Domestic Institutions as a Source of Comparative Advantage*

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Abstract

Domestic institutions can have profound effects on international trade. This chapter reviews the theoretical and empirical underpinnings of this insight. Particular attention is paid to contracting institutions and to comparative advantage, where the bulk of the research has been concentrated. We also consider the reverse causation running from comparative advantage to domestic institutions.

Keywords

International trade, Institutions, Contracts, Property rights

JEL classification codes

D23, F10, F19

1. INTRODUCTION

When Ricardo first presented his theory of comparative advantage, he was preaching to an English audience that was in the midsts of a technological revolution that would transform human history. To Ricardo's cocksure audience, nothing less than divine right dictated that the exporter of the manufactured good should be England, while the exporter of fortified wine should be Portugal, a country whose coast was patrolled to great profit by Her Royal Majesty's loyal navy. It is clear that Portugal would have preferred to be in the midst of an industrial revolution that gave her a comparative advantage in manufacturing, but this was not an option. The question is: Why not?

Today we understand that 19th century English comparative advantage in advanced manufacturing goods can be traced back in no small part to its institutions, institutions that promoted innovation and commercial enterprise. The link between institutions and industrial structure, or between institutions and comparative advantage, has been

discussed for decades by economic historians. However, it is only recently that systematic empirical attempts have been made to assess the importance of this link.

There is, of course, a long history of research on the relationship between levels of development and industrial structure. Rich and poor countries export very different baskets of goods. Our knowledge of the relationship between a country's mix of exports and its income dates back at least to the discussion of ladders of development by Chenery (1960) and Leamer (1984). What has breathed new life into this literature are the insights that come out of the literature on institutions and long-term growth. See Helpman (2004), Acemoglu et al. (2005a), and La Porta et al. (2008) for reviews of this literature. Previous research on comparative advantage and economic development had given pride of place to technology/innovation together with physical and human capital accumulation as the drivers both of growth and, in the tradition of Ricardo and Heckscher-Ohlin, of comparative advantage. We now understand that these proximate drivers of growth are themselves the product of deeper social, political, and economic processes that have come to be gathered under the rubric of "institutions." This insight from the institutions-and-growth literature suggests that we could profitably push beyond these proximate drivers of comparative advantage and dig deeper into the institutional determinants of international trade.

A simple example makes the main point about the role of institutions for comparative advantage. Consider a complex product such as a commercial airliner. Its production requires high levels of innovative effort by all parties involved and this effort is so difficult to verify in a legal setting that only the most incomplete of contracts can be written between these parties. In contrast, more standardized products such as blue jeans do not require any relationship-specific, non-contractable inputs. Thus, a country with good contracting institutions will have relatively low costs of producing airliners and relatively high costs of producing blue jeans. That is, contracting institutions will be a source of comparative advantage. This theme is developed in Section 2.

A skeptic will argue that all this is obvious: Institutions matter for comparative advantage because institutions affect factor accumulation and technological innovation. So to what extent is there anything new in this literature? Has it simply pushed back the determinants of comparative advantage from proximate causes (e.g., endowments) to more fundamental causes (e.g., institutions)? The empirical research to be presented indicates that institutional sources of comparative advantage can and do operate through fundamentally different channels than do traditional sources of comparative advantage such as endowments. Institutions are statistically and economically important determinants of comparative advantage even after controlling for factor endowments. Indeed, there is abundant evidence that institutions are quantitatively as important as these traditional sources.

A skeptic might also argue that contracting institutions are not important because, in their absence, alternative institutions will evolve to deal with underinvestment. There is in fact some evidence of this in the international trade literature. Repeated interactions in long-term relationships, kin- and ethnic-based networks, and vertical integration can all

be used as substitutes for weak contracting institutions. Cultural beliefs (e.g., about trust) can also play a similar role. In Section 3 we explore the implications of these alternatives for comparative advantage.

In Section 4, we briefly cast a wider net by considering the indirect impacts of domestic institutions, particularly those working through government policies.

A major obstacle faced by the literature on the impact of domestic institutions on comparative advantage is that of reverse causality: Comparative advantage exerts strong impacts on domestic institutions. The causal mechanism involves power and politics. International trade generates wealth and power and this may be distributed either inclusively or exclusively. To the extent that specialization and trade enriches specific groups in society, it will provide economic power that can translate into political power and affect institutional change. This has been shown historically in studies examining the 17th–19th century Atlantic three-corner trade (Engerman and Sokoloff, 1997; Acemoglu et al., 2005b; Nunn, 2008a; Dippel et al., 2012). The striking lesson from the historical literature is that initial conditions, working through their effect on comparative advantage, are crucially important for whether changes in international trade lead to inclusive or exclusive institutional change. For example, the Atlantic triangle trade enriched a Caribbean plantation elite who then used their riches to exclude workers from political power as well as from education and other public goods. In Europe, the Atlantic triangle trade enriched an emerging merchant class who used their riches to push for growth-enhancing improvements in property-rights institutions. Within Africa, the specialization of production in slaves resulted in a deterioration of domestic institutions and property rights. As we show in Section 5, these heterogeneous institutional responses to changes in international trade patterns are in large part explained by characteristics of the goods initially exported, such as sugar versus manufactures versus slaves. That is, institutional responses to trade depend on initial comparative advantage.

Finally, the reader will have noticed that we have studiously avoided defining institutions. North (1990) famously defines institutions as the "rules of the game"; however, this definition is both narrow and problematic and reviewing alternative definitions would take us too far afield. Deeper thinkers are referred to Greif (2006b, Chapter 1). In a landmark definition of pornography, Supreme Court Justice Stewart states simply: "I know it when I see it." This is a pretty good definition of institutions, too.

2. CONTRACTING AND PROPERTY-RIGHT INSTITUTIONS: IMPACTS ON COMPARATIVE ADVANTAGE

Examples of contracting institutions include laws on the books and contractual flexibility that mitigate contractual incompleteness (La Porta et al., 2008, p. 300). Nunn (2007) was one of the first to empirically examine the impacts of contracting institutions on comparative advantage, focusing specifically on their impacts working through hold-up and underinvestment. Levchenko (2007) examined institutions more broadly

defined—contracting institutions, property-rights institutions, etc.—and provided evidence for their impacts on comparative advantage. This set of findings are the subject of Section 2.1.

There are many other institutions that affect comparative advantage, each in its own way. Institutions associated with financial development (e.g., bankruptcy law, securities law, and corporate law) are also a source of comparative advantage: Industries with large fixed costs relative to sales require access to external finance and this external finance comes cheaply when outside investors are protected from the opportunistic behavior of insiders such as CEOs. Beck (2003) and, more persuasively, Manova (2008, 2013) were the first to empirically examine this channel. This is explored in Section 2.3.

A variety of labor-market-related institutions affect comparative advantage. These include institutions that affect the ability of a firm and its workers to enter into contracts that induce high levels of effort (Costinot, 2009), institutions that affect hiring and firing costs (Cunat and Melitz, 2012), and institutions that affect labor market search frictions (Davidson et al., 1999; Helpman and Itskhoki, 2010). These are discussed in Section 2.4.

2.1. Product Markets

In the canonical model of incomplete contracts, an input supplier produces a customized input for a final goods producer. Because the customized input has greater value to the buyer than to other potential buyers, the investments made to produce the input are relationship-specific—i.e., their value is higher within the relationship than outside of it. If contracts are imperfectly enforced, then after the input supplier makes the relationship-specific investments, the purchaser has an incentive to renegotiate the terms of the original agreement. In short, there is a hold-up problem, e.g., Williamson (1985). Anticipating this ex-post renegotiation, the input supplier provides an inefficiently low level of relationship-specific investment and this inefficiency drives up the cost of production. This well-known phenomenon has a striking implication for international trade. Think of contractual incompleteness as an institutional feature that varies across countries and think of the relationship-specific investment as a technological feature that varies across products. Then a country with "good" contracting institutions will suffer less from hold-up and hence be a low-cost producer of goods requiring high levels of relationship-specific investments. In short, good contracting institutions are a source of comparative advantage in industries that intensively use relationship-specific investments.

Levchenko (2007) offers up a formal general equilibrium model of this. Consider first a standard 2×2 Hecksher-Ohlin model with factor price equalization in which one sector only users labor (L with price w) and the other sector only uses capital (K with price r). Factor price equalization pins down w and r. Now introduce a Leontief "middle" sector M that requires one unit each of capital and labor to produce one unit of output. Further, as in Caballero and Hammour (1998), capital is subject to one-sided hold-up. This is captured by assuming that in the M sector labor is able to grab a share

ϕ of the capital. The surplus from the relationship, per unit of input and/or output, is $s \equiv p_M - w - (1 - \phi)r$ where p_M is the price of the final good, w is the outside option of labor (its value in the L-intensive sector), and $(1 - \phi)r$ is the outside option of what remains of the capital (its value in the K-intensive sector). Assuming Nash bargaining over s with equal bargaining weights and equating the returns to capital in the K-intensive and M sectors yields:[1]

$$p_M = w + \phi r + r.$$

Absent hold-up ($\phi = 0$), this is a standard equation relating price to marginal cost. So the key term is ϕr, which captures the hold-up rents received by labor. Neatly, Levchenko has reduced the entire problem of characterizing the equilibrium to the more familiar problem of characterizing the equilibrium of a Heckscher-Ohlin model with a factor-market distortion, and this is a well-understood problem. In particular, while capital receives r in both the K-intensive and M sectors, labor receives w in the L-intensive sector and $w + \phi r$ in the M sector. Since $w + \phi r > w$, there is a distortion.

Levchenko assumes that the hold-up problem is more severe in the North than in the South so that $\phi^N < \phi^S$. When trade opens up, and assuming that factor price equalization holds, the North will be the low-cost producer of M and hence all M production will migrate there. This has two implications. In terms of welfare, if the two countries have identical endowments then opening up to trade raises both r and w. This raises welfare for capital in both countries. It also raises welfare for labor in the L-intensive sectors of both countries. However, labor that was in the Southern M sector migrates to the L-intensive sector and, as a result, it loses its rents ϕr. This may or may not be offset by the rise in w i.e., some Southern labor may not gain from trade.

The second implication of Levchenko's models is that *the country with better institutions will have a comparative advantage in the product whose costs are sensitive to the quality of institutions*. Berkowitz et al. (2006) and Nunn (2007) informally make similar arguments. It is this implication that has been subject to a substantial body of empirical research. A unifying theme of this empirical research is the following estimating equation:

$$y_{gi} = \alpha_g + \alpha_i + \beta(z_g \cdot q_i) + X_{gi}\gamma + \varepsilon_{gi}, \tag{1}$$

where y_{gi} is a measure of country i exports of good g, q_i is a measure of the quality of contracting institutions in country i, and z_g is a measure of the sensitivity of industry g costs to the quality of contracting institutions. α_g and α_i are industry and country fixed effects, respectively, and X_{gi} is a vector of other determinants of comparative advantage. The theory predicts $\beta > 0$, that is, a country with high-quality contracting institutions will export relatively more of those goods whose costs are sensitive to the quality of contracting institutions.

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[1] To derive this equation, note that Nash bargaining implies that capital in the M sector receives $s/2 + (1 - \phi)r$. Since capital is mobile ex ante, this must equal r, which is what capital receives in the K-intensive sector. The equation follows from manipulating $s/2 + (1 - \phi)r = r$ where $s \equiv p_M - w - (1 - \phi)r$.

The interaction term in equation (1) has a long lineage in international trade, though interest in the equation waned in light of the critique by Leamer and Bowen (1981). Interest was revived for two reasons. The first was the theoretical/structural underpinnings provided by Romalis (2004). The second was the reduced-form difference-in-difference rationale provided by Rajan and Zingales (1998).

The equation (1) prediction that $\beta > 0$ cannot be examined without a credible measure of z_g. By and large, the literature appears to have settled on Nunn's (2007) notion of the "contract intensity" of goods. Nunn starts with Rauch's (1999) three-way classification of goods:

1. Goods that are sold on an organized exchange (e.g., oil);
2. Goods that have a reference price (i.e., they appear in catalogs); and,
3. Differentiated goods (i.e., goods that are neither sold on an organized exchange nor have a reference price).

Nunn interprets a good that is bought and sold on an exchange or that is referenced priced in a trade publication as a good that is traded in a thick market with many buyers and sellers. If there are multiple buyers for an input, then the value of the input outside of the relationship is close to the value within the relationship. Therefore, the investments made to produce the good are not relationship-specific. Put differently, if the buyer were to attempt to renegotiate a lower price ex post, then the seller could simply sell the input to another buyer. On the other hand, if there are only a small number of buyers of a good, then an input produced for a particular buyer has limited value outside of the relationship and the investments undertaken to produce the good are relationship-specific.

Nunn's next step is to calculate, for each output g, the share of its inputs that are not bought and sold on thick markets i.e., whose production involves relationship-specific investments. This information is easily culled from the U.S. input-output Use table. The calculated share is Nunn's measure of the relationship-specific investment intensity of good g. This is a bit of a mouthful so Nunn coins the term "contract intensity" of the good. It enters equation (1) as z_g.

Table 5.1 presents the 20 most and 20 least contract-intensive industries. The ordering of industries he reports is intuitive. For example, the least contract-intensive goods/industries according to his metric are "poultry processing" and "flour milling." For both of these industries, their primary inputs—chickens and wheat—are homogenous and sold on thick markets; therefore, any investments made by wheat and chicken suppliers are not specific to any buyer–seller relationship and hence are not subject to hold-up. Re-stated, if the purchaser were to try and renege on the initially agreed upon contract, the input producers would simply sell their products elsewhere. The most contract-intensive industries include automobile, truck, and aircraft manufacturing. The production of these goods requires the use of customized relationship-specific inputs that are susceptible to hold-up. If the purchaser attempts to renegotiate ex post, the supplier's outside option is limited because he or she will be hard-pressed to find an alternative buyer for these customized inputs.

Table 5.1 Contract Intensity from Nunn (2007)

	Least Contract Intensive		Most Contract Intensive
z_g	*Industry Description*	*z_g*	*Industry Description*
.024	Poultry processing	.810	Photographic & photocopying equip. manuf.
.024	Flour milling	.819	Air & gas compressor manuf.
.036	Petroleum refineries	.822	Analytical laborator instr. manuf.
.036	Wet corn milling	.824	Other engine equipment manuf.
.053	Aluminum sheet, plate, & foil manuf.	.826	Other electronic component manuf.
.058	Primary aluminum production	.831	Packaging machinery manuf.
.087	Nitrogenous fertilizer manuf.	.840	Book publishers
.099	Rice milling	.851	Breweries
.111	Prim. nonferrous metal, ex. copper, & aluminum	.854	Musical instrument manuf.
.132	Tobacco stemming & redrying	.872	Aircraft engine & engine parts manuf.
.144	Other oilseed processing	.873	Electricity & signal testing instr. manuf.
.171	Oil gas extraction	.880	Telephone apparatus manuf.
.173	Coffee & tea manuf.	.888	Search, detection, & navig. instr. manuf.
.180	Fiber, yarn, & thread mills	.891	Broadcast & wireless comm. equip. manuf.
.184	Synthetic dye & pigment manuf.	.893	Aircraft manuf.
.190	Synthetic rubber manuf.	.901	Other computer peripheral equip. manuf.
.195	Plastics material & resin manuf.	.904	Audio & video equipment manuf.
.196	Phosphatic fertilizer manuf.	.956	Electronic computer manuf.
.200	Ferroalloy & related products manuf.	.977	Heavy duty truck manuf.
.200	Frozen food manuf.	.980	Automobile & light truck manuf.

Notes: Data are from Nunn (2007), Table 2.

In estimating equation (1), Nunn's baseline measure of a country's ability to enforce contracts (q_i in equation (1)) is the country's rule of law from Kaufmann et al. (2003). He also considers objective measures of the quality of the judicial system from World Bank (2004). As is common in this literature, results are not usually sensitive to the measure of q_i. Nunn's dependent variable y_{gi} is the log of country *i*'s total exports of industry *g* in 1997. His positive estimates of β establish that countries with better contracting institutions export relatively more in contract-intensive industries. Quantitatively, these effects of institutions on comparative advantage are greater than the combined impacts of skill and capital endowments. We discuss magnitudes further below.

In analysis pre-dating Nunn (2007), Berkowitz et al. (2006) consider a variant of equation (1) in which z_g is a dummy variable equal to 1 if the good is differentiated in Rauch's sense and 0 if the good is reference-priced. Goods sold on an organized exchange are deleted from the sample. Their estimate of β is positive, but is huge in that it implies that a one-standard-deviation improvement in the rule of law leads to a 1256% increase in exports.[2] These enormous effects suggest issues of endogeneity: For example, advanced countries have both good institutions and a production structure skewed toward complex goods, which leads to a spurious correlation or bidirectional causality between good institutions and comparative advantage.

The recent analysis by Ma et al. (2010) confirms Nunn's finding at the firm level. Motivated by evidence that domestic institutions vary subnationally (Laeven and Woodruff, 2007; Acemoglu and Dell, 2010), the authors examine perceptions of the quality of the judicial system among approximately 8792 firms in 28 countries, taken from the World Bank's Enterprise Surveys. Although the firm-level variation in judicial quality is surely explained by differences in perception or measurement error, much of the variation is also likely explained by differences in firms' access to the judicial systems because of power or political connections. The authors provide evidence for this by showing that within-country cross-firm differences are correlated with observable characteristics in a sensible manner: For example, state-owned firms report having access to a better judicial system.

Estimating a variant of equation (1) that looks at firm-level exports across a number of countries, Ma et al. find that firms with access to better judicial institutions tend to export more in contract intensive industries, measured using Nunn's (2007) contract-intensity variable. Interestingly, the authors show that this effect is above and beyond the standard comparative advantage effect, which is that firms in *countries* with better judicial quality tend to export more in contract-intensive industries. The authors show that in their data, the standard country-level comparative advantage impacts can be seen. In addition, there also exist subnational comparative advantage effects that work at the firm level.

This firm-level comparative advantage effect has also been confirmed by Li et al. (2012) who look at 77,000 Chinese firms located in the capital of 31 provinces producing in 29 2-digit Chinese Industry Classification (CIC) industries. The authors find that firms located in Chinese regions with better contracting institutions tend to specialize in the production of contract-intensive goods.

Feenstra et al. (2012) also examine cross-province comparative advantage using Nunn's (2007) contract-intensity measure, which they construct using Chinese I–O tables. Their analysis, which looks at variation across 30 provinces, 11 years, and 22 industries, also distinguishes between processing trade and ordinary trade as well as between foreign-owned firms, joint ventures, and domestically owned firms. Consistent with Li et al. (2012), Feenstra et al. (2012) find that provinces with better domestic institutions tend to

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[2] A subsequent study by Ranjan and Lee (2007), using the same general methodology but different data, roughly confirms the findings from Berkowitz et al. (2006): The impact of better contracting institutions on exports is greater for complex goods than for simple goods (also proxied for using Rauch's measure).

export more in contract-intensive industries. They also show that the impact of domestic institutions on comparative advantage is stronger for foreign-owned firms and for processing trade.

A common characteristic of these papers is that they all examine the impact of contracting institutions on horizontal specialization—i.e., specialization across industries. However, it is also possible that contracting institutions also affect specialization in higher- or lower-quality goods within industries—i.e., vertical specialization. Essaji and Fujiwara (2012) hypothesize that since the production of higher-quality varieties of a good typically requires the use of higher-quality inputs requiring more customization and relationship-specific investments, a country with a better contracting environment will have a comparative advantage in the production of higher-quality varieties of a given good (all else equal). In other words, imperfect contracting institutions and the existence of relationship-specific investments may cause vertical specialization as well as horizontal specialization.

Essaji and Fujiwara (2012) test their hypothesis using data on imports to the United States from 123 exporting countries. The export data, which are measured at the HS 10 product level, report both quantities and prices. Following the empirical strategy of Hallak and Schott (2010) and Khandelwal (2010), the authors infer product quality of exports of all HS 10 products from all countries using unit values and market shares. The authors use Nunn's (2007) contract-intensity measure and show that countries with better contracting institutions (measured by the rule of law) tend to export higher-quality varieties of goods.

Nunn (2007) focuses narrowly on the impact of rule of law on non-contractible relationship-specific investments. However, Levchenko's (2007) theoretical model has a broader interpretation and it is this interpretation that Levchenko takes to the estimation of equation (1). He also undertakes an empirical examination of the importance of institutions for comparative advantage. The main difference from Nunn is in the measure of the sensitivity of a good to the quality of contracting institutions (z_g). Levchenko (2007, page 807) argues theoretically that the larger the number of input suppliers needed to produce a good, the more complex the good is, and therefore the more sensitive it is to imperfect institutions. Empirically, he measures "institutional dependence" as the Herfindahl index of intermediate input use (times minus 1), computed from the U.S. input-output Use table for 1992. For concreteness, suppose that an industry purchases equal amounts of inputs from n sectors. Then each input accounts for a share $1/n$ of all inputs and the Herfindahl index (times minus 1) is $-\sum (1/n)^2 = -n(1/n)^2 = -1/n$. Thus, the more industries that supply inputs, the greater is the measure of institutional dependence. A second motivation for the measure is that every time an intermediate good is purchased, institutions are needed to facilitate the transaction. Therefore, the greater the variety of goods needed for production, the greater the reliance on domestic institutions. The 10 least and 10 most institutionally intensive industries according to Levchenko's (2007) measure are reproduced in Table 5.2.

Table 5.2 Institutional Intensity from Levchenko (2007)

	Least Institutionally Intensive		Most Institutionally Intensive
Code	*Industry description*	*Code*	*Industry description*
2011	Meat packing plants	3728	Aircraft parts and equiment, n.e.c.
2075	Soybean oil mills	3296	Mineral wool
2015	Poultry slaughtering and processing	3842	Surgical appliances and supplies
2429	Special product sawmills, n.e.c.	3565	Packaging machinery
2021	Creamery butter	3644	Noncurrent-carrying wiring devices
2911	Petroleum refining	3643	Current-carrying wiring devices
2026	Fluid milk	3482	Small arms ammunition
2296	Tire cord and fabrics	3999	Manufacturing industries, n.e.c.
2083	Malt	3321	Grey and ductile iron foundries
2652	Setup paperboard boxes	2451	Mobile homes

Notes: Data are from Levchenko (2007), Table 2, Table A1. Industries classified by 4-digit Standard Industry Classification (SIC). Industry codes and descriptions are reported. n.e.c.: not elsewhere classified.

Armed with this institutional-dependence measure of z_g, Levchenko estimates equation (1) using U.S. imports from 116 countries across 389 4-digit SIC industries in 1998. He measures the quality of exporters' domestic institutions (q_i) using the Kaufmann et al. (2003) rule-of-law variable. As predicted by his model, Levchenko estimates a positive β: countries with better rule of law have a comparative advantage in "institutionally dependent" goods. We discuss the magnitude of this estimate below in Section 2.5.

Summarizing, there is now a large body of evidence about the impact of contracting institutions on exports of contract-intensive goods. Empirical evidence strongly confirms that contracting institutions are indeed a source of comparative advantage.

2.2. Methodological Issues

2.2.1. Identification

The interaction term in equation (1) arises because of the complementarity between an industry characteristic and a country characteristic. The nice feature of the interaction term is that it allows one to control directly for country fixed effects and industry fixed effects, resulting in an estimating equation that has the same logic as a standard difference-in-difference equation. However, this also means that as with standard difference-in-difference estimates, the coefficient estimate can only be interpreted as causal given specific assumptions.

The first concern is that of reverse causality. Countries that specialize in the production of contract-intensive or institutional-intensive industries have a greater incentive to develop and maintain good contracting institutions. Not doing so would be very costly.

A few of the papers considered address endogeneity. For example, Nunn (2007) provides instrumental variable (IV) estimates, instrumenting a country's contracting environment with its legal origin.[3] Since legal origin is predetermined and unaffected by current trade flows, it helps to alleviate the concern of reverse causality. However, this IV strategy does raise concerns about whether the exclusion restriction is satisfied; that is, whether legal origin affects the pattern of trade only through contracting institutions. This is particularly true given the large number of studies that have emerged, many since the publication of Nunn (2007), showing that a country's legal origins have wide-ranging impacts on a variety of outcomes including military conscription, labor market regulations, and even economic growth (La Porta et al., 2008).[4]

Recognizing this concern with the IV estimates, Nunn (2007) undertakes an auxiliary procedure to address the issue of causality. He uses propensity-score matching and compares the relative exports of paired British common law and French civil law countries across industries. Matching on per capita GDP, human capital stock, physical capital stock, financial development, and trade openness, Nunn (2007) shows that British common law countries export relatively more in contract-intensive industries relative to (matched) French civil law countries. This same strategy is also employed in subsequent research by Ma et al. (2010) who examine subnational variation in contracting institutions.

One advantage of the matching estimates is that they hold constant a large number of country characteristics in the analysis. Unlike the IV estimates, this can be done without taking a stance on exactly how the country characteristics affect the pattern of trade. In other words, one does not have to take a stance on what the country-industry interactions look like. Since only matched country-pairs (and not all countries) are being compared in the analysis, these country differences, no matter how they affect the pattern of trade, are accounted for.

Another concern is that of omitted-variables bias. As an example, consider the empirical finding from Levchenko (2007) that countries with a better rule of law tend to specialize in goods requiring a broader range of inputs. Producers in an industry that uses a wide variety of inputs may not only produce more complex goods that intensively use institutions, but they may also more intensively use communication, transportation, and distribution infrastructure, because more inputs are being ordered and shipped to the locations of production. The Herfindahl index of input concentration has been proposed by Christopher Clague (1991b), not as a measure of institutional intensity, but as a measure of how "self-contained" an industry is, which affects the extent to which it relies on transportation and communication infrastructure. Given that countries with better institutions

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[3] See Acemoglu and Johnson (2004) for earlier evidence on the link between legal origin and contract enforcement.

[4] Other studies have employed other instruments to address the issue of reverse causality. For example, Feenstra et al. (2012), who estimate the impacts of provincial-level institutions on comparative advantage within China, use the identity of the colonizer measured in 1953 to address the issue of reverse causality. Essaji and Fujiwara (2012) use a country's population density in 1500, urbanization in 1500, and the European settler mortality measure from Acemoglu et al. (2001).

also have better-developed infrastructure, there is a concern that the estimated interaction between rule of law and Levchenko's measure of institutional dependence may be biased by the fact that countries with better infrastructure specialize in goods whose production relies heavily on this. See Yeaple and Golub (2007) for evidence on the importance of infrastructure.

The primary strategy undertaken by the studies described here is to control for alternative interactions between country and industry characteristics. For example, Levchenko (2007) and Nunn (2007) both control for Heckscher-Ohlin interactions (human capital endowment times skill intensity and capital endowment times capital intensity) in their baseline regressions. As well, Levchenko (2007) recognizes the possibility that his measure of institutional intensity may be correlated with other industry characteristics, including Clague's notion of how self-contained an industry is. To deal with this, Levchenko includes industry fixed effects interacted with a country's real per capita GDP: These interactions control for the possibility that richer countries tend to produce in industries whose characteristics are correlated with his institutional–intensity measure. When these additional interactions are included in his regressions, Levchenko finds that the coefficient on his interaction of interest actually increases.

2.2.2. Benchmarking Bias

A final methodological issue within the literature arises from the fact that all studies rely on an industry measure taken from one country, usually the United States, to approximate the industry characteristic in all countries. In other words, z_g is used rather than z_{gi}. The typical justification for this is that industry characteristics are by-and-large technologically determined and therefore their intensity ordering does not change when moving from one country to another. As an example, although richer countries use more capital than poorer countries this is true across all industries and in a way that preserves the ordering of capital intensity in the different countries. In all countries, construction is relatively capital intensive while services are not, although on average more capital is used in the United States than in Ghana. As an alternative example, consider Levchenko (2007) and Nunn (2007) who both construct their measures using the United States' input–output tables. Their presumption is that no matter where goods are produced they still require the same inputs and in the same proportions. For example, wherever cars are manufactured, they generally still require tires, windshields, textiles for seats, etc.

Ciccone and Papaioannou (2010) derive the properties of OLS estimates when the industry measure from one country is an imperfect proxy for the other countries. They identify two sources of bias. One is standard attenuation bias. If there is random measurement error associated with the industry measure, z_g, then the estimate of β will be biased downwards. However, there is also a second bias that arises if the measure being used z_g is systematically a better proxy for certain countries. They refer to this as amplification bias. As an example, again consider the measure from Levchenko (2007) or Nunn (2007).

If it is the case that countries that are similar to the United States in terms of the rule of law are also similar in terms of input–output production structures, then the industry measure is going to be more accurate for countries with U.S.-like institutions. Ciccone and Papaioannou (2010) show that this results in an estimate of β that is biased away from zero e.g., upwards if $\beta > 0$. The authors suggest a two-step procedure that, under certain conditions, can yield consistent estimates.[5]

2.3. Financial Markets

There are many potential ways that financial development could affect comparative advantage. However, there is no standard model or mechanism for this. Theoretical contributions include Kletzer and Bardhan (1987), Baldwin (1989), Xu (2001), Beck (2002), and Matsuyama (2005). In each of these models, credit market imperfections raise costs in some industries relative to others, thus creating comparative advantage. Beck (2002) was the first to empirically examine the role of financial development for comparative advantage. Following Kletzer and Bardhan (1987), he argues theoretically that manufacturing-sector firms face up-front fixed costs whereas agricultural-sector firms do not. Credit market imperfections make it costly to finance the fixed costs. Since countries with well-developed financial markets have lower finance costs, such countries have a comparative advantage in manufacturing.[6]

Beck (2002) examines the cross–country relationship between manufacturing exports as a share of total exports and measures of financial development. Beck estimates a positive β, which means that more financially developed countries have a comparative advantage in manufacturing. The estimated effect is economically large: A one standard deviation increase in private credit leads to half of a standard deviation increase in manufacturing as a share of total exports. However, he does not control for the endogeneity of financial development.

While Beck's analysis considers just two types of sectors, subsequent research allows for a much richer set of industries. The seminal study by Rajan and Zingales (1998) shows that financially developed countries tend to have higher output in industries that traditionally require large amounts of external finance. They measure *external financial dependence*, e_g, as the fraction of a firm's capital expenditure that is financed from sources

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[5] Nunn and Trefler (2010) find no evidence of such bias in their work examining the distribution of tariffs across industries. They find very similar results when using factor intensities from countries other than the United States.

[6] There are two types of market frictions in Beck (2002). First, firms have private information about their productivity and hence about their default productivities, information that can only be revealed to financial intermediaries through costly monitoring. Second, savers cannot invest directly in firms but must instead use costly financial intermediation. These costs are proportional to the amount of the investment. (Beck interprets this as costly search, but does not actually model the search.) There are two sectors, one featuring constant returns (agriculture) and one featuring increasing returns (manufacturing) as in Krugman (1980). Because of its fixed costs, manufacturing is relatively more sensitive to intermediation costs than is agriculture. As a result, countries with low costs of financial intermediation have a comparative advantage in manufacturing.

external to the firm. More precisely, it is:

$$e_g \equiv \frac{(\text{capital expenditures}) - (\text{cash flow from operations})}{(\text{capital expenditure})}.$$

The firm–level data are from the United States (COMPUSTAT) and the industry–level data are the external financial dependence of the median firm in each industry. Rajan and Zingales estimate:

$$\Delta VA_{gi} = \alpha_g + \alpha_i + \beta(e_g \cdot f_i) + X_{gi}\gamma + \varepsilon_{gi}, \tag{2}$$

where g indexes 36 International Standard Industrial Classification (ISIC) industries (manufacturing only), i indexes 41 countries, ΔVA_{gi} is the change in real value added between 1980 and 1990, f_i is a measure of financial development, and X_{gi} is a vector of other covariates.[7] β is estimated to be positive, indicating that financially developed countries experienced relatively rapid value-added growth in industries with a high degree of external financial dependence.

This methodology is immediately applicable to studying comparative advantage since all that is needed is to replace the dependent variable in equation (2) with a measure of exports:

$$\gamma_{gi} = \alpha_g + \alpha_i + \beta(e_g \cdot f_i) + X_{gi}\gamma + \varepsilon_{gi}, \tag{3}$$

where γ_{gi} is a measure of country i exports of good g. Note that this is simply a variant of equation (1) described above and that this is precisely what Beck (2003) estimates. Measuring γ_{ic} as industry-i exports divided by GDP and using a sample of 56 countries and 36 industries averaged over the 1980s, he finds the expected positive estimate of β. However, the magnitude is implausibly large and the sample statistics suggest that there are outliers. Also, as Beck points out, there is an issue of endogeneity, but his method of dealing with it is unsatisfactory.

Svaleryd and Vlachos (2005) consider a variant of equation (3) for 20 OECD countries and 32 4-digit ISIC industries in which the dependent variable is a somewhat unusual measure of competitiveness.[8] Their estimate of β is not statistically significant

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[7] Rajan and Zingales (1998) provide a large number of empirical measures of financial development at the national level. Many of these are collected in Beck et al. (2010). Studies of financial development as a source of comparative advantage typically report results for several such measures. Rajan and Zingales (1998) prefer to use private credit *plus* stock market capitalization. The correlation between this sum and private credit is 0.67. The seminal cross-country study by King and Levine (1993) considers four measures: (KL 1) The size of the formal financial intermediary sector relative to GDP (specifically, the ratio of liquid liabilities to GDP); (KL 2) The importance of banks relative to the central bank (specifically, deposit money bank domestic credit divided by deposit money bank plus central bank domestic credit); (KL 3) The percentage of credit allocated to private firms (specifically, the ratio of claims on the non-financial private sector to total domestic credit); and, (KL 4) The ratio of credit issued to private firms to GDP (specifically, the ratio of claims on the non-financial private sector to GDP). Rajan and Zingales (1998) consider three measures: (RZ 1) Total capitalization (the ratio of domestic credit plus stock market capitalization to GDP); (RZ 2) Private credit (credit extended to the private sector as a share of GDP); and, (RZ 3) Accounting standards.

[8] The measure is $(C_{gi} + X_{gi} - M_{gi})/C_{gi}$ where C_{gi} is consumption, X_{gi} is exports, and M_{gi} is imports.

when f_i is private credit,[9] but is statistically significant when other measures of f_i are used.[10] The authors do not interpret the magnitude of their estimates. They do, however, attempt to deal with the endogeneity of financial development: A country with industrial structure that is skewed toward sectors with high external financial dependence will have a high demand for financial development. They instrument financial development using a measure of civic engagement from Knack and Keefer (1997). This IV strategy is unfortunately not successful as it produces large standard errors on the estimates of β.

Becker et al. (2012) argue that exporting requires fixed costs and that these fixed costs are higher in financially less-developed countries. Further, fixed costs are higher in industries that are differentiated in the sense of Rauch (1999) or require large sales and R&D outlays. They thus interact private credit f_i with either (a) the average fraction of sales devoted to R&D and advertising by U.S. firms (from COMPUSTAT) or (b) a dummy for being a differentiated product.[11] In a regression similar to equation (3), but with e_g now either the R&D/sales or Rauch variables, the authors estimate a β that is positive. That is, access to lower fixed costs of exporting is a source of comparative advantage.

As discussed, a significant methodological problem with estimating equation (1) or, by symmetry, equation (3) is that there may be omitted country-level factors that interact both with industrial structure and with f_i. This possibility suggests that endogeneity may be a concern. Manova (2008) tackles this in a very neat way. She looks at what happens to the composition of a country's exports as it goes through a period of financial liberalization. Specifically, she starts with:

$$y_{git} = \alpha + \beta(e_g \cdot f_{it}) - \beta'(e'_g \cdot f_{it}) + \varepsilon_{git}, \tag{4}$$

where t indexes years, y_{git} is the log of country i exports of good g, f_{it} is a measure of the degree to which equity markets are liberalized in country i in year t, e_g is external financial dependence in industry g, and e'_g is asset tangibility.[12] Asset tangibility is the share of property, plant, and equipment in total assets (again, for the median firm in the industry). It captures the idea that industries with large fixed assets can use these as collateral for a loan, thus making financial development less important. We have put a minus sign in front of $(f_{it} \cdot e'_g)$ so that we expect $\beta' > 0$. Manova estimates β and β' to be positive and statistically significant, as expected. Further, these results hold even when controlling for interactions between country-level factor endowments and industry-level factor intensities.

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[9] This is defined as the ratio of credit issued to private firms to GDP. ("Private" here means claims on the non-financial private sector.)

[10] Specifically, the size of the stock market relative to GDP (RZ 1 in footnote 7) or accounting standards (RZ 3).

[11] Point (b) is closely related to what Berkowitz et al. (2006) do. See the above discussion.

[12] Manova's data for external financial dependence and asset tangibility are from Braun (2003).

What makes Manova's paper stand out is the treatment of endogeneity. Let d_{it} be a dummy that equals 1 after an equity market liberalization and equals 0 before an equity market liberalization. Then, as in Trefler's (2004) study of the Canada–U.S. trade liberalization, one can estimate a difference-in-difference specification either in levels or in changes:

$$\ln \gamma_{git} = \alpha + \beta(e_g \cdot d_{it}) - \beta'(e'_g \cdot d_{it}) + \varepsilon_{git}, \tag{5}$$

$$\Delta \ln \gamma_{gi} = \alpha + \beta e_g - \beta' e'_g + \varepsilon_{gi}, \tag{6}$$

where $\Delta \ln \gamma_{gi}$ is the log difference of exports before and after liberalization. Manova estimates that β and β' are positive, indicating that financial liberalization leads to a greater comparative advantage in goods that require large levels of external finance and small levels of tangible (collateralizable) assets. While equation (6) does not eliminate endogeneity concerns entirely (the timing of financial liberalization might be endogenous), it is a very large step forward.

The financial crisis of 2008 provides an interesting experiment into the role of financial intermediation. The crisis was more severe in some countries than in others and operated through different mechanisms in different countries. This has allowed researchers to dig deeper into the impacts of short-run financing problems on aggregate trade and comparative advantage. The interested reader is referred to the symposium in the May 2012 (vol. 87, No. 1) issue of the *Journal of International Economics*.

Although this chapter is primarily concerned with comparative advantage across sectors, there have been interesting studies of other outcomes, notably, comparative advantage across firms within a sector and the mode of entry into foreign markets. We start with comparative advantage across firms within a sector. Since the seminal contributions of Bernard et al. (2003) and Melitz (2003), attention has shifted to the role of heterogeneous firms, and in particular, to the role of selection into and out of exporting. Chaney (2005) and Manova (2013) both offer models in which firm heterogeneity interacts with financial constraints. We focus here on Manova's work because it includes a major empirical component. Manova (2013) observes that firms that cannot find financing will be unable to export. This means that in thinking about comparative advantage, it is important to distinguish between the extensive-margin and intensive-margin effects of financial market imperfections. To do this she develops a heterogeneous-firm model (Melitz, 2003) with countries at different levels of financial development and sectors with different levels of tangible assets.

In the model, firms must borrow to cover their fixed costs of exporting. Recognizing that there is default risk, lenders will only lend an amount that is incentive compatible i.e., that will be repaid. This incentive compatible amount will depend on the firm's sales and hence on the firm's productivity. Very productive firms will be able to borrow as much as they need. Very unproductive firms will not export and hence will not need

to borrow. Firms with intermediate levels of productivity would borrow and export if credit markets were perfect, but can do neither because they are credit-constrained.[13]

Applying this model to aggregate trade data, Manova (2013) studies the mechanisms through which credit constraints operate and finds that credit constraints substantially reduce exports both at the extensive margin (whether or not to export, how many products to export, and which destinations to enter) and at the intensive margin (how much to export of a product to a destination).

Credit constraints can also have an influence on the mode of entry into foreign markets i.e., on the choice between FDI and outsourcing. This is discussed in Antràs and Foley (2011), Manova et al. (2011), and Shen (2012). Finally, credit constraints can have effects on the size distribution of firms, which has implications for trade via the selection of firms into exporting.

Finally, we have focused here on financial underdevelopment to the exclusion of regulatory barriers to entry. Both of these affect the fixed costs of setting up a business and thus affect the extensive margin of trade. However, as La Porta et al. (2008) point out, financially underdeveloped countries typically have high regulatory barriers to entry. In an influential paper, Helpman et al. (2008) show that regulatory barriers to entry have a major impact on the extensive margin of trade. Thus, more work is needed to sort out the separate roles of regulatory barriers to entry and financial underdevelopment.

2.4. Labor Markets

Research has also explored the importance of other institutions for comparative advantage. Here we consider labor market institutions, starting with Costinot (2009). Costinot emphasizes a trade-off between the costs and benefits of a greater division of labor in production. A good is produced with many tasks, each of which has a fixed training cost so that there are returns to scale at the task level. In a very large market, a firm would like to have each worker learn a single task and specialize in it. This is Adam Smith's observation that specialization is limited by the extent of the market. Against this benefit are the costs of monitoring workers. Each worker exerts non-contractible effort and performs his or her assigned task less than 100% of the time; unfortunately, a good is produced only if all tasks are produced. The greater is the degree of specialization in tasks, the more workers are needed and the lower is the probability that the good will be produced. This trade-off between the productivity gains from task specialization (scale returns) and the productivity costs of task specialization (incomplete contracting/worker monitoring costs) leads to predictions about institutions as a source of comparative advantage. Countries that are effectively able to monitor workers have a comparative advantage in goods that require many tasks i.e., complex goods.

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[13] In contrast, Chaney (2005) assumes that firms have a randomly drawn, exogenous amount of liquidity which they must use toward the fixed costs of exporting.

To connect the theory with empirics, Costinot shows that in equilibrium there is a one-to-one relationship between the unobservable complexity of a good (i.e., the number of tasks required) and the observable average training costs per worker. Thus, his main result can be stated in terms of observables: Goods with high training costs will locate in countries with better worker monitoring. Costinot creatively measures training costs using responses to the following Panel Study of Income Dynamics (PSID) question: "Suppose someone had the experience and education needed to start working at a job like yours. From that point, how long would it take them to become fully trained and qualified (to do a job like yours)?" Costinot aggregates the individual responses up to 20 2-digit SIC industries.

Costinot first estimates the determinants of bilateral exports across a panel of industries in 1992:

$$\gamma_{gij} = \alpha_{gj} + \alpha_{ij} + \beta_i z_g + \varepsilon_{gij}, \tag{7}$$

where γ_{gij} is a measure of the log of country i's exports to j of good g, α_{gj} and α_{ij} are industry-importer and exporter-importer fixed effects, respectively, and z_g is Costinot's training-cost measure of complexity. Notice that the key term $\beta_i z_g$ is independent of the importer (j) so one can aggregate across importers, which leads to a specification that is very similar to equation (1). The key differences are that the measure of complexity is very different from Levchenko (2007) and Nunn (2007) and β_i flexibly replaces βq_i where q_i is the rule of law. Costinot estimates this model and shows, not surprisingly, that the estimated β_i are positively correlated with the rule of law. More interestingly, Costinot shows that the estimated β_i are positively correlated with an "Ability to Perform" index. This index is calculated from the Business Environment Risk Intelligence (BERI) survey of business persons' views about various country characteristics including: work ethic; availability and quality of trained manpower; class, ethnic and religious factors; attention span and health; and absenteeism. In short, Costinot's result shows that incomplete contracts in labor markets are a source of comparative advantage.[14]

Tang (2012) also studies how a country's labor market institutions, by affecting workers' incentives to acquire skills, can shape export patterns. He develops an open–economy model in which workers undertake non-contractible activities in order to acquire firm-specific skills on the job. In the model, labor market protection raises workers' incentives to acquire firm-specific skills relative to general skills, turning labor laws into a source of comparative advantage. In particular, the model shows that countries with more protective labor laws export relatively more in firm-specific skill-intensive sectors. This is true for both the intensive and extensive margins of exporting.

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[14] Costinot's analysis is actually more subtle in a very interesting way. His model also predicts an interaction between traditional human capital endowments and a country's ability to monitor workers; specifically, the most complex goods will be produced in the country for which the product of human capital per worker and the effectiveness of worker monitoring is greatest. He is able to show that β_i is correlated with human capital endowments and that the correlation between β_i and ability to perform holds after controlling for human capital.

To test the theoretical predictions, he constructs sector proxies for firm-specific skill intensity and industry-specific skill intensity by estimating the returns to firm tenure and the returns to industry tenure for 63 3-digit U.S. manufacturing industries between 1974 and 1993. Firm-specific skill intensity is measured using firm-tenure returns from a Mincer equation on PSID data. Data on labor regulations (for 84 countries) are taken from the World Bank's *Doing Business Survey* (Botero et al., 2004). Based on countries' legal documents from the late 1990s, Botero et al. quantify the extent to which labor market regulations cover employment, collective relations, and social security. Tang then estimates sector-level gravity equations for 84 countries using the Helpman et al. (2008) framework, and provides evidence that countries with institutions that protect labor have a comparative advantage in goods that are intensive in firm-specific skills.

Cunat and Melitz (2012) explore the impacts of the flexibility of a country's labor market institutions on comparative advantage. They begin by observing that workers change jobs much more flexibly in some countries than in others. For example, gross job flows in manufacturing are twice as high in the United States as in Portugal. Further, workers are much more likely to move jobs in some industries than in others. For example, ranking U.S. manufacturing industries by their gross job flows, the 90th-percentile industry has gross job flows that are twice as high as in the 10th-percentile industry. This suggests that countries with more flexible labor markets will have a comparative advantage in industries that require higher gross job flows.

The precise mechanism that Cunat and Melitz (2012) explore focuses on differences in the volatility of industries—defined as the dispersion of firm-level shocks within an industry—and the extent to which this drives the reallocation of workers across firms within an industry. They conjecture that firms in countries with greater labor market flexibility are better able to respond to firm-specific shocks by hiring and firing workers as necessary. Therefore, countries with more flexible labor market institutions have a comparative advantage in more volatile industries.[15]

Cunat and Melitz (2012) develop a model that illustrates this source of comparative advantage, showing how it manifests itself as a Ricardian technology difference. (See Cunat and Melitz (2010) for a more general version of their model.) Also, a second insight arises from the model when capital is introduced: Their mechanism should be weaker in industries that are more capital intensive. This insight suggests that capital intensity can affect comparative advantage in a manner beyond standard Heckscher-Ohlin effects.[16]

The authors find cross-sectional support for the predictions of their model: Countries with more flexible labor market institutions concentrate their exports in sectors with greater volatility. Also, greater capital intensity reduces this effect. Flexibility of a country's labor market institutions is measured using the 2004 World Bank *Doing Business Survey*

[15] This link between labor market flexibility and specialization of production also appears in Saint-Paul (1997) and Davidson et al. (1999).

[16] Ju and Wei (2011) offer an analysis with a similar flavor that involves financial intermediation.

(see Botero et al., 2004), from which they build an index based on hiring costs, firing costs, and restrictions on changing the number of hours worked. Motivated theoretically, the authors measure a sector's volatility in 2004 as an average of the time-series volatility of each firm within the sector. Their estimating equation is of the form:

$$\gamma_{gi} = \alpha_g + \alpha_i + \beta'(z'_g \cdot q'_i) + \varepsilon_{gi}, \tag{8}$$

where γ_{gi} is the log of country i's exports of good g, q'_i is their measure of labor market flexibility, and z'_g is their measure of volatility.[17] The authors find that β' is indeed positive, indicating that flexible labor markets are a source of comparative advantage in volatile industries.

Cunat and Melitz (2012) are clearly concerned with unemployment, but their formal model does not explicitly model the phenomenon. Unemployment varies dramatically across sectors so that unemployment must have important implications for comparative advantage. There are many strands of the literature on trade and unemployment. These include models featuring minimum wages (Brecher, 1974; Davis, 1998), implicit contracts (Matusz, 1986), efficiency wages (Copeland, 1989 and Matusz, 1996 in Heckscher-Ohlin and Ricardian settings, respectively, and Davis and Harrigan, 2011 in a heterogeneous-firms setting), fair wages (Agell and Lundborg, 1995; Kreickemeier and Nelson, 2006; Egger and Kreickemeier, 2009), and unions (Mezzetti and Dinopoulos, 1991; Gaston and Trefler, 1995; Eckel and Egger, 2009; Karasik, 2012). Here we focus on Diamond-Mortensen-Pissarides-type models featuring search and matching in labor markets. We emphasize that our interest here is only in comparative advantage whereas most contributors to the literature are concerned in addition with the impact of trade liberalization on unemployment, income distribution, and welfare.

Consider a world economy with two countries ($i = A, B$), two factors (workers L and firms K), and two identical industries ($g = 0, 1$). In each industry one worker pairs with one firm to produce one unit of output. Suppose that $L > K$ in country A. Because technologies are Leontief and identical across industries there can be no Stolper-Samuelson or Rybczynski effects: $L - K$ workers will be unemployed. In this setting there is unemployment, but no source of comparative advantage and no trade.

Now introduce Diamond-Mortensen-Pissarides search and matching. A worker–firm match produces on unit of output and, since there is a bilateral hold-up problem with zero outside options, each party is assumed to receive a fixed share of the revenue. Workers and firms are in one of two states, matched or unemployed. Unemployed workers and firms choose an industry in which to search—the industry that offers the highest expected future returns—and match probabilistically in the chosen industry. Matched pairs produce, share revenues and then, with probability b_g, the match dissolves and the pair

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[17] They also include (1) an interaction of sector g's U.S. capital stock times q'_i, (2) g's capital stock times country i's capital endowment, and (3) g's skilled-labor stock times country i's skill endowment. These all perform as expected.

becomes unemployed. All of this happens in continuous time so that $1/b_g$ is the expected duration of a match. The instantaneous probability of matching depends positively on a matching-efficiency parameter m_i.[18] In this setting there are two causes of unemployment: Some matches dissolve and some of the unemployed fail to match. These two causes are controlled by b_g and m_i, respectively.

Consider an unemployed worker's choice of sector. A match has an expected duration of $1/b_g$ so that if a matched worker receives w_{gi} per *period* then he or she receives expected return w_{gi}/b_g per *match*. Suppose $b_1 > b_0$ so that industry 1 has relatively short-lived matches. Then ceteris paribus, w_{1i}/w_{0i} must be high in order to compensate workers for short match durations. Now suppose $m_A > m_B$ so that country A's unemployed workers find new matches relatively fast. This advantage reduces the level of compensation needed by workers in industry 1. That is, $m_A > m_B$ and $b_1 > b_0$ imply $w_{1A}/w_{0A} < w_{1B}/w_{0B}$: Country A has a comparative advantage in industry 1. Empirically, this puts us on familiar ground in that the interaction of a country characteristic m_i with an industry characteristic b_g produces an institutional source of comparative advantage. Since industry 1 has the relatively high rate of unemployment, one may state this result in a more interesting way: *The country with better labor market institutions will have a comparative advantage in the high-unemployment sector.*[19]

This basic argument appears in Davidson et al. (1999, Lemmas 3 and 4). It was first formulated by Davidson et al. (1988) and Hosios (1990), who developed the argument in a Heckscher-Ohlin context. In those earlier models, which use the same production structure as we have used, all adjustment occurs via changes in the pool of unemployed workers and firms. For example, if there is an increase in a country's endowment of workers then the country must expand the sector whose pool of unemployed has relatively more workers than firms. Restated, the Heckscher-Ohlin term "labor intensity of an industry" is now replaced with the term "labor intensity of an industry's pool of unemployed."

There are a number of drawbacks to the above analysis that are elegantly addressed by Helpman and Itskhoki (2010). First, we treated firms as exogenous endowments even though trade economists prefer to allow for the free entry of firms. Second, we assumed that firms are identical even though the importance of productivity heterogeneity for

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[18] More specifically, the measure of pairs that form instantaneously in industry g in country i is given by the matching function $f(L_{gi}, K_{gi}) = m_i L_{gi}^{\chi} K_{gi}^{1-\chi}$ where L_{gi} and K_{gi} are the measures of workers and firms, respectively, who are searching in sector g in country i.

[19] We said that w_{1i}/w_{0i} must be high *ceteris paribus* and it is useful to explain this. Let p_{gi} be the price of good g in country i. In our simple model, p_{gi} is the per-period surplus of a match so that w_{gi} will be proportional to p_{gi}. If demand outstrips supply for good g then p_{gi} will rise, w_{gi} will rise, and workers will be attracted to the industry. There is thus an upward-sloping industry supply, as is standard in models with industry specificity. As such, w_{1i}/w_{0i} will also depend on demand conditions that influence p_{1i}/p_{0i}. On a separate note, the possibility of a downward-sloping supply schedule is debated by Davidson et al. (1988) and Hosios (1990): The possibility is ruled out if there is efficient matching (the "Hosios Rule").

exporting has been widely acknowledged. Third, we assumed that there is one worker per firm despite overwhelming evidence on heterogeneity in the number of workers per firm. Helpman and Itskhoki address all of these drawbacks by introducing Melitz-style firm heterogeneity. This leads to important insights about the impact of labor market frictions on both firm entry and firm exporting decisions. It also leads to a rich set of predictions about unemployment, income distribution, and the gains from trade that are beyond the scope of this review chapter.

Note that Helpman and Itskhoki (2010) is not a trivial extension of existing work. For example, they address issues with the underlying search-and-matching structure of earlier studies. These studies assume that the key parameter b_g is exogenous. Helpman and Itskhoki address this by eliminating match breakup altogether ($b_g = 0$) and introducing, realistically, costly posting of vacancies by firms. Posting costs v_g together with matching efficiencies m_i generate a source of comparative advantage. Eliminating match breakups also allows Helpman and Itskhoki to move from a complicated dynamic model to a one-period model, which in turn allows them to explore free entry and the extensive margin of trade. Another problem is that when firms choose to hire more than one worker they must engage in multilateral bargaining with these workers. This is elegantly modeled as in Stole and Zwiebel (1996).

The above models do not allow for heterogeneous workers and cannot explain the important fact that large firms pay high wages.[20] Helpman et al. (2010) introduce heterogeneous workers and screening for high-ability workers. This leads to another interesting set of comparative advantage and welfare results, as well as a prediction that large firms and exporters will pay a wage premium. Helpman et al. (2012) show that matched worker-firm data from Brazil is consistent with the predictions of Helpman and Itskhoki (2010) and Helpman et al. (2010). Davidson et al. (2012a,b) also offer a model of two-sided heterogeneity (both workers and firms) and matching. They show empirically that trade liberalization leads to better matching between workers and firms. Clearly, much more empirical work is needed to assess the large class of models featuring unemployment.[21]

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[20] On the correlation between wages and firm size in an international trade context, see also Davis and Harrigan (2011) and Amiti and Davis (2012). On worker heterogeneity, see also Ohnsorge and Trefler (2007).

[21] Paralleling the literature on labor market frictions is a literature on non-Walrasian product markets. In product markets, buyers and sellers may not be able to identify one another except via costly search and this has a variety of implications. One of these is that specialists in matching buyers and sellers—trade intermediaries—may arise in equilibrium. Antràs and Costinot (2010, 2011) explore the role of intermediaries in reducing matching frictions and draw welfare implications from trade liberalization. Rauch and Watson (2004) explore how costly search affects the evolution of trade networks between developed-country buyers and developing-country suppliers. (See also Rauch (1999, 2001).) A large number of studies have shown that intermediation through wholesalers is empirically important in international trade. See Ahn et al. (2011) for China; Akerman (2010) for Sweden; Basker and Van (2010), Felbermayr and Jung (2011), and Bernard et al. (2010) for the United States; Bernard et al. (2011) for Italy; Bernard et al. (2012) for Belgium; and Blum et al. (2010, 2011) for Chile, Argentina, and Colombia.

2.5. All Together Now

One of the frustrating elements of empirical research in economics (and arguable in all the sciences), is that there are often many statistically significant explanations of a single phenomenon. Often, many studies claim to explain the phenomenon in its entirety, creating an embarrassment of riches. In particular, it is tempting to interpret the above survey as indicating that there are enough institutional explanations of comparative advantage to explain trade patterns many times over. What would happen if all the explanations were examined simultaneously? Would we find that explanatory variables are so highly correlated that none are statistically significant? These questions are answered by Chor (2010).

Chor simultaneously tests five of the comparative advantage mechanisms discussed above. To do this he first constructs the following 2-digit SIC industry measures of z_g in equation (1). These are (1) the average relationship-specificity of inputs (Nunn, 2007); (2) the Herfindahl index of input concentration (Levchenko, 2007); (3) the average complexity of tasks (Costinot, 2009); (4) sales volatility (Cunat and Melitz, 2012); and, (5) external finance dependence (Beck, 2003; Manova, 2013). He also constructs standard Heckscher-Ohlin measures of capital and skill intensity.

The pairwise correlation coefficients of Chor's industry measures are reported in Table 5.3. Coefficients that are statistically significant are in bold. The highest correlation in the matrix is between skill intensity and Costinot's (2009) measure of job complexity. This is intuitive since Costinot's measure is based on the time required to learn the skills of a job, which one would expect to be positively correlated with educational attainment in an industry. The measure of external finance dependence constructed by Chor is also highly correlated with both Levchenko's (2007) input concentration measure and with Costinot's (2009) job complexity measure. For these variables, there is no obvious reason to expect the measures to be correlated.

With these five industry measures of z_g in hand, Chor re-estimates equation (1), but now includes all of the $z_g \cdot q_i$ interactions in a single specification. Letting m index the five models of Nunn, Levchenko, Costinot, Cunat and Melitz, and Manova, Chor estimates

$$y_{gij} = \alpha_i + \alpha_{gj} + \sum_{m=1}^{5} \beta^m \left(z_g^m \cdot q_i^m \right) + X_{ij}\gamma + \varepsilon_{gij}, \tag{9}$$

where y_{gij} is the log of bilateral exports from country i to country j of product g and where $z_g^m \cdot q_i^m$ is the comparative advantage interaction term implied by model m. The regression also includes exporter fixed effects (α_i), industry-importer fixed effects (α_{gj}), and a vector of gravity controls X_{ij} that includes bilateral distance as well as dummies for common language, colony, border, regional trade agreement, and World Trade Organization (WTO) membership. The sample includes 83 countries and 20 SIC 2-digit industries. The coefficients of interest are the $\beta^{m'}$s.

Table 5.3 Pairwise Correlation Coefficients Based on Chor (2012)

	Manova (2013): External Finance Dependence	Levchenko (2007): Input Concentration	Nunn (2007): Input Relationship-Specificity	Costinot (2009): Job Complexity	Cunat and Melitz (2012): Sales Volatility	Capital Intensity
Levchenko (2007): Input concentration	**0.628** **(0.00)**					
Nunn (2007): Input relationship-specificity	0.131 (0.58)	**0.551** **(0.01)**				
Costinot (2009): Job complexity	**0.652** **(0.00)**	**0.539** **(0.01)**	0.210 (0.37)			
Cunat & Melitz (2012): Sales volatility	0.382 (0.10)	0.106 (0.66)	−0.200 (0.40)	0.068 (0.78)		
Capital intensity	0.104 (0.66)	−0.344 (0.14)	**−0.536** **(0.01)**	0.191 (0.42)	0.059 (0.80)	
Skill intensity	0.524 (0.02)	**0.465** **(0.04)**	0.088 (0.71)	**0.820** **(0.00)**	−0.085 (0.72)	**0.382** **(0.10)**

Notes: Pairwise correlation coefficients are reported, with *p*-values in parentheses. Coefficients that are statistically significant at the 10% level or lower are reported in bold. Each correlation is across 20 2-digit SIC industries. Authors' calculations based on data from Chor (2010).

Table 5.4 The Significance of Each of the Institutional Determinants of Comparative Advantage (Chor, 2010, Table 1).

	Slope Estimates			Impacts	
	β	Std. Err.	*t*-stat	Beta Coeff.	75th–25th
	(1)	(2)	(3)	(4)	(5)
Product Market Institutions					
(Relationship-specificity)$_g$ $\times$ (Rule of Law)$_i$	9.64	0.86	11.27	0.49	1.6
(Input concentration)$_g$ $\times$ (Rule of Law)$_i$	14.31	1.67	8.57	0.65	1.7
(Job complexity)$_g$ $\times$ (Rule of Law)$_i$	2.92	0.45	6.52	0.15	1.3
(Job complexity)$_g \times \ln(H/L)_i$	1.46	0.43	3.41	0.10	1.2
Labor Market Institutions					
(Sales volatility)$_g$ $\times \ln$(Flexible lab. markets)$_i$	9.04	2.24	4.04	0.09	1.1
Financial Market Institutions					
(External fin. depend.)$_g$ $\times$ (Fin. develop.)$_i$	1.28	0.09	14.37	0.11	1.2
Heckscher–Ohlin $\ln(H/L)_g \times \ln(H/L)_i$	1.25	0.25	4.98	0.17	1.3
$\ln(K/L)_g \times \ln(K/L)_i$	0.16	0.02	8.20	0.49	1.6

Notes: The first column reports estimates of equation (9). The dependent variable y_{gij} is the log of bilateral exports from country *i* to country *j* for industry *g*. The trade data are for 1990. Industries are coded at the 2-digit SIC (1987) level so that there are 20 industries. There are 83 countries (accounting for 82% of world trade) and hence 83×82 bilateral pairs per good, of which 45,034 (one-third) have positive trade flows. (Zero trade flows are omitted.) The specification also includes a set of regressors that are not reported: (1) the log of distance; (2) indicator variables for common language, colony, border, regional trade agreement, and WTO membership; and, (3) exporter and industry-importer fixed effects.

Table 5.4 reports the results. The first column reports estimates of the β^m in equation (9). The second and third columns report standard errors and *t*-statistics. Each row reports a single regressor. Row 1 corresponds to Nunn (2007), row 2 to Levchenko (2007), rows 3–4 to Costinot (2009), row 5 to Cunat and Melitz (2012), and row 6 to Manova (2013). The final two rows correspond to traditional Heckscher-Ohlin interactions of industry variables (human- and physical-capital intensity) with country variables (human and physical capital endowments relative to labor). Looking at the *t*-statistics, the truly remarkable conclusion is that each and every one of the regressors is individually significant.

Chor's findings raise an important question: How is it that all the determinants are significant? The answer lies in the fact that although the determinants considered are each highly significant, the contribution of each to the overall variation in trade patterns

is small. For example, Nunn (2007, p. 583) reports that his judicial quality–contract intensity interaction only explains 2.3% of the residual variation in the pattern of trade i.e., variation after controlling for country fixed effects and industry fixed effects. Therefore, the many results from the studies examined here can all be simultaneously true without over-explaining the pattern of trade.

Columns 4–5 examine the economic importance of each factor. Beta coefficients are a standardized measure of in-sample fit: They are the predicted standard deviation change in the dependent variable induced by a one standard deviation change in the independent variable. (Beta coefficients are also proportional to the contribution of the regressor to the R^2.) Chor finds that the most important regressors are those suggested by Levchenko (2007) and Nunn (2007). For example, a one standard deviation change in Nunn's $z_g \cdot q_i$ leads to a 0.49 standard deviation change in log exports. Incredibly, both are at least as important as traditional Heckscher-Ohlin determinants of comparative advantage.

Another economic measure of importance is the OLS estimate of β^m times the interquartile range of the explanatory variable. The latter is the 75th quartile minus the 25th quartile. This measure appears in the last column of Table 5.4. By this economic measure, all of the variables are very important. We conclude from this that each of the many institutional determinants of comparative advantage considered in the literature are important for understanding comparative advantage.

In addition to this remarkable conclusion, another remarkable result has come out of the literature. Institutions matter even after controlling for traditional sources of comparative advantage such as factor endowments. Indeed, institutions matter even after controlling for the interaction of per capita GDP with either Nunn's contract-intensity measure (Nunn, 2007, Table 5) or with industry fixed effects (Levchenko, 2007, Table 3). This is a satisfying conclusion. The obvious interpretation is that institutions affect costs more in some industries than in others and that such relative cost impacts are better captured by institutional variables than by endowments or per capita GDP. Adding Ricardian productivity measures at the country-sector level to the above regressions, something no researcher has done, would help confirm that this interpretation is correct.

3. INFORMAL INSTITUTIONS AND THEIR IMPACTS ON COMPARATIVE ADVANTAGE

It is easy to argue that contracting institutions are not important because, when they are weak, alternative institutions evolve to deal with hold-up problems. In this section we explore the ways in which such alternative institutions have impacted comparative advantage and the extent to which they substitute for formal institutions in the fact of contractual incompleteness.

3.1. Repeated Interactions and Dynamics

As is well known, repeated interactions can facilitate cooperation even in an environment in which contract enforcement is poor. Further, repeated interactions themselves can lead to the creation of networks, especially non–kin-based networks. The standard folk theorem suggests that as long as both parties value the future sufficiently, with repetition full investment can be obtained. Empirically, we do observe many instances in which reputation substitutes for formal contract enforcement. For example, Bigsten et al. (2000) show that for manufacturers in Burundi, Cameroon, Ivory Coast, Kenya, Zambia, and Zimbabwe, repeat relationships are very common and are used as a substitute for legal contract enforcement. In these countries, only the largest firms rely on legal forms of contract enforcement. Further, these reputation-based relationships appear to be one of the most important determinants of success. In addition to providing a form of contract enforcement, the relationship, once formed, is also used to share risk and pool information (Fafchamps and Minten, 1999).

McMillan and Woodruff (1999) study buyer–seller relationships within the Vietnamese context, examining 259 non-state firms between 1995 and 1997. They also find evidence for the importance of repeat relationships. Using the provision of trade credit as a proxy for trust, they show that a seller is more trusting of a buyer the longer is the duration of the relationship.

An important point, however, is that repeat relationships and relational contracting is not without costs. Because well-tested relationships have value, buyers and sellers are likely to stick with existing relationships rather than establishing new, untried ones. This creates barriers to entry and inefficiencies, particularly in dynamic environments, where old partnerships soon become less productive. Johnson et al. (2002) provide evidence for such an effect of relational contracting among countries from the former Soviet Union. They examine 1741 privately owned manufacturing firms from Poland, Slovakia, Romania, Russia, and the Ukraine. They ask firms how likely they would be to switch to a supplier that provided an input at a 10% lower price. They find, consistent with repeat relationships causing barriers to entry, that only 50% of firms in the sample would be willing to switch. They also find that firms that perceive the courts to be more effective are more likely to switch. More generally, they find that the primary impact of courts is to encourage the formation of new buyer–seller relationships.

While the importance of repeat relationships for international trade has received little attention, there are notable contributions. Araujo et al. (2012) develop a model of trade with imperfect contract enforcement. Although the model does not have predictions for comparative advantage per se, it does provide insights into reputation-based trade relationships in an environment with incomplete contracting. The model predicts that trading partners will begin trading small volumes that then grow over time. This dynamic generates a positive relationship between duration and the destruction of

trading partnerships. Examining Belgian firm-level data from 1995 to 2008, the authors find support for these patterns, as well as others predicted by their reputation-based trade model. In short, the evidence provided in the study suggests that reputation, not just formal contract enforcement, does play a role in international trade. The findings, however, do not provide evidence for whether reputation and repeat relationships are also important for comparative advantage.

3.2. Networks

Very closely related to the notion of repeat interactions is that of networks, which can also help alleviate contracting issues. While repeat relations—and the accompanying folk theorem—are typically thought about bilaterally, networks can feature a large number of individuals or more complex relationship structures that may or may not feature regular repetition.

If being within the network is valuable to its members, then a credible threat of being expelled can maintain cooperative behavior, such as non-renegotiation, even if the single-period relative payoffs provide an incentive to do so.[22] The value of being within the network could arise for a host of reasons. For example, the network may be a social one that provides direct utility to its members. Alternatively, it could be a business network that provides future benefits.

A second, closely related, reason that networks can help alleviate contractual issues is that information flows are typically higher with networks than without. Therefore the formation of networks may make contracts more complete by reducing the states of the world or contingencies that cannot be contracted upon.

Finally, if networks are kin-based, then participants within the network care about the payoffs of others within the network. In other words, entering into contractual relations among those genetically related kin helps to overcome contracting issues because of altruism within the group. The reason why genetically related organisms care about each other is due to gene-level selection under evolutionary forces.

McMillan and Woodruff's (1999) study of Vietnamese firms in the 1990s provides evidence for the importance of business networks. They distinguish between two benefits of networks: Increased ability to sanction and increased information. They argue that the informational benefit of networks should be decreasing over the life of a buyer–seller relationship. Through increased interactions, the buyer and seller gain information about one another over time. The authors find that in the Vietnamese context, and consistent with the importance of networks, buyers identified by sellers through business networks tended to receive more trade credit. Further, they find that this effect persists over the duration of the buyer–seller relationship, suggesting that it reflects the sanctioning of

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[22] An important caveat here is that the threat of expulsion must be credible. See Greif (1993, 1994) for an examination of this in an environment of long-distance trade with moral hazard issues.

buyers within the network rather than the increased information about buyers within the network.

The analysis of networks within the international trade literature has focused on the effect that the formation of international buyer–seller networks has on aggregate bilateral trade flows (e.g., Rauch, 1999, 2001; Rauch and Trindade, 2002; Chaney, 2011). Although comparative advantage is not at the core of these studies, some of the findings do have implications for the pattern of trade. For example, Gould (1994) estimates a bilateral gravity equation explaining trade with the United States. He examines the importance of immigrant populations for bilateral trade and shows that the presence of immigrant populations from a particular country is positively correlated with trade with that country. In addition, he finds that the effect is greater for consumer goods than for producer goods. Gould interprets the estimates as reflecting the presence of ethnic networks that facilitate the flow of product information and this increases trade. Gould argues that because consumer goods are more differentiated, information about product characteristics is more important and the effects are stronger for these products relative to producer goods. In a follow-up study, Head and Ries (1998) confirm Gould's findings for immigrant populations in Canada.

Rauch and Trindade (2002) also consider ethnic networks but focus solely on ethnic Chinese networks. They estimate a standard gravity model of countries' bilateral trade and test how the presence of ethnic Chinese populations in the two countries affects bilateral trade flows. (In the gravity equation, Rauch and Trindade include the product of the two shares.) The estimates show that the presence of ethnic Chinese populations in both the importing and exporting countries increases bilateral trade. The authors then disaggregate total trade into goods that are bought and sold on organized exchanges, reference-priced, or differentiated. They find that the impact of ethnic Chinese populations is greatest for differentiated goods, precisely where one might think that informational barriers to trade are most pronounced and hence networks most important.

The studies by Gould (1994) and Rauch and Trindade (2002) provide some evidence that international networks may affect the composition of exports. However, we know little about how the density of domestic networks affects comparative advantage, if at all. One can think about many different reasons that networks would affect production differentially across industries. For example, because resources (e.g., expertise in different fields, entrepreneurship, etc.) within networks tend to be limited—particularly kin-based groups—there are limits to the types of goods that could be produced. It is more difficult to produce more sophisticated goods that require a diversity of skills, expertise, and inputs working solely within a small network. It is possible that higher quality formal contract enforcement (rather than informal networks) enables firms to specialize much more in the production of goods that require expansion beyond the network.

Kolasa (2012) is one of the only studies that provides direct evidence on the importance of informal networks for solving contracting issues. The author examines 10,000

large firms in India from 1998 to 2008. He first shows that firms located in states with better judicial quality tend to capture a greater market share in industries that are contract intensive as defined and measured by Nunn (2007). He then shows that this comparative-advantage effect is much weaker among firms operating within business groups, which are networks of firms with informal connections with one another. It has been argued that these networks, where participants are "linked by relations of interpersonal trust, on the basis of a similar personal, ethnic, or communal background," have emerged in response to institutional failures (Leff, 1978, p. 663). One of the primary benefits of these networks is that they facilitate the purchase and sale of intermediate inputs (Leff, 1978). Therefore, Kolasa's findings suggest that, at least in the Indian context, underinvestment in relationship-specific investments due to imperfect contract enforcement has been partially alleviated by the formation of business groups.

3.3. Cultural Beliefs

The potential importance of cross-country culture differences for determining comparative advantage has received little attention in the literature. There are, however, some important exceptions. Guiso et al. (2009) examine the impact that bilateral trust has on bilateral trade flows. Examining bilateral trade flows among 16 European countries, the authors show that an exporting country's trust of an importing country is strongly correlated with bilateral trade flows even after controlling for importer and exporter fixed effects. The estimated impacts are enormous: A one-standard-deviation increase in bilateral trust is associated with an increase in trade of 1.6 standard deviations. Interestingly, the authors find that the impact of trust only exists for goods classified by Rauch (1999) as differentiated (neither sold on exchanges nor reference priced). Although these results provide some evidence that trust not only affects aggregate trade but also its composition, exactly why differentiated goods are "bilateral-trust-intensive" remains unclear.

Tabellini (2008a) also considers the importance of trust for international trade, but examines the role of trust of citizens within a country rather than trust of those from other countries. He hypothesizes that in contract-intensive industries, trust—in addition to contract enforcement—may be a way to overcome issues related to hold-up. If this is the case, then countries with higher levels of trust should have a comparative advantage in contract-intensive industries.

Tabellini re-estimates the comparative-advantage equations from Nunn (2007)—see equation (1) above—with the addition of an interaction between a country's average level of trust among its citizens and Nunn's contract-intensity measure. Tabellini finds that the trust interaction is highly correlated with trade flows: Countries with more trust tend to specialize in the production of contract-intensive goods. Consistent with the hypothesis that trust can substitute for formal legal enforcement, Tabellini shows that trust only has

an impact on the pattern of trade among the countries in the sample with rule of law below the median value.

An important point to bear in mind is that although Tabellini (2008a) and Guiso et al. (2009) both consider trust and trade flows, there is no direct connection between the findings from the two papers. Tabellini considers the level of trust of citizens within a country toward others within the same country. By contrast Guiso et al. do not consider the levels of trust among citizens within a country, but trust between countries. Therefore, it is likely that their analysis has less to do with comparative advantage (as typically understood as being driven by country characteristics), but with frictions between countries and which goods tend to be more sensitive to these distrust-induced trade frictions.

3.4. The Interplay between Culture, Institutions, and International Trade

Belloc and Bowles (2013) study how both culture and institutions can impact comparative advantage. The authors develop a 2-factor, 2-good, and 2-country model in which both preferences (i.e., culture) and contracts (i.e., institutions) are endogenously determined. In the model, production is undertaken by matched employer-employee pairs. Two types of employment contracts are possible: (i) a fixed-wage contract with monitoring and (ii) a partnership where the surplus is split between the employer and the employee.

The cultural trait examined is reciprocity. Employees with reciprocal preferences care about the nature of the contract and their employer's payoff. If the employer implements a fixed-wage monitoring contract the reciprocal worker takes this as a sign of distrust and as a result gets negative utility from the employers' payoff. If the employment contract is a partnership in which the employee's share is judged to be fair, then the employee gets positive utility. Those without the reciprocity trait have conventional self-interested preferences.

The two goods are produced using two types of labor, one that is verifiable and the other that is not. Non-verifiable labor services (e.g., care, creativity, problem-solving) can be provided by the worker in addition to verifiable effort (e.g., time at work, compliance with explicit directions) at a higher cost for him or her. Production requires verifiable aspects of work and productivity is further enhanced by non-verifiable labor services but in different degrees in the two sectors.

Employees in fixed-wage monitoring contracts cannot be forced to provide non-verifiable labor, and they choose not to in equilibrium. By contrast, reciprocal types choose to provide non-verifiable labor under partnership contracts, because in addition to their own return under the share contract, they also place a positive value on the resulting profits of the employer.

In the model, employers' employment contracts (i.e., institutions) and employees' preferences (i.e., culture) evolve over time through a dynamic process based on the relative benefits of each type. The authors show that there are two evolutionarily stable equilibria:

one in which employers choose fixed-wage monitoring contracts and employees do not have reciprocal preferences, and one in which employers choose partnership contracts and employees have reciprocal preferences. Multiple equilibria arise because of the complementarity between partnership contracts and reciprocal preferences. Since reciprocal workers always provide more productive non-verifiable labor services under partnership contracts, countries in the reciprocal preferences, and partnership contracts equilibrium have an absolute advantage in both goods, but also enjoy a comparative advantage in the production of goods intensive in non-verifiable labor investments.

One of the interesting results of the model is that trade liberalization does not support convergence to Pareto-optimal cultural-institutional equilibria configurations, but instead enhances the persistence of existing cultures and institutions, even Pareto-dominated ones.

Tabellini (2008b) provides a theoretical framework for understanding the coevolution of culture and institutions in an environment of international trade. He considers a setting where a continuum of individuals are located on a circle. Individuals are randomly matched and play a prisoner's dilemma game, which can be interpreted as exchange. It is assumed that in addition to material payoffs, individuals obtain utility from cheating on the other trader. The utility from cooperating is decreasing in the distance between the two traders; distance can be interpreted as geographic, cultural, etc. There are two types of cultures in the economy: A "bad" culture characterized by a higher rate of utility decay in distance and a "good" type with a lower rate. This environment results in both types not cheating when matched with less-distant traders and cheating when matched with a trader from a further distance away. The cut-off determining cheating versus cooperation is further away for "good" types than for "bad" types.

In the model, preferences are determined endogenously and are shaped by the effort parents expend instilling values in their children. Parents invest in their children, evaluating their child's expected outcome using their own utility function. "Good" parents make investments to instill "good" values in their children and "bad" parents do not.

The setting is then used to examine the impacts of improved enforcement of cooperation (i.e., better institutions) on the equilibrium prevalence of good types in the economy. Interestingly, the impact of better enforcement institutions depends on whether the enforcement is for less-distant (e.g., domestic) versus more-distant (e.g., international) trades. If enforcement is increased for international trade, then this only affects the good types (since the bad types always cheat in more-distant trades). For the good types, the improved institutions increase the trade distances over which they choose to cooperate. This in turn accentuates the differences in actions between the good and bad types, which causes good parents to invest more in their children, causing an increase in the prevalence of good types in society. In other words, improved enforcement of long-distance trades causes an increase in the prevalence of good types in the economy. Enforcement of close (e.g., domestic) trades impacts bad types, but not good types (since they cooperate at these

distances no matter what). Specifically, it increases the length of distances over which bad types continue to cooperate. This in turn decreases the difference between good and bad types making it less important for good parents to invest in instilling good values in their children. Therefore, this form of enforcement decreases the amount of good culture in the economy.

The model highlights an interesting asymmetry in the relationship between institutions and culture in the context of international trade. Better enforcement of domestic trades decreases the prevalence of good culture in the economy. Here, better institutions crowd out good culture. However, better enforcement of international trades increases the prevalence of good culture. Here, better institutions crowd in good culture.

Tabellini (2008b) also allows enforcement of distant trades to be an endogenous outcome of voting. He shows that if the initial prevalence of bad types is large enough, then voting results in weak enforcement (i.e., poor institutions), which in turn maintains a low level of good types in the economy. Here, because of the complementarity between culture and institutions, a society can be stuck in an equilibrium with low levels of successful exchange, poor institutions, and bad culture.

3.5. Vertical Integration, Offshoring, and Outsourcing

Another way for firms to partially overcome underinvestment due to hold-up is through vertical integration. If hold-up is one-sided then underinvestment can be alleviated if the other party purchases and controls the party that underinvests. If hold-up is two-sided, so that both parties underinvest, then the total underinvestment can be reduced by allocating control to one party or the other. If profits are more sensitive to the buyer's underinvestment, then it will be efficient for the buyer to purchase (control) the selling firm. Similarly, if profits are more sensitive to the seller's underinvestment, then it will be efficient for the seller of the product to purchase the buying firm. In short, the possibility of vertical integration provides an additional tool that can be used to help alleviate underinvestment due to hold-up.

The possibility that vertical integration, by affecting the severity of incomplete contracting, has an impact on comparative advantage is noted in Nunn (2007). He reasons that vertical integration as a way to overcome incomplete contracts is more difficult if production requires many different inputs. In this case, a firm has to vertically integrate with many different suppliers to reduce underinvestment. If instead a producer has one important supplier, then underinvestment can be overcome with only one purchase. Consistent with vertical integration being used to alleviate hold-up, he shows that the impact of a country's rule of law on specialization in contract-intensive industries is smaller among the subset of industries that have a large number of inputs (i.e., in which vertical integration is more difficult).

Ferguson and Formai (2011) provide a deeper empirical examination of the interaction between contract enforcement, vertical integration, and comparative advantage.

The authors construct a measure of the ease of vertical integration across industries by looking at the actual prevalence of vertical integration within the United States. The authors re-estimate Nunn's (2007) comparative advantage equations using his measure of contract intensity, but allow for a differential impact of the rule of law on specialization in contract-intensive industries. Consistent with vertical integration providing a way of (at least partially) alleviating contracting issues, they find weaker comparative advantage effects in industries in which vertical integration is easier.

The most progress, on both the theoretical and empirical front, has been on the determinants of vertical integration internationally rather than domestically. A discussion of the determinants of international vertical integration (i.e., FDI versus outsourcing) appears in the Antràs and Yeaple chapter of this handbook volume (see Chapter 2).[23] Although the focus of the literature is on explaining the determinants of the boundaries of the multinational firm, some of the findings provide insights into the determinants of countries' specialization of production. The manner in which contracting institutions affect the way goods are traded (i.e., within or outside of firm boundaries), not just what goods are traded, is also an important impact of institutions for international trade.

Antràs and Helpman (2004) model a headquarter, located in a developed country (North), that chooses to source its products either domestically or from a developing country (South), and either within firm boundaries or at arm's length. The model allows for a headquarter-and-supplier specific (i.e., match-specific) productivity of production. Production is Cobb-Douglas in two inputs: headquarter-provided services and supplier-produced components.

After observing the productivity of the match, the headquarter decides whether to source the product from the North or the South, and whether to vertically integrate or not. The fixed costs associated with each decision satisfy: $f_v^s > f_o^s > f_v^n > f_o^n$, where f_v^s is the fixed cost of vertically integrating production in the South, f_o^s is the fixed cost of sourcing from a stand-alone firm in the South, f_v^n is the fixed cost of vertical integration in the North, and f_o^n is the fixed cost of outsourcing in the North.

As is standard in this literature, it is assumed that contracts are incomplete. Therefore, the headquarter and input supplier bargain over the surplus from the relationship ex post. As in Antràs (2003), the distribution of the surplus is sensitive to the organizational form. When the headquarter owns the input supplier, it is assumed that the headquarter obtains a greater share of the ex-post surplus than when it does not own the firm. Because the ex-post non-contractability affects ex-ante investment, which organizational form is chosen by the headquarter depends on which party's inputs are relatively more important in the production process. If the supplier's investment is most crucial to production, then it is optimal for the headquarter to incentivize the supplier by not vertically integrating. This is the basic insight from Antràs (2003).

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[23] For earlier reviews of this literature see Spencer (2005), Helpman (2006), and Nunn and Trefler (2008).

Working through the model, Antràs and Helpman (2004) show that the location of production and ownership structure are driven by the relative importance of the head-quarter's contribution and the supplier's contribution to production. When the supplier's components are relatively more important, then outsourcing is always preferred to verti-cal integration. In this environment, the headquarter wants to incentivize the supplier's investment and does this through outsourcing. In addition, the fixed costs of outsourcing are lower than the fixed cost of vertical integration whether the component is produced in the North or the South. Therefore, it is always optimal for the headquarter to purchase the component at arm's length. Further, it is shown that for less productive matches, the component is sourced from the North (which has lower fixed costs but higher wages) and for more productive matches the component is sourced from the South (which has higher fixed costs but lower wages).

When headquarter services are relatively more important, then the headquarter no longer wants to incentivize the supplier (whose investments are less important). Now there is a trade-off since the fixed costs of vertical integration are greater than the fixed cost of outsourcing. The decision of whether to outsource or vertically integrate now depends on the trade-off between higher fixed costs and more efficient production. The benefit depends crucially on the productivity of the match. Intuitively, for more productive matches (with greater production), underinvestment is relatively more important than the one-time fixed costs. This suggests that all else equal more productive matches will vertically integrate.

Antràs and Helpman (2004) fully characterize both the location and integration deci-sion for this scenario. They show that the sourcing strategy of the headquarter depends on the productivity of the match, and the outcome can be characterized by four regions in the productivity space. In the region of the lowest productivity matches, the headquarter chooses to source the component from a stand-alone supplier in the North. In the next more productive region the headquarter vertically integrates with a Northern supplier. Matches of even greater productivity induce the headquarter to source from a stand-alone firm in the South, and the most productive matches result in vertical integration in the South.

Although Antràs and Helpman (2004) do not model a country's contracting envi-ronment explicitly, it is reasonable to believe that the average quality of the buyer-supplier match (or their dispersion within industries and countries) may be affected by the quality of domestic institutions. For example, better institutions, all else equal will generate more productive matches. According to their model, this will result in more components being produced in the South, and in a greater prevalence of FDI relative to outsourcing.

Antràs and Helpman (2008) extend the model of Antràs and Helpman (2004) and explicitly model contracting institutions. They do this by allowing for partial contractibil-ity of the inputs provided by the headquarter and of the supplier. It is assumed that a

portion μ_h of the headquarter's inputs is contractible and a portion μ_m of the supplier's inputs is contractible. They show that all of the intuition of Antràs and Helpman (2004) continues to hold, with one important exception. Now, when the headquarter engages in its make-or-buy decision, what is important is no longer the relative contribution of the inputs of the headquarter and supplier, but the relative contribution of the *non-contractible* inputs of the headquarter and supplier. This is intuitive, since it is the non-contractible inputs that lead to underinvestment by both parties, which in turn affects the headquarter's make-or-buy decision.

Nunn and Trefler (2013) test the implications of Antràs and Helpman (2008). Specifically, they show that as predicted by the model, when looking across industries, an increase in non-contractible inputs provided by the headquarter is associated with greater FDI and less outsourcing, which they measure at the industry level using the share of U.S. imports that are intra-firm. By contrast, an increase in contractible inputs provided by the headquarter is not associated with a greater share of intra-firm imports. The authors follow Antràs (2003) and assume that capital is an input provided by the headquarter. They further disaggregate capital into buildings, computers, automobiles, and other machinery. They assume that investments in buildings, computers, and automobiles are contractible because they have value outside of the relationship i.e., they are not relationship-specific.

Unfortunately, the model of Antràs and Helpman (2008) does not yield clear predictions for changes in contractibility of the supplier's input. When the headquarter's input is unimportant, an increase in the supplier's contractibility μ_m has no impact on the headquarter's sourcing decision, and when the headquarter's input is important an increase in μ_m increases the share of components sourced from the South, but has an ambiguous impact on the share of these that are through FDI versus outsourcing (i.e., on the share of imports that are intra-firm). The ambiguity arises due to two effects that work in opposite directions. One effect, which Nunn and Trefler (2008) call the "standard effect", is that an improvement in μ_m causes some U.S. production to migrate abroad where it is outsourced, decreasing the share of U.S. imports that are intra-firm. The second effect, which they call the "surprise effect," arises because an improvement in μ_m causes the most productive outsourcing relationships to become vertically integrated, increasing the share of U.S. imports that are intra-firm. In reality, which of the two effects dominates is an empirical question.

Nunn and Trefler (2008) examine data on U.S. intra-firm imports of 5423 products from 210 countries and conclude that improved contracting of the suppliers' inputs increases the share of imports that are intra-firm. They use Nunn's (2007) measure of contract intensity (the share of intermediate inputs that are relationship-specific and susceptible to hold-up problems) to measure the proportion of the supplier's production that is non-contractible. They find that consistent with Antràs and Helpman (2008), for low values of headquarter intensity a change in supplier contractibility μ_m has no impact on the share of imports that are intra-firm. They also find that in headquarter-intensive

industries, the surprise effect dominates the standard effect. In other words, an increase in supplier contractibility is associated with an increase in the share of U.S. imports that are intra-firm.

Costinot et al. (2011) propose an alternative measure of contractability based on the extent to which production is composed of predictable and routine tasks, arguing that these can be foreseen and written into contracts. Using information from the U.S. Department of Labor's Dictionary of Occupation Titles (DOT) on the extent to which industries are composed of tasks for which "making decisions and solving problems" are important, the authors construct a measure of routineness that is based on the absence of decisions and problem solving. Their results show that in less routine industries (with worse contractability), a greater share of imports into the United States occurs within firm boundaries.

Their finding is consistent with a Williamsonian theory of firm boundaries, where contracting issues can be overcome through vertical integration. This prediction stands in contrast to a Grossman–Hart–Moore property-rights theory of the firm. Lower contractability of a supplier's product results in a need to incentivize the supplier through independent sourcing rather than vertical integration. Their finding also stands in contrast to Nunn and Trefler (2008) who find that improved contracting is associated with greater vertical integration, not less (at least for the most productive firms).

Overall, the recent literature on the boundaries of the multinational firm show that a country's domestic institutions not only affect what goods a country produces (i.e, its comparative advantage), but they also impact the form that trade takes—namely, whether trade occurs within or outside of firm boundaries. A clear lesson from the literature is that the impacts of institutions on the form of trade are often complex and not obvious ex ante.

4. POLICIES AND THE INDIRECT IMPACTS OF INSTITUTIONS ON COMPARATIVE ADVANTAGE

An important impact of institutions on comparative advantage—and one that we have ignored to this point—arises due to the impact of institutions on intervening factors that in turn affect trade flows. While few papers have examined this indirect relationship directly, there are well-developed literatures showing that: (i) domestic institutions have important and sizeable impacts on many aspects of an economy, such as the accumulation of factors of production and the implementation of economic policies, and (ii) these factors are important for comparative advantage.

Yeaple and Golub (2007) examine the impact of roads, telephone lines, and electrical power generation facilities on comparative advantage and find that roads and electrical power affect comparative advantage, but telecommunications infrastructure does not. These findings complement earlier work by Clague (1991a,b), providing indirect

evidence of transportation and communication infrastructure as being important for comparative advantage. In addition, a number of studies (e.g., Romalis, 2004) have shown that a country's stock of physical and human capital are important sources of comparative advantage. Therefore, by affecting the accumulation of infrastructure, education, and capital, domestic institutions also have an indirect impact on comparative advantage.

Institutions not only affect the aggregate endowments of factors in a society, but also their distributions. This is significant since a number of theoretical and empirical papers document the importance of endowment dispersion (inequality) for comparative advantage. These include Grossman and Maggi (2000), Grossman (2004), Ohnsorge and Trefler (2007), and Bombardini et al. (2012). This is another indirect mechanism through which institutions affect comparative advantage.

An additional indirect channel occurs due to the impact of institutions on per capita income. As hypothesized by Linder, per capita income can itself be a source of comparative advantage and affect the pattern of trade. Hallak (2010) provides empirical evidence consistent with income being a source of comparative advantage. Essaji (2008) empirically uncovers another way that underdevelopment may affect comparative advantage. He shows that less-developed countries, with limited human resources and bureaucratic capital, have a comparative disadvantage in the production of products that are heavily exposed to technical regulations. Using data on countries' exports to the United States across 4019 products, he shows that countries with better capacity to meet technical regulations specialize in sectors that have more technical measures.

Turning to policies, Nunn and Trefler (2010) have shown that countries with poor domestic institutions also tend to have tariff structures that are biased toward less skill-intensive industries, which in turn through a dynamic process reduces a country's comparative advantage in skill-intensive industries. Therefore, through endogenous trade policies, domestic institutions can impact comparative advantage.

Once one begins to think about indirect impacts of domestic institutions on the pattern of trade, the potential channels soon become overwhelming. We have simply noted a few here.

5. THE IMPACT OF TRADE AND COMPARATIVE ADVANTAGE ON DOMESTIC INSTITUTIONS

So far we have discussed the impact of institutions on trade and comparative advantage. We have also repeatedly noted a severe endogeneity problem: International trade can have impacts on domestic institutions. Viewed in this way, this reverse causality is nothing more than a nuisance, a detour on the route to understanding the impacts of institutions on comparative advantage. However, it is less widely recognized that the impact of international trade on domestic institutions may be a tremendously important

phenomenon. Increasingly, research outside of the mainstream of international economics is providing evidence that international trade has had major impacts on the evolution of domestic institutions. Given that institutions are slow-moving, much of the evidence is from the fields of economic history and economic growth. These studies are reviewed in Section 5.1.

A shortcoming of this literature from our perspective is that it typically focuses on the *volume* of trade rather than on the mix of goods being traded i.e., on comparative advantage. One of the surprising conclusions of this review is that international trade's confusingly varied impacts on domestic institutions can in fact be systematically explained by comparative advantage: The mix of goods that a country exports has a profound impact on the form of the institutions that develop. The example of the Atlantic triangle trade (English manufacturing exports, Caribbean sugar exports, and African slave exports) is one of many illustrative historical examples reviewed in Section 5.2. Contemporary examples are reviewed in Section 5.3.

5.1. International Trade and Domestic Institutional Change

Medieval Europe experienced a massive expansion of long-distance trade during the "Commercial Revolution" of 950–1350 (e.g., de Roover, 1965; Lopez, 1971; North and Thomas, 1973). In response, medieval Europe embarked on a set of major institutional reforms that laid the groundwork for the Rise of the West.

Medieval long-distance trade created a host of commitment problems. Consider a merchant traveling to a distant land. First, the merchant sets out with the capital of his investors, literally carrying the capital over the horizon and out of sight. What real commitment could the merchant give to his investors? Second, the merchant arrives in a foreign land ruled by a powerful monarch who has every short-run incentive to expropriate the merchant's goods. What real commitment could the ruler give to foreign merchants? Third, the merchant contracts with other merchants from other lands who have every short-run incentive to cheat and run. What real commitments could merchants from diverse lands give each other? The Commercial Revolution, by creating the potential for great profits from long-distance trade, was an impetus to institutional innovations that solved these three commitment problems in a way that proved fundamental to Europe's later growth miracle. The innovations included the rapid development of property-right institutions and contracting institutions.

The most discussed innovation is the Law Merchant, which is universally accepted as the foundation of modern commercial law (Berman, 1983). Its very scope—the use of a court of peers to adjudicate commercial disputes between merchants traveling in distant lands—means that the Law Merchant was a direct and immediate response to the needs of long-distance trade (Kadens, 2004). Milgrom et al. (1990) discuss how the Law Merchant was a response to commitment problems. Other examples include property-right protections that committed rulers not to prey on merchants (Greif et al., 1994), the rise of

a nascent Western legal system beginning exactly when long-distance trade began to take off (Berman, 1983; Landau, 2004), and the development of many new innovations in contracting institutions (e.g., González de Lara (2008) and additional work by Greif described below). By the early fourteenth century, the latter included: the appearance of rudimentary limited-liability joint stock companies (the *commenda*); thick markets for debt (especially bills of exchange); secondary markets for a wide variety of debt, equity and mortgage instruments; bankruptcy laws that distinguished illiquidity from insolvency; double-entry accounting methods; business education (including the use of algebra for currency conversions); deposit banking; and a reliable medium of exchange. All of these innovations can be related directly back to the demands of long-distance trade. See Puga and Trefler (2012).

The above historical research is pervaded by two themes. First, institutional change does not occur because it is efficient, but because it is advanced by powerful special interests. Second, as trade grows it affects the domestic distribution of income and hence the relative power of competing special interests. It is this change in relative power that drives institutional change.

Puga and Trefler's (2012) analysis of Venice during the Commercial Revolution illustrates these two themes. They show that increases in long-distance trade that were exogenous to Venice enriched a broad-based group of merchants and these merchants then pushed for constraints on the executive i.e., for the end of a *de facto* hereditary Doge in 1032 and for the establishment of a parliament or Great Council in 1172. The merchants also pushed for remarkably modern innovations in contracting institutions (such as the *commenda*) that facilitated large-scale mobilization of capital for risky long-distance trade. The fact that participation in long-distance trade was inclusive and risky (which leads to rapid income churning) led to a society that displayed remarkable economic, political, and social mobility. Over time, a group of extraordinarily rich merchants emerged and in 1323 they were able to erect barriers to political mobility: Participation in parliament became hereditary. These rich merchants then built a coercive state apparatus that was used to suppress opposition. With this state apparatus in place, the rich merchants moved to reduce competition on the most lucrative segments of long-distance trade, especially the state-controlled galley trade. Puga and Trefler document this "oligarchization" using a unique database on the names of 8103 parliamentarians and their families' use of the *commenda*. They show that before 1323 there was tremendous political mobility into and out of parliament and broad-based participation in the *commenda*. After 1323, the oligarchs formed themselves into an exclusive nobility and non-oligarch participation in the *commenda* melted away. In short, long-distance trade first encouraged institutional dynamism and then created powerful forces that blocked social inclusion. These changes operated via the impacts of trade on the distribution of wealth and power.

The role of income distribution as a mediator of the impact of trade on institutions appears elsewhere. Greif and Laitin (2004) and Greif (2006b) study the role of changing income distribution for institutional change in their comparative study of Venice

and Genoa. They show that the (endogenous) evolution of income distribution was a decisive force behind Genoa's political instability. Jha (2010) uses detailed data from the English Long Parliament (1640–1660) to examine the formation of a coalition supporting stronger constraints on the Crown. Using data on the investments of about 500 parliamentarians, Jha finds that a financial innovation—shares in overseas companies that allowed broader investor participation—was key in aligning interests against royal discretion over foreign economic affairs.

Jha (2008) provides evidence that in medieval India, overseas trade generated domestic institutions that helped to maintain peace between Hindus and Muslims until this day. Looking across cities within modern India, Jha finds a negative relationship between participation in overseas trade during the medieval period and religious conflict during the late 19th and early 20th centuries. Because Muslims provided access to the markets of the Middle East, in the towns connected to this overseas trade the returns to Hindu–Muslim cooperation were much higher. As a result, institutions that supported exchange and a peaceful coexistence between Hindus and Muslims were developed.

5.2. Heterogeneous Impacts of Trade on Institutions: The Role of Comparative Advantage

The previous subsection dealt with the impacts of rising trade without reference to comparative advantage. From a historical perspective, the rise of the Atlantic three-corner trade following the discovery of the Americas provides a nice case study for examining the impacts of comparative advantage on institutional development. Merchants and entrepreneurs in each of the three corners of the trade—Europe, the Americas, and Africa—specialized in the production and export of very different commodities. While Europe specialized in the production of manufactures such as firearms, gunpowder, copper and iron products, the Americas specialized in the production of raw commodities such as sugar, tobacco, and cotton, while Africa specialized in the export of human beings (slaves). The standard trade circuit saw manufactured items being shipped to Africa for slaves, which were then shipped to the Americas for raw commodities, which were then shipped to Europe where they were used in production (e.g., cotton) or consumption (e.g., sugar).

A number of studies, primarily in the historical development literature, have separately estimated the institutional impacts of specialization in each corner of the trade. For Africa, comparative advantage during the Atlantic trade is equated with the most malign form of resource extraction: the slaving of human beings. Nunn (2008a) shows that the slaving of Africans had very negative effects on post-colonial African growth rates: Growth was slowest in regions whose populations were largely composed of heavily slaved ethnicities. Nunn and Wantchekon (2011) examine the mechanism involved. They document numerous accounts of (supposed) friends, family members, and neighbors tricking, kidnapping, and selling each other into slavery. In the environment of complete

insecurity brought on by the slave trade, the temptation to slave or be enslaved proved too much for many. The authors hypothesize that in such an environment, norms of mistrust may have evolved and spread throughout society. Combining individual-level survey data with ethnicity-level slave export estimates (constructed using data sources from Nunn, 2008a), the authors show that individuals belonging to an ethnicity that was more severely affected by the Indian Ocean and trans-Atlantic slave trades exhibit less trust today. This is true for trust in relatives, neighbors, co-ethnics, other ethnicities, and the local government. The authors show that part of this is explained by the fact that the slave trades had a detrimental impact on local institutions that enforce good behavior. Another part is explained by persistent norms of mistrust that evolved over time and persist until today.

The significance of these findings lies in the fact that we now increasingly understand, both theoretically and empirically, that trust is a fundamental determinant of economic development (Fukuyama, 1995; Algan and Cahuc, 2010). Inikori (2003) offers a mechanism consistent with the comparative advantage view in which specialization determines the type of institutions demanded. Inikori points out that Africa was forced to specialize in goods (human slaves) whose production does not require high-quality domestic institutions. To the contrary, the slave trade required *insecurity* of property rights and the *disrespect* of human rights. That is, comparative advantage specialization in slaves created a demand for growth-retarding institutional change.

In Latin America, trade led to specialization in plantation products such as sugar, tobacco, and cotton and in extractive activities such as silver mining. These activities required large landholdings and coercive labor policies that created extreme inequality, with a handful of Europeans garnering vast fortunes. Engerman and Sokoloff (1997, 2000) argue that this comparative advantage specialization and the resulting economic inequality allowed these European elites to dominate politics and shield themselves from economic and social competition. This "shield" involved growth-retarding institutions such as skewed land-tenure rights, abusive labor rights, corporate law, and financial regulation that favored incumbents, and the under-provision of education and other public goods. See also Engerman and Sokoloff (2012).

A particularly careful empirical study of this phenomenon appears in Dell's (2010) fine-grained study of Spanish silver mining in Potosi in modern-day Bolivia. She examines the long-term impacts of the Spanish forced labor system—mining *mita*—that was used to recruit slaves to work in the Potosi silver mines. She finds that the forced labor system had permanent long-term impacts on consumption, education, and public-goods provisions. Naritomi et al. (2012) study the impact of comparative advantage specialization across Brazilian municipalities. They find that colonial specialization in sugar is associated with greater inequality today and that specialization in gold mining is associated with worse governance and property-rights institutions today.

Bruhn and Gallego (2012) extend the Engerman and Sokoloff (1997) thesis in their comparative study of North and South America. The authors construct an impressive

dataset of the goods that were initially produced across 345 regions in 17 countries in the Americas. The authors divide the goods into two categories: (i) Those that display economies of scale and were historically produced using coercive methods including slavery e.g., gold, silver, and sugar; and, (ii) Those that display constant returns to scale e.g., subsistence crops, ranching, and manufacturing. The authors show that regions that specialized in increasing-returns goods are less developed today. Further, regions that specialized in constant-returns goods were *not* guaranteed future development because in some of those regions, those with large native populations, constant-returns production may have employed coerced native labor. On a closely related point, Mitchener and McLean (2003) show that the parts of the United States that relied heavily on slave labor in 1860, subsequently had lower levels of labor productivity in manufacturing. Similarly, Nunn (2008b) shows that the historical use of slave labor is associated with long-term underdevelopment both within the United States and across the Americas more broadly.

Europe's experience during the Atlantic trade was very different from the Americas and Africa. Many have argued that the Atlantic trade played an important part in the industrial revolution (e.g., Inikori, 2002). Acemoglu et al. (2005b) empirically examine this assertion, focusing in particular on the institutional impacts of the trade. In Britain and the Netherlands, the Atlantic trade shifted the balance of political power in favor of commercial interests and away from the interests of the royal circle. Since the merchants representing commercial interests were in favor of strong property-rights protections, they used their newfound political muscle to push for reforms that constrained the power of the monarchy. Perhaps the most famous of these is the Glorious Revolution of 1688 which dramatically shifted power from the English Crown to Parliament (Acemoglu and Robinson, 2012, Chapter 7).

To study the links between trade, institutions and economic growth, Acemoglu et al. (2005b) examine variation across countries and cities and show that the rise of Western Europe was due to the economic growth of Atlantic traders—in particular, Britain, the Netherlands, France, Portugal, and Spain. In addition, they also show that the quality of domestic institutions, measured by constraints on the executive, were improved by the Atlantic trade. Perhaps the most interesting part of their analysis is their examination of heterogeneity. They show that among the countries with better initial institutions (measured in 1400 and 1500), the Atlantic trade resulted in greater institutional improvements and greater economic growth. In other words, the impact of international trade on domestic institutions depends critically on initial conditions.

Acemoglu et al.'s finding that the impacts of international trade were dependent on initial conditions has also been shown in other contexts. In particular, in a series of articles Greif (1992, 1993, 1994, 2006a,b) examines how the impacts of medieval trade differed across regions within the Old World. He argues that today's institutions constrain the set of institutions that can develop tomorrow and therefore, trade's impact will depend on initial institutions. While initial property-rights institutions are part of the equation, they need not be the most salient. This is illustrated by Greif's comparative analysis of

medieval trade in Western Europe versus the Islamic world (including the Maghreb in North Africa). Comparing initial institutions in Western European versus Islam, one sees individualistic versus kin-based institutions, weak versus strong states, and norms of self-legitimization versus religion-based legitimization. At the start of the medieval period, both regions organized trade in kin-based (and community-based) networks. However, as trade expanded, its volume reached a level that was not supportable by kin-based organizations. The Western European response, as we have seen, was a set of new institutions such as the precursor of the modern corporation. These corporations were collections of non-kin-based individuals and were legitimated by the civil statutes of the cities that flourished under relatively weak Western European monarchs. In contrast, such an institutional response was not possible in Islam. Indeed, one continues to see limited institutional responses to this day, as evidenced for example by the problems with Islamic banking.

Another example of the importance of initial institutions is found in a trio of papers that estimate the impact of terms-of-trade shocks on wages in coercive societies (Bobonis and Morrow, 2010; Dippel et al., 2012; Naidu and Yuchtman, 2013). In neoclassical trade models, favorable term-of-trade shocks translate into positive demand shocks and positive demand shocks translate into higher wages. However, this need not be the case in coercive societies. Dippel et al. (2012) examine the impact of secular movements in sugar prices on wages and coercion in 14 British Caribbean sugar colonies over the period 1838–1914. In a regression of wages on world sugar prices they estimate a zero coefficient on sugar prices. They then argue that this zero effect is caused by an offsetting institutional effect: When sugar prices rise secularly, the plantation elite grows stronger and uses coercion to depress wages. To show this, Dippel et al. first use archival data on the share of sugar in total exports to get a measure of the strength of the plantation economy by colony and year. When this measure is added to their wage regression, the coefficient on sugar becomes very positive (the neoclassical channel) and the coefficient on the strength of the plantation economy becomes very negative (the institutional channel). Dippel et al. (2012) also show that higher sugar prices translate into more coercion as measured by incarceration rates of those of African origin. Finally, Dippel et al. provide a precise mechanism. When the plantation economy is strong, there is no land available for small freeholds so that workers have no choice but to work on the plantation. This makes coercion cheap.[24]

Bobonis and Morrow (2010) examine the impact of world coffee price shocks on labor coercion in 19th century Puerto Rico. Between 1849 and 1874, unskilled workers were forced to work for legally titled landowners. Using variation in labor demand driven by changes in world coffee prices, they show that increased demand for labor increased the coercive measures undertaken by Puerto Rican landowners.

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[24] Acemoglu and Wolitzky (2011) define coercion as an active attempt to reduce the outside options of workers. As will become apparent, the examples studied in Bobonis and Morrow (2010), Dippel et al. (2012), and Naidu and Yuchtman (2013) are all instances of coercion in this sense.

Finally, Naidu and Yuchtman (2013) examine the impact of labor demand shocks on wages during a coercive period of British labor history. While their paper is not about trade per se, the analysis is of obvious relevance and elegance. The 18th century British Master and Servant Act forced apprentices to sign long-term contracts with their masters. If an apprentice ran away—as was common when positive demand shocks led masters to compete for apprentices—the run-away was criminally prosecuted. Naidu and Yuchtman show that during periods of high demand the Act prevented apprentice wages from rising and led to more incarcerations. Further, when the Act was repealed in 1875, wages became more responsive to demand shocks, especially in those counties with initially high incarceration rates i.e., in those counties that exported textiles, iron, and coal.

5.3. Comparative Advantage and Domestic Institutions: Contemporary Evidence

The insight that international trade can have very different impacts depending on initial conditions and comparative advantage has also been empirically verified using contemporary data. This is most immediately seen in the literature on the "curse of natural resources," which documents a negative relationship between specialization in natural resource production and economic growth. See Ross (1999) for a review of the literature. A number of studies focus on oil production and find that specialization is associated with negative institutional development. An early contributor to this literature is Barro (1999), whose cross-country regression estimates show that oil extraction hinders democracy. Tsui (2011) documents a relationship between oil discoveries and movements of regimes away from democracy and toward autocracy.

The historical evidence examined above suggests that the impact of trade depends on which groups are enriched by changes in the structure of production. According to Acemoglu et al. (2005b), the Atlantic trade empowered merchants that supported pro-business institutions and constraints on the monarchy. In a contemporary context, Braun and Raddatz (2008) test for this same mechanism, but within the context of financial development. A benefit of a more developed financial system is that it facilitates the entry of new firms, thereby increasing competition and reducing the rents of incumbents. The authors use the average price–cost margin of firms in an industry as a measure of the degree of product market competition and profitability of incumbents. They then estimate the relationship between the price–cost margin and a country's level of financial development (measured as private credit to GDP) for 28 3-digit ISIC industries.[25] This generates, for each industry, a measure of the extent to which financial development erodes incumbent profits in the industry. This is then used to group industries into "promoters" and "opponents" of financial development. The "opponents" are defined as the

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[25] In practice, in a country and industry panel, the price–cost margin is regressed on industry fixed effects, country fixed effects, and country-level financial development interacted with industry fixed effects.

14 industries for which financial development has the most adverse effect on incumbent profitability; the "promoters" are the remaining 14 industries. Braun and Raddatz (2008) then examine the liberalization episodes of 73 countries and show that improvements in financial development following liberalization episodes were greater the greater the economic growth of "promoters" relative to "opponents" of financial development. In other words, if the industries that were strengthened due to trade liberalization were industries that tended to be hurt most by financial development, then financial development tended to be slow after liberalization.

Do and Levchenko (2007) also focus on the relative demand for financial innovation across industries. They start by observing that some industries require more external finance than others. They hypothesize that countries with a comparative advantage in industries that are highly dependent on external finance will have a greater demand for external finance and hence more developed financial markets. To show this empirically, they estimate a cross-section regression in which the dependent variable is private credit as a share of GDP and the key independent variable is the average external-finance intensity of a country's exports. All variables are measured as annual averages from 1970 to 1999. The coefficient estimate is positive, indicating that trade, by raising the demand for external finance, can lead to financial development. To account for potential reverse causality, Do and Levchenko employ an IV strategy that extends the strategy of Frankel and Romer (1999) to a multi-industry setting. In particular, the authors estimate the gravity regressions from Frankel and Romer (1999) sector by sector (across ISIC 3-digit industries) and construct country- and sector-specific measures of predicted exports. They then use this measure of predicted exports to calculate a measure of a country's financial dependence of predicted exports. This is used as an instrument for a country's actual measure of financial dependence of exports.

In subsequent analysis, Levchenko (2013) estimates the relationship between a country's average rule-of-law measure between 1996 and 2000 and its average contract intensity of predicted exports between 1970 and 1999, where predicted exports are constructed as in Do and Levchenko (2007). Levchenko combines the measure of predicted exports with Nunn's (2007) measure of contract intensity. He finds a robust positive relationship between the contract intensity of a country's predicted exports and its rule of law. This is interpreted as evidence that a natural comparative advantage in contract-intensive industries increases the returns to improved institutions and thus causes better institutions in the long run. In other words, trade and comparative advantage shape domestic institutions.

Finally, there is also a literature that examines the potential impacts that international trade has on cultural traits. See for example Olivier et al. (2008), Thoenig et al. (2009), and Atkin (2013).

To conclude, the historical evidence makes clear that international trade has had pronounced impacts on domestic institutions. We noted that for institutions to change,

the change must be supported by powerful special interests. Often it is trade itself that makes these groups powerful. Finally, the type of trade (whether or not it involves the production of goods that require good supporting institutions) and the level of coercion trade generates play key roles in whether the institutional change is growth-enhancing or growth-retarding.

6. CONCLUSION

The literature on institutions as a source of comparative advantage has grown rapidly. In this chapter we provided evidence that institutional sources of comparative advantage can and do operate through fundamentally different channels than traditional sources of comparative advantage such as endowments. Indeed, institutional sources of comparative advantage are quantitatively as important as traditional sources. We also reviewed the rapidly growing literature on the impact of international trade on domestic institutions. These impacts are profound, so much so that one is left conjecturing that the impact of international trade on domestic institutions is the single most important source of long-run gains from trade.

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