

Persistence and Change in Culture and Institutions under Autarchy, Trade, and Factor Mobility[†]

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Differences among nations in culture (preferences including social norms) and institutions (contracts) may result in specialization and gains from trade even in the absence of exogenous differences in factor endowments or technologies. Goods differ in the kinds of contracts that are appropriate for their production, and so strategic complementarities between contracts and social norms may result in a multiplicity of cultural-institutional equilibria. The resulting country differences in culture and institutions provide the basis for comparative advantage. In our evolutionary model of endogenous preferences and institutions, transitions among persistent cultural-institutional configurations occur as a result of decentralized and uncoordinated contractual or behavioral innovations by employers or employees. We show that the gains from trade raise the cost of deviations from the prevailing culture and institutions. As a result, trade liberalization impedes decentralized transitions, even to Pareto-improving cultural-institutional configurations. International factor mobility has the opposite effect. (JEL D02, D86, F11, F21, J41, O43, Z13)

Among history's great puzzles are the many instances of centuries-long persistence of institutional and cultural differences between populations, often enduring long after their initial causes have disappeared.¹ In epochs and social orders marked by limited contact and restricted competition among geographically separated areas, persistent cultural and institutional differences are hardly surprising. Even in a globally integrated world economy, however, competition among nations need not induce institutional and cultural convergence.²

Our explanation of the persistence of cultural and institutional differences under trade liberalization is based on the endogenous codetermination of institutions,

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¹See, for instance, Banerjee and Iyer (2005); Dell (2010); Guiso, Sapienza, and Zingales (2009); Nunn and Wantchekon (2011); and Sokoloff and Engerman (2000).

²Empirical evidence is provided by Acemoglu, Robinson, and Verdier (2015); Boltho and Carlin (2013); and Greif and Tabellini (2010).

cultures, and economic specialization, a nexus long-studied by economists with a historical bent,³ but not heretofore formally modeled. We study the decentralized evolution of both culture and institutions and find that, when complementarities exist between them, this process can support durable differences between otherwise identical economies. Because the impact of culture and institutions on the cost of production differs across commodity groups, these between-country differences provide a basis for comparative advantage. In this case, specialization and trade do not lead to cultural and institutional convergence even if there is a cultural-institutional configuration that would confer absolute advantage in the production of all goods. Instead, the resulting gains from trade make transitions away from the status quo culture and institutions more unlikely. International mobility of the factors of production has the opposite result.

We develop a two-country/two-factor/two-good model in which countries may differ in their institutions and cultures. We refer to differences across economies in the distribution of preferences (including social norms) as cultural differences, while differences in the distribution of employment contracts are referred to as institutional differences. Thus, we might say that Norway has a trusting culture because most Norwegians exhibit high levels of interpersonal trust, or that farming by former slaves in the postbellum US South was governed by the institution of share cropping because this was by far the most common contract. Note that an institution—the prevalence of a particular share contract in farming, for example, or primogeniture as a wealth inheritance practice—need not reflect deliberate public policy, for example, the explicit prohibition of alternative contracts. Instead, like cultures, institutions may persist as the result of decentralized actions in noncooperative settings (Young 1998).

Institutional differences in our model are captured by two contracts, which reflect the core aspects of a firm's organizational structure and, hence, define the firm type. The two contracts differ in the degree of gain-sharing between employer and employee. In one, the fixed-wage contract, the employer is the sole residual claimant, while the employee is paid a fixed wage and works under close supervision by the employer (as in some traditional manufacturing and many secondary labor market jobs). In the second, the partnership contract, work is motivated by gain-sharing with the employer, based on joint residual claimancy (as is the case in many legal practices, financial consulting, and in open-source software production).

Cultural differences are captured by two kinds of preferences that dictate workers' behavior and, hence, their type. Here, our model builds on the idea that the same social norm may have different effects on productivity depending on the kind of incentives that are implemented.⁴ Thus, we assume that some employees have preferences over the form of the contract under which they work per se, that is, in addition to the material payoffs. For these individuals, close supervision and threats of sanctions for noncompliance signal distrust or otherwise offend their reciprocal

³See, for instance, Gerschenkron (1944), Kindleberger (1962), and Sokoloff and Engerman (2000).

⁴This is modeled by Huck, Kübler, and Weibull (2012) and shown empirically by Bandiera, Barankay, and Rasul (2005).

or other social preferences that are essential to mutually beneficial exchange, as has been found in a large number of natural environments and experimental studies.⁵

There are two types of labor. Quantitative labor includes time at work, compliance with explicit directions, simple effort readily measured either by input or output, and other aspects of work that are verifiable at low cost, and hence can be enforced by explicit contracts. By contrast, qualitative labor consists of care, creativity, problem solving, and other nonroutine aspects of work that are more difficult to verify, and hence are not cost-effectively employed using explicit contracts conditional on individual performance. Where non-verifiable aspects of work are important to production, social norms such as reciprocity or a positive work ethic are required for high levels of productivity. Production requires quantitative labor, but is enhanced when, in addition, qualitative labor is supplied by the worker. As we will see, qualitative labor is provided under the partnership contract but not under the fixed-wage contract.

The two goods differ in the extent to which their production depends on these two types of labor. As a consequence, goods also differ in which cultural-institutional settings are appropriate for their production. Goods intensive in quantitative labor include standardized manufactured goods (exemplified by most goods produced on an assembly line and any good the production of which is cost-effectively compensated by piece rates), most grains, and sugar. Goods intensive in qualitative labor include knowledge-intensive goods (and services), complex and quality-variable manufactured goods (such as wine and cigars), personal services ranging from legal advice and research to preparing meals, caring for the young or the elderly, and care-sensitive agricultural products (many vegetables and fruits).⁶

Employers may occasionally update their type, that is, the contract they offer and the associated organizational structure of the firm. They do this in light of the distribution of workers' preferences in the population, using a standard payoff monotonic dynamic, namely myopic best response (Kandori, Mailath, and Rob 1993). The distribution of employee types in the population likewise evolves by a payoff monotonic cultural revision process in which the expected utility associated with different preferences (and the behaviors they support) depend on the distribution of contracts in the economy. As a result of the complementarity between distinct preferences and contracts—reciprocal worker types responding positively to partnerships and negatively to the fixed-wage contracts—there may exist a number of joint distributions of employer and worker types that are stationary in the above updating dynamic because the contracts and preferences associated with the types jointly prevalent in these states are mutual best response to the other. The stationary states that are evolutionarily stable are termed cultural-institutional conventions.

⁵See, in particular, Bewley (1999); Fehr, Klein, and Schmidt (2007); Falk and Kosfeld (2006); Houser et al. (2008); and Fehr and Rockenbach (2003); surveys are offered by Bowles (2008) and Bowles and Polania-Reyes (2012).

⁶Nilsson (1994) investigates the effects on comparative advantage and specialization resulting from the emancipation of slaves at the time of the US Civil War. Cotton, according to Nilsson, was a "slave commodity" for which kinds of labor beyond that which could be coerced from the worker were of little importance. For other commodities (manufactures and tobacco) variations in the labor quality were more important, and impossible to secure by coercion.

It is this mutual dependence of preferences and contracts, along with the differences among goods in the importance of non-verifiable qualitative labor services that are provided only under the partnership, that supports differing competitive prices in autarchy and, as a result, allows gains from specialization and trade. Like differences in technologies in the Ricardian approach or relative factor endowments in the standard Heckscher-Ohlin model, the autarchic price differences induced by alternative cultural-institutional conventions are an independent source of comparative advantage.⁷

Transitions occur among cultural-institutional conventions when sufficiently many innovators deviate from the status quo convention (switching types and hence implementing non-best response preferences or contracts) due to individual experimentation or other forms of idiosyncratic updating.⁸ Because in our model institutions as well as culture are endogenous and the two are jointly determined, we are able to explore the impact of economic integration on the persistence of institutions.⁹

We derive two main results.

First, economic integration between economies at different cultural-institutional conventions will reinforce rather than destabilize institutional and cultural diversity and will impede transitions, even to Pareto-improving conventions (Theorem 1).¹⁰ This result contradicts the view, popular among critics of trade liberalization since John Maynard Keynes (1933, 762), that trade will lead to institutional and cultural convergence and thus defeat attempts by nations that, as he put it, would prefer to “have a try at working out our own salvation.” Keynes’ view is especially thought to be true when one nation’s culture and institutions confer absolute advantage in all or most products. But, since trade allows countries to specialize in the goods in which they are relatively more advantaged (or less disadvantaged) given their culture and institutions, it increases the joint surplus in the cultural-institutional status quo, even in an absolutely disadvantaged country.¹¹ These gains from trade increase

⁷Our paper thus contributes to the literature on institutional comparative advantage (surveyed in Nunn and Trefler 2014 and Belloc 2006), among others, Acemoglu, Antràs, and Helpman (2007); Costinot (2009); Levchenko (2007); and Nunn (2007). In contrast to previous approaches, in our model it is the complementarity between culture and institutions and the resulting endogenously evolved cultural-institutional differences among economies (rather than exogenously given institutional differences alone) that provide the basis for specialization and trade.

⁸As in Bidner and Francois (2011), Tabellini (2008), and Belloc and Bowles (2013), we model the interacting dynamics of culture and institutions. To do this, we extend the stochastic evolutionary game approach pioneered by Foster and Young (1990) and Kandori, Mailath, and Rob (1993) and study the joint evolution of both institutions and culture as the result of decentralized noncooperative interactions among economic agents.

⁹Our paper departs from and complements the related work by Do and Levchenko (2009) and Levchenko (2013), in which national institutions may be modified by a cooperative lobbying game. In our model, they emerge as endogenously generated noncooperative cultural-institutional conventions. See, also, Greif (2006).

¹⁰An alternative approach on the relation between economic integration and cultural dynamics (surveyed in Bisin and Verdier 2014) considers not social norms and preferences as in our model, but cultural goods, that is, goods to which people attach special nonutilitarian importance. Cultural identity emerges from group consumption externalities and resulting group differences, which in turn provide the basis for exchanges within communities. Trade integration, by changing the relative prices between cultural goods, modifies social consumption behavior and reshapes consumption groups. The implications of these processes are studied by Bala and Van Long (2005); Francois and van Ypersele (2002); Janeba (2007); Olivier, Thoenig, and Verdier (2008); and Rauch and Trindade (2009).

¹¹Our work also relates to the symmetry breaking literature (see, e.g., Matsuyama 2004). The common thread is that trade (or financial market liberalization) instead of homogenizing nations can support equilibria with greater between-nation differences. In Matsuyama’s model (and others in this literature), the market size effects of trade, along with economies of scale (or some other positive feedback mechanism), generate divergence. Different

the returns available to employers and employees and, hence, raise the cost of an employer-employee mismatch that is likely to occur as the result of deviations from the prevalent preferences and contracts. This trade-induced increase in the “innovation penalty” acts as an impediment to cultural-institutional transitions.

Our second result is that, in contrast to trade, international mobility of factors of production facilitates transitions between cultural-institutional conventions (Theorem 2). The reason is that factor mobility provides a kind of “innovation insurance” as it lowers the expected costs of deviating from the status quo.¹² This innovation insurance effect works on the extensive margin: it increases the likelihood that a deviant will experience a mutually beneficial match without altering the value of the match. The innovation penalty associated with trade liberalization, by contrast, works on the intensive margin: it raises the value of the status quo match, which is the opportunity cost of innovating, while the probability of the right match remains unaffected.

The paper is organized as follows. After providing, in Section I, some empirical evidence motivating our approach, in Section II we introduce the setup of the model describing production in an autarchic economy and the payoffs associated with the set of possible matches between preferences and contracts (IIA) and define the conditions for the existence of persistent cultural and institutional differences (IIB). In Section III, we describe how agents revise their preferences or contracts (IIIA) and then illustrate the process by which transitions between cultural-institutional conventions are possible (IIIB). In Section IV, we apply the model to the two-country case in which cultural-institutional differences provide a basis for specialization and trade (IVA), explore the persistence of cultural and institutional differences following trade integration (IVB), and illustrate public policies (a tariff, for example) that will induce a transition (IVC). In Section V, we introduce factor mobility (VA) and investigate its effects on transitions (VB). Section VI shows that, conditional on the existence of multiple cultural-institutional conventions, our main results follow directly from the gains from trade that these differences allow and are robust to plausible variations in our modeling choices. Section VII concludes.

I. Empirical Motivation: Culture, Institutions, and Trade

Here we offer three empirical motivations for our approach. First, the norms and preferences that influence economic behavior, as well as institutions, differ significantly among economies.¹³ In particular, reciprocal social preferences appear to be more prevalent in the higher income countries. Herrmann, Thöni, and Gächter (2008), for example, show that among subjects in 15 countries, the level of cooperation sustained in a public goods experiment in which the altruistic punishment of free riders was possible was much higher in wealthier nations. Likewise institutions that favor gain-sharing, such as democratic governance, trade unions, and the rule of law,

mechanisms are operating in our model: they arise not from scale economies but from the strategic complementarities between the employer population's contract and the employee population's preferences.

¹²Hence, as in Olivier, Thoenig, and Verdier (2008) and Karabay and McLaren (2010), we find contrasting convergence effects of trade integration and factor market integration.

¹³Empirical evidence is provided by Bloom and Van Reenen (2007); Bloom, Sadun, and Van Reenen (2012); Inglehart (1977); Tabellini (2010); Henrich et al. (2005); Bisin and Verdier (2011); and Knack and Keefer (1997).

are more highly developed in the European, North American, and other richer nations (e.g., Worldwide Governance Indicators 2013, Polity IV Project 2013, and Przeworski et al. 2000). For these reasons, we represent an economy whose cultural-institutional nexus is characterized by gain-sharing and reciprocal preferences as having a superior cultural-institutional environment and, as a result, enjoying absolute advantage with respect to countries in which fixed-wage contracts and high levels of monitoring elicit only routine labor services from self-regarding economic agents.

Second, consistent with our view that cultural (in addition to institutional) differences may influence comparative advantage, we find a statistical association between a country's trade specialization and the level of reciprocity and related social norms among its population. As a measure of reciprocity, we use the level of cooperation sustained in the already mentioned behavioral experiment conducted by Herrmann, Thöni, and Gächter (2008). To capture the features of goods relevant to our study, we use the index computed by Costinot, Oldenski, and Rauch (2011) that measures the importance of "problem solving" (that we term qualitative labor) and routine activities (quantitative labor).¹⁴ We obtain a measure of countries' comparative advantage in routine intensive goods by matching these data with international bilateral trade data from Feenstra et al. (2005).¹⁵

In Figure 1, we report the relationship between the reciprocity index and the residuals from a regression of the comparative advantage measure on a constant and GDP per capita (World Bank 2012). From the figure we can see two things. First, there are substantial cultural differences across nations. And, second, these differences are associated with patterns of trade: countries with higher levels of reciprocity have a comparative advantage in the production of goods whose labor inputs are less routine and more oriented toward problem solving, even after controlling for GDP per capita.

A third set of empirical observations motivates our choice of a long-term and evolutionary model to represent the endogenous dynamics of the distribution of preferences and contracts. Both culture and institutions change slowly and often in response to a very large number of noncoordinated actions taken by individuals best responding to their recent experience rather than engaging in the forward-looking calculative approach common in most economic models. The protracted nature of cultural revision is motivated by the fact that preferences, like accents, tend to be formed early in life and to persist over long periods (Newcomb et al. 1967, Bloom 2010, and Rakoczy and Schmidt 2013). A similar inertia in the firms' institutional revision process is a major finding in the field of organizational ecology; the relationships between employers and their employees are among the "core" highly persistent organizational features of firms (Hannan and Freeman 1993). Concerning these, Hannan finds "that founders [of firms] impose blueprints on nascent organizations and that altering such blueprints destabilizes organizations" (Hannan 2005, 61).

Thus, the organizational structure of firms reflected in the kinds of contracts implemented may be also persistent.¹⁶ The conflictual labor relations at Fiat, for

¹⁴ See online Appendix A for data details.

¹⁵ We find similar results using a survey-based measure of trust (Knack and Keefer 1997).

¹⁶ Persistence of organizational structures is a feature of the evolutionary theory of the firm pioneered by Nelson and Winter (1982).

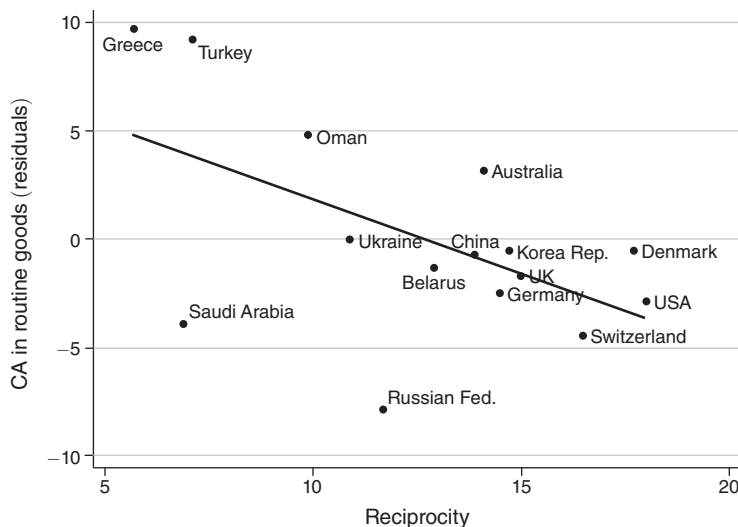


FIGURE 1. COMPARATIVE ADVANTAGE IN ROUTINE INTENSIVE GOODS AND RECIPROCITY

Notes: *Reciprocity* is the mean of contributions to a public good (20 is the maximum contribution possible, zero the minimum). *CA in routine goods (residuals)* is the residual from a regression of comparative advantage in routine intensive goods on GDP per capita. The correlation coefficient is -0.683 (p -value = 0.035).

example, could not quickly be abandoned were the employees suddenly transformed into Volkswagen's workers, accustomed to a more cooperative approach. Introducing Google-style work organization at General Motors would take years. For analogous reasons, we assume that production requires some product-specific kinds of capital (which we do not model here) so that firms cannot switch their product mix costlessly (General Motors could not costlessly shift to producing software if, by chance, it found itself with a self-motivated workforce for one period).

These results and observations motivate our model of the effects of culture and institutions on trade and the effects of trade and factor mobility on the evolution of culture and institutions.

II. Setup: Production and Cultural-Institutional Conventions in Autarchy

An economy is populated by z firms and z employees, where z is a large and finite real number. They engage in two stages: production and type updating. In the production stage, employers hire randomly matched employees (each employer can hire just one employee and each employee can be hired by only one employer) for a single interaction, in which, depending on his type, the employer implements one of the two contracts under which the employee works, the employee responding according to her own type; and production takes place. Following production (described in Section IIA below), employers' and employees' types may change as the result of a standard perturbed myopic best response process (described in Section IIIA).¹⁷

¹⁷ A similar updating process is also used by Weibull (1995) and Young (1998).

A. Production

Each employee is endowed with one unit of labor, which has the two aspects: quantitative labor (time at work and compliance with explicit directions, as described above; denoted by N) and qualitative labor (care and problem solving; denoted by L). The worker may provide either quantitative labor alone or both quantitative and qualitative labor. We normalize the disutility of labor by assuming that applying quantitative labor incurs no cost to the worker, while supplying qualitative, in addition to quantitative, labor incurs a positive cost. Production requires quantitative labor and is also enhanced by qualitative labor. Hence, denoting by Q_N^i the quantity of good i produced with a single unit of quantitative labor only and by Q_L^i the output produced when the employee supplies both qualitative and quantitative labor, it follows that

$$(1) \quad Q_L^i > Q_N^i \quad \forall i.$$

Labor is perfectly mobile across industries but (until Section V) immobile across countries. There are no other factors of production. Markets are competitive in the sense that employers take the price of the good as exogenously given.

There are two goods. One is intensive in quantitative labor and termed transparent (denoted by t), because it is more intensive in the labor activities that are readily observed. The production of the other good, which we term opaque (and denote by o), by contrast, depends more on qualitative aspects of work. Hence, the additional production obtained employing both quantitative and qualitative labor (rather than quantitative labor only) is relatively greater in the opaque than in the transparent sector, or

$$(2) \quad Q_L^o / Q_N^o > Q_L^t / Q_N^t.$$

Agents consume a given composite bundle (indicated by c) made up of one-half of a unit each of the transparent and opaque goods. Thus, prices do not affect consumption proportions. (We show in Section VI that this simplification is not essential and that taking account of substitution effects in consumptions would strengthen our results.)

For simplicity, under autarchy, each firm produces a quantity C_N of the composite bundle, if a single unit of just quantitative labor is employed, or a quantity C_L , if qualitative in addition to quantitative labor is supplied by the worker. Using (1) and (2), it follows that¹⁸

$$(3) \quad C_L > C_N.$$

¹⁸The quantity of N -labor needed to produce one unit of the composite bundle is: $(1/Q_N^o + 1/Q_N^t)/2 = (Q_N^o + Q_N^t)/(2Q_N^o Q_N^t)$. The productivity of one unit of N -labor in terms of composite basket will be just the inverse of this ratio; and similarly, we can obtain the productivity of one unit of L -labor. It follows $C_L = 2Q_L^o Q_L^t / (Q_L^o + Q_L^t) > C_N = 2Q_N^o Q_N^t / (Q_N^o + Q_N^t)$.

Payoffs (profits and utility) are measured in the number of units of the composite basket commanded, which is the *numeraire*. The (risk-neutral) utility function of employees is additive in consumption, the subjective utility associated with the type of contract (for some agents), and the disutility of labor if qualitative labor is provided.

The two types of employer implement different contracts: fixed-wage contracts and partnerships (denoted by F and P , respectively). Under the former, the worker is paid w and is closely monitored by the employer. (We avoid notational clutter by abstracting from any monitoring cost.) Under the partnership, the wage is some given fraction b of the revenue of the firm and there is no supervision. The key difference in the contracts is the degree of gain-sharing. (The contracts we study are extreme points on a gain-sharing continuum. We discuss in Section VI, and show in online Appendix C, that our results are robust to allowing a degree of gain-sharing in the “fixed-wage” contract, as long as the degree of gain-sharing in the partnership is greater.) Hence, firms’ profits (assumed positive throughout) are

$$(4) \quad \pi^{firm} = \begin{cases} (1-b)C_k & \text{with } k = N, L, \text{ under a } P\text{-contract} \\ C_k - w & \text{with } k = N, L, \text{ under an } F\text{-contract} \end{cases}$$

The two types of worker, reciprocator or Homo economicus (denoted by R and E , respectively), respond differently to the different types of contract. Both worker types’ utility is increasing in its own payoff (π^{work}) and for the reciprocator also either increasing or decreasing in the payoff to the employer (π^{firm}) depending on the type of the employer with whom he interacts.¹⁹ The utility of an employee is given by

$$(5) \quad \begin{aligned} u^{work} &= \pi^{work} + \alpha\gamma\pi^{firm} \text{ where} \\ \pi^{work} &= \begin{cases} bC_k - \delta_k & \text{with } k = N, L, \text{ under a } P\text{-contract} \\ w - \delta_k & \text{with } k = N, L, \text{ under an } F\text{-contract} \end{cases} \end{aligned}$$

where δ_k ($\delta_L = \delta$ and $\delta_N = 0$) is the disutility of labor, α (≥ 0) is the strength of the worker’s reciprocity preferences, and γ ($= \{-1, 1\}$) is the reciprocal worker’s belief about the employer’s type, the latter depending on the form of contract that the employer implements. For reciprocal employees ($\alpha > 0$), a partnership signals the good will and trust of the employer, so $\gamma = 1$; while a fixed-wage contract signals distrust with $\gamma = -1$, as a result. Other employees ($\alpha = 0$), who we term Homo economicus, care only about their own material payoffs irrespective of the contract: hence, for self-regarding workers, $u^{work} = \pi^{work}$. (We show in Section VI that the assumption $\gamma = \{-1, 1\}$ is not crucial to our results.)

We now use this setup: first (Section IIB), to determine the parameter set for which two economies that are identical except for their recent cultural and institutional histories may have quite different distributions of contracts and preferences

¹⁹The utility function we adopt in this model is in the spirit of Rabin (1993); Levine (1998); Fehr and Falk (2002); and Celen, Schotter, and Blanco (2015).

and, second, to describe the process by which in a given economy a transition from one of these persistent states to the other might occur (Section III).

B. Cultural-Institutional Complementarity

The basis of the cultural and institutional differences between countries that we study is the complementarity between preferences and contracts, which we model using two assumptions on the parameters.

The first ensures that workers with different preferences respond differently to partnerships.

ASSUMPTION 1: $0 < \delta - b(C_L - C_N) < \alpha(1 - b)(C_L - C_N)$.

Under a partnership, the *E*-worker provides quantitative labor only because the share of increased output associated with providing qualitative labor is less than the additional disutility of labor (first inequality in Assumption 1). By contrast, when working in a partnership, the *R*-worker offers both quantitative and qualitative labor, because his positive valuation of the payoff to the employer, in addition to the higher productivity of labor, is sufficient to offset the greater disutility δ (second inequality in Assumption 1). Under the fixed-wage contract, both self-interested and reciprocal workers provide quantitative labor only. The reason is that, in the absence of gain-sharing, neither type of worker will be compensated for the greater disutility associated with providing, in addition, qualitative labor.

The second assumption guarantees that, for given contracts, employers obtain different profits depending on the type of worker with whom they are matched.

ASSUMPTION 2: $(1 - b)C_N < C_N - w < (1 - b)C_L$.

Hence, employers matched with *E*-workers have strictly greater profits when implementing a fixed-wage contract than a partnership because, when only quantitative labor is provided, the workers' compensation under a partnership is greater than the fixed wage (first inequality in Assumption 2). By contrast, qualitative (in addition to quantitative) labor is sufficiently more productive than just quantitative labor so that employers matched with reciprocal workers have strictly greater profits under a partnership than under a fixed-wage contract (second inequality in Assumption 2).

Table 1 gives the employer and employee payoffs in the four possible contract-preference pairings.²⁰ As a consequence of Assumptions 1 and 2, partnership firms and reciprocal workers (denoted *PR*) or fixed-wage firms and self-regarding workers (denoted *FE*) represent matches with higher payoffs (marked in bold in Table 1) than would result if one of the pair deviated to an alternative contract or

²⁰ For instance, regarding the worker's payoff under the *PR* match, we set $\alpha > 0$ (the worker is a reciprocator) and $\gamma = 1$ (the employer is a partnership type) in equation (5) and, using the above description of contracts and preferences, obtain: $(bC_L - \delta) + \alpha(1 - b)C_L = [b + \alpha(1 - b)]C_L - \delta$. The derivation of the other payoffs is straightforward.

TABLE 1—MATRIX OF PAYOFFS

Firm/contract	Worker/preference	
	Reciprocator	Homo economicus
Partnership	$(1 - b)C_L, [b + \alpha(1 - b)]C_L - \delta$	$(1 - b)C_N, bC_N$
Fixed-wage	$C_N - w, w - \alpha(C_N - w)$	$C_N - w, w$

Note: Payoffs, measured in units of the composite bundle, are derived from equations (4) and (5) in the text.

preference type. Hence, persistent cultural-institutional differences may exist in this model; that is, states in which (virtually) all partnership firms are matched with (virtually) all reciprocal workers or employers offering fixed-wage contracts are paired with self-regarding employees. In what follows, we assume that Assumptions 1 and 2 hold throughout.

Denoting by ω the fraction of the workers that have reciprocal preferences, the expected payoffs to employers implementing the *P*-contracts and *F*-contracts are, respectively,

$$(6) \quad \begin{aligned} v^P(\omega) &= (1 - b)[\omega C_L + (1 - \omega) C_N], \\ v^F(\omega) &= C_N - w; \end{aligned}$$

while, denoting by ϕ the fraction of the firms that implement partnerships, the expected payoffs to the *R*-employees and *E*-employees are

$$(7) \quad \begin{aligned} v^R(\phi) &= \phi[b + \alpha(1 - b)]C_L - \delta + (1 - \phi)[w - \alpha(C_N - w)], \\ v^E(\phi) &= \phi b C_N + (1 - \phi)w. \end{aligned}$$

Expected payoffs are depicted in Figure 2, where the costs of idiosyncratic type revision (Δ) in, respectively, the *FE* match (ω and ϕ both equal to 0; denoted by subscript 0) and the *PR* match (ω and ϕ both equal to 1; denoted by 1), for firms and workers, are given by²¹

$$(8) \quad \begin{aligned} \Delta_0^{firm} &= bC_N - w \quad \text{and} \quad \Delta_0^{work} = \alpha(C_N - w), \\ \Delta_1^{firm} &= (1 - b)C_L - (C_N - w) \quad \text{and} \\ \Delta_1^{work} &= \{[b + \alpha(1 - b)]C_L - \delta\} - bC_N. \end{aligned}$$

Costs of deviation from the *FE* (*PR*) match for respective firms and workers are represented by differences in the payoff function intercepts of the left (right) vertical axes in Figure 2.

²¹ The cost of idiosyncratic type revision for an *F*-contracting firm in a population of self-regarding workers is given by $\Delta_0^{firm} = v^F(\omega = 0) - v^P(\omega = 0)$, from which the first expression in (8) is obtained by using (6). Other expressions in (8) are easily derived.

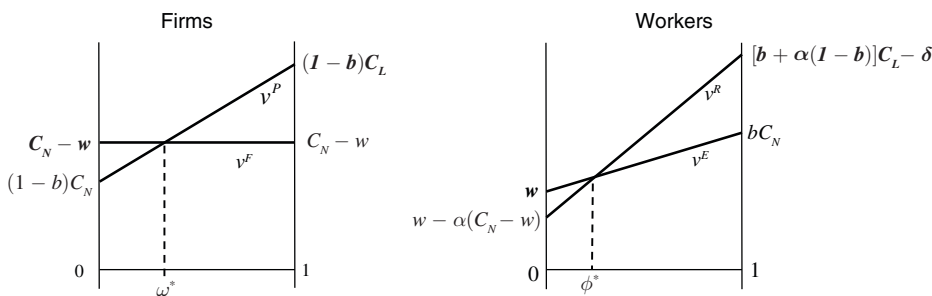


FIGURE 2. EXPECTED PAYOFFS UNDER AUTARCHY TO FIRMS (left) AND WORKERS (right)

Notes: ω is the fraction of R -workers and ϕ is the fraction of P -firms. The vertical intercepts are from Table 1.

LEMMA 1 (Costs of deviation): *The costs of deviation from the FE match, Δ_0^{firm} and Δ_0^{work} , (a) are positive and (b) increase with C_N , for both firms and workers. Corresponding costs of deviation from the PR match, Δ_1^{firm} and Δ_1^{work} , (a') are positive and (b') increase with C_L and decrease with C_N , for both firms and workers.*

Parts (a) and (a') follow from Assumptions 1 and 2. Parts (b) and (b') are evident by inspection of (8) (see Appendix B1).

Intersections of the two expected payoff lines in Figure 2 identify the critical fractions of workers and firms that equate the expected payoffs for firms implementing different contracts and workers adopting different preferences, respectively. They are

$$(9) \quad \omega^* = \frac{bC_N - w}{(1-b)(C_L - C_N)},$$

$$\phi^* = \frac{\alpha(C_N - w)}{\{[b + \alpha(1-b)]C_L - \delta\} - bC_N + \alpha(C_N - w)}.$$

Assumption 2 ensures that ϕ^* is interior to the unit interval; the second inequality in Assumption 1 ensures that ω^* is also interior. For future use, note that the critical fractions ω^* and ϕ^* are given by the costs of deviation, for firms and workers, respectively, from the FE match divided by the sum of this cost and the cost of deviation from the PR match. Consistently, $1 - \omega^*$ and $1 - \phi^*$ will be given by the costs of deviation from the PR match divided by the sum of this cost and the cost of deviation from the FE match.

LEMMA 2 (Critical fractions): *The critical fractions, ω^* and ϕ^* , both (a) increase with C_N and (b) decrease with C_L .*

It immediately follows that $1 - \omega^*$ and $1 - \phi^*$ increase with C_L and decrease with C_N . Proof of Lemma 2 is evident by differentiating (9). (See online Appendix B1 for details.)

The two critical fractions play a key role in the results to follow. For values greater than ω^* and ϕ^* , payoffs to employers offering partnership contracts exceed those offering F -contracts, and employees adopting R -preferences will have higher payoffs than E -employees. So, if the process by which contracts and preferences are revised is payoff monotonic, the fractions of P -contracts and R -employees will increase. Similar dynamics hold for values less than ω^* and ϕ^* : any payoff monotonic adjustment process increases the fraction of F -contracts and E -preferences in the population.

For an economy at the state in which (virtually) all employers offering fixed-wage contracts are paired with (virtually) all self-regarding employees, one can think of ω^* and ϕ^* as measures of the impediments to making a transition to the Pareto-efficient state. They represent the minimum number of employers and employees, respectively, that would be sufficient were they to change their types, to initiate a process that would carry the population to the other state in the absence of further non-best response play.²²

We will show in Section IV that trade liberalization increases both ω^* and ϕ^* ; while in Section V we show that factor market integration has the opposite effect.

III. Cultural-Institutional Dynamics

Formalizing these intuitions about why trade liberalization, for example, makes it more difficult to escape the status quo convention requires modeling the process by which employers and employees update their contracts and preferences, to which we now turn. If agents with certainty best respond to the past period's distribution of types, then the states ($\omega = 0, \phi = 0$) and ($\omega = 1, \phi = 1$) are absorbing: transitions will not occur. To study transitions, then, we model cultural and institutional evolution as a stochastic, rather than deterministic, Markov process in which agents occasionally deviate from a best response.

A. Revision of Preferences and Contracts

The type updating stage follows production (described in Section IIA). Each worker is born into a cohort in which parental socialization takes place before passing on to the second cohort in which the person works and then parents her (asexually produced) single child (as in Bisin and Verdier 2001) before dying. Like the payoffs to firms, the utility of workers is cardinal and observable in that individuals with differing preferences, and hence differing behaviors, can be seen by others to have more or less fulfilling lives. Using this information, parents (when best responding) socialize their children to adopt the preferences that will maximize the children's expected utility, given the behaviors that the preferences will motivate and the distribution of the employer types (assumed known to the parent). To be concrete, the parent asks: "given the distribution of firm types in the population,

²²To avoid addressing the integer problem, we simplify here by letting $z\phi^*$ and $z\omega^*$ be respectively these minimum numbers. We show in online Appendix B2 that our results are unaffected by addressing the integer considerations explicitly, but at the cost of considerable notational clutter.

would my child be happier with E -preferences, and acting accordingly, or with R -preferences, and acting accordingly?" Given this setup, the implied real-time scale on which preferences are revised is generational.

For simplicity, we assume the same time scale for firms, whose organizational structure, reflected in the kinds of contracts implemented, may persist over very long periods. Hence, we suppose that firms are family held, and that major changes in firm core structure take place only when the older generation retires. Abstracting from idiosyncratic updating (non-best responders described below), when revising contracts, firms adopt the contract type with the higher expected profits given the distribution of workers' types.

Thus, we let each employer and employee represent a "parent" who before dying socializes his replacement. In the perturbed myopic best response updating process, agents are boundedly rational. So, with probability $(1 - \sigma)$, parent firms and workers best respond to the distribution of types as described immediately above. But with probability σ , for reasons external to the model, including errors or experimentation, workers and firms do not best respond. They idiosyncratically update their types (meaning they socialize the next generation of employees and firms, respectively, to have non-best response preferences and to implement non-best response contracts).

On plausibility grounds, the likelihood of idiosyncratic type revision should be sensitive to the expected costs of mismatch, rather than being simply fixed as in many of the initial perturbed Markov process models of this type. (We discuss in Section VI, and show in online Appendix D, that our results also hold using a fixed rate of idiosyncratic updating.) Hence, as in Blume (2003) and subsequent contributions to evolutionary game theory,²³ the probability of deviating from the best response for an individual h in state j is defined as

$$(10) \quad \sigma_j^h = \frac{1}{1 + e^{\beta \Delta_j^h}} \quad \text{with } h = \text{work, firm and } j = 0, 1,$$

where Δ_j^h is the cost of deviation from the best response, $j = 0$ denotes the state $(0, 0)$ ($j = 1$ stands for $(1, 1)$), and β is a measure of rationality of the agent. From (10) we see that σ_j^h is decreasing in β : the more rational is the agent (the larger is β), the greater the probability that she will best respond. When $\beta = 0$, the agent chooses randomly between the two options, and as β goes to infinity (with positive Δ_j^h), the agent never deviates, that is σ_j^h tends to zero. Agents are identical with respect to β .

B. Persistence and Transitions

The types of workers and firms are occasionally updated by the payoff monotonic process with idiosyncratic play just described, in which the type with higher payoffs in the previous period increases its share of the population. As a device to

²³ See, e.g., Myatt and Wallace (2004), Sandholm (2010), Staudigl (2012), Dokumaci and Sandholm (2011), Alós-Ferrer and Netzer (2010), and Kreindler and Young (2013).

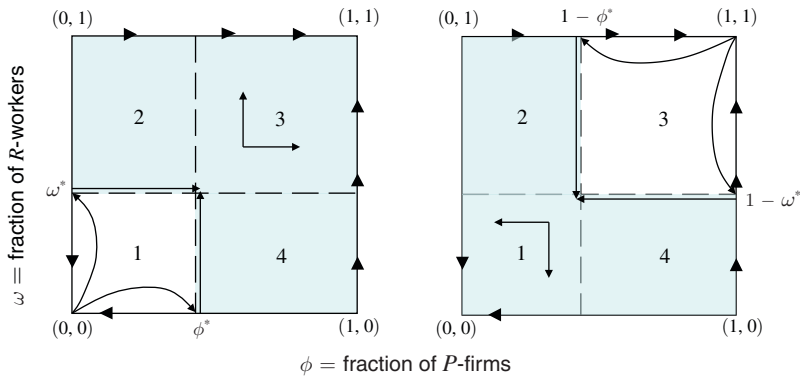


FIGURE 3. TRANSITIONS

Notes: Workers' and firms' population size is normalized to 1. In any period, if the fraction of deviants from the FE (PR) convention is equal to or exceeds ϕ^* or ω^* ($1 - \phi^*$ or $1 - \omega^*$), subsequent best response updating will lead the population to the PR (FE) convention.

ensure that the process is acyclic, we let revision be asynchronous (as in Binmore, Samuelson, and Young 2003). Thus, in even numbered periods, one population has the opportunity to revise first, after which the other population revises; in odd numbered periods, the order is reversed.

Figure 3 gives the state space of this process. The state of play in each period is the fraction of firms implementing partnerships and employees adopting reciprocal preferences denoted, respectively, by ϕ and ω , where both ϕ and ω are elements of $(0, 1/z, 2/z, \dots, (z-1)/z, 1)$. The evolutionarily stable states are those in the figure labeled (0, 0) and (1, 1); that is, states in which all matches are either FE or PR.

LEMMA 3 (Evolutionary stable states): (a) *The states (0, 0) and (1, 1) are stationary and evolutionarily stable in the unperturbed dynamics described by (6)–(10).* (b) *The state (1, 1) Pareto-dominates (0, 0).*

Part (a) follows directly from the fact that, by Assumptions 1 and 2, both ω^* and ϕ^* ($1 - \omega^*$ and $1 - \phi^*$) are interior, which entails that there exist a neighborhood of both (0, 0) and (1, 1) such that at states in these neighborhoods the payoff monotone updating process described by equations (6)–(10) returns the population to the stationary state if agents are sufficiently rational. These neighborhoods are the basins of attraction of the evolutionary stable states. Given Assumptions 1 and 2, part (b) is straightforward. The interior state (ϕ^*, ω^*) is stationary and unstable, that is, a saddle.

DEFINITION 1 (Cultural-institutional conventions): *The two evolutionary stable states are termed cultural-institutional conventions. They represent strict mutual best responses conditional on sufficiently many (but not necessarily all) other agents doing the same.*

For sufficiently rational agents, once a population is in the neighborhood of either of the two states $(0, 0)$ and $(1, 1)$, the associated cultural-institutional convention, namely FE and PR , will persist over very long periods. The reason is that non-best response revision will be rare and, even if by chance this perturbed state is a substantial displacement from uniform adherence to the convention, in the next period the population will with high probability return to the vicinity of the status quo state. Because agents have only a one-period memory, this excursion from the convention will have no lasting effect.²⁴ Hence, we study the minimum numbers of deviant firms and workers such that, with sufficiently rational agents, the population starting at one convention will enter the basin of attraction of the other evolutionary stable state.

Suppose that, in the first period, firms previously implementing F -contracts revise and that $z\phi^*$ idiosyncratically implement P -contracts instead of best responding with F -contracts. In the subsequent period, the next cohort of workers are socialized by their parents, and because the parents' best response to the state $z\phi^*$ is to transmit R -preferences rather than E -preferences, each next generation worker will acquire R -preferences with probability $1 - \sigma$. But as β goes to infinity, σ goes to zero, so there exists some finite β such that, as a result of parental socialization, with virtual certainty we will have $z\omega \geq z\omega^*$, and the population will then be in the set of states (quadrant 3 of Figure 3) for which both firms' and parents' best responses will lead to state $(1, 1)$. Thus, the minimum number of P -contracting firms sufficient to escape from the Pareto-inferior convention is $z\phi^*$.

Analogous reasoning shows that the minimum number of R -workers resulting from idiosyncratically responding parents that is sufficient to escape the inferior convention is $z\omega^*$. It follows that, from the initial state $(0, 0)$, the basin of attraction of the superior state $(1, 1)$ is composed of quadrants 2, 3, and 4 in Figure 3.²⁵ Following analogous reasoning, one can derive the basin of attraction of the inferior state $(0, 0)$, composed of quadrants 2, 1, and 4.

Because deviations from best response are independent, the waiting time for a transition from one cultural-institutional configuration to the other induced by the idiosyncratic updating of firms and workers (respectively) is approximated by the inverse of the probabilities that, in a given period, the number of firms or workers (respectively) deviating from the convention will be sufficient to enter the basin of attraction of the other evolutionary stable state. Because we assume a large population and a small rate of idiosyncratic updating (β sufficiently large), this will be approximated by the probability that the minimum number of deviants in that population will occur.²⁶ Thus, the probabilities of a transition from the FE (state

²⁴ For the sake of simplicity, we focus on "one-step transitions," as in Kandori, Mailath, and Rob (1993, 52), where "an equilibrium is upset by large jumps (from the equilibrium to the basin of attraction of the other equilibrium)" or as in Binmore, Samuelson, and Young (2003, 309), where "single burst of mutations" are considered. However, our results apply to any path of any number of steps from any state in the basin of attraction of the state $(0, 0)$ to a state not contained in it.

²⁵ From the initial state $(0, 0)$, the basin of attraction of $(1, 1)$ is constituted by the quadrants not containing $(0, 0)$, the two basins of attraction not being disjointed in this case, as in Binmore, Samuelson, and Young (2003).

²⁶ For a large β , the probability that greater numbers deviate is sufficiently small to be ignored in this approximation (see, e.g., Binmore, Samuelson, and Young 2003).

$(0,0)$ to the *PR* convention (state $(1,1)$), for firms and workers,' respectively, μ_0^{firm} and μ_0^{work} , are

$$(11) \quad \mu_0^{firm} = \left(\frac{z}{z\phi^*} \right) (\sigma_0^{firm})^{z\phi^*} (1 - \sigma_0^{firm})^{z-z\phi^*},$$

$$(12) \quad \mu_0^{work} = \left(\frac{z}{z\omega^*} \right) (\sigma_0^{work})^{z\omega^*} (1 - \sigma_0^{work})^{z-z\omega^*},$$

where σ_0^h ($h = work, firm$) is the probability of idiosyncratic type revision in state $(0,0)$, given by (10). The analogous probabilities of a transition from *PR* to *FE*, μ_1^{firm} , and μ_1^{work} , are easily obtained. Our main results to follow, Theorems 1 and 2, apply independently to μ_0^{firm} and μ_0^{work} (μ_1^{firm} and μ_1^{work}), so for simplicity we continue to study these escape probabilities separately rather than the joint probability that a transition occurs from either source or both. Since we are interested in the effect of the integration of goods and factor markets on the probability of an exit from the status quo convention, we now replace the single country autarchic economy with the two-country model of specialization and trade.

IV. Trade Integration

We consider two otherwise identical countries (same technologies, no differences in workers' skills, identical demand functions), one in which *P*-contracts and *R*-workers are matched and the other in which *F*-contracts and *E*-workers are paired. We refer to the country at the Pareto-inferior *FE* convention as country 0 (ω and ϕ both equal to 0) and to the country at the superior *PR* convention as country 1 (ω and ϕ both equal to 1). First, in Section IVA, we illustrate the comparative advantage resulting from cultural and institutional differences between the two countries and the consequent specialization and trade. Then, in Section IVB, we describe the effects of trade on the likelihood of transition between conventions. In what follows, a tilde ($\sim$) over the variable denotes trade.

A. Cultural-Institutional Comparative Advantage

Autarchy prices will differ between the two countries because the relative cost of production of the two (opaque and transparent) goods depends on whether both qualitative and quantitative labor is used in the prevailing match (country 1) or quantitative labor only (country 0). Let p_j^i denote the autarchic price of good i in terms of the composite bundle c (how many units of c one can purchase with one unit of the i -good) in country j , where $i = o, t$ and $j = 0, 1$. Since under autarchy both transparent and opaque goods (making up the composite bundle) are produced in competitive equilibrium in both countries, producers must be indifferent to which product to produce: this is ensured by $p_0^t/p_0^o = Q_N^o/Q_N^t$ in country 0 and $p_1^t/p_1^o = Q_L^o/Q_L^t$ in country 1. In what follows, C_N^0 and C_L^1 are the quantities of the

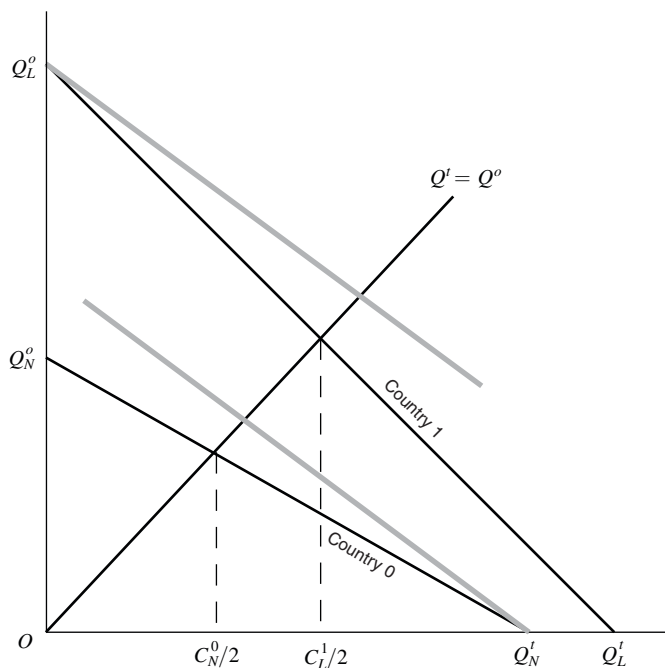


FIGURE 4. PRODUCTION POSSIBILITY FRONTIERS AND THE GAINS FROM TRADE IN THE TWO COUNTRIES

Notes: The workers' population size is normalized to 1. The slope of the gray lines indicate the international terms of trade.

composite bundle obtained by the prevailing employer-employee pair under autarchy in country 0 and in country 1, respectively.²⁷

In Figure 4, the two solid lines represent the production possibility frontiers of the two countries. Given inequality (1), country 1, where the established cultural-institutional convention is able to elicit qualitative (in addition to quantitative) labor in virtually all the matches, is advantaged in the production of both commodities. But, given inequality (2), this country enjoys a relatively greater advantage in the production of the *o*-good where qualitative aspects of work are relatively more important. By contrast, country 0 has a culture and institutions for which employees provide quantitative labor only and, as a consequence, has comparative advantage in the production of the *t*-good that is relatively less intensive in non-verifiable labor services:

$$(13) \quad \frac{p_0^t}{p_0^o} = \frac{Q_N^o}{Q_L^t} < \frac{p_1^t}{p_1^o} = \frac{Q_L^o}{Q_L^t},$$

²⁷In a given evolutionary stable state (where virtually all firms implement the same type of contract and virtually all workers, given their preferences, supply the same type of labor), costs are the same. Hence, for profits to be equal, the employer's revenue must be equal across the production of the two goods, thus: $C_N^0 = Q_N^o p_0^o = Q_N^t p_0^t$ and $C_L^1 = Q_L^o p_1^o = Q_L^t p_1^t$ in the two countries, respectively. Using $C_N^0 = 2 Q_N^o Q_N^t / (Q_N^o + Q_N^t)$ and $C_L^1 = 2 Q_L^o Q_L^t / (Q_L^o + Q_L^t)$ (see footnote 18), we know that $p_0^o = 2 Q_N^t / (Q_N^o + Q_N^t)$ and $p_0^t = 2 Q_N^o / (Q_N^o + Q_N^t)$ in country 0, and $p_1^t = 2 Q_L^o / (Q_L^o + Q_L^t)$ and $p_1^o = 2 Q_L^t / (Q_L^o + Q_L^t)$ in country 1. It follows, as one would expect, that we have equality between the relative price and the relative cost of the two goods.

or, given the definition of autarchic prices in the two countries, $p_0^t < p_1^t$ and $p_1^o < p_0^o$.²⁸ Thus, providing that the international terms of trade, represented in Figure 4 by the slope of the gray lines and denoted by $\tilde{p}^t / \tilde{p}^o$, falls strictly between the autarchic relative prices of the two countries ($p_0^t / p_0^o < \tilde{p}^t / \tilde{p}^o < p_1^t / p_1^o$ or $p_0^t < \tilde{p}^t < p_1^t$ and $p_1^o < \tilde{p}^o < p_0^o$), specialization and trade will be mutually advantageous and, in the absence of impediments, will take place.²⁹

LEMMA 4 (Specialization and trade): *Under trade, country 0 will specialize in the production of (and will export) the transparent good, while country 1 will specialize in the production of (and will export) the opaque good.*

Lemma 4 shows that our model of cultural-institutional conventions reproduces the key result in the literature on institutional comparative advantage. But the fact that the culture and institutions prevailing in each country are a source of comparative advantage, and that opening up to trade enables the two otherwise identical countries to specialize and enjoy welfare gains, would be of little interest if trade were to erode the differences upon which cultural-institutional comparative advantage depends. Our next results show that this is not the case.

B. Trade and Transitions

Consider country 0 (1) at the *FE* (*PR*) convention facing the prices prevailing at that state under autarchy and under trade. We now study how the difference in prices and the resulting specialization will affect the likelihood that a sufficient number of agents will deviate from the status quo, inducing a transition to the other cultural-institutional convention. Because the myopic best response type revision process uses information about the state in the previous period, it is based on the status quo prices (rather than the prices that would obtain were a transition to have occurred).

LEMMA 5 (Gains from trade favor status quo matches): *In country 0 (country 1), after trade and specialization in the *t*-good (*o*-good) production, the value of production in terms of the composite basket (a) increases in the prevailing *FE* (*PR*) match, that is $\tilde{C}_N^0 > C_N^0$ ($\tilde{C}_L^1 > C_L^1$) and (b) decreases in the idiosyncratic *PR* (*FE*) match, that is $\tilde{C}_L^0 < C_L^0$ ($\tilde{C}_N^1 < C_N^1$).*

The intuition behind this result is the following. After specialization in the *t*-good (*o*-good) production, both the prevalent *FE* (*PR*) match and the rare *PR* (*FE*) match

²⁸ Recall that p_0^t and p_1^t (p_0^o and p_1^o) are relative prices (the price of *t*-good (*o*-good) in terms of the composite bundle).

²⁹ Unless the two economies happen to be of the “right” size, given the fixed proportions in the composite consumption bundle there will either be excess supply of one of the two goods under complete specialization following trade integration. To retain the valuable simplifications due to both complete specialization and fixed proportions in consumption, we could (artificially, but harmlessly) assume that under trade integration the “smaller” nation specializes and that firms in the other country produce a joint product of the two goods in the proportions necessary to satisfy global demands for the two goods. We opt for the simpler assumption that the countries are of a size to equilibrate world commodity markets, thereby avoiding notational clutter associated with joint production in one country.

in country 0 (country 1) benefit from the positive price effect of trade: the relative price of the transparent (opaque) good in terms of the composite bundle has increased. However, the two matches incur opposite production effects: the *FE* (*PR*) match now devotes all its labor to the production of the good for which its absolute disadvantage is least (its absolute advantage is greatest); the *PR* (*FE*) match, by contrast, specializes in the production of the good for which it is comparatively disadvantaged. Hence, trade in country 0 (country 1) is beneficial to the *FE* (*PR*) match, for which the two effects go in the same direction, but has adverse impact on the *PR* (*FE*) match for which the production effect dominates the price effect (see online Appendix B2 for more details).

All the other terms (α , δ , and w) entering the agents' expected payoffs are measured in units of the composite basket, and so remain unaltered. Hence, as a result of trade integration, the expected payoffs lines, whose equations are given by (6) and (7), change as depicted in Figure 5, top and bottom panel for country 0 and country 1, respectively. Differences between left (right) vertical intercepts of, respectively, black and gray lines in Figure 5 illustrate the cost of deviating from the status quo convention under autarchy and trade in country 0 (country 1). Inspection of the figure motivates the following result.

LEMMA 6 (Effects of trade on costs of deviation): *Trade integration increases the cost of deviating from the status quo convention in country 0 (country 1) for firms and workers, respectively, that is $\tilde{\Delta}_0^{firm} > \Delta_0^{firm}$ ($\tilde{\Delta}_1^{firm} > \Delta_1^{firm}$) and $\tilde{\Delta}_0^{work} > \Delta_0^{work}$ ($\tilde{\Delta}_1^{work} > \Delta_1^{work}$).*

The key intuition behind this result (and the results that follow) is that deviating from the convention almost always entails a mismatch and hence forgoing some of the surplus, the value of which is higher after trade integration as a result of the gains from specialization and trade. We call this result the “innovation penalty” effect of trade.

In addition to increasing the incentive not to innovate, we have the following.

LEMMA 7 (Effects of trade on critical fractions): *Trade integration increases the critical fractions of innovating *R*-workers (*E*-workers) and *P*-contracting (*F*-contracting) firms sufficient to escape the status quo convention in country 0 (country 1), that is, for transitions induced by respectively workers and firms, $\tilde{\omega}_0^* > \omega_0^*$ ($1 - \tilde{\omega}_1^* > 1 - \omega_1^*$) and $\tilde{\phi}_0^* > \phi_0^*$ ($1 - \tilde{\phi}_1^* > 1 - \phi_1^*$).*

The intuition is readily provided by Figure 5. In country 0 after trade and specialization, because (by Lemma 5) $\tilde{C}_N^0 > C_N^0$ and $\tilde{C}_L^0 < C_L^0$, the differences between the left axis vertical intercepts (that is the costs of deviation from the *FE* match defined in (8)) increase, whereas the differences between the right axis vertical intercepts decrease, the result necessarily being a rightward shift (away from (0, 0)) in the two critical values (ω_0^* and ϕ_0^*) in the top panels. A symmetric mechanism works in country 1: we observe a leftward shift (away from (1, 1)) in the two critical values (ω_1^* and ϕ_1^*) in the bottom panels.

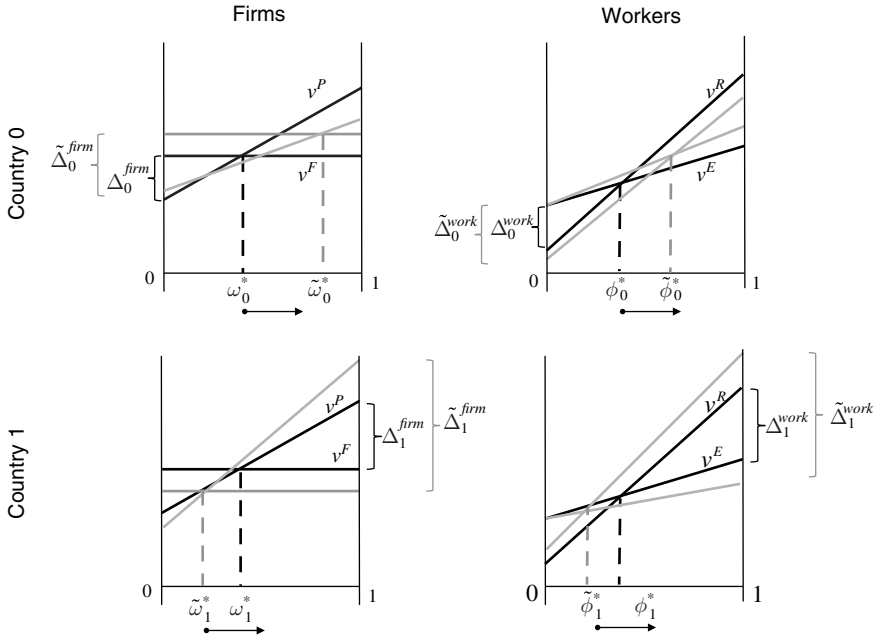


FIGURE 5. PAYOFFS TO FIRMS (left) AND WORKERS (right) IN COUNTRY 0 (top) AND 1 (bottom) BEFORE AND AFTER TRADE INTEGRATION

Notes: ω is the fraction of R -workers and ϕ is the fraction of P -firms. Black and gray lines represent expected payoff lines under, respectively, autarchy and trade. A tilde ($\sim$) denotes variables under trade.

Theorem 1 gives the effects of trade on the expected waiting time of a transition from the status quo convention.

THEOREM 1 (Effects of trade integration on transitions): *If agents are sufficiently rational, trade integration decreases the probability of escaping the status quo convention in country 0 (country 1), that is, for transitions induced by respectively workers and firms, $\tilde{\mu}_0^{work} < \mu_0^{work}$ ($\tilde{\mu}_1^{work} < \mu_1^{work}$) and $\tilde{\mu}_0^{firm} < \mu_0^{firm}$ ($\tilde{\mu}_1^{firm} < \mu_1^{firm}$).*

We know, by Lemma 6, that trade increases the cost, to both firms and workers, of deviating from the status quo cultural-institutional nexus. Since, by Lemma 7, we also know that trade increases the critical fraction of idiosyncratically updating agents sufficient to induce a transition, it follows from (11) and (12) that the probability that a transition will occur must be reduced by trade and, hence, (for sufficiently rational agents) the expected waiting time of escaping the basin of attraction of the status quo convention is increased. Thus, removing impediments to international exchange does not undermine, and indeed fortifies, the preexisting cultural and institutional differences upon which specialization and trade are based. This is true even if there exists a cultural-institutional convention to which a transition would be Pareto-improving.

C. A Tariff-Induced Transition to the Pareto-Superior Convention

While the impediments to a transition to a superior cultural-institutional convention are increased by trade, such a transition can be induced by a range of public policies designed to affect the opportunity cost of innovating. While not an optimal policy for accomplishing this end, a trade restriction can guarantee this result even in the absence of idiosyncratic play. There exists a tariff protecting the (imported) opaque good in country 0 such that a best response-induced cultural-institutional transition will occur, country 0 adopting the *PR* cultural-institutional convention. The tariff accomplishes this by shifting the interior critical points ω_0^* and ϕ_0^* to the left, so that adhering to the status quo Pareto-inferior convention is no longer a best response for either employees or employers.

Assuming that the international price ratio is not affected by the tariff, let θ_ω^* and θ_ϕ^* be the ad valorem tariff rates on the opaque (imported) good which will implement an (after-tariff) domestic price ratio in country 0 such that, respectively, $\omega_0^* = 0$ and $\phi_0^* = 0$.³⁰ The minimal transition-inducing tariff is given by $\theta^* = \min[\theta_\omega^*, \theta_\phi^*]$. Using equations (9) under trade integration, it can be shown that:

LEMMA 8 (Transition inducing tariff rates): *The tariff rates which induce, respectively, firms and workers to implement a transition from the inferior FE to the superior PR convention are given by*

$$(14) \quad \theta_\omega^* = \frac{b\tilde{C}_N^0}{w} - 1 \quad \text{and} \quad \theta_\phi^* = \frac{\tilde{C}_N^0}{w} - 1.$$

Not surprisingly, the logic of the transition-inducing tariff is exactly the opposite of the mechanism underlying the fact that trade liberalization is transition-impeding. The tariff on the opaque imported good makes the transparent good less valuable in terms of the composite basket it can command and, hence, reduces the joint surplus available to firms and workers.³¹ It follows that, after the introduction of the tariff, the costs of deviation from the *FE* convention, for respective employers and employees, become equal to $b\tilde{C}_N/(1+\theta) - w$ and $\alpha[\tilde{C}_N/(1+\theta) - w]$. A sufficiently large tariff will, thus, eliminate the deviation costs entirely. The level that eliminates the cost of deviation for either of the two classes is the minimal transition-inducing tariff, θ^* .

If $\theta^* = \theta_\omega^*$, it would be the employers who induce the transition, because the tariff would reduce the value of output in terms of the composite bundle to such an extent that the labor compensation under partnerships would equal the fixed wage under *F*-contracts; then, employers matched with *E*-workers would have no greater profits if implementing *F*-contracts than partnerships. Any tariff greater than this

³⁰ We assume that the tariff revenues are spent in some way that does not affect the dynamics under consideration here.

³¹ The after-tariff domestic price of one unit of the *t*-good in terms of the (imported) *o*-good is $\bar{p}'/[\bar{p}^o(1+\theta)]$ and so the price of one unit of the *t*-good in terms of the composite basket is $\bar{p}'/(1+\theta)$. It follows that the quantity of the composite bundle that the prevailing employer-employee match (producing *t*) in country 0 can command after the introduction of the tariff becomes $\tilde{C}_N^0/(1+\theta) = \bar{p}'Q_N^0/(1+\theta)$.

makes the partnership a strict best response for the employers. If $\theta^* = \theta_\phi^*$, the tariff would reduce profits under the F -contract to zero; and if the employer is making zero profits, the reciprocal employee's utility is not decreased under a fixed-wage contract. As a result, the E -employees are indifferent to switching to R -types, so the FE convention would no longer be evolutionarily stable.

It is readily seen from equation (14) that $\theta_\omega^* < \theta_\phi^*$, so the minimal transition inducing tariff will induce employers to best respond by shifting to the partnership contract, thereby inducing employees to update to be reciprocal.

V. Factor Market Integration

In contrast to goods market integration, factor market integration facilitates transitions between cultural-institutional conventions. The reason is that factor market integration has just the opposite effects as did trade: it reduces expected costs of deviation from the status quo convention, and it also reduces the critical number of deviants sufficient to induce a transition to the alternative cultural-institutional nexus. After introducing factor market integration into our model (Section VA), we will take up these two results in turn (Section VB).

A. Factor Mobility

A parsimonious way to represent factor market integration, and one that captures the essentials, is to posit a distinct cosmopolitan matching process in addition to the within-economy matching we have assumed thus far. Suppose that some matches are made entirely with one's own nationals, while others are made randomly in the global population. As pictured in Figure 6, there are now three factor markets: two of them national-specific and, the third, a common pool without country identification. The common pool is populated by agents drawn at random from the two country-specific pools and, hence, has the same distribution of preferences and contracts as the meta-population (both countries combined). For both employers and employees we have the following.

DEFINITION 2 (Factor market integration): *The degree of factor market integration is equal to $1 - \lambda$, where with probability λ an agent is matched with an agent randomly drawn from his own nation, and with probability $1 - \lambda$ he is matched with an agent randomly drawn from the common pool.*

When factors are immobile across national borders, one may imagine the countries as two "villages" within which all production takes place. But, with international mobility of factors of production, some (a random draw from each of the two villages) go to the cosmopolitan "city," where they make random matches with members of the other population whom they encounter there. In this model, λ is not chosen by the individual agents: it is a characteristic of the two countries' cultures, language differences, geographical distance, immigration policies, and other influences on factor movement that are exogenous from the standpoint of the individual employer or employee. In the autarchic factor markets, we have thus far assumed

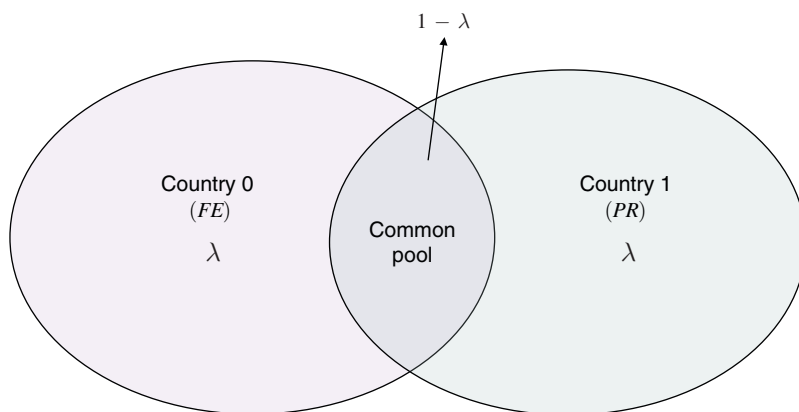


FIGURE 6. FACTOR MARKET INTEGRATION

Note: λ is the degree of national specificity of the factor markets and $1 - \lambda$ is the degree of factor market integration.

$\lambda = 1$. But, if $\lambda < 1$, one's expected match is λ times the fraction of agents in one's own country plus $1 - \lambda$ times the distribution of contracts and preferences in the common pool.³²

The expected payoff after factor market integration is the weighted sum of the expected payoff in the national factor market plus the expected payoff in the common pool, the weights being the relative sizes of the two pools, λ and $1 - \lambda$. The expected payoff in the common pool, in turn, is the weighted sum of the expected payoffs from matching an individual resident in country 0 and in country 1 with weights given by the relative sizes of the two countries. (Expected payoff lines and critical values are depicted in Figure 7; the corresponding equations are reported in online Appendix B3 for reasons of space).

B. Factor Market Integration and Transitions

We now consider the effect of factor market integration on the expected cost of idiosyncratic updating. When factors are mobile across countries, the probability of an optimal match for idiosyncratic R -workers and P -firms is not just the (vanishingly small) likelihood of meeting an idiosyncratic firm or worker from one's own economy, but also the substantial chance for the "right" match, which occurs when paired with best responding individuals from the other country in the pool. Thus, factor market integration has what we call an "innovation insurance" effect. This is in contrast to commodity market integration, which imposes an "innovation penalty" because, as we have seen, the gains from trade heighten the opportunity costs of the mismatches that innovators may expect when paired with agents from

³² As shown in online Appendix B3, the following results can be obtained using either autarchic or trade prices, meaning that the effect of factor market integration on transitions to the Pareto-superior convention is independent of whether the status quo is nationally specific factor markets under autarchy or trade integration. For simplicity, in this section, we consider the case where the status quo is autarchy.

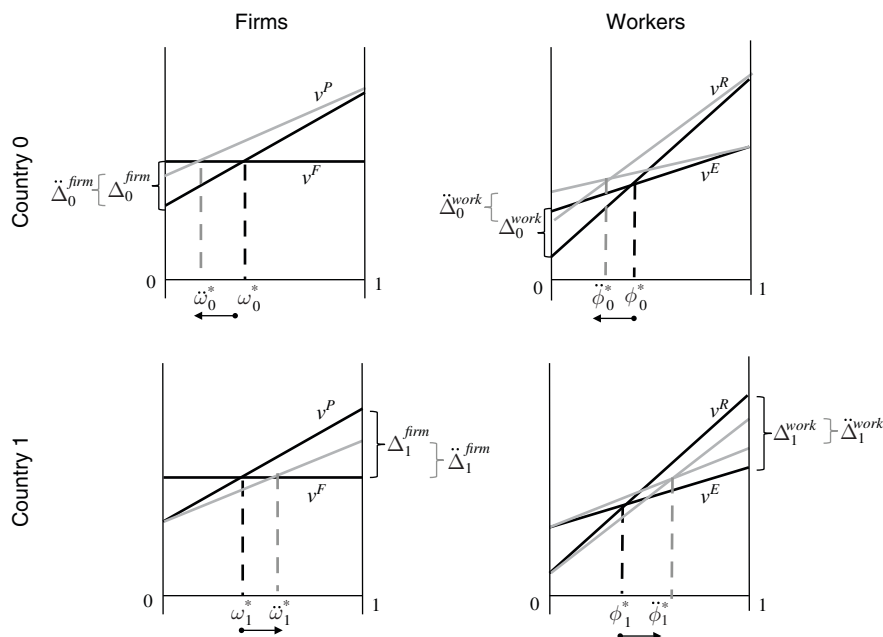


FIGURE 7. PAYOFFS TO FIRMS (left) AND WORKERS (right) IN COUNTRY 0 (top) AND 1 (bottom) BEFORE AND AFTER FACTOR MARKET INTEGRATION

Notes: ω is the fraction of R -workers and ϕ is the fraction of P -firms. Black and gray lines represent expected pay-off lines under, respectively, factor immobility and factor mobility. A double-dot ($\ddot{\cdot}$) over the variable denotes factor mobility.

their own country. In what follows, a double-dot ($\ddot{\cdot}$) over the variable denotes factor mobility.

LEMMA 9 (Effects of factor market integration on costs of deviation): *Factor market integration (a reduction in λ) decreases the cost of deviating from the status quo convention in country 0 (country 1) for firms and workers respectively, that is, $\ddot{\Delta}_0^{firm} < \Delta_0^{firm}$ ($\ddot{\Delta}_1^{firm} < \Delta_1^{firm}$) and $\ddot{\Delta}_0^{work} < \Delta_0^{work}$ ($\ddot{\Delta}_1^{work} < \Delta_1^{work}$).*

A graphical representation of this result is offered in Figure 7, for country 0 and country 1 in the top and bottom panel, respectively. First, consider country 0. The case of employers is straightforward. The best responding F -contracting employer will be unaffected by factor market integration because profits do not depend on the preferences of the employee with whom she is matched. By contrast, after factor market integration, employers who idiosyncratically implement P -contracts will enjoy a payoff-enhancing match with a reciprocal worker not only with the rare innovators from their own economy, but also with the prevalent worker types from the other country, who will constitute a sizable fraction of the workers in the cosmopolitan pool. So, while the expected payoff to the best responder is unchanged, the expected payoff to the idiosyncratic agent increases, leading to a lessened cost of innovation.

The case of employees is less straightforward, but easily demonstrated. Because the worker's share in a partnership is larger than the wage in a fixed-wage contract even when only quantitative labor is provided (guaranteed by the first inequality in Assumption 2), factor market integration increases the expected payoff to best responding workers who adopt *E*-preferences. But, by increasing the probability of meeting a *P*-contracting firm, factor market integration raises the expected payoff to workers idiosyncratically adopting reciprocal preferences even more (the payoff of a reciprocal employee matched with a partnership firm is larger than that of a *Homo economicus* working under a partnership, by the second inequality in Assumption 1), and thereby lessens the cost of deviating from the *FE* convention. Similar reasoning applies to country 1.

In addition to the reduced cost of innovating, it is easily shown that:

LEMMA 10 (Effects of factor market integration on critical fractions): *Factor market integration (a reduction in λ) decreases the critical fractions of innovating *R*-workers (*E*-workers) and *P*-contracting (*F*-contracting) firms sufficient to escape the status quo convention in country 0 (country 1), that is, for transitions induced by respectively workers and firms, $\ddot{\omega}_0^* < \omega_0^*$ ($1 - \ddot{\omega}_1^* < 1 - \omega_1^*$) and $\ddot{\phi}_0^* < \phi_0^*$ ($1 - \ddot{\phi}_1^* < 1 - \phi_1^*$).*

The economic intuition behind this result is transparent. Recall (from Section IIB) that the critical fractions sufficient to induce a transition from the *FE* (*PR*) convention to the other is given by the cost of deviating from the prevailing *FE* (*PR*) match divided by the sum of this cost and the cost of deviation from the idiosyncratic *PR* (*FE*) match. We know from Lemma 9 that, in country 0, for both workers and firms, the cost of deviating from the prevailing *FE* match decreases after factor market integration because of the “innovation insurance” effect. As a result, the critical fractions must decrease because for neither idiosyncratic firms nor workers can the cost of deviating from the *PR* match be altered by integration of the factor market with country 1, where virtually all the workers are *R*-type and all the firms are *P*-type. Analogous reasoning (*mutatis mutandi*) can be applied to country 1. A graphical illustration is given in Figure 7.

Summing up, Lemma 9 and Lemma 10 show that factor market integration reduces the costs of deviation from the status quo convention, while also reducing the critical fractions of deviants. It follows directly from these two results that:

THEOREM 2 (Effect of factor market integration on transitions): *If agents are sufficiently rational, factor market integration (a reduction in λ) increases the probability of escaping the status quo convention in country 0 (country 1), that is, for transitions induced by respectively workers and firms, $\ddot{\mu}_0^{firm} > \mu_0^{firm}$ ($\ddot{\mu}_1^{firm} > \mu_1^{firm}$) and $\ddot{\mu}_0^{work} > \mu_0^{work}$ ($\ddot{\mu}_1^{work} > \mu_1^{work}$).*

VI. Robustness

Is our model robust to plausible variations in assumptions? We have made two sets of modeling choices. The first defines an environment in which cultural-institutional

differences may persist and provide the basis for comparative advantage and specialization. While our modeling choices refer to a particular setup, the two generic requirements for this to be the case are readily generalized to other formulations. The first, embodied in Assumptions 1 and 2, is the complementarity of preferences and contracts, according to which different contracts work better with different individual motivations. The second, embodied in (13), is the distinction between transparent and opaque goods and the insight that different contract-preference matches will differ in the degree to which they are appropriate for the production of each.

Where these two conditions occur, there may be gains from trade made possible by specialization based on cultural-institutional differences. As a consequence, mismatches from status quo contracts and preferences are more costly under trade than autarchy, the key condition for our major result that trade enhances the impediments to cultural-institutional convergence. Our model is just one way to represent these underlying mechanisms, which, in light of the evidence cited in Section I, may be applicable quite generally.

The second set of assumptions concerns the particular model we have used to demonstrate our results (Theorems 1 and 2). For reasons of tractability and transparency, we have modeled two specific contracts and preferences, but the underlying mechanisms work under more general conditions. For example, we show in online Appendix C that allowing workers in the fixed-wage contract to share some of the gains from trade is consistent with our results, as long as the difference in the two contracts is sufficient to motivate the two types of workers to respond differently to them.

A model with concave production functions might entail less than complete specialization, but would not affect the mechanisms underlying our theorems. Relaxing the strong complementarity in consumption would allow substitution in consumption and resulting increases in the gains from trade. The reason is that in our setup the gains from trade are restricted to income effects and do not allow substitution effects, which, if included, would increase the gains from trade due to the price change following integration. This would increase the difference between trade and autarchy in the costs of deviating from the status quo convention and, *ceteris paribus*, by equations (6)–(12) reduce the likelihood of transition between cultural-institutional conventions, reinforcing our main result.

Our revision process for preferences and contractual choices and the resulting dynamics could also be modified without changing our conclusions, as shown in online Appendix D. While the way that our model takes account of the cost of idiosyncratic updating is plausible and the fact that trade increases this cost (and international factor mobility reduces it) should be taken into account in studying the effects of integration on transitions, even this feature could be jettisoned without altering our results. For example, were we to adopt a revision process with a fixed probability of idiosyncratic updating independent of payoffs (as in Young 1998 and Kandori et al. 1993), our Theorem 1 would remain unchanged. This is because trade increases the critical amount of idiosyncratic updating sufficient to induce a transition, which, for a given rate of idiosyncratic updating, necessarily entails a reduced probability of escaping from the status quo convention in a given

period. Theorem 2 remains valid for analogous reasons: the fact that factor market integration reduces the critical numbers required to induce a transition is sufficient for the proof.

The assumption that the reciprocal employee's belief about the employer's type can take just two values ($\gamma = \{-1, 1\}$) simplifies the model notation, but is not crucial to our conclusions. Our results would be unaffected if we, more generally, assumed that for a reciprocal worker $\gamma > 0$ under a partnership and $\gamma < 0$ under a fixed-wage contract. If, instead, we imposed $\gamma = 0$, then under the *F*-contract the reciprocal worker's utility would not depend on the profits of the employer and hence would be equal to that of the Homo economicus. As a consequence, the cost of deviation from an *FE* match would be null for employees, and σ (by equation (10)) would be equal to $1/2$. The implications of this case are equivalent to those explored above for a constant rate of idiosyncratic type revision.

VII. Conclusions

We have studied both the effect of culture and institutions on trade and the effect of trade on culture and institutions. Concerning the former, by considering culture and institutions jointly and explicitly modeling their coevolution, our results provide an extension (albeit unsurprising) of the existing literature on institutional comparative advantage: in our model, the complementarity between culture and institutions and the resulting cultural-institutional differences among economies provide the basis for comparative advantage, specialization, and gains from trade.

By contrast, our results on the less well explored effects of trade on cultural-institutional differentiation are novel and somewhat surprising. Gains from trade resulting from cultural-institutional comparative advantage make behavioral or contractual experimentation more costly, thereby supporting cultural-institutional persistence, even when a Pareto-superior alternative convention exists and when the status quo convention confers absolute disadvantage in all goods.

Many of the effects of international economic integration—like factor price equalization in Samuelson's (1948) theorem—are independent of whether integration is accomplished through the elimination of barriers to trade in commodities or through the mobility of factors of production. However, where comparative advantage is based on country differences in culture and institutions, as in our model, this is not the case. In contrast to trade integration, factor market integration favors cultural-institutional transitions because it reduces the expected cost of experimentation providing a kind of insurance against mismatches that would occur almost certainly in the nations' own factor market.

By showing that differences in culture and institutions provide a durable basis for specialization, our model may provide a piece of the puzzle of comparative advantage and specialization in today's global economy (Hanson 2012). Moreover, the model may account for the ways in which trade patterns deviate from predictions based on across country differences in technology or factor endowments (e.g., Trefler 1995. See, Helpman 1999, for a survey). The model may allow an extension of Ricardian models, beyond differences in technology as the basis of comparative advantage, to include cultural and institutional determinants of differential

national productivities across sectors. And our distinction between qualitative and quantitative labor, and the cultural-institutional conditions under which each will be obtained, may provide a deepening of Heckscher-Ohlin models. These extensions of existing models may be especially valuable in a world in which national differences in both technologies and relative factor supplies are declining and can no longer be considered to be exogenous endowments. This is true due to the rapid diffusion of many new technologies, the mobility of capital and professional labor, and the reduction in the measured human capital differences among nations (e.g., years of schooling: Hertz et al. 2007).

Extensions of our model may help explain patterns of specialization, for example, in the city states of Italy in the early modern period (Goldthwaite 2009). It may also provide insights on the institutional and economic divergence among the nations of Europe in the late nineteenth century (Gourevitch 1977, Gerschenkron 1944), the entire Western Hemisphere since the seventeenth century (Sokoloff and Engerman 2000), and between China and Europe during the “great divergence” (Greif and Tabellini 2010).

Finally, our result that a tariff can induce a transition away from the Pareto-dominated convention allows for an active role of public policy in a hybrid extension of our model adding a top-down centralized element to our decentralized bottom-up framework.

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