the analysis, we leave this interesting idea for future investigation.

[12] One could imagine that workers who migrate to a new region gradually establish themselves on an equal footing with existing native workers and thus participate in the same types of long-term contracts as existing workers. Such contracts would provide workers, including immigrants, with some protection against *future* risks; however, the present analysis focuses on migration as an ex post response to the realization of economic risks and as such it is appropriate to distinguish between the labor market conditions facing workers who do not migrate and those who do.

layoffs occur. We must therefore analyze how the equilibrium contract, i.e., the degree of labor market rigidity, depends on the mobility of workers.

The present subsection considers only how the equilibrium contract is determined in a single jurisdiction, assuming that migration costs are not prohibitively high ($c \leq c^*$). Since the spot wage w^* is determined in competitive markets involving firms and workers from many regions, it is taken as parametrically given by the firms and workers in any one jurisdiction. The description of how the value of w^* is determined as part of the equilibrium for an entire system of regions is postponed to Section 3. As in the autarky case, the representative firm within a single region competes in a local ex ante labor market by offering contracts subject to an expected utility constraint. The formal analysis of the firm's problem with migration is very similar to that of the autarky case, except that it is necessary to take into account the fact that firms may hire migrant workers in the ex post spot market if they have favorable technological shocks and that workers who are laid off in the bad state may find migration to be a better alternative than remaining unemployed in their original jurisdiction of residence.

A representative firm's wage and employment policy in the presence of migration can be represented by a vector (w_1, w_2, n_0, n_1, n_2) describing the wages that it pays in each state to its workers, w_1 and w_2, the number of workers in the ex ante labor market that accept the firm's employment offer, n_0, and the level of employment in each state, n_1 and n_2. Due to the possibility of migration, a firm may choose $n_1 > \overline{n}$ in the ex post spot market for migrant labor. The difference between the number of workers hired initially and those employed in the bad state, $n_0 - n_2$, represents layoffs. Of course, $n_0 \leq \overline{n}$, and, as will be shown later, $n_0 = \overline{n}$ in equilibrium in most cases of interest.

The representative firm's expected profits when migration is possible can now be written as

$$\Pi_M = \rho(p_1 f(n_1) - w_1 n_0 - w^*(n_1 - n_0)) + (1-\rho)(p_2 f(n_2) - w_2 n_2); \tag{5}$$

note that any workers hired in the ex post spot market for labor are paid w^*. Firms can implement a wage and employment policy (w_1, w_2, n_0, n_1, n_2) only if the expected utility of the workers initially residing in the jurisdiction is at least as great as $\tilde{u}_M$, the utility that they can attain if they refuse to accept a firm's contract in the ex ante labor market.[13] The maximization problem the representative firm faces can thus be formulated as

$$(P_M) \qquad \max_{<w_1, w_2, n_0, n_1, n_2>} \quad \Pi_M$$

subject to

$$\rho u(w_1) + (1-\rho)\frac{n_2}{n_0}u(w_2) + (1-\rho)\frac{n_0 - n_2}{n_0}u(w^* - c) - \tilde{u}_M \geq 0, \tag{6}$$

assuming that migration is at least as attractive to laid-off workers as unemployment, i.e., $u(w^* - c) \geq u(b)$.[14] Letting $\mathcal{L}_M(n_0, n_1, n_2, w_1, w_2, \lambda_M)$ represent the Lagrangian for (P_M), the first-order conditions characterizing the profit-maximizing choice of wages in each period are

$$\frac{\partial \mathcal{L}_M}{\partial w_1} = -\rho n_0 + \lambda_M \rho u'(w_1) = 0 \tag{7a}$$

$$\frac{\partial \mathcal{L}_M}{\partial w_2} = -(1-\rho)n_2 + \lambda_M (1-\rho)\frac{n_2}{n_0}u'(w_2) = 0. \tag{7b}$$

[13] The determination of the equilibrium value of $\tilde{u}_M$ is discussed at the end of this section.

[14] The objective of the analysis at this stage is to describe how the terms of contracts are determined, assuming that migration actually occurs. This can only be the case if $u(w^* - c) \geq u(b)$.

Using these equations to eliminate λ_M, it follows that

$$u'(w_1) = u'(w_2) \quad \Leftrightarrow \quad w_1 = w_2, \tag{8}$$

that is, exactly as in the autarky case, *the wage rate is state-invariant under an equilibrium contract*. Henceforth, this state-invariant wage is denoted by w.

The first-order conditions for the choice of ex ante and ex post employment levels are

$$\frac{\partial \mathcal{L}_M}{\partial n_0} = \rho(w^* - w) - (1-\rho)\frac{n_2}{n_0}\frac{u(w) - u(w^* - c)}{u'(w)} = 0 \tag{7c}$$

$$\frac{\partial \mathcal{L}_M}{\partial n_1} = \rho(p_1 f'(n_1) - w^*) = 0 \tag{7d}$$

$$\frac{\partial \mathcal{L}_M}{\partial n_2} = (1-\rho)(p_2 f'(n_2) - w) + (1-\rho)\frac{u(w) - u(w^* - c)}{u'(w)} = 0, \tag{7e}$$

where Eq. (7a) is used to eliminate λ_M.

Rearranging Eq. (7c),

$$w^* - w = \frac{(1-\rho)}{\rho}\frac{n_2}{n_0}\frac{u(w) - u(w^* - c)}{u'(w)}. \tag{9}$$

As in the autarky case, the left-hand side can be interpreted as an insurance premium that workers pay to the firm in the good state to obtain insurance against income risk. It follows immediately from Eq. (9) that

$$w^* = w \quad \text{if} \quad c = 0 \tag{10a}$$

$$w^* > w > w^* - c \quad \text{if} \quad c > 0. \tag{10b}$$

Hence, in the special case of zero migration costs, there exists only one wage rate $w^* = w$, so that workers always obtain employment at the same wage no matter whether there is a favorable or unfavorable shock in the jurisdiction where they reside initially. This important polar case illustrates how migration can insure workers from unemployment risk. With free mobility, there is no need for labor contracts to provide insurance, and, therefore, no reason for labor markets to exhibit rigidities that give rise to unemployment. When migration costs are positive, however, workers will be better off under favorable technology shocks in their home jurisdiction, and long-term contracts will continue to serve as a partial insurance device. In the good state, as Eq. (7d) and Eq. (10b) reveal, non-migrant ("native") workers pay an "insurance premium" to their employer in the form of the difference between their wage w and the spot wage earned by immigrant workers, which is equal to the value of the marginal product of labor in the good state, i.e., they pay a premium of

$$p_1 f'(n_1) - w = w^* - w > 0. \tag{11}$$

In the bad state, however, they receive a wage higher than the value of the marginal product; from Eq. (7e), it follows that

$$w - p_2 f'(n_2) = \frac{u(w) - u\,(w^* - c)}{u'(w)} > 0. \tag{12}$$

Note that the workers who are laid off in the bad state can get a higher wage abroad than they could get at home if employed. At first glance, this may seem paradoxical, since one normally associates a loss of employment with a loss of income. To avoid confusion, it must thus be emphasized that w^* is the "producer price" of migrant labor in the ex post spot market, whereas $w^* - c$ is what migrants actually receive on net. The migration cost "wedge" between the price paid by firms for workers and the net income received by workers can be divided in many ways, and the observed wage paid by firms to new workers may lie anywhere in the interval $[w^* - c, w^*]$ depending on how the costs of migration are split between workers and their employers. For example, firms that have experienced favorable technology shocks and that are hiring workers in the spot market might in practice absorb some or all of the out-of-pocket costs of relocation for workers, the costs of advertising and recruiting for new employees, and the costs of training workers for their new jobs, all of which should be interpreted as part of migration costs, c. Having covered these costs, the explicit wage paid to employees would be correspondingly reduced. [15] There may remain some costs of migration – search costs, some out-of-pocket relocation costs, subjective losses from disruption of one's affairs associated with relocation – that workers end up absorbing. The wage net of *all migration* costs $w^* - c$ will be equal to the wage actually paid to workers less that portion of migration costs absorbed by workers, and, by Eq. (10b), we know that $w^* - c < w$, that is, workers who are laid off are definitely worse off than those who are not laid off. In fact, the observed wage that firms pay to newly-hired workers will lie below the wage w received by existing workers if firms absorb a relatively high proportion of the costs of migration.[16]

The fact that workers who migrate (or remain unemployed) are worse off than those who are not laid off is the key to understanding how the equilibrium level of expected utility, $\tilde{u}_M$, is determined. Just as in the autarky case, clearing of the ex ante labor market requires that $\tilde{u}_M$ adjust so that all of the workers who initially reside in a region do in fact enter into an employment relationship with a local firm. Failure to obtain a job initially means that workers will either be hired by local firms at a wage of w^* if there is a favorable realization of technology or, if there is an unfavorable realization, they will either migrate to another region and receive $w^* - c$ or remain unemployed and receive b. We assume, however, that long-term contracts dominate this alternative, so that $n_0 = \bar{n}$ at the equilibrium value of $\tilde{u}_M$.[17]

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[15] Note that domestic workers cannot apply for a spot market job as the contract is (assumed to be) enforceable, in Section 2.1. above.

[16] It goes beyond the scope of our formal analysis to consider heterogeneity of workers. However, in practice, seniority rules will typically mean that laid-off workers are younger and less experienced than those retained by employers experiencing unfavorable shocks. If one thinks of younger workers as possessing less effective labor services than those who are more experienced, then young migrant workers who are laid off by firms facing unfavorable shocks and who are then hired by firms in other regions experiencing favorable shocks will tend to receive lower observed wages per worker than the more senior workers already employed by these firms. For this reason, as well as those mentioned above, it would be incorrect to interpret Eq. (10b) to imply that the observed wage paid to newly-hired migrant workers would exceed the wage paid to a firm's existing work force. It may further be noted that empirical evidence (e.g., Topel (1991)) indicates that job changes account for a substantial amount of lifetime earnings growth for typical workers. Ignoring the costs of job search and relocation, therefore, it is evidently true empirically that workers often obtain higher wages after separations.

[17] In general, if migration costs are lower than c^*, ex ante labor market equilibrium requires that $(\tilde{u}_M - [\rho u(w^*) + (1-\rho)u(w^* - c)])(\bar{n} - n_0) = 0$, analogously to footnote 9.

3. Equilibrium in a system of jurisdictions with migration

The analysis so far has examined how contracts enforced by labor market institutions would be determined within a given region when it is possible for laid-off workers to migrate to other regions and earn an exogenously-given spot wage of w^*. However, although w^* is taken as given by any *one* region, its equilibrium value is determined by the competition for migrant workers in the system of regions as a whole. Since the supply of workers to the spot market depends on the willingness of laid-off workers to migrate in search of other jobs, which in turn depends on the level of migration costs c, the equilibrium spot wage ultimately depends on the value of c as well.

As the analysis will make clear, there are two distinct types of equilibria that can arise. Speaking informally, when migration costs are sufficiently high, relatively few laid-off workers will, in equilibrium, choose to migrate to other jurisdictions, since the benefits of higher wages elsewhere are largely offset by the cost of moving. In these cases, some but not all of the workers laid off in regions experiencing unfavorable technology shocks will leave to find jobs elsewhere; those left behind will remain unemployed and receive the reservation income b. On the other hand, if migration costs are sufficiently low, the payoff to workers from migration will be highly attractive relative to unemployment and workers will then choose not to remain unemployed. We call the latter situation a "full-employment" regime, while the former case, in which there is some migration but also some unemployment, is called a "mixed" regime. Intuitively, the mixed regime is an intermediate case between autarky (i.e., prohibitively high migration costs) and free mobility. It is of course the mixed case that is of greatest interest in the present context, since it is mainly the existence of unemployment that motivates consideration of the role of labor market institutions. We now analyze the equilibrium of the system of jurisdiction for each of these cases.

3.1. System-wide equilibrium in the mixed regime

Imagine to start with that the migration cost parameter c is just equal to $c^* \equiv w^*_{\max} - b$. At this value of c, $w^*_{\max}$ is in fact the equilibrium spot wage. At this wage, firms are unwilling to hire any additional workers when technology shocks are favorable, and workers are indifferent between remaining unemployed (and receiving an income of b) and migrating (and receiving an income net of migration costs of $w^*_{\max} - c$), so that there is no excess demand for or supply of labor in the spot market. If the migration cost parameter c falls below c^*, workers who are laid off would definitely prefer to find employment in the spot market at a wage of $w^*_{\max}$ rather than remain unemployed, since their income would then be strictly higher ($w^*_{\max} - c > b$), and thus for $c < c^*$ there would be excess supply in the spot labor market if $w^* = w^*_{\max}$. There would thus be downward pressure on the spot wage as c falls and the amount of labor demanded by firms in the spot market would rise, so that there would be a strictly positive level of migration.

For any given spot wage w^*, the average demand for labor in the spot market is given by $\rho(n_1(w^*) - \bar{n})$ where $n_1(w^*)$ is determined by the condition

$$p_1 f'(n_1) = w^*. \tag{13}$$

Obviously, $\partial n_1(w^*)/\partial w^* = 1/p_1 f_1''(n_1) < 0$. The mean supply of workers to the spot market is perfectly elastic, up to the quantity $(1-\rho)(\bar{n} - n_2)$, provided that $w^* - c = b$; for lower values of

w^*, the supply of labor is zero (workers prefer unemployment to migration), and for higher values of w^*, the supply of labor is equal to $(1-\rho)(\overline{n}-n_2)$ (migration dominates unemployment for all laid-off workers). The equilibrium value of w^* is thus

$$w^* = b + c \tag{14}$$

for any value of c and n_2 such that

$$\rho(n_1(w^*) - \overline{n}) < (1-\rho)(\overline{n}-n_2). \tag{15}$$

These two conditions define a system-wide equilibrium in the mixed regime. Condition (14) states that workers who are laid off will be indifferent between migrating to find new jobs and receiving their reservation income of b in their home jurisdiction. Condition (15) states that the number of workers absorbed as new hires in the spot market (the left-hand side) is less than the number laid off by firms experiencing unfavorable shocks (the right-hand side). The inequality in Eq. (15) means that there is some unemployment in equilibrium, and it is this condition which is no longer satisfied in the full-employment regime discussed in the next subsection. Note that Eq. (15) definitely holds when $c=c^*$, since then the left-hand side is zero while the right-hand side is positive. As discussed further in Appendix B, the functions in Eq. (15) are continuous in c, which means that the system must be in a mixed equilibrium for some range of values of c that are sufficiently close to c^*.

Changes in the extent of labor market integration in this system can be represented by changes in the migration cost parameter c:

Theorem 1. *For values of the migration cost parameter c such that the system reaches a mixed equilibrium, increased economic integration (i.e., a reduction in the migration cost parameter c) results in:*

(i) *a decrease in the ex post spot-market wage rate* w^* *(i.e.,* $dw^*/dc>0$*);*
(ii) *a decrease in the equilibrium long-term wage w (i.e.,* $dw/dc>0$*);*
(iii) *an increase in the level of employment in the good state (i.e.,* $dn_1/dc<0$*);*
(iv) *a decrease in the level of employment in the bad state (i.e.,* $dn_2/dc>0$*).*

Proof. See Appendix B. □

While the full proof of this theorem is given in the appendix, it is immediately apparent from Eq. (14) that $\partial w^*/\partial c=1$, from which (i) clearly follows. Intuitively, a reduction in migration costs increases the supply of workers in the spot market, resulting in a decrease in the spot wage and an increase in employment in the good state (iii). In turn, this means that the implicit insurance premium charged by firms for protection of workers — which is the difference between the marginal product of labor in the good state and the state-invariant contract wage w, as shown in Eq. (9) – would fall, *cet. par.* The firm therefore requires compensation either in the form of a lower equilibrium contract wage w or, alternatively, by insisting on more layoffs in the bad state. In fact, differentiating Eq. (12) shows that a change in the contract wage or level of layoffs *alone* cannot be optimal, and thus, as stated in (ii) and (iv), both of these adjustments – i.e., a reduction in w and an increase in layoffs in the bad state – occur in equilibrium.[18]

[18] Total differentiation of Eq. (12) with respect to n_2 and c reduces the left-hand side while leaving the right-hand side unchanged (recalling that w^*-c is constant in the mixed regime). Similarly, an increase in w alone must also lower the left-hand side relative to the right-hand side, given that workers are risk averse.

Increased economic integration, then, gives rise to greater local fluctuations in both output and employment, as layoffs are increased in the bad state and there is increased hiring in the spot market when there are favorable production shocks. Labor market institutions shelter workers from income risk to a lesser degree when the interjurisdictional mobility of workers is increased. The rise in layoffs in the bad state indicates a less rigid labor market, showing that the extent of labor market integration influences the degree of flexibility in observed labor market institutions.

3.2. System-wide equilibrium in the full-employment regime

As noted, the mixed regime must occur when migration costs are sufficiently high. However, when migration costs are sufficiently low, there may be no unemployment at all. As shown in Eq. (10a), $w^* = w = w^* - c$ when $c = 0$, which means that workers who are laid off are no worse off than those who are not laid off or who are initially employed in regions that have favorable production shocks. In this case, workers who initially reside in regions experiencing unfavorable shocks and who are laid off can costlessly relocate to regions experiencing favorable shocks, earning the spot wage w^*. The long-term wage contract completely degenerates in this case, with firms always employing workers at a level where their state-contingent marginal product is equal to their wage; workers face no wage risk, pay no implicit insurance premium, and receive no implicit insurance benefits. Provided that the equilibrium wage with zero migration costs strictly exceeds the reservation income b, no workers who are laid off will remain unemployed. Adverse production shocks produce labor turnover in this case, but do not produce unemployment. Workers are therefore completely insured against unemployment and income risk by a fully integrated and flexible labor market. This confirms, for the extreme case where $c = 0$, the finding obtained in a full-employment market-clearing model in Wildasin (1995) that free mobility itself can provide perfect insurance against income risk. We assume henceforth that the economy does achieve full employment when $c = 0$, which will be the case if b is sufficiently small or the equilibrium wage with zero migration costs is sufficiently high.[19] As discussed further in Appendix C, the equilibrium of the system varies continuously in the migration cost parameter c, and it thus follows that the economy will be in the full-employment regime for all values of c sufficiently close to 0.

As in the mixed regime, a change in migration costs affects the entire equilibrium constellation of wages and employment levels in all regions. In the mixed regime, condition (14) provides a rigid linkage between the equilibrium spot-market wage w^* and the migration cost parameter c. In the full-employment case, by contrast, changes in c do not necessarily give rise to unit-for-unit changes in w^*. Provided, however, that the market for mobile workers is stable in the Hicksian (or Walrasian) sense, i.e., the excess demand function for mobile workers is

[19] The equilibrium wage with zero migration costs satisfies

$$p_1 f'(n_1) = p_2 f'(n_2).$$

Full employment requires that

$$\rho n_1 + (1-\rho) n_2 = \bar{n}.$$

These two conditions determine n_1 and n_2 and thus the equilibrium wage $p_1 f'(n_1) = p_2 f'(n_2)$; it is easily verified that the equilibrium wage is lower, the higher the value of $\bar{n}$. Thus, provided that either b is sufficiently small, $\bar{n}$ is sufficiently small, or both, the equilibrium wage with zero migration costs must exceed b.

decreasing in w^* (a condition stated formally in Appendix C as condition (S)), comparative-statics analysis shows that:

Theorem 2. *For values of the migration cost parameter c such that the system reaches a full-employment equilibrium, and assuming that the spot-market stability condition* (S) *is satisfied, increased economic integration (i.e., a reduction in the migration cost parameter c) results in:*

(i) *a decrease in the ex post spot-market wage rate* w^* *(i.e.,* $dw^*/dc > 0$*);*
(ii) *an increase in the level of employment in the good state (i.e.,* $dn_1/dc < 0$*);*
(iii) *a decrease in the level of employment in the bad state (i.e.,* $dn_2/dc > 0$*).*

Proof. See Appendix C. □

This result closely parallels the findings for the mixed regime, although in this case the impact of increased integration on the contract wage rate w is uncertain. Broadly speaking, the qualitative impacts of economic integration on the state-contingent levels of employment and output are the same in this case as in the mixed regime.

3.3. C. Autarky vs. full integration: global comparisons

The analysis so far has shown that there are three possible types of equilibria in the model. In autarky, migration costs are so high that migration is never observed. Worker protection by state-invariant wage contracts result in layoffs that generate unemployment for some workers in regions with unfavorable production shocks. When migration costs are very low, equilibrium labor contracts also result in layoffs when there are unfavorable production shocks, but workers that are laid off migrate to other regions where they are able to find new jobs, so that there is no unemployment. In between these extremes, if migration costs are sufficiently high but not prohibitive, long-term labor contracts will give rise to layoffs in the bad state and while some of the workers who are laid off will migrate to other regions and find new jobs, others will remain in the jurisdictions in which they are laid off and will be unemployed. For present purposes, the mixed regime is of greatest interest, since we wish to explore the implications of migration in an economy with unemployment. Before turning to a more detailed analysis of the mixed regime in Section 4, however, it is useful to make some comparisons of the equilibria across regimes.

Imagine a process of economic integration in which migration costs are at first prohibitively high, falling gradually over time and finally ending in a situation of free migration where workers are perfectly mobile among jurisdictions. Comparing the starting and ending points of this process, we note that employment contracts in autarky are characterized by positive levels of unemployment in bad states. When migration costs vanish, however, there is no longer any unemployment. In regions experiencing favorable shocks, output and employment are higher than they would be under autarky, while the opposite is true for regions experiencing adverse shocks. Nevertheless, workers receive the same wage in both states, and this wage is equal to the marginal product of labor. In fact, workers face no wage or unemployment risk at all. The need for labor market institutions to insure workers against income risk is obviated and thus they completely disappear.

Starting from an equilibrium in a mixed regime, the elimination of migration costs eliminates all unemployment. Similarly, starting from an equilibrium in the full-employment regime, an increase in migration costs to prohibitively high levels brings about unemployment. It is not necessarily the case, however, that small reductions in migration costs necessarily cause unemployment to

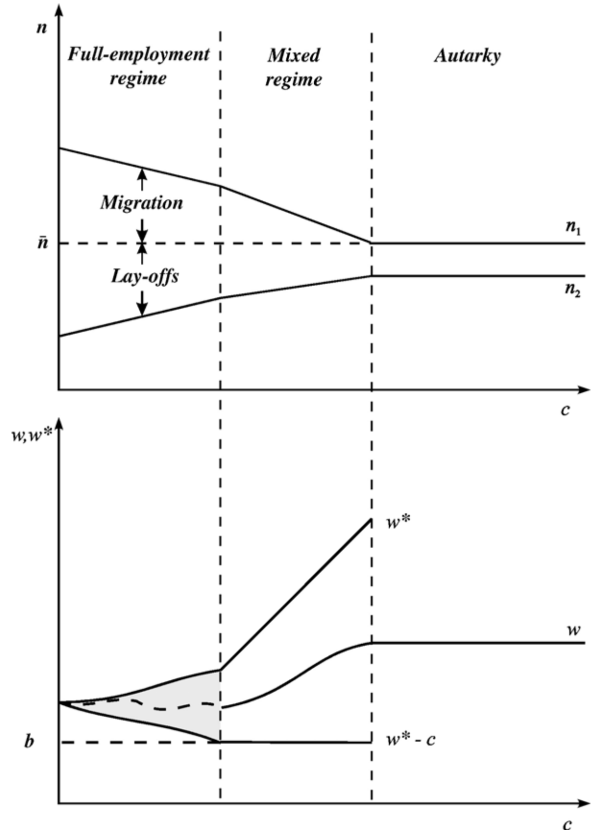

Fig. 1.

decrease. It is easy to see from Theorems 1 and 2 that the state-contingent employment levels n_1 and n_2 vary monotonically across regimes, with n_1 steadily rising as c falls and n_2 steadily falling. In general, however, total employment in the system as a whole, $\rho n_1+(1-\rho)n_2$, may rise or fall as c falls incrementally. Thus, there may be several intervals where we observe mixed regimes and full-employment regimes; from a global viewpoint, we can only be certain that we switch from the autarky case to the mixed regime at some high critical value of c and that there is full employment for migration cost values close to zero.[20] In Fig. 1, we illustrate some of the main results obtained so far, for the case where there is only one interval of values of the migration cost parameter in which each regime can occur.

4. Economic integration, income distribution, and welfare in the mixed regime

This section extends the analysis to consider how changes in migration costs affect economic welfare. We are mainly interested in the impact of economic integration and migration in an

[20] We have proven neither existence nor uniqueness of equilibrium. Both are easily guaranteed as p_1-p_2 goes to zero, however, indicating that the model is fundamentally technically well-behaved.

economy where there is also some unemployment, and thus we restrict attention in this section to the welfare effects of increased labor mobility in the mixed regime discussed in Section 3.1.

So far, the model has assumed that there are two different groups of agents in the economy, workers and firms and their owners, respectively. For the moment, let us consider workers and the owners of firms as completely distinct groups, with the welfare of the former given by expected utility and the welfare of the latter given by expected profits (or returns to fixed factors like land or natural resources) because they are assumed to be risk-neutral.

As shown in Theorem 1, increased economic integration (a reduction in c) causes the equilibrium number of workers laid off in the bad state to rise. In the mixed regime, laid-off workers may either be unemployed or may migrate, but in either case they receive a net income of b (recall Eq. (14)), irrespective of the value of c. Furthermore, the long-term contract wage w received by those workers who are not laid off must fall as migration costs fall. Unambiguously, therefore, the expected utility of workers must *fall* as c falls. Formally, recalling the expression for expected utility given in Eq. (6),

$$\frac{\mathrm{d}Eu}{\mathrm{d}c} = \rho u'(w)\frac{\mathrm{d}w}{\mathrm{d}c} + (1-\rho)\left[\frac{n_2}{\overline{n}}u'(w)\frac{\mathrm{d}w}{\mathrm{d}c} + \frac{u(w)-u(w^*-c)}{\overline{n}}\frac{\mathrm{d}n_2}{\mathrm{d}c}\right] > 0. \tag{16}$$

The impact of a change in c on expected profits is also easily calculated, essentially using an envelope-theorem argument. From Eq. (5), using Eq. (7d), it follows that

$$\frac{\mathrm{d}\Pi_M}{\mathrm{d}c} = \rho\left[-\overline{n}\frac{\mathrm{d}w}{\mathrm{d}c} - (n_1 - \overline{n})\frac{\mathrm{d}w^*}{\mathrm{d}c}\right] + (1-\rho)\left[(p_2 f'(n_2) - w)\frac{\mathrm{d}n_2}{\mathrm{d}c} - n_2\frac{\mathrm{d}w}{\mathrm{d}c}\right] < 0. \tag{17}$$

The inequality in Eq. (17) follows from Theorem 1, which shows that w^*, w, and n_2 are all increasing in c, and from Eq. (12), which shows that workers are paid more than the value of their marginal products in the bad state. In words, the wage rate at which firms hire workers in the spot market in the good state is higher when migration costs are higher. The long-term contract wage rate is also higher in both states, which tends to raise costs for given levels of employment in each state; moreover, the number of workers employed in the bad state is higher, and the amount that these additional workers are paid exceeds the extra revenue that they produce for their employers. For all of these reasons, an increase in migration costs lowers expected profits. In summary:

Theorem 3. *For values of the migration cost parameter c such that the system reaches a mixed equilibrium, increased economic integration (i.e., a reduction in the migration cost parameter c) results in:*

(i) *a decrease in the expected utility of workers (i.e., $dEU/dc > 0$);*
(ii) *an increase in the expected profits of firms (or returns to fixed factors) (i.e., $d\Pi_M/dc < 0$).*

Economic integration thus works against the interests of workers and in favor of those who receive profits or rents. Roughly speaking, greater migration opportunities increase the supply of workers to expanding firms (those that experience favorable production shocks) and lowers the marginal product of labor in the good state. This “depreciates” the implicit insurance premium paid by workers in the good state; anticipating this, the long-term contract wage w is reduced and the level of layoffs in the bad state is increased. The downward pressure on wages and the increased flexibility of state-contingent employment raises expected profits (or rents). For workers, however, the reduced state-invariant contract wage results in a worse outcome in the good state and also a worse outcome in the bad state if they are not laid off. Some of those who are laid off may migrate rather than remain unemployed, but migrants do not enjoy any net gain from doing so as the spot wage is only sufficiently high to compensate them for migration costs. Furthermore, more workers end up being laid off when migration costs are lower. The upshot is that the increased migration that results from more integrated labor markets reduces labor market rigidities, but in a way that only helps firms and actually makes workers worse off.[21] It is worth recalling, in this context, that increased labor mobility may or may not reduce overall unemployment. It is important to note that workers are harmed by labor market integration even if the total unemployment rate is reduced.

Since labor market integration benefits one group while harming another, it is obviously not Pareto-improving. It is natural to ask, however, how the gains and losses to different groups compare, and whether it could be possible for the gainers to compensate the losers. To address this question, it is necessary to make the gains and losses to each group comparable in some way. One natural way to do so is to assume that the value of money income is equally valuable for both groups. The welfare of the owners of firms is measured in money in any case, which thus has a marginal value of unity. For workers, one unit of money income, obtained with certainty, raises expected utility by the amount

$$Eu'(\cdot) \equiv \rho u'(w) + (1-\rho)\left[\frac{n_2}{\bar{n}} u'(w) + \frac{(\bar{n}-n_2)}{\bar{n}} u'(w^* - c)\right]$$

which means that a worker is willing to pay an amount of money $1/Eu'(\cdot)$ in order to obtain a one-unit increase in expected utility (or must be paid this amount to compensate for a one unit reduction in expected utility). Thus, in monetary terms, the impact of a change in c on the expected utility of workers is given by

$$\frac{1}{Eu'(\cdot)} \frac{\mathrm{d}Eu}{\mathrm{d}c}.$$

Greater labor market integration results in a potential Pareto improvement if the gains to firms are more than sufficient to compensate workers for their losses. Formally, the gains to the firms in a jurisdiction net of the monetized value of the losses to the workers can be determined from Eqs. (16) and (17):

$$\begin{aligned} \frac{\mathrm{d}\Pi_M}{\mathrm{d}c} + \bar{n}\frac{1}{Eu'(\cdot)}\frac{\mathrm{d}Eu}{\mathrm{d}c} = & -\left[\rho\,\bar{n}\frac{\mathrm{d}w}{\mathrm{d}c} + (1-\rho)\frac{u(w)-u(w^*-c)}{u'(w)}\frac{\mathrm{d}n_2}{\mathrm{d}c}\right] \\ & \times \left[\frac{Eu'(\cdot)-u'(w)}{Eu'(\cdot)}\right] - (n_1-\bar{n})\frac{\mathrm{d}w^*}{\mathrm{d}c} < 0, \end{aligned} \tag{18}$$

using Eq. (12). That is, it is possible, in principle, for the owners of firms (or land/natural resources) to make compensation payments to workers that would offset the adverse effects of labor market integration and allow both groups to gain from increased mobility of workers:

Theorem 4. *For values of the migration cost parameter c such that the system reaches a mixed equilibrium, increased economic integration (i.e., a reduction in the migration cost parameter c) is potentially Pareto-improving.*

[21] By way of comparison, workers may or may not benefit from increased labor market integration in a model with flexible wages and full employment (cf. Wildasin (1995)), depending on the precise form of the production technology and on the degree of risk aversion of workers.

In practice, of course, it is difficult or impossible to devise distortionless compensation schemes.

5. Conclusion

The preceding analysis has investigated the consequences of changes in the extent of labor market integration when labor markets are not necessarily characterized by full employment in all circumstances. As we have seen, changes in labor mobility alter long-term employment relationships, and thus observed wages and levels of employment in different states of the world. These contracts are part of the institutional structure of labor markets, implemented not only through purely private arrangements between firms and workers but also through public policies such as labor market regulations. Thus, in exploring the dependence of equilibrium contract structures on the "technology" of labor mobility, as represented by a migration cost parameter c, our analysis sheds light on the determinants and evolution of institutional structure.

The analysis shows that the risks faced by workers, their economic welfare, and the profits of firms (or returns to fixed factors) all change as labor mobility increases. As migration costs diminish, labor market institutions adjust so that employment varies more across states of nature. Mobility allows otherwise unemployed workers to move to jurisdictions with high demand for labor; in the limit, unemployment completely disappears. However, if migration costs remain relatively high, some workers who are laid off will remain unemployed even though others migrate and find new jobs. Increased integration of labor markets nevertheless harms workers, at least in cases where migration costs do not fall sufficiently to completely eliminate unemployment. On the other hand, the owners of firms (or immobile resources) benefit from labor mobility in the sense that expected returns (profits or rents) necessarily rise as migration costs fall.

Although labor market integration may have adverse effects on workers, it also improves the efficiency of resource allocation. In particular, it is possible, in principle, for the increased profits of firms to be used to offset the losses suffered by workers in such a way that all could benefit from increased labor mobility. In practice, workers do share some of the profits and rents that accrue to immobile resources, through ownership of financial instruments, housing, and other assets. Wealth inequality and market imperfections limit the extent to which such market-based "compensation" occurs.

The migration cost parameter c that represents the degree of labor market integration in the analysis should be interpreted to include fundamental technological determinants of labor mobility (transportation, communication, and information costs) but also policies and political developments that influence mobility. These include events like the breakdown of the former communist regimes in Eastern Europe, German unification, or the accession of new EU member states, as well as a wide range of social, fiscal, and regulatory policies that affect migrants. By identifying the gainers and losers from increased integration (i.e., its distributional effects), our analysis can help to identify the political forces at work that shape these developments. It also helps to show why free mobility of labor, as guaranteed by the US Constitution and the Treaty of Rome, may be attractive from an *ex ante* "constitutional" perspective in which all parties step behind the "veil of ignorance", even if conflicts over the implementation of such mobility arise subsequently.[22]

[22] See, e.g., Saint-Paul (1996a,b) for more explicit analysis of the political economy of labor-market regulations.

Agell (1999, 2002), consistent with the spirit of the present analysis, discusses how labor market rigidities can help to mitigate risks faced by workers, observing that many of the institutions that support these rigidities originated, historically, during episodes in which workers appear to have been exposed to substantial uninsured risks. Agell argues that trade liberalization and other trends that contribute to integration of markets for *goods and services* can expose workers to greater risks and thus might increase the demand for risk-mitigating rigidities in labor markets; by the same token, trade liberalization may be more palatable in countries with strong "welfare state" provisions. The foregoing analysis, by contrast, shows that integration of the market for *labor* can be conducive to the development of more *flexible* labor market institutions. In a classic study, Mundell (1957) shows that trade and factor mobility can be "market substitutes". The results above, however, suggest that liberalization of factor markets and liberalization of output markets may to some extent be "policy complements", in that the costs of risk arising from openness in output markets may be offset, to some degree, by increased openness in labor markets.

As noted, markets may provide imperfect compensation mechanisms through which workers can share the efficiency gains from labor market integration. Public policies, including tax/transfer systems, may also help workers to capture part of the increases in profits and rents generated by increased mobility. Other public policies, however, might accentuate the adverse effects of integration on workers. For example, pay-as-you-go public pension programs are a major asset for many households in advanced economies. The implicit rate of return in such systems is highly positively correlated with labor market conditions. Since labor market integration increases the risk of layoffs and (at least in some cases) reduces wages, national public pension programs in EU countries, far from compensating workers for the adverse effects of greater mobility, actually exacerbate these effects. Further investigation of these issues, however, lies beyond the scope of the present paper.

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Appendix A. Autarky comparative statics

If the equality holds in Eq. (2), and making use of $w_1=w_2=w$, condition (2) defines the state independent contract wage as a function of the employment level in each state n_1 and n_2, and the expected utility that workers obtain elsewhere:

$$w(n_1, n_2, \tilde{u}_A).$$

From total differentiation of Eq. (2) we obtain:

$$\frac{\partial w}{\partial n_1} = \frac{(1-\rho)n_2}{n_1(\rho n_1 + (1-\rho)n_2)} \frac{u(w)-u(b)}{u'(w)} > 0 \tag{A.1}$$

$$\frac{\partial w}{\partial n_2} = -\frac{n_1}{n_2}\frac{\partial w}{\partial n_1}<0 \tag{A.2}$$

$$\frac{\partial w}{\partial \tilde{u}_A} = \frac{n_1}{[\rho n_1 + (1-\rho)n_2]u'(w)}>0. \tag{A.3}$$

The profit function (1) can then be rewritten as

$$\Pi_A = \rho p_1 f(n_1) + (1-\rho)p_2 f(n_2) - w(n_1, n_2, \tilde{u}_A)[\rho n_1 + (1-\rho)n_2] \tag{A.4}$$

which firms maximize with respect to n_1 and n_2. Using Eqs. (A.1) and (A.2), the first-order conditions are:

$$\frac{\partial \Pi_A}{\partial n_1} = \rho[p_1 f'(n_1) - w] - (1-\rho)\frac{n_2}{n_1}\frac{u(w)-u(b)}{u'(w)} = 0 \tag{A.5}$$

$$\frac{\partial \Pi_A}{\partial n_2} = (1-\rho)[p_2 f'(n_2) - w] + (1-\rho)\frac{u(w)-u(b)}{u'(w)} = 0. \tag{A.6}$$

Using Eqs. (A.1) and (A.2) again, the second (cross) derivatives are

$$\frac{\partial^2 \Pi_A}{\partial n_1^2} = \rho p_1 f''(n_1) + (1-\rho)\frac{n_2}{n_1}\frac{[u(w)-u(b)]u''(w)}{u'(w)^2}\frac{\partial w}{\partial n_1}<0 \tag{A.7}$$

$$\frac{\partial^2 \Pi_A}{\partial n_2^2} = (1-\rho)p_2 f''(n_2) + (1-\rho)\frac{n_1}{n_2}\frac{[u(w)-u(b)]u''(w)}{u'(w)^2}\frac{\partial w}{\partial n_1}<0 \tag{A.8}$$

$$\frac{\partial^2 \Pi_A}{\partial n_1 \partial n_2} = \frac{\partial^2 \Pi_A}{\partial n_2 \partial n_1} = -(1-\rho)\frac{[u(w)-u(b)]u''(w)}{u'(w)^2}\frac{\partial w}{\partial n_1}>0. \tag{A.9}$$

Straightforward calculations show that the second-order conditions are satisfied, i.e.

$$\frac{\partial^2 \Pi_A}{\partial n_i^2}<0, \qquad \left|\frac{\partial^2 \Pi_A}{\partial n_i \partial n_j}\right|>0. \tag{A.10}$$

Finally, we have to calculate

$$\frac{\partial^2 \Pi_A}{\partial n_1 \partial \tilde{u}_A} = -\left[\rho + (1-\rho)\frac{n_2}{n_1}\left(1-\frac{[u(w)-u(b)]u(w)}{u'(w)^2}\right)\right]\frac{\partial w}{\partial \tilde{u}_A}<0 \tag{A.11}$$

and

$$\frac{\partial^2 \Pi_A}{\partial n_2 \partial \tilde{u}_A} = -\frac{[u(w)-u(b)]u''(w)}{u'(w)^2}\frac{\partial w}{\partial \tilde{u}_A} > 0. \tag{A.12}$$

Using Cramer's rule, we then can calculate

$$\frac{\partial n_1}{\partial \tilde{u}_A} = -\frac{\frac{\partial^2 \Pi_A}{\partial n_1 \partial \tilde{u}_A}\frac{\partial^2 \Pi_A}{\partial n_2^2} + \frac{\partial^2 \Pi_A}{\partial n_2 \partial \tilde{u}_A}\frac{\partial^2 \Pi_A}{\partial n_1^2}}{\left|\frac{\partial^2 \Pi_A}{\partial n_i \partial n_j}\right|} < 0. \tag{A.13}$$

Appendix B. Proof of Theorem 1

The first-order conditions for the maximization problem P_M, Eqs. (7c), (7d), and (7e), together with Eq. (14), provide four equations that determine the impact of changes in the migration cost parameter c on the equilibrium values of the variables n_1, n_2, w, and w^*.

First, from Eq. (14),

$$\frac{\partial w^*}{\partial c} = 1, \tag{B.1}$$

establishing part (i) of the theorem.

Second, differentiating Eq. (7d) with respect to n_1 and w^* and substituting from Eq. (B.1) yields

$$\frac{\mathrm{d}n_1}{\mathrm{d}c} = \frac{1}{p_1 f''(n_1)} < 0, \tag{B.2}$$

which proves part (iii) of the theorem.

Using the implicit function theorem, Eq. (7e) determines the level of employment in the bad state, n_2, as a function of the long-term contract wage w, such that

$$\frac{\partial n_2}{\partial w} = \frac{1}{p_2 f''(n_2)}\frac{(u(w)-u[w^*-c])u''(w)}{u'(w)^2} > 0. \tag{B.3}$$

In turn, Eq. (7c) can be used to determine the equilibrium contract wage w in terms of n_2 and w^*-c. Using Eq. (14), differentiation of Eq. (7c) thus yields

$$\mathrm{d}c = \left[\frac{(1-\rho)}{\rho}\frac{u(w)-u(w^*-c)}{\bar{n}u'(w)}\frac{\partial n_2}{\partial w} + 1 + \frac{(1-\rho)}{\rho}\frac{n_2}{\bar{n}}\left(1-\frac{[u(w)-u(w^*-c)]u''(w)}{u'(w)^2}\right)\right]\mathrm{d}w. \tag{B.4}$$

Combining Eqs. (B.3) and (B.4) and rearranging yields

$$\frac{\mathrm{d}w}{\mathrm{d}c}=\rho\bar{n}\left(\rho\bar{n}+(1-\rho)n_2+(1-\rho)\frac{[u(w)-u(w^*-c)]u''(w)}{u'(w)^2}\left[\frac{u(w)-u(w^*-c)}{u'(w)p_2f''(n_2)}-n_2\right]\right)^{-1}>0, \tag{B.5}$$

which establishes part (ii) of the theorem.

Finally, the change in the employment level in the bad state is given by

$$\frac{\mathrm{d}n_2}{\mathrm{d}c}=\frac{\partial n_2}{\partial w}\frac{\partial w}{\partial c}>0, \tag{B.6}$$

which proves part (iv) of the theorem. □

Appendix C. Proof of Theorem 2

The comparative statics results for the full-employment regime are similar to the mixed regime. Eqs. (7c), (7d), and (7e) represent the first-order conditions. However, under full employment, the equilibrium spot wage is no longer determined by condition (14); rather, full-employment requires that

$$\rho n_1+(1-\rho)n_2=\bar{n}. \tag{C.1}$$

Eqs. (7c), (7d), and (7e) and Eq. (C.1) provide a system of four equations to determine the equilibrium values of n_1, n_2, w, and w^*.

To begin with, Eq. (7e) can be used to solve implicitly for n_2 as a function of w and w^*-c. The derivative of n_2 with respect to w is already given in Eq. (B.3); analogously,

$$\frac{\partial n_2}{\partial(w^*-c)}=\frac{1}{p_2f''(n_2)}\frac{u'(w^*-c)}{u'(w)}<0. \tag{C.2}$$

Next, substituting the implicit function n_2 (w, w^*-c) into Eq. (7c), one can solve for w as a function of (w^*, c). Defining

$$A\equiv\rho+\frac{1-\rho}{\bar{n}}\left(\frac{u(w)-u(w^*-c)}{u'(w)}\frac{\partial n_2}{\partial w}+n_2\left[1-\frac{u(w)-u(w^*-c)}{u'(w)}\frac{u''(w)}{u'(w)}\right]\right), \tag{C.3}$$

and noting that $A>0$, implicit differentiation of Eq. (7c) yields

$$\frac{\partial w}{\partial w^*}=\frac{\rho}{A}-\frac{1-\rho}{\bar{n}}\left(\frac{u(w)-u(w^*-c)}{u'(w)}\frac{\partial n_2}{\partial(w^*-c)}-n_2\frac{u'(w^*-c)}{u'(w)}\right)A^{-1}>0. \tag{C.4}$$

$$\frac{\partial w}{\partial c}=\frac{1-\rho}{\bar{n}}\left(\frac{u(w)-u(w^*-c)}{u'(w)}\frac{\partial n_2}{\partial(w^*-c)}-n_2\frac{u'(w^*-c)}{u'(w)}\right)A^{-1}<0. \tag{C.5}$$

Substituting from Eq. (C.1) and using the implicit functions n_2 (w, w^*-c) and $w(w^*, c)$ derived from Eqs. (7e) and (7c), it is now possible to write Eq. (7d) as

$$p_1 f'\left(\frac{\bar{n}}{\rho}-\frac{1-\rho}{\rho}n_2[w(w^*,c),w^*-c]\right)=w^*. \tag{C.6}$$

It is assumed that an increase in w^* reduces the demand for labor, i.e., that

$$B\equiv 1+p_1 f''(n_1)\frac{1-\rho}{\rho}\left(\frac{\partial n_2}{\partial w}\frac{\partial w}{\partial w^*}+\frac{\partial n_2}{\partial(w^*-c)}\right)>0. \tag{S}$$

Condition (S) implies that an increase in w^* leads to an excess supply as can be seen from differentiating Eq. (C.1) with respect to w^* and substituting in Eq. (13). Equivalently, Eq. (S) means that the labor market for migrants is stable in the Hicksian or Walrasian sense that an increase in w^* results in an excess supply of migrant workers.[23] Assuming that Eq. (S) holds, implicit differentiation of Eq. (C.6) yields

$$\frac{\mathrm{d}w^*}{\mathrm{d}c}=-p_1 f''(n_1)\frac{1-\rho}{\rho}\left(\frac{\partial n_2}{\partial w}\frac{\partial w}{\partial c}-\frac{\partial n_2}{\partial(w^*-c)}\right)B^{-1}. \tag{C.7}$$

Substituting from Eqs. (B.3), (C.2), and (C.5), the bracketed expression in Eq. (C.7) can be written as

$$\begin{aligned}&\left(\frac{1}{p_2 f''(n_2)}\frac{(u(w)-u[w^*-c])u''(w)}{u'(w)^2}\right)\frac{1-\rho}{\bar{n}}\left(\frac{u(w)-u(w^*-c)}{u'(w)}\frac{\partial n_2}{\partial(w^*-c)}-n_2\frac{u'(w^*-c)}{u'(w)}\right)A^{-1}\\&-\frac{1}{p_2 f''(n_2)}\frac{u'(w^*-c)}{u'(w)}=\frac{A^{-1}}{p_2 f''(n_2)}\frac{u'(w^*-c)}{u'(w)}\\&\times\left(\frac{1-\rho}{\bar{n}}\frac{(u(w)-u[w^*-c])^2}{u'(w)^2}\frac{u''(w)}{u'(w)}\frac{1}{p_2 f''(n_2)}-n_2-A\right),\end{aligned} \tag{C.8}$$

where the equality in Eq. (C.8) follows after substituting again from Eq. (C.2). Finally, substituting from Eq. (B.3) into Eq. (C.3) and thence into Eq. (C.8), it follows after some rearrangement that the bracketed expression in Eq. (C.7) is positive, which establishes part (i) of Theorem 2. Part (ii) follows immediately from part (i) and Eq. (7d), and (iii) follows from (ii) and Eq. (C.1). □

[23] Condition (S) hinges on the (local) properties of the production and utility functions. In the absence of stronger conditions on preferences and technology than imposed so far, local variations in marginal productivity of labor and in the marginal utility of income, which determine the (local) elasticities of demand and supply, could conceivably cause Eq. (S) to fail.

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