Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade

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Abstract

When relationship-specific investments are necessary for production, under-investment occurs if contracts cannot be enforced. The efficiency loss from under-investment will differ across industries depending on the importance of relationship-specific investments in the production process. As a consequence, a country's contracting environment may be an important determinant of comparative advantage. To test for this, I construct measures of the efficiency of contract enforcement across countries and the relationship-specificity of investments across industries. I find that the contracting environment is an important determinant of comparative advantage. Countries with better contract enforcement specialize in industries that rely heavily on relationship-specific investments. This is true even after controlling for traditional determinants of comparative advantage such as endowments of human capital, physical capital, and natural resources.

JEL classification: D23; D51; F11; L14; O11.

Keywords: International trade; Comparative advantage; Relationship-specific investments; Contract enforcement.

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1 Introduction

What determines a country's comparative advantage? Despite this being one of the oldest, most fundamental questions in international trade, we still lack a clear understanding of the primary determinants of comparative advantage and the resulting pattern of trade.[1] Empirical studies have found that factor endowments, such as capital, skilled labour and natural resources, are important determinants of trade patterns,[2] but the vast majority of the variation in trade flows remains unexplained. In this paper, I consider an additional determinant of comparative advantage: differences in the quality of the contracting environment across countries. I test whether a country's ability to enforce written contracts is an important determinant of its comparative advantage.

The channel that I consider builds on a well-established insight from the theory of the firm: when investments are relationship-specific under-investment will occur if contracts cannot be enforced. An investment is "relationship-specific" if its value within a relationship is higher than in its best alternative use outside the relationship. An example is an investment made by an input supplier to customize a product to the needs of a final good producer. If production of a final good uses tailored inputs, requiring relationship-specific investments, then ex post opportunistic behavior is possible. If contracts are imperfectly enforced, then the buyer of the inputs may "hold-up" the supplier by reneging on the initially agreed upon price, instead offering to pay the supplier the value of the investment outside the relationship, which is the lowest price the supplier will accept. The supplier, anticipating the possibility of this ex post opportunistic behavior, will under-invest in the necessary relationship-specific investments.

In industries requiring relationship-specific investments, imperfect contract enforcement generates suboptimal levels of investment, raising the costs of production. In countries with good contract enforcement, there is less under-investment and the costs of production are low relative to countries with poor contract enforcement. The more important are relationship-specific investments in the production process, the greater the cost advantage of a good contracting country relative to poor contracting countries. In other words, countries with good contract enforcement have a comparative advantage in the production of goods that require relationship-specific

[1] See Davis and Weinstein (2001) for a survey and discussion of the profession's limited empirical understanding of international trade patterns.

[2] For a recent study on the importance of factor endowments in explaining the pattern of trade see Romalis (2004).

investments.

To test whether a country's contracting environment is a source of comparative advantage, I require a measure of the quality of the contracting environment for each country, and a measure of the necessity of relationship-specific investments (i.e. contract-intensity) across industries. As a measure of the contracting environment, I use the quality of the judicial system, measured by the 'rule of law' variable from the Governance Matters III data set.[3] To quantify the relationship-specificity of investments across industries, I construct a variable that measures, for each commodity, the proportion of its intermediate inputs that are relationship-specific. I use the United States input-output tables to determine which intermediate inputs are used in the production of each final good, and in what proportions. I use whether an input is sold on an organized exchange as an indicator of whether or not its production required investments that are relationship-specific. If an input is sold on an organized exchange, this indicates that the market for this input is thick, with many alternative buyers. Therefore, the value of the input outside of the relationship is close to the value inside the relationship and therefore the investments made to produce the good are not relationship-specific.

I test for the effect of contract enforcement on comparative advantage by comparing how the export ratios of country-pairs differ across industries. I find that differences in the contracting environment across countries are an important determinant of comparative advantage. Countries with good contract enforcement export more in industries that rely heavily on relationship-specific investments. The estimated magnitudes are significant. For example, if Thailand could improve its contract enforcement to equal Taiwan's, then its exports of "electronic computer manufacturing" commodities would increase from 2.8 to 8.1 billion U.S. dollars per year, and Thailand's share of world production in these commodities would increase from 3.0 to 8.6%.

Controlling for other determinants of comparative advantage such as endowments of human and physical capital, and natural resources, I find the contracting environment to be the most important determinant of comparative advantage. Cross-country differences in judicial quality account for more of the variation in exports across countries and industries than do factor endowments.

I perform a number of sensitivity and robustness tests. The results are robust to the use of alternative measures of cross-country contract enforce-

[3] See Kaufmann et al. (2003).

ment and cross-industry contract-intensity, to the omission of influential outliers, to changes in the sample of countries and industries, and to changes in the time period used. I also test predictions of the model at the country-level. The estimation results from these tests confirm my findings at the country-industry level.

I correct for the possibility of omitted country-specific characteristics that may lead to biased estimates by pursuing three strategies. First, I include a number of determinants of comparative advantage that if omitted may bias my results. Second, I estimate my equations using instrumental variables (IV). As instruments I use each country's legal origin.[4] Third, I compare the relative exports of British and French legal origin countries, restricting my comparison to pairs of countries that are otherwise similar except for their legal origin. I match country-pairs using per-capita income, financial development, factor endowments and trade openness. All three strategies yield estimates that confirm the baseline OLS results.

This paper is most related to the literature on the organization of the multinational firm. These studies also use the insight that the existence of relationship-specific investments creates a potential for hold-up, but they also exploit the additional insight that integration of the two parties is a possible solution to the hold-up problem.[5] This literature incorporates these insights into general equilibrium trade models to understand the organization of multinational firms. McLaren (2000) models the effect that international openness can have on firm structure. In his model, increased openness helps alleviate the hold-up problem and leads to a decrease in vertical integration. Grossman and Helpman (2002) study the determinants of firms' make-or-buy decisions in a model where the organization of the firm is endogenous. Antràs (2003) develops a model that is able to explain the stylized relationship between the factor intensity of production and the proportion of trade that occurs within the firm. Antràs and Helpman (2004) develop a model where multinational firms choose both the location of input manufacture and the ownership structure.[6]

This paper also fits into a new and growing empirical literature that examines the relationship between institutions and trade. Using gravity models, a number of papers have tested for the impact that a country's in-

[4]See La Porta et al. (1999).

[5]See for instance Williamson (1975, 1985), Grossman and Hart (1986) and Hart and Moore (1990).

[6]Other key papers in this literature include Antràs (2005), Grossman and Helpman (2003, 2005), Marin and Verdier (2002), and Puga and Trefler (2002).

stitutional quality has on its volume of trade.[7] A number of papers have tested for the effects that institutions have on comparative advantage, finding that countries with better institutions are relatively more productive and specialize in goods that require a large number of intermediate inputs.[8]

Last, this paper is also related to two recent papers that consider how the vertical structure of Japan's keiretsu system in the auto industry may have supported increased levels of relationship-specific investments. Spencer and Qiu (2001) show how the increase in relationship-specific investments by Japanese parts suppliers can act as a barrier to trade, causing a fall in the range of parts that are imported. Head, Ries and Spencer (2004) test for this effect and find that U.S. exports to Japan are reduced for parts where keiretsu sourcing is most important.

The paper is organized as follows. In the next section, I develop a simple, stylized model that illustrates how differences in contract enforcement between countries can determine comparative advantage and trade specialization. In Section 3, I describe the data. In Section 4, I report the estimation strategy, which is motivated by the model. As well, I report the empirical results. Section 5 concludes.

2 The Model

There is a continuum of final goods indexed by $z \in [0,1]$. Each unit of final good z requires one unit of a standardized input and $a(z)$ units of a customized input, where $a(z) > 0$. A customized input is distinguished from a standardized input by one key characteristic of the production process: the investments needed to produce a customized input are relationship-specific. The production function for final good z is given by

$$\min\left\{X^s(z), \frac{1}{a(z)}X^c(z)\right\}$$

where $X^s(z)$ and $X^c(z)$ denote the total usage of each input.[9] Consumers' preferences are identical and Cobb-Douglas.

[7] See for example Anderson (2002), Berkowitz and Moenius (2004), de Groot (2004), and Ranjan and Lee (2004).

[8] See Clague (1991a, 1991b), Cowan and Neut (2002) and Levchenko (2004).

[9] The results of the model are not dependent on the assumed functional form for production. For example, if $a^c(z)$ units of the customized input and $a^s(z)$ units of the standardized input are required to produce one unit of the final good, then all results of the model hold. As well, one could allow for substitutability between inputs, modelling the production function as Cobb-Douglas. Again, all results hold in this environment.

2.1 Customized Input Production

Production of customized inputs requires a principal and an agent. Each principal is endowed with the knowledge of how to produce an input for a particular final good producer. Each principal hires an agent to produce the input. I assume that the agent can produce an input at zero cost. The productivity of the input produced varies depending on how customized the input is. Let $q \geq 0$ denote the level of customization. If q units of customization are implemented, then this produces $f(q)$ units of the input measured in efficiency units. I assume that $f(0) = 0$, and that the efficiency of an input is increasing at a constant or decreasing rate ($f'(q) > 0$ and $f''(q) \leq 0$).

Before production takes place, the principal and agent negotiate a split of the surplus of the relationship, which is equal to the price that the input supplier pays for each unit, denoted p^c, multiplied by the number of effective inputs produced, $f(q)$. Let s denote the agent's share of the surplus.

After the inputs have been produced by the agent, the principal can attempt to renegotiate the contract. The only protection the agent has against renegotiation is the judicial system. If the principal attempts to renegotiate the contract, the agent can take the case to court. I assume that with probability γ the judge is able to perfectly observe and verify the surplus. She therefore rules for the agent. With probability $1 - \gamma$, the judge is unable to verify all of the surplus. The probability γ is thus a measure of the quality of the judicial system and of its ability to enforce contracts. I assume that when the surplus cannot be fully verified by the judge, she is only able to observe a proportion of the surplus given by $0 < g(q) < 1$. I assume that customization makes the surplus increasing difficult to verify ($g'(q) < 0$), and that verifiability is decreasing at a constant or increasing rate ($g''(q) \leq 0$). The court enforces the ex ante contract for the proportion of the surplus that is verifiable. For the remainder the principal pays zero.

To summarize, the timing of events is as follows.

1. Contract Negotiation: The principal and agent match. They negotiate a split of the surplus, s.

2. Customization: The agent produces the input, choosing the amount of customization to undertake, q.

3. Litigation and Renegotiation: With probability γ, the judge perfectly observes the surplus and rules for the agent. With probability $1 - \gamma$, the judge is only able to imperfectly observe the surplus.

I solve for the subgame perfect equilibrium, working backwards from period 3 to period 1.

2.1.1 Period 3: Litigation and Renegotiation

I assume that the cost of going to court is zero for both the principal and the agent. If the court rules in favor of the agent, then the principal is forced to uphold the contract and the principal does not face further penalty. If the court rules in favor of the principal, the principal is free to renegotiate the contract. Given these assumptions, in equilibrium, the principal always breaks the contract and the agent always takes her to court.

2.1.2 Period 2: Customization

The agent's payoff is as follows. With probability γ, the contract is enforced and the agent receives $sf(q)p^c$. With probability $1-\gamma$, the courts can only verify the proportion $g(q)$ of the surplus, and the agent receives $sf(q)p^c g(q)$. Thus, the agent's expected payoff is

$$\pi_{\text{A}}(q, s, \gamma, p^c) = sf(q)p^c[\gamma + (1-\gamma)g(q)] \tag{1}$$

The agent chooses q to maximize $\pi_{\text{A}}(q, s, \gamma, p^c)$. The optimal level of customization, q^*, is given by

$$\frac{\gamma}{1-\gamma} + g(q^*) = -g'(q^*)\frac{f(q^*)}{f'(q^*)} \tag{2}$$

The LHS of (2) is decreasing in q. Because $g''(q) \leq 0$ and $f''(q) \leq 0$, the RHS of (2) is increasing in q. An increase in γ increases the LHS of (2) and therefore increases q^*; i.e. $q^{*\prime}(\gamma) > 0$.

The principal's payoff is equal to $f(q)p^c$ minus the payoff that the agent receives. The principal's payoff can be written

$$\pi_{\text{P}}(q^*, p^c, b, \gamma) = f(q^*)p^c[1 - \gamma s - (1-\gamma)g(q^*)s] \tag{3}$$

where q^* is given by (2).

2.1.3 Period 1: Contract Negotiation

The initial contract specifies the share, s, that the agent receives of the surplus $q(\gamma)p^c$. I model the determination of s as the outcome of Nash bargaining. If the principal and agent fail to come to an agreement, both receive zero. Therefore, the Nash bargaining solution is given by

$$\max_s \Pi(s) = \pi_{\mathrm{A}}(q^*, p^c, s, \gamma) \cdot \pi_{\mathrm{P}}(q^*, p^c, s, \gamma) \tag{4}$$

Substituting (1) and (3) into (4) and maximizing with respect to s yields

$$s(\gamma) = \frac{1}{2[\gamma + (1-\gamma)g(q^*)]} \tag{5}$$

Substituting (5) into (1) yields the agent's payoff as a function of p^c and γ:

$$\pi_{\mathrm{A}}(p^c, \gamma) = \frac{p^c f(q^*(\gamma))}{2} \tag{6}$$

where $q^*(\gamma)$ is the agent's optimal q.

2.2 Standardized Input Production

The production of standardized inputs is similar to the production of customized inputs, except that inputs are not made for a specific final good producer. Because of this, there is no possibility of the principal holding-up the agent. I assume that each period, each agent can produce one input. I assume that the principal and agent split the value of the input, p^s, according to the Nash bargaining solution. Thus, the principal and agent have payoffs equal to $p^s/2$.

Because agents are free to enter both input markets, agents must be equally well off in both sectors:

$$\frac{p^c f(q^*(\gamma))}{2} = \frac{p^s}{2}$$

Thus, the price of customized inputs relative to standardized inputs is

$$p^c/p^s = \frac{1}{f(q^*(\gamma))} \tag{7}$$

Because $q^*(\gamma)$ is increasing in γ, $\frac{\partial(p^c/p^s)}{\partial\gamma}$ is decreasing in γ. In a country with a poor legal system, the relative price of customized inputs to standardized inputs is higher than in a country with a better legal system.

2.3 Final Goods Production and the Pattern of Trade

Consider the case of two countries with judicial systems of different qualities. Denote the country with the lower quality judicial system by $'$, so that $\gamma > \gamma'$. The key result that ensures that the country with the better judicial system has a comparative advantage in contract-intensive industries (high z goods) is given in the following lemma, the proof of which is in Appendix A.

Lemma. *The ratio $c(p^s, \gamma, z)/c(p^{s'}, \gamma', z)$ of the cost of producing one unit of good z in the good judiciary country relative to the poor judiciary country is decreasing in z.*

From the lemma it follows that in an equilibrium with trade, the cost of producing some good (call this $\tilde{z}$) is equal in both countries. Further, goods for which $z < \tilde{z}$ will be produced in the country with the poor judicial quality, whereas goods for which $z > \tilde{z}$ will be produced in the country with the good judicial quality. This is shown in Figure 1, which displays the minimum cost functions for both countries as a function of z.[10]

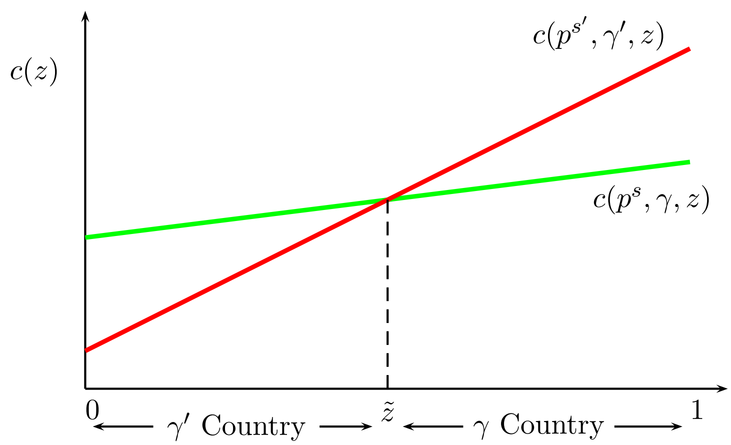

Figure 1: Specialization of production with two countries.

The determination of the equilibrium can be seen from Figure 1. The slope of each country's cost curve is fixed by γ and $a(z)$. Changes in $p^s/p^{s'}$ shift the costs curves vertically relative to one another, increasing or decreasing $\tilde{z}$ and the range of goods produced by each country, so that trade

[10]The cost curves are not restricted to be linear as drawn in the graph. This will only occur if $a(z)$ is increasing at a constant rate in z.

is balanced. The equilibrium values of $p^s/p^{s'}$ and $\tilde{z}$ are determined by two conditions: balanced trade, and equal costs of production for good $\tilde{z}$.

The following proposition, the proof of which is in Appendix A, states that for any two countries with different levels of judicial quality, there exists an unique equilibrium with trade.

Proposition. *For any two countries with $\gamma \neq \gamma'$ an equilibrium with trade exists and is unique.*

When there are more than two countries, each country specializes in an interval of goods. Because $a(z)$ is the same for all countries, differences in γ between countries result in differences in the slope of their minimum cost curves. The lower a country's γ, the steeper is the slope of the country's cost curve. Differences between the countries in the slopes of their cost curves ensures that each country specializes in a continuum of goods. If a country's cost curve lies everywhere above at least one other country's curve, then the wage in that country will decrease, so that the country becomes the lowest cost producer for some interval of goods. The decrease in the country's price paid for inputs will be determined by the country's balanced trade condition.

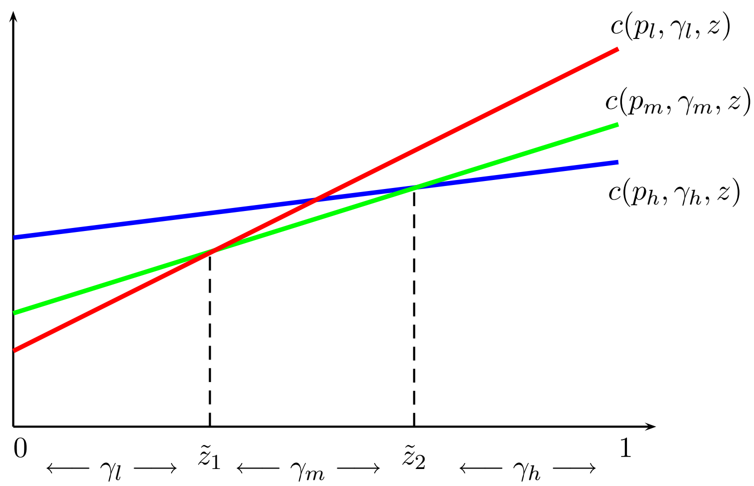

Figure 2: Specialization of production with three countries.

Figure 2 shows the equilibrium when there are three countries, each with a different level of γ. The country with the lowest γ specializes in the segment of the lowest z goods, $[0, \tilde{z}_1]$. The country with the intermediate level of γ specializes in the middle range of z goods, $[\tilde{z}_1, \tilde{z}_2]$. The high γ country specializes in the highest z goods, $[\tilde{z}_2, 1]$. The equilibrium for the case with N countries is described in Appendix B.

The model provides guidance when empirically testing for comparative advantage arising from imperfect contract enforcement. In Section 4, I use the model to motivate the equations that will be estimated. Before doing this, I first describe the data that I use.

3 The Data

Unless otherwise indicated, all data are from 1997. Trade data are from the World Trade Flows Database.[11] The original trade data are classified using the 4-digit SITC Rev. 2 system, which I convert to the IO1997 system. The export data are disaggregated into 223 industries and are available for 146 countries. I also use data on trade flows in 1963. These are from the United Nation's Comtrade database.

Measures of the capital, skill and material intensities of production in each industry are from the NBER-CES Manufacturing Industry Database. The data are for the United States in 1996.[12] Measures of factor endowments for each country are from Antweiler and Trefler (2002). I use the most recent year available from their data set, which is 1992.

As my primary measure of judicial quality, I use a variable from the Governance Matters III database called the 'rule of law'.[13] The variable is a weighted average of a number of variables that measure individual's perceptions of the effectiveness and predictability of the judiciary and the enforcement of contracts. A list of the countries in the analysis ordered by their measured rule of law is provided in Table 1.

The shortcoming of this measure is that it is not an objective measure of judicial quality. Objective measures are also available, but only for a smaller set of countries and only for 2003.[14] Using them reduces the number of countries in my sample from 146 to 93. I use these measures to test the robustness of my results; this is reported in Section 4.1.1.

The fact that my main measure is subjective is also a benefit. Objective measures of the judicial system fail to take into account informal mechanisms of contract enforcement, which the subjective measure is more likely to take

[11] See Feenstra (2000) for the full documentation of the data.
[12] These data are unavailable for 1997.
[13] See Kaufmann et al. (2003).
[14] These are from Djankov et al. (2003).

Table 1: Countries in the sample, ordered by rule of law.

Country	Rule of law	Country	Rule of law	Country	Rule of law
Switzerland	.972	Argentina	.548	Ecuador	.375
Singapore	.948	India	.543	Maldives	.370
Norway	.943	South Africa	.543	Kiribati	.369
New Zealand	.935	Turkey	.538	Solomon Islands	.369
Austria	.921	Egypt	.534	Colombia	.367
Finland	.912	Lebanon	.532	Yemen	.365
U.K.	.909	Guyana	.513	Niger	.360
Netherlands	.904	Belize	.507	Guatemala	.359
Australia	.898	Mongolia	.505	Pakistan	.357
Denmark	.897	Zimbabwe	.501	Bangladesh	.356
Canada	.896	Panama	.495	Sierra Leone	.356
Sweden	.890	Philippines	.492	Cambodia	.354
Germany	.881	Ghana	.488	Suriname	.353
Iceland	.880	Bhutan	.486	Russia	.345
Ireland	.863	Brazil	.482	Paraguay	.344
U.S.A.	.854	Sri Lanka	.479	Algeria	.342
Hong Kong	.846	Uganda	.477	Vietnam	.339
Japan	.844	El Salvador	.461	Nicaragua	.337
France	.789	Bulgaria	.457	Togo	.335
Qatar	.779	China	.456	Burundi	.330
Oman	.770	Ethiopia	.453	Centr. Afr. Rep.	.326
U.A.E.	.754	Jamaica	.452	Guinea	.322
Chile	.752	Romania	.451	Yugoslavia	.317
Taiwan	.734	Nepal	.450	Cameroon	.316
Kuwait	.731	Syria	.449	Albania	.304
Israel	.717	Senegal	.447	Comoros	.306
Italy	.714	Tanzania	.444	Indonesia	.305
Bahrain	.706	Gambia	.443	Chad	.304
Bahamas	.698	Papua New Guin.	.436	Haiti	.302
Mauritius	.692	Djibouti	.435	Madagascar	.298
Brunei Dar.	.683	Bolivia	.434	Mozambique	.297
Saudi Arabia	.679	St. Kitts	.433	Kenya	.296
Costa Rica	.676	Seychelles	.433	Myanmar	.288
Cyprus	.675	Zambia	.432	Laos	.286
South Korea	.664	Mexico	.425	Libya	.278
Malaysia	.663	Benin	.424	Afghanistan	.274
Hungary	.656	Fiji	.420	Rwanda	.259
Malta	.638	Burkina Faso	.415	North Korea	.258
Greece	.633	Peru	.412	Congo	.254
Czech Rep.	.623	Gabon	.404	Guinea-Bissau	.252
Jordan	.620	Mauritania	.403	Nigeria	.240
Poland	.615	Iran	.402	Angola	.211
Barbados	.610	Cuba	.400	Iraq	.164
Morocco	.607	Malawi	.397	Equatorial Guin.	.162
Uruguay	.599	Ivory Coast	.396	Liberia	.141
Tunisia	.588	Mali	.386	Somalia	.139
Thailand	.580	Honduras	.376	Zaire	.106
Trin. & Tobago	.577	Venezuela	.375		

Notes: In the table, the reported rule of law measures have been rounded from six digits to three digits.

into account. As shown in Appendix E, if one uses objective measures of the formal judicial system that do not take into account informal contract enforcement, this will tend to bias towards zero OLS estimates of the effect of contract enforcement on comparative advantage.

3.1 Constructing Measures of Relationship-Specificity: z_i

The last variable needed to test the model is a measure of the importance of relationship-specific investments across industries. I construct a variable that directly measures the relationship-specificity of intermediate inputs used in the production process. I use the 1997 United States input-output tables to identify which intermediate inputs are used and in what proportions in the production of each final good.

I then identify which inputs require relationship-specific investments. An investment is relationship-specific if its value outside of the relationship is significantly lower than inside. In the model, investments made to produce customized components are relationship-specific because the components are tailored to fit the needs of a final good producer. Alternatively, investments in generic components are not relationship-specific because many alternative buyers exist. As indicators of whether an intermediate input is relationship-specific, I use whether or not it is sold on an organized exchange and whether or not it is reference priced in a trade publication. If an input is sold on an organized exchange then the market for this good is thick, with many alternative buyers. If a good is not sold on an organized exchange, it may be reference priced. This indicates that multiple buyers exist, even though the market for this product is not thick enough for it to be bought and sold on an exchange. Goods not sold on an exchange but referenced in trade publications can be thought of as having an intermediate level of relationship-specificity. Goods can be classified into one of three categories: goods that are traded on an organized exchange, goods that are reference priced, and goods that are neither sold on an exchange nor reference priced.[15]

Combining the information from the United States input-output tables with information of which inputs are bought and sold on exchanges and which are reference priced, I am able to construct for each final good a measure of the proportion of its intermediate inputs that are relationship-

[15] This classification of goods is from Rauch (1999). Rauch has both a liberal estimate and a conservative estimate. Throughout the paper, I use the liberal estimate. None of the results of the paper are affected by this decision. The original classification groups goods by the 4-digit SITC Rev. 2 system. I convert this data to IO1997 classification by converting the 4-digit SITC to HS10, and HS10 to the IO1997 classification system.

specific. I construct two measures. One measure classifies reference priced goods as relationship-specific and the other measure classifies these goods as not being relationship-specific. I denote the two measures $rs1$ and $rs2$, where 'rs' stands for 'relationship-specific'. The first variable, z_i^{rs1}, measures the proportion of intermediate inputs used in industry i that are neither sold on an organized exchange nor reference priced, and the second variable, z_i^{rs2}, measures the proportion of components that are not sold on an organized exchange:

$$z_i^{rs1} = \frac{1}{u_i} \sum_j u_{ij} \, I_j^{neither}$$

$$z_i^{rs2} = \frac{1}{u_i} \sum_j u_{ij} \, I_j^{neither} + \frac{1}{u_i} \sum_j u_{ij} \, I_j^{ref\ price}$$

where u_{ij} is the value of input j used to produce goods in industry i; u_i is the total value of all inputs used in industry i; $I_j^{neither}$ is an indicator variable that equals one if the input is neither sold on an organized exchange or reference priced; and $I_j^{ref\ price}$ is an indicator variable that equals one if the input is not sold on an organized exchange but is reference priced. A list of the twenty least and twenty most contract intense industries using z_i^{rs1} is provided in Table 2.

As a test of the sensibility of my measures, I consider whether the measures are correlated with one another, and whether the measures are correlated with the extent of vertical integration in each industry.[16] I use two measures of vertical integration. One is derived from the BEA's make and use tables (denoted vi1) and the other combines information from Standard & Poor's Compustat North America Database with information from the BEA's use table (denoted vi2).[17] The correlations are shown in Table 3. As can be seen, the two measures of relationship-specificity are highly correlated. The correlation coefficient between z_i^{rs1} and z_i^{rs2} is .61. In addition both measures are positively correlated with the measures of vertical integration.

[16] As production requires more relationship-specific investments to be made, the costs of contracting and benefits of vertical integration will increase. Therefore, one would expect there to be more vertical integration in relationship-specific investment intense industries. See Klein, Crawford and Alchian (1978).

[17] The construction of both variables are described in detail in Appendix D.

Table 2: The 20 least and 20 most contract intense industries.

20 Least Contract Intense: lowest z_i^{rs1}		20 Most Contract Intense: highest z_i^{rs1}	
z_i^{rs1}	Industry Description	z_i^{rs1}	Industry Description
.023	Poultry processing	.801	Electromedical apparatus manuf.
.024	Flour milling	.801	Analytical laboratory instr. manuf.
.034	Petroleum refineries	.818	Air & gas compressor manuf.
.035	Wet corn milling	.819	Other electronic component manuf.
.050	Nitrogenous fertilizer manufacturing	.825	Other engine equipment manuf.
.053	Aluminum sheet, plate, & foil manuf.	.832	Packaging machinery manuf.
.056	Fiber, yarn, & thread mills	.839	Book publishers
.057	Primary aluminum production	.850	Breweries
.096	Rice milling	.854	Musical instrument manufacturing
.101	Coffee & tea manufacturing	.857	Electricity & signal testing instr.
.112	Prim. nonferrous metal, ex. copper & alum.	.875	Telephone apparatus manufacturing
.132	Tobacco stemming & redrying	.875	Aircraft engine & engine parts manuf.
.144	Other oilseed processing	.885	Search, detection, & navig. instr.
.150	Noncellulosic organic fiber manufacturing	.889	Broadcast & wireless comm. equip.
.150	Plastics packaging materials	.890	Aircraft manufacturing
.153	Nonwoven fabric mills	.894	Audio & video equipment manuf.
.157	Phosphatic fertilizer manufacturing	.895	Other computer peripheral equip. manuf.
.161	Resilient floor covering manufacturing	.956	Electronic computer manufacturing
.167	Carpet & rug mills	.974	Heavy duty truck manufacturing
.167	Synthetic dye & pigment manufacturing	.979	Automobile & light truck manuf.

Notes: In the table, the reported measures have been rounded from seven digits to three digits.

Table 3: Correlation coefficients between z_i^{rs1}, z_i^{rs2}, vi1, and vi2.

	z_i^{rs1}	z_i^{rs2}	vi1	vi2
z_i^{rs1}	1.0			
z_i^{rs2}	.61***	1.0		
vi1	.13*	.22***	1.0	
vi2	.25***	.21***	.27***	1.0

Notes: *indicates statistical significance at the 10% level; ***indicates statistical significance at the 1% level; $n = 214$.

4 Estimation and Results

To test the model, I use two different approaches. In one, I test the predictions of the model at the country-industry level. This approach is motivated by the two country version of the model. The lemma shows that when comparing the relative costs of two countries across industries, the cost of the country with the better judicial quality, relative to the country with the poor judicial quality, is decreasing in the contract-intensity of goods. Therefore, one should observe that the exports of the better judicial quality country relative to the poor quality country should be increasing in the contract-intensity of goods. To test this prediction, I compare the exports of country-pairs across industries. The second approach is to test the model at the country level. This is motivated by the multi-country version of the model, which predicts that across countries, the average contract-intensity of exports is increasing in judicial quality.

4.1 Industry-Country Level Analysis

Standard test of the Ricardian model take two countries and compares how their relative export volumes vary across industries. The Ricardian model predicts that the country that is relatively more efficient at producing in industry i should export relatively more in industry i. Tests of this nature have their origins with MacDougall (1951), Stern (1962) and Balassa (1963), and most recently have been performed by Golub and Hsieh (2000). MacDougall compared total exports to all countries by the United States and Britain in 1937. He found that across industries the ratio of U.S. exports relative to U.K. exports was positively correlated with the ratio of U.S. to U.K. labour productivities. That is, relative to the U.K., the U.S. exported more in industries where production was relatively more efficient.

I generalize these tests by comparing the relative export ratios of country-pairs for all countries in my sample. I test whether countries with good judiciaries have relatively higher exports of goods requiring greater relationship-specific investments. The model that I estimate is

$$\ln\left(\frac{x_{ic}}{x_{ic'}}\right) = \alpha_{cc'} + \beta_1 z_i + \varepsilon_{icc'} \tag{8}$$

where x_{ic} is country c's total exports to all countries in industry i; z_i is the contract-intensity of industry i; c denotes the country of the pair with the better legal system; c' denotes the country with the worse legal system; and $\alpha_{cc'}$ denotes controls for country-pair fixed effects. The model predicts that $\beta_1 > 0$: across industries, the ratio of exports in the good judiciary country relative to those in the poor judiciary country should increase as one moves from the least contract-intense industry to the most contract-intense industry.

In the model, differences in the slope of the cost functions increase the greater is the difference between γ and γ'. This can be seen in Figure 1. Holding constant γ, the more one decreases γ', increasing $\gamma - \gamma'$, the greater is the difference in slopes of the two curves. The curves will shift vertically to ensure that trade is balanced, but as one moves away from $\tilde{z}$, the cost differences between the two countries increases at a faster rate. This can also be seen in the multi-country version of the model, illustrated in Figure 2. Compare the cost curves of country γ_h to γ_m and γ_h to γ_l. From this it can be seen that the more dissimilar the judicial quality of the two countries, the more the slopes of their cost curves differ, and the more the difference costs increases as one moves away from $\tilde{z}$. I test this prediction of the model by including an interaction term of the difference in judicial quality and contract-intensity: $z_i(\gamma_c - \gamma_{c'})$. The equation becomes

$$\ln\left(\frac{x_{ic}}{x_{ic'}}\right) = \alpha_{cc'} + \beta_1 z_i + \beta_2\, z_i(\gamma_c - \gamma_{c'}) + \varepsilon_{icc'} \tag{9}$$

Because, by definition, γ_c is greater than $\gamma_{c'}$, β_2 is expected to be positive. The greater the difference in judicial quality between the two countries, the greater their cost differences, and the more cross-industry differences in contract-intensity will influence the pattern of exports. Further, when the interaction is included in the estimating equation, the expected coefficient for z_i is zero. To see this consider the case of two countries with equal judicial quality, $\gamma_c = \gamma_{c'}$. In this case the interaction term is equal to zero, and the expected variation in the export ratio across industries is equal to $\beta_1 z_i$. Because the two countries have identical cost curves, the pattern of trade should be unrelated to z, and therefore β_1 should be zero. Because I am not interested in the estimated coefficient of z_i when the interaction term is included in the regression, for my baseline specification, I estimate the equation with industry fixed effects. The fixed effects capture the potential influence of z_i, as well as other industry specific characteristics. Therefore, my baseline model is

$$\ln\left(\frac{x_{ic}}{x_{ic'}}\right) = \alpha_{cc'} + \alpha_i + \beta\, z_i(\gamma_c - \gamma_{c'}) + \varepsilon_{icc'} \tag{10}$$

Conceptually, I would like to compare every country-pair using the 146 countries in my data set. However, including every country-pair in a regression would involve a large amount of double counting. For example, once I compare the export ratios of Korea and Japan, and Taiwan and Japan, then I have implicitly compared Korea and Taiwan. The third regression equation can be calculated from the first two regression equations. Ultimately, it is sufficient to compare only 145 pairs of countries.[18] I compare each country relative to the United States. Because there are 214 industries, the number of possible observations is $145 \times 214 = 31,030$. However, an observation is only included in the regression if both countries export a non-zero amount in that industry. The number of actual observations in each regression is 21,598.

Table 4: Testing the model. Dependent variable is $\ln\left(\frac{x_{ic}}{x_{ic'}}\right)$.

	(1)	(2)	(3)
Contract intensity: z_i	.11	.01	
	(6.65)	(1.51)	
Judicial quality-contract intensity interaction: $z_i(\gamma_c - \gamma_{c'})$		.18	.18
		(19.3)	(21.9)
Country-pair FE	Yes	Yes	Yes
Industry FE	No	No	Yes
R^2	.77	.78	.82
Number obs.	21,598	21,598	21,598

Notes: Beta coefficients are reported, with t-statistics in brackets. The contract- intensity measure used is z_i^{rs1}. Standard errors in column 1 are adjusted for clustering within industries.

Estimation results are reported in Table 4, where z_i^{rs1} is the measure of contract-intensity used. Column 1 reports results when (8) is estimated. This specification does not include the interaction between the country-pair difference in judicial quality and contract-intensity across industries. As predicted by the model the coefficient on z_i is positive and statistically significant. In column 2, I estimate (9), which includes the judicial quality, contract-intensity interaction. As predicted by the model, the coefficient for the interaction is positive, while the coefficient for z_i is not statistically

[18] An alternative strategy is to estimate a regression that includes every possible country-pair, but to make the necessary adjustment to the standard errors. Doing this yields nearly identical results.

different from zero. In column 3, I estimate (10), which includes the interaction term with industry fixed effects. The estimated coefficient for the interaction term remains statistically significant. Overall, the predictions of the model are confirmed. Differences in judicial quality across countries are a significant determinant of comparative advantage. Countries with better judicial systems specialize in goods that are contract-intensive.

The magnitude of the estimated effects are economically significant. The estimated coefficient from column 3 implies that if South Africa could improve its contract enforcement to equal that of the United States, then its exports of commodities classified under "autos and light truck manufacturing" would increase from 41.7 to 351.2 million U.S. dollars each year. South Africa's share of these commodities in world exports would increase from 0.02 to 0.2%. If Thailand could improve its contract enforcement to equal Taiwan's, then its exports of "electronic computer manufacturing" commodities would increase from 2.8 to 8.1 billion U.S. dollars per year. Thailand's share of world production in these commodities would increase from 3.0 to 8.6%.

I control for additional sources of comparative advantage by including interaction terms between the country-pair difference in factor endowments and the factor intensity of production in each industry. I consider three factors of production: capital, skill, and raw materials. The availability of data on factor endowments and production intensities is more limited than for the data on judicial quality and contract-intensity. Data on factor endowments are only available for 70 countries and data on the factor intensities of production are only available for 177 industries, resulting in a maximum of $69 \times 177 = 12{,}213$ observations. Because of missing observations and zero exports, the actual number of observations in each regression is 10,518.

The results after controlling for alternative sources of comparative advantage are summarized in Table 5. In column 1, I re-estimate (10) using the smaller sample of countries and industries. Judicial quality remains an important determinant of the pattern of trade. In column 2, I estimate the model with capital and skill interactions included. The interactions test whether differences in the aggregate stock of capital and skilled labor between countries is a determinant of comparative advantage.[19] A positive coefficient suggests that the country with the higher stock of capital per worker exports relatively more in industries that are capital intense, and similarly for skill. This is what is predicted by endowments based mod-

[19]The justification for using these factor endowment interactions has been derived in Romalis (2004).

els of comparative advantage, such as the Heckscher-Ohlin model with a continuum of goods.[20]

Table 5: Controlling for factor endowments. Dependent variable is $\ln\left(\frac{x_{ic}}{x_{ic'}}\right)$.

	(1)	(2)	(3)	(4)	(5)
Judicial quality interaction: $z_i(\gamma_c - \gamma_{c'})$	.22		.21		.20
	(20.5)		(17.6)		(17.3)
Skill interaction: $h_i(h_c - h_{c'})$		.20	.13	.21	.14
		(15.0)	(9.69)	(15.5)	(10.2)
Capital interaction $k_i(k_c - k_{c'})$		.02	.10	−.01	.07
		(.98)	(5.76)	(−.56)	(4.26)
Materials interaction: $r_i(r_c - r_{c'})$				.13	.11
				(6.43)	(5.51)
Country-pair FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
R^2	.84	.83	.84	.83	.84
Number obs.	10,518	10,518	10,518	10,518	10,518

Notes: Beta coefficients are reported, with t-statistics in brackets. The measure of contract-intensity used is z_i^{rs1}.

Overall, the initial results, reported in column 2, are consistent with factor endowment based models of comparative advantage. The coefficients on both of the variables are positive as expected, although the coefficient for the capital interaction is not statistically significant. In column 3, I include the judicial quality interaction. The judicial quality interaction and the skill interaction remain positive and significant, and the capital interaction remains positive and becomes statistically significant. The estimated coefficient for the skill interaction decreases significantly, while the coefficient for the judicial quality interaction remains approximately the same size. In column 4, I include an additional factor endowment interaction. I interact the material intensity of production in an industry with the country-pair difference in the sum of forest, pasture and cropland per worker. The estimated coefficient is positive and statistically significant. Again, the capital interaction is insignificant. Column 5 reports the specification with all three endowment interactions included along with the judicial quality interaction.

[20] See Dornbusch, Fischer and Samuelson (1980) and Romalis (2004).

The coefficient of the judicial quality interaction remains positive and statistically significant. Again, the coefficient of the skill interaction decreases significantly, but remains significant. The capital interaction becomes positive and statistically significant. Overall, the results suggest that the result that the contracting environment affects the pattern of trade is robust to the inclusion of more traditional determinants of comparative advantage.

The relative magnitudes of the estimated coefficients suggests that the effect of judicial quality on specialization is approximately the same magnitude as the combined effects of human capital and physical capital. From the results of column 5, a one standard deviation increase in the judicial quality interaction, increases the dependent variable by .20 standard deviations, while a simultaneous one standard deviation increase in the skill per worker and capital per worker interactions increase the dependent variable by .21 standard deviations. One may be concerned that the importance of judicial quality relative to skill and capital endowments is a result of my estimated skill and capital coefficients being unusually low. However, the estimated magnitudes of these coefficients are similar to what other studies have found. For example, Levchenko (2004) estimates an equation that is very similar to my baseline equation with skill and capital factor endowment interactions included.[21] The estimated beta coefficients for his skill and capital interactions are .10 and .12, which are very similar to the magnitudes that I estimate here.

4.1.1 Robustness and Sensitivity Analysis

To test the robustness of my findings, I re-estimate (10), but use alternative measures of the ability of the judicial system to enforce contracts. I use four additional measures, of judicial quality taken from Djankov et al. (2003). One advantage of the measures is that they are objective measures that are not based on individuals' perceptions. The authors, in cooperation with Lex Mundi member law firms across the world, document the exact procedures used by courts and litigants to evict a tenant for non-payment of rent and to collect a bounced check. Using this information, the authors construct four variables that can be used as measures of the quality of the judicial system and contract enforcement: a procedural formalism index, a procedural complexity index, total litigation costs, and the duration of the

[21]This is reported Table 1, column 2 of Levchenko (2004). In this study the dependent variable is exports to the United States in 1998. The data for skill and capital endowments are from different sources, while the data for factor intensities are from the same source but constructed in a slightly different manner.

full legal procedure. I scale each variable so that the measure is increasing in formalism, complexity, total costs and duration.[22] Therefore, for each variable a higher number indicates a better judicial system.

Table 6: Alternative measures of judicial quality and contract-intensity. Dependent variable is $\ln\left(\frac{x_{ic}}{x_{ic'}}\right)$

	Contract intensity measure:	
Judicial quality measure:	z_i^{rs1}	z_i^{rs2}
Rule of law	.18	.27
($n = 21,598$)	(21.9)	(18.2)
Procedural Formalism	.13	.18
($n = 16,055$)	(16.0)	(11.6)
Litigation Costs	.06	.11
($n = 16,055$)	(6.80)	(6.66)
Complexity	.13	.16
($n = 16,462$)	(15.6)	(11.0)
Duration	.09	.09
($n = 16,634$)	(12.1)	(6.53)

Notes: Beta coefficients and t-statistics are reported for $z_i(\gamma_c - \gamma_{c'})$. Each regression includes industry fixed effects and country-pair fixed effects.

I re-estimate (10) using these alternative measures of the contracting environment. The results are summarized in Table 6. Because I have constructed two measures of contract-intensity and I have a total of five measures of judicial quality, I report the estimates from ten different regression equations. Each row of the table reports the estimated coefficient and t-statistic for the interaction term $z_i(\gamma_c - \gamma_{c'})$ when a measure of the contracting environment is used with each of the two measures of cross-industry contract-intensity. Reported in the first column of each row is the number of observations in each regression when that particular measure of the contracting environment is used. In each of the regressions, the estimated coefficient is positive and statistically significant. The finding that a

[22]See the Appendix B for more details.

country's contracting environment is an important determinant of its pattern of trade is not sensitive to the measures of the contracting environment and relationship-specificity that are used.

I perform a number of additional robustness checks. These are summarized in Table 7. In the first panel of the table, I omit observations with studentized standard errors greater than 2.0 and re-estimate (10).[23] The results are robust to the removal of outlying observations. Using either measure of contract-intensity, the coefficient of the interaction term is positive and statistically significant. In the second panel, I restrict my sample to OECD countries.[24] This serves as a check of whether the results are being driven by broad differences between developing and developed countries or whether the importance of judicial quality can be seen among the group of more developed countries. In addition, the quality of data among this group of countries is of reasonably good quality. Therefore, by dropping non-OECD countries, I am also testing the robustness of the results by omitting countries with lower quality data. The results continue to hold when the equation is estimated using only OECD countries. The estimated coefficients on the interaction terms remain positive and statistically significant. As an additional sensitivity check, I test whether my findings are robust to the time period being considered. I re-estimate (10) using data from 1963.[25] The trade data are from the UN's Comtrade database. Because the rule of law measure is not available for this year, I use a measure of each country's legal quality in 1970.[26] My 1963 sample includes 42 countries and 178 industries. As reported in the last panel of Table 7, the estimated coefficients for the judicial quality interactions are positive and statistically significant. In addition, the estimated beta coefficients are of a similar magnitude to the estimates for 1997. Overall, the estimates from 1963 confirm the findings for 1997.

[23]Studentized standard errors are calculated from a regression with the observation in question excluded. This methodology allows one to recognize an outlier that strongly influences the estimated regression line, resulting in a small standard error. See Belsley, Kuh and Welsch (1980).

[24]Defined as those countries that joined the OECD in or prior to 1997.

[25]I choose to report 1963 estimates because this is the earliest year for which data are available. I have also estimated the equations using data from 1967, 1972, 1977, 1982, 1987 and 1992, and the results are robust to each of these alternative samples. Unfortunately, one is unable to create a panel data set because the industry classification of the trade data and the production data are not consistent over time.

[26]I have also estimated the same equation using alternative measures of contract enforcement. Using GDP per capita in 1963 as a rough measure produces very similar results to what is reported here. Although the data on legal quality is from 1970 rather than 1963, I feel that it is a better measure than income per capita in 1963.

Table 7: Robustness of the results. Dependent variable is $\ln\left(\frac{x_{ic}}{x_{ic'}}\right)$.

	Contract intensity measure:	
	z_i^{rs1}	z_i^{rs2}
Outliers Omitted		
Judicial quality interaction:	.16	.27
$z_i(\gamma_c - \gamma_{c'})$	(22.7)	(21.9)
Number obs.	20,608	20,585
R^2	.88	.88
OECD Countries Only		
Judicial quality interaction:	.14	.27
$z_i(\gamma_c - \gamma_{c'})$	(10.0)	(12.1)
Number obs.	16,215	16,215
R^2	.71	.72
Using Data from 1963		
Judicial quality interaction:	.20	.33
$z_i(\gamma_c - \gamma_{c'})$	(9.80)	(7.90)
Number obs.	6,620	6,620
R^2	.68	.68

Notes: Beta coefficients are reported, with t-statistics in brackets. Each regression includes industry and country-pair fixed effects.

The final sensitivity check that I perform tests the robustness of my results to the use of the United States input-output tables when constructing my measure of contract intensity. Because highly disaggregated I-O tables do not exist for all countries, I am forced to assume that each country's intermediate input use is the same as in the U.S. For 51 of the 146 countries in my sample, I-O tables disaggregated into 57 sectors exist.[27] Using these tables, I construct measures of the similarity of each country's I-O table to the U.S. I-O table. I then re-estimate my baseline equation after restricting the sample to include only countries with I-O tables that are similar to the U.S. I-O table.

To construct a measure of similarity to the U.S., I follow Elmslie and Milberg (1992). I take the vector of final goods produced in the U.S. in 1997

[27] These are from the Global Trade Analysis Project (GTAP) Data Base version 5.4 for the year 1997.

Table 8: Robustness to the reliance on U.S. I-O tables for every country. Dependent variable is $\ln(\frac{x_{ic}}{x_{ic'}})$.

	Beta coef	t-stat	R^2	Number obs
All countries with I-O tables	.23	18.7	.79	9,524
Omitted if $\hat{\rho} < .5$	.25	18.3	.79	8,163
Omitted if $\hat{\rho} < .6$	.26	17.6	.78	7,130
Omitted if $\hat{\rho} < .7$	.26	16.1	.78	6,117
Omitted if $\hat{\rho} < .8$	.21	10.3	.73	4,805
Omitted if $\hat{\rho} < .9$	.17	4.77	.66	2,315

Notes: Each regression includes industry and country-pair fixed effects.

and, using the U.S. I-O table, I calculate the amount of each intermediate input that is used to produced this output vector. For every other country for which an I-O table is available, I use the country's I-O table and calculate the vector of intermediate inputs required to produce the same vector of outputs. I then compare each country's input vector with the U.S. input vector, by calculating the pairwise correlation coefficient of the two vectors. Using this measure, I omit countries from the sample that have I-O tables that are different from the U.S. I-O table. This procedure tests whether the results are affected by my assumption that all countries use intermediate inputs in the same proportions as the United States.

The results of this robustness test are summarized in Table 8. I report estimates of (10) with z_i^{rs1} used as my measure of contract-intensity.[28] Each row reports the results from one regression. In the first row, I only include the 51 countries that have comparable I-O tables. In the subsequent rows, I exclude countries with I-O tables that are dissimilar to the U.S. I-O table. I first omit countries with a correlation coefficient less than .5, then .6, and so forth. The results remain robust to the omission of countries that have input-output structures different from the U.S. In all samples, the estimated coefficient of interest remains positive and of a similar magnitude to the estimate of .18 from the full sample.

[28]The results when z_i^{rs2} is used are not reported because of space limitations. They are qualitatively identical to the results when z_i^{rs1} is used.

4.1.2 Endogeneity and Omitted Variables Bias

In this section, I correct for the possibility of omitted variables bias. When estimating (10), I assume that the true model is

$$\ln\left(\frac{x_{ic}}{x_{ic'}}\right) = \alpha_{cc'} + \alpha_i + \beta z_i(\gamma_c - \gamma_{c'}) + \varepsilon_{icc'} \tag{11}$$

However, this model may be mis-specified, omitting important country characteristics. Instead, the true model may be

$$\ln\left(\frac{x_{ic}}{x_{ic'}}\right) = \alpha_{cc'} + \alpha_i + \beta z_i(\gamma_c - \gamma_{c'}) + \delta g_i(g_c - g_{c'}) + \varepsilon_{icc'}$$

where the variable g_c is the true underlying determinant of trade specialization, and g_i is the true industry characteristic that matters for comparative advantage. If z_i and g_i or γ_c and g_c are correlated, and one estimates (11) using OLS, then the estimate of β will be biased and inconsistent. The estimated coefficient may be significant only because it is correlated with the true determinants of specialization.

To correct for this potential bias, I pursue a number of different strategies. My first strategy is to control for a number of alternative determinants of comparative advantage that if omitted may bias my results. The results of this are summarized in Table 9. In the first column, I include an interaction that controls for the possibility that high income countries specialize in high value added goods. Including this interaction changes the judicial quality interaction coefficient very little. I also include an interaction between income and the amount of intra-industry trade in each industry, measured usin.[29] My results may be biased because high income countries tend to have high levels of trade in these industries. The estimated coefficient for this interaction is large and statistically significant, but the estimated coefficient and significance of the judicial quality interaction changes little. In the third column, I control for the possibility that high income countries may have a comparative advantage in dynamic industries where technological progress is rapid. To control for this possibility, I interact income with total factor productivity (TFP) growth between 1977 and 1997 for each industry in the United States. Again, the results remain robust to the inclusion of this variable.

[29] I use the Grubel-Lloyd index from the United States in 1997 as my measure of the amount of intra-industry trade in each industry.

Table 9: Controlling for other determinants. Dependent variable is $\ln\left(\frac{x_{ic}}{x_{ic'}}\right)$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Judicial quality interaction: $z_i(\gamma_c - \gamma_{c'})$	.18	.17	.17	.18	.20	.16	.19	.20
	(21.9)	(19.0)	(20.2)	(20.1)	(20.4)	(18.4)	(18.8)	(16.0)
Income, value added: $va_i(y_c - y_{c'})$		.01					$-.05$	$-.03$
		(1.06)					(-3.03)	(-1.46)
Income, intra-industry trade: $iit_i(y_c - y_{c'})$			.19				.22	.21
			(20.8)				(20.4)	(16.6)
Income, TFP growth: $\Delta tfp_i(y_c - y_{c'})$				.01			$-.00$	$-.01$
				(.85)			($-.49$)	(-2.48)
Credit/GDP, capital: $k_i(cr_c - cr_{c'})$					.04		.02	.04
					(4.64)		(2.86)	(2.97)
Income, input variety: $(1 - HI_i)(y_c - y_{c'})$						.34	.19	.18
						(11.5)	(4.30)	(3.46)
Factor endowment interactions	No	No	No	No	No	No	No	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.82	.84	.83	.84	.84	.82	.84	.84
Number obs.	21,598	17,529	20,797	17,529	15,473	21,526	15,338	10,518

Notes: Beta coefficients are reported, with t-statistics in brackets. The measure of contract-intensity used is z_i^{rs1}.

Next, I control for the possibility that countries that have better developed financial systems may have a comparative advantage in industries that require a large amount of external financing. I include an interaction of the ratio of private credit to GDP of each country with the capital intensity of each industry.[30] The coefficient for the judicial quality interaction remains robust.

The last control variable that I include is motivated by the work of Clague (1991a), Blanchard and Kremer (1997), Cowan and Neut (2002), and Levchenko (2004). I include an interaction between income and one minus the Herfinahl index of input concentration in each industry. A small Herfindahl index indicates that an industry uses a wide variety of inputs. Therefore, one minus the Herfindahl index will be larger the wider the range of inputs that is used. The interpretation of the one minus the Herfinahl index measure differs slightly in the different studies. Clague (1991a) views the variable as a measure of how 'self-contained' the industry is. His hypothesis is that because developing countries have poorly developed transportation, communication and distribution infrastructures, they will specialize in production that is 'self-contained'. Blanchard and Kremer (1997), Cowan and Neut (2002) and Levchenko (2004) interpret the variable as measuring the 'complexity' of a good. Because complex goods rely more heavily on institutions than simple goods, high income countries, with superior institutions, should specialize in these more complex goods. Both interpretations of the measure predict a positive coefficient for the interaction term. High income countries should specialize in industries that use a wide variety of inputs. As reported in column 6, this is found in the data. As well, the coefficient of the variable of interest remains robust to the inclusion of this variable.

In column 7, I include all five of the control variables simultaneously. In column 8, I also add the three factor endowment interactions. In both cases, the coefficient of interest remains positive and significant.

The second strategy that I pursue is the use of instrumental variables (IV). The validity of this strategy rests on the existence of instruments that are uncorrelated with the omitted variables. The instruments can be used to isolate variation in the variable of interest that is uncorrelated with the omitted variables. As instruments, I use the legal origin of each country. Previous empirical work has found that the quality of the judicial system

[30] I have also tested the robustness of my results using a number of different measures of financial development. I have used private credit by deposit money banks and other financial institutions to GDP, stock market capitalization to GDP, and stock market total value traded to GDP. The results are robust to the use of each of these alternative measures.

is higher in British common law countries than in French civil law countries, and that German and Scandinavian civil law countries are found to lie between the French and British legal systems.[31]

Estimation results are reported in Table 10. The results from the first stage are summarized in the bottom panel of the table. The coefficient for each legal interaction term is statistically significantly, and the F-statistics are high. The signs of the coefficients are as expected. Because the omitted category is Scandinavian legal origin, all coefficients are relative to this category. The signs and magnitudes of the coefficients suggest that British legal origin countries have the best rule of law, followed in order by German, Scandinavian, Socialist and French.[32]

The estimates of the second stage are reported in the top panel of the table. For comparison, in columns 1 and 3, I report the OLS results with and without factor endowment interactions included in the regression equation. Columns 2 and 4 report the corresponding IV estimates. In both specifications, the IV coefficients are similar in magnitude to the OLS estimates, and are statistically significant. The Hausman test rejects the null hypothesis of consistency of OLS for both specifications, suggesting that judicial quality is endogenous. The results from tests of the over-identification restrictions are mixed. Without factor endowment interactions, the Chi-Squared test statistic is 12.0 and the null hypothesis can be rejected at the 1% significance level. But, with factor endowment interactions, the test statistic is 2.46 and the null hypothesis cannot be rejected at any standard significance level. The tests show that unless the factor endowment interactions are included in the second stage, the instruments are correlated with the second stage error term. One explanation for this is that a country's legal origin and the resulting quality of the judicial system affect trade by facilitating the accumulation of physical and human capital. If one does not control for each country's factor endowments, legal origin appears to have an effect on trade flows through other channels. But once one controls for factor endowments, legal origin does not appear to have any additional effect on trade flows.

Despite controlling for factor endowments in the second stage, there is still the possibility that my instruments may be correlated with the second stage error term. To correct for this possibility I use the following strat-

[31] See La Porta et al. (1998) and Mahoney (2001).

[32] Because factor endowment data are not available for any of the Socialist countries, this dummy variable is not available as an instrument when factor endowment interactions are included in the second stage. This is why a coefficient estimate is not reported for this variable in column 4 of the table.

Table 10: IV Regressions using legal origin.

	OLS (1)	IV (2)	OLS (3)	IV (4)
Second Stage: Dep var is $\ln\left(\frac{x_{ic}}{x_{ic'}}\right)$				
Judicial quality interaction: $z_i(\gamma_c - \gamma_{c'})$	.18	.26	.20	.46
	(21.9)	(15.15)	(17.3)	(13.9)
Skill interaction: $h_i(h_c - h_{c'})$			.14	.05
			(10.2)	(3.19)
Capital interaction: $k_i(k_c - k_{c'})$			.07	.18
			(4.26)	(8.21)
Country-pair FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
R^2	.82	.82	.84	.83
Number obs.	21,598	21,598	10,518	10,518
Hausman t-statistic		5.12		8.10
Over-id test: $nR^2 \sim \chi^2$		12.0		2.46
First Stage: Dep var is $z_i(\gamma_c - \gamma_{c'})$				
British interaction: $z_i(B_c - B_{c'})$		.30		.33
		(15.8)		(14.1)
French interaction: $z_i(F_c - F_{c'})$		−.26		−.20
		(−15.2)		(−9.25)
German interaction: $z_i(G_c - G_{c'})$		.08		.08
		(9.84)		(7.03)
Socialist interaction: $z_i(S_c - S_{c'})$		−.25		
		(−21.7)		
R^2		.33		.25
F-statistic		2,704		1,152

Notes: Beta coefficients are reported, with t-statistics in brackets. The measure of contract-intensity used is z_i^{rs1}. In the first stage, the omitted category is Scandinavian legal origin.

egy. I continue to use differences in legal origin as a measure of differences in the quality of the judicial system, except I now restrict my analysis to comparisons of British and French legal origin countries only.[33] I compare the export ratio of British common law countries relative to French civil law countries. I restrict my comparison to country-pairs that are have similar measures of important variables that may bias my estimates if not controlled for. Conceptually, this estimation procedure compares the pattern of trade between two countries that are similar in important ways, except for the origin of their judicial system. By restricting my sample to matched country-pairs, I remove bias that may exist in my estimates if the differences in these particular characteristics of the countries were ignored.[34]

I match countries based on variables that may be affected by legal origin and which may in turn affect a country's comparative advantage: real GDP per capita, financial development, trade openness, and factor endowments. I continue to use the same measures of financial development and factor endowments as before. Trade openness to trade is defined as the sum of aggregate exports and imports divided by total income. By matching countries using these measures, I hold constant important channels through which legal origin may affect trade other than the quality of the judicial system and its ability to enforce control. I am controlling for influence that legal origin may have on the pattern of trade through it effect on the level of economic development, factor accumulation, financial development or trade orientation.

To match countries based on multiple characteristics, I match countries using their estimated propensity score, which is constructed as follows.[35] My legal origin dummy variable is given by

$$L_c = \begin{cases} 0 & \text{if legal origin} = \text{French civil law} \\ 1 & \text{if legal origin} = \text{British common law} \end{cases}$$

I estimate the probit equation

$$P_c = \Pr\{L_c = 1 \,|\, \mathbf{X_c}\} = \Phi(\mathbf{X_c'}\beta)$$

[33]In the data set there are 16 socialist, 6 German and 5 Scandinavian legal origin countries. An additional strategy is to include German and Scandinavian civil law countries with the French civil law countries. This is not done because there are significant differences between the French, German and Scandinavian systems. Including all civil law systems together does not alter the results of the paper.

[34]This is often referred to as subclassification. Cochran (1968) show that five subclasses are often sufficient to remove over 90% of the bias due the subclassifying variable. Using the matching technique constructs much more than 5 subclasses.

[35]See Rosenbaum and Rubin (1983, 1984).

Table 11: Comparing matched British common law and French civil law countries. Dependent variable is $\ln\left(\frac{x_{i\text{B}}}{x_{i\text{F}}}\right)$.

	Matched by				
	Per-capita Income	Factor Endowments	Financial Development	Trade Openness	All Variables
Contract intensity: z_i	.05 (2.63)	.17 (8.17)	.04 (2.65)	.07 (4.63)	.06 (2.51)
Country-pair FE	Yes	Yes	Yes	Yes	Yes
R^2	.19	.26	.20	.30	.20
Number obs.	5,046	4,177	4,714	4,166	4,122

Notes: Beta coefficients are reported, with t-statistics in brackets. Standard errors have been adjusted for clustering within industries. The measure of contract-intensity used is z_i^{rs1}.

where $\Phi(\cdot)$ is the normal CDF; $\mathbf{X_c'}$ is the vector of the variables that are used to match the countries. After calculating each country's predicted propensity score, $\hat{P}_c$, for each British common law country B, I choose the French civil law country F that minimizes the distance between the propensity scores of the two countries. That is, for each B, the matched F satisfies

$$\text{F}(\text{B}) = \arg\min_{\text{F}} |\hat{P}_{\text{B}} - \hat{P}_{\text{F}}| \ \ \forall \ \ \text{F} \in \{F\}$$

where F denotes the set of French legal origin countries. This procedure is often referred to as the nearest neighbor matching method.

Using the sample of matched country-pairs, I estimate the following equation:

$$\ln\left(\frac{x_{i\text{B}}}{x_{i\text{F}}}\right) = \alpha_{cc'} + \beta z_i + \varepsilon_{icc'} \tag{12}$$

where $x_{i\text{B}}$ and $x_{i\text{F}}$ denotes total exports from a British and French legal origin country in industry i. The results are reported in Table 11. Reported in the first column are the OLS estimates of (12) when country pairs are matched by per-capita income. The results show that the exports of British common law countries relative to French civil law countries are increasing in the contract-intensity of the goods produced. The estimated coefficient is positive and statistically significant. Among British-French country-pairs at the same level of economic development, British legal origin countries tend to specialize in goods that are contract-intense. The results are similar when country-pairs are matched by endowments of skill and capital. This is reported in the second column in Table 11. The estimated coefficient is positive and statistically significant. In the third and fourth columns country-pairs are matched by level of financial development and by trade openness. Again, the results show that British legal origin countries specialize in contract-intense goods. In the fifth column, country-pairs are matched using all variables: GDP per capita, factor endowments, financial development and trade openness.[36] Again, the results indicate that British legal origin countries specialize in goods that use most intensely relationship-specific investments.

Using either matching or instrumental variables to correct for the possibility of omitted variables bias, the OLS results are supported. The results continue to show that countries with good judicial systems export goods that are contract-intense, while countries with poor judicial systems tend to export goods that are not contract-intense.

4.2 Country Level Analysis

In the equilibrium of the multi-country version of the model, each country specializes in an interval of goods. The country with the lowest γ specializes in the interval of the least contract-intensive goods, the country with the second lowest γ specializes in the next interval of goods, and so forth. This prediction of the model can be tested empirically. To see this consider the following measure of the average contract-intensity of exports,

$$Z_c = \frac{1}{x_c} \int_{\underline{z}_c}^{\bar{z}_c} x_{ic}(z)\, z \,\mathrm{d}z$$

where x_{ic} denotes total exports of country c in industry i, and x_c denotes total exports of country c in all industries. The model predicts that the better a country's judicial quality γ_c, the higher will be its average contract-intensity of exports Z_c.

To test this prediction of the model, for each country, I construct the finite version of Z_c:

$$Z_c = \frac{1}{x_c} \sum_i x_{ic}\, z_i$$

I construct two measures of Z_c, using both measures of z_i. I then estimate the following equation

$$Z_c = \beta_0 + \beta_1 \gamma_c + \varepsilon_c \tag{13}$$

[36] I have also tried matching based on different subsets of variables. This yields very similar results to what I report here.

Table 12: Country-level regressions in 1997. Dependent variable is Z_c.

	z_i used to construct Z_c			
	z_i^{rs1}	z_i^{rs2}	z_i^{rs1}	z_i^{rs2}
	All Observations		Outliers omitted	
Rule of law: γ_c	.30	.27	.38	.32
	(3.77)	(3.35)	(4.81)	(3.95)
Number obs.	146	146	141	141
R^2	.09	.07	.10	.10

Notes: Beta coefficients are reported, with t-statistics in brackets.

Table 13: Country-level regressions in 1963. Dependent variable is Z_c.

	z_i used to construct Z_c			
	z_i^{rs1}	z_i^{rs2}	z_i^{rs1}	z_i^{rs2}
	All Observations		Outliers omitted	
Legal quality: γ_c	.57	.41	.72	.56
	(4.37)	(2.80)	(6.39)	(4.14)
Number obs.	42	42	40	40
R^2	.32	.16	.52	.31

Notes: Beta coefficients are reported, with t-statistics in brackets.

The results are reported in Table 12. For both measures, the estimated relationship between the average contract-intensity of exports and judicial quality is positive and statistically significant. In the third and fourth columns of the table, I test the robustness of the results by omitting outlying observations. The coefficient for the rule of law remains positive and statistically significant.

To further test the robustness of the results, I re-estimate (13) using the 1963 data. The results are reported in Table 13. In the first two columns, I estimate (13) using both measures of z_i. The estimated coefficients in both regressions are positive and statistically significant. In the third and fourth columns, I re-estimate (13) after omitting outlying observations. Again, the coefficients remain positive and statistically significant.

Overall, the country-level results provide added support for the findings at the country-industry level. Countries with better contracting environments specialize in goods that require relationship-specific investments.

5 Conclusions

I test whether a country's contracting environment is an important determinant of its comparative advantage and resulting pattern of trade. To test for this, I construct two measures of the importance of relationship-specific investments in each industry. Both variables measure the relationship-specificity of intermediate inputs used to produce each final good. Using the measures, I find that differences in the contracting environment across countries are an important determinant of what goods countries export. Countries with good contract enforcement specialize in industries for which relationship-specific investments are important.

A Proofs

Lemma. *The ratio* $c(p^s, \gamma, z)/c(p^{s'}, \gamma', z)$ *of the cost of producing one unit of good* z *in the good judiciary country relative to the poor judiciary country is decreasing in* z.

Proof. The minimum cost function for each good z is given by

$$c(p^s, p^c, z) = p^s + p^c a(z)$$

Using (7), this can be rewritten

$$c(p^s, \gamma, z) = p^s[1 + a(z)/f(q^*(\gamma))]$$

The cost of the good judiciary country relative to the poor judiciary country is given by

$$\frac{c(p^s, \gamma, z)}{c(p^{s'}, \gamma', z)} = \frac{p^s}{p^{s'}} \left[\frac{1 + a(z)/f(q^*(\gamma))}{1 + a(z)/f(q^*(\gamma'))}\right]$$

which can be rewritten

$$\frac{c(p^s, \gamma, z)}{c(p^{s'}, \gamma', z)} = \frac{p^s}{p^{s'}} \left[1 - \frac{f(q^*(\gamma'))^{-1} - f(q^*(\gamma))^{-1}}{a(z)^{-1} + f(q^*(\gamma'))^{-1}}\right]$$

Because $a(z)$ is increasing in z, $c(p^s, \gamma, z)/c(p^{s'}, \gamma', z)$ is decreasing in z. □

Proposition. *For any two countries with $\gamma \neq \gamma'$ an equilibrium with trade exists and is unique.*

Proof. Because consumers' preferences are Cobb-Douglas, the constant expenditure share $b(z)$ is given by

$$b(z) = \frac{P(z)C(z)}{Y + Y'} > 0$$

where $P(z)$ is the price of good z, $C(z)$ is the consumption of good z by both countries, and Y and Y' are the aggregate incomes in each country. The fraction of total income spent on goods produced by the country with the better judiciary is $\int_{\tilde{z}}^{1} b(z)\,\mathrm{d}z$ and the fraction spent on goods from the country with the poor judiciary is $\int_{0}^{\tilde{z}} b(z)\,\mathrm{d}z$.

For trade to be balanced, the amount spent by each country on the other's goods must be equal:

$$\int_{0}^{\tilde{z}} b(z)\,\mathrm{d}zY = \int_{\tilde{z}}^{1} b(z)\,\mathrm{d}zY' \tag{14}$$

Total income is given by $Y = f(q^*(\gamma))p^c L^c + p^s L^s$. Using (7), the expression for income becomes $Y = p^s(L^c + L^s) = p^s L$, where L is the endowment of labour in the country. Analogously, income for the country with the poor judicial system is given by $Y' = p^{s'} L'$. Substituting the expressions for Y and Y' into (14), and rearranging yields:

$$\frac{p^s}{p^{s'}} = \frac{\int_{\tilde{z}}^{1} b(z)\,\mathrm{d}z}{\int_{0}^{\tilde{z}} b(z)\,\mathrm{d}z}\left(\frac{L'}{L}\right) \equiv B(\tilde{z}; L'/L)$$

$B(\tilde{z}; L'/L)$ is continuous and decreasing in z. We have $B(1; L'/L) = 0$, and $B(\tilde{z}; L'/L) \to \infty$ as $\tilde{z} \to 0$.

The second condition that must be satisfied is equality of the cost of the good that is produced by both countries: $c(p^s, \gamma, \tilde{z}) = c(p^{s'}, \gamma', \tilde{z})$. This condition is equivalent to

$$\frac{p^s}{p^{s'}} = \frac{1 + a(\tilde{z})/f(q^*(\gamma'))}{1 + a(\tilde{z})/f(q^*(\gamma))} \equiv C(\tilde{z})$$

From the lemma, it follows that $C(\tilde{z})$ is increasing in $\tilde{z}$, and because $a(\tilde{z})$ is continuous, it follows that $C(\tilde{z})$ is also continuous.

Because $B(\tilde{z}; L'/L)$ and $C(\tilde{z})$ are continuous in $\tilde{z}$, $C(\tilde{z})$ is increasing in $\tilde{z}$, and $B(\tilde{z}; L'/L)$ is strictly decreasing in $\tilde{z}$ and ranges from zero to infinity, it follows that there exists an equilibrium that is unique; this is illustrated in Figure 3. □

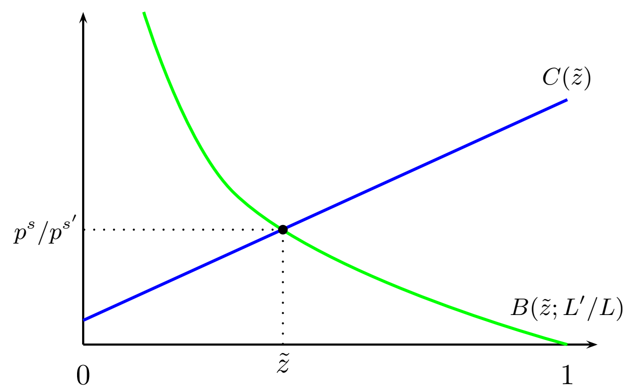

Figure 3: Existence and uniqueness of the equilibrium.

B N Country Equilibrium

Consider the general case with N countries. I order these countries from 1 to N in increasing order of γ, such that $\gamma_1 < \gamma_2 < \ldots < \gamma_{N-1} < \gamma_N$.

For each country $i = 1, \ldots, N$, the following balance of trade condition must hold.

$$\sum_{j \neq i} p_j^s L_j \int_{\tilde{z}_{i-1}}^{\tilde{z}_i} b(z)\, \mathrm{d}z = p_i^s L_i \left(\int_0^{\tilde{z}_{i-1}} b(z)\, \mathrm{d}z + \int_{\tilde{z}_i}^1 b(z)\, \mathrm{d}z \right)$$

where $\tilde{z}_{i-1}$ and $\tilde{z}_i$ are the lower and upper cut-offs for country i, i.e. country i produces goods $z \in [\tilde{z}_{i-1}, \tilde{z}_i]$.

These conditions give $N-1$ independent equations. The balance of trade condition for the N^{th} country follows from the balance of trade condition of the other $N-1$ countries. In addition, $N-1$ equal cost conditions must be satisfied. For each $i = 1, \ldots, N-1$:

$$\frac{p_{i+1}^s}{p_i^s} = \frac{1 + a(\tilde{z}_i)/f(q^*(\gamma_i))}{1 + a(\tilde{z}_i)/f(q^*(\gamma_{i+1}))}$$

The balanced trade and equal cost conditions for each country provide $2N-2$ equations. Choosing any country's input price as the numéraire equal to one results in an additional equation so that there are $2N-1$ equations in total. There are $2N-1$ unknowns: $N-1$ cut-offs, $\tilde{z}_1, \ldots, \tilde{z}_{N-1}$, and N input prices rates, $p_1^s, \ldots, p_N^s$.

C Data

C.1 Industry-Level Data

Contract intensity ($\mathbf{z_i}$): This measures the importance of relationship-specific investments in each industry. Source: author's calculations. See the paper for a complete description of the measures that are constructed.

Capital intensity ($\mathbf{k_i}$): Capital stock, calculated as the total real capital stock in industry i (in millions of dollars), divided by the value added (in millions of dollars) in industry i for the United States in 1996. Source: NBER-CES Manufacturing Industry Database. The original data are classified according to the SIC87 system. This is converted to IO1997 by using the concordance from SIC87 to HS10, and then HS10 to IO1997. Both concordances are provided by the BEA.

Skill intensity ($\mathbf{h_i}$): The ratio of non-production worker wages to total wages in industry i in the United States in 1996. Source: NBER-CES Manufacturing Industry Database.

Material intensity ($\mathbf{r_i}$): The total cost of materials used in industry i divided by the total value of industry shipments in industry i in the United States in 1996. Source: NBER-CES Manufacturing Industry Database.

Exports ($\mathbf{x_{ic}}$): The total value (in thousands of U.S. dollars) of exports to all other countries by country c in industry i in 1997. Source: World Trade Flows Database. The original data are classified using the 4-digit SITC Rev. 2 classification system, which is converted to the IO1997 classification system, by first using the concordance from SITC to HS10, and the concordance from HS10 to IO1997. The first concordance is from the NBER Trade Database, Disk 1. The second concordance is from the BEA. Data from 1963 are from the UN's Comtrade database. In the original data goods are classified by the 4-digit SITC Rev. 1 system. The trade data are converted to the IO1963 classification system using a concordance from SITC Rev. 1 to SIC72, which the IO1963 system is based on. The concordance is from the NBER and is described in Feenstra (1996).

Value added ($\boldsymbol{va}_\mathbf{i}$): Total value added divided by the total value of shipments in industry i in 1997.

Intra-industry trade ($\boldsymbol{iit}_\mathbf{i}$): The amount of intra-industry trade in each industry. I use the Grubel-Lloyd index for the United States in 1997. The index is equal to $1 - \frac{|x_i - m_i|}{x_i + m_i}$, where x_i and m_i are exports and imports in industry i.

TFP growth ($\boldsymbol{\Delta tfp_i}$): Average growth rate in TFP in the United States between 1977 and 1997 in industry i. Source: NBER-CES Manufacturing Industry Database.

1 minus Herfindahl Index ($\boldsymbol{1 - HI_i}$): The Herfindahl index for industry i is given by $\sum_j u_{ij}^2$, where u_{ij} is the value of inputs j used to produce final good i. The measure was constructed using the 1997 United States use table.

C.2 Country-Level Data

Real per capita GDP ($\mathbf{y_c}$): Real GDP per capita in 1997. I use 'rgdpch' from the Penn World Tables (PWT) Mark 6.1 data set. Income data from Maddison (2001) are used for countries without 1997 PWT income data. I link the two measures based on the following cross-country regression: rgdpch1997 = 288.1184 + 1.145986 maddison1997. For the regression $n = 100$, $R^2 = .9767$, the t-statistic for β_0 is 1.66, and the t-statistic for β_1 is 64.13.

Capital endowment ($\mathbf{k_c}$): Log of the average capital stock per worker in 1992. Source: Antweiler and Trefler (2002).

Human capital endowment ($\mathbf{h_c}$): Log of the fraction of workers that completed high school to those that did not complete high school in 1992. Source: Antweiler and Trefler (2002).

Endowment of productive land ($\mathbf{r_c}$): Log of the total area of land per worker that is used as either cropland, pasture, or forest in 1992. Source: Antweiler and Trefler (2002).

Rule of law ($\gamma_\mathbf{c}$): The rule of law in 1998. The variable, which ranges from 0 to 1, measures the extent to which agents have confidence in and abide by the rules of society. These include perceptions of the incidence of crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts. A higher number indicates a better rule of law. Source: Kaufmann et al. (2003).

Procedural formalism: An continuous index ranging 0 to 7 that measures the procedural formalism of dispute resolution for each country. Because higher formalism is associated with a lower quality of the legal system, I use 7 minus the formalism measure. Therefore, a higher number indicates a less formal and a higher quality judicial system. Source: Djankov et al. (2003).

Complexity: An continuous index ranging 0 to 7 that measures the complexity of the judicial process. For the original measure, 7 is the highest level of complexity. I use 7 minus complexity in my analysis, so that a higher number indicates less complexity and a better legal system. Source: Djankov et al. (2003).

Litigation costs: The sum of attorney fees and court fees during the litigation process, divided by per capita GNI. The measure that I use is 600 minus costs. Therefore, a higher number indicates lower costs of litigation and a better legal system. Source: Djankov et al. (2003).

Duration: The total estimated duration of the full legal procedure in calendar days. It equals the sum of duration until completion of service of process, duration of trial, and duration of enforcement. I use 1,500 minus duration. Therefore, a higher number indicates a shorter duration and a better legal system. Source: Djankov et al. (2003).

Legal quality: A measure of the "legal structure and the security of property rights" in 1970. The measure is an index from 1 to 10, which is comprised of five component indices also from 1 to 10. The component indices are from two sources: the *International Country Risk Guide* (ICRG) and the *Global Competitiveness Report* (GCR). The component indices measure: judicial independence (GCR), impartial courts (GCR), protection of intellectual property (GCR), military influence in the rule of law and political process (ICRG), and the integrity of the legal system (ICRG). Source: Gwartney and Lawson (2003).

Legal origin: The legal origin of each country. Countries are classified as either: German, Scandinavian, British, French or Socialist. Source: La Porta et al. (1999).

Financial development (cr_c): Private credit by deposit money banks to GDP in 1997. Source: Financial Structure and Economic Development Database. See Beck, Demirgüç-Kunt and Levine (1999).

D Constructing Measures of Vertical Integration

A measure of vertical integration requires data on the goods used and produced by firms in each industry. These data are available for firms in the United States input-output accounts. Data on the goods used by firms in each industry are available from use tables, while data on the goods produced in each industry are available from make tables. My measure of vertical integration is the fraction of goods that are used and made by firms in industry i, relative to all goods used by firms in industry i. To do this, I first construct the indicator variable,

$$I_{ij} = \begin{cases} 1 & \text{if } m_{ij} > 0 \\ 0 & \text{otherwise} \end{cases}$$

where m_{ij} is the value of goods j that are produced by an establishment whose primary production is good i. Using this variable, I construct the following measure:

$$\text{vi1} = \frac{1}{N_{J^*}} \sum_{j \in J^*} \text{I}_{ij}$$

where J^* is the set of inputs j that satisfy: $j \neq i$ and $u_{ij} \neq 0$; N_{J^*} is the number of inputs in set J^*;[37] and u_{ij} is the value of inputs j used by firms in industry i.

I construct a second measure of vertical integration because of the following short-coming of the first measure. The surveys used to construct the input-output tables are at the establishment level, where an establishment is defined as a unit of production in one geographic location. The establishment level surveys are then aggregated to the industry level. Therefore, any inputs that are produced at one location and then used at another location are not be included in the make tables.

For the second measure, I construct an artificial make table using production data from Standard & Poor's Compustat North America Database. Although the database only includes publicly traded companies in the United States and Canada, it does provide detailed production data at both the firm and establishment level. The production data are classified according to NAICS. I aggregate the data to the IO1997 classification system and construct a make table and use this to calculate a second measure of vertical integration, vi2, using the same procedure as for vi1.[38]

E Bias From Mis-Measured Variables

If a country has a poorly functioning formal judicial system, then informal means of enforcing contracts may develop as a substitute for the formal judicial system. Let γ_c^* denote the true measure of the quality of the contracting

[37] That is, I assume that the primary good produced in the industry is the final good and therefore exclude it when constructing the measure.

[38] When creating the artificial make table, I use Compustat data from the years 1996 to 1998. I do this to smooth out noise that may occur in the data because of strategic reporting that occurs in the financial reports of the publicly traded companies.

environment and γ_c the observed measure. Because $\gamma_c = 1$ is the measure of a perfect contracting environment, $1-\gamma_c$ is a measure of contracting imperfections. Because γ_c does not take into account informal forms of contract enforcement, it will overstate contracting imperfections in countries with a poor contracting environment. That is $1-\gamma_c$ will be larger than $1-\gamma_c^*$. Motivated by this, I assume that the relationship between γ and γ_c takes the following form:

$$1-\gamma_c = \frac{1-\gamma_c^*}{\phi} + w_c \tag{15}$$

where $\phi < 1$. This specification captures in a simple way the fact that informal mechanism of contract enforcement will act as a substitute for a formal judicial system when the formal judicial system is ineffective. This specification also allows for the existence of classical measurement error, captured by w_c, which is assumed to be i.i.d. drawn from a normal distribution. Rearranging (15) gives

$$\gamma_c = \frac{\gamma_c^*}{\phi} - \frac{1-\phi}{\phi} - w_c \tag{16}$$

At the industry level, the more important are relationship-specific investments in an industry, the greater the benefit to vertical integration, which will help alleviate some of the under-investment arising because of imperfect contract enforcement. Let z_i^* denote the true measure of the importance of contracts across industries that takes into account the ability of the firm to vertically integrate with its suppliers. My measure is z_i which measures the relationship-specificity of inputs. For higher values of z_i the benefit to vertical integration is greater, and vertical integration is more likely. Therefore, for higher values of z_i, the greater will be the measurement error: $z_i - z_i^*$. The following relationship between z_i and z_i^* captures this logic:

$$z_i = \frac{z_i^*}{\eta} + v_i \tag{17}$$

where $\eta < 1$ and v_i is i.i.d. drawn from a normal distribution.

Expressing all variables as deviations from their means, the true relationship between trade flows, the contracting environment, and contract-intensity is given by,

$$\ln x_{ic} - \ln x_{ic'} = \beta\, z_i^*(\gamma_c^* - \gamma_{c'}^*) + \varepsilon_{ic} \tag{18}$$

Because my estimating equation uses the observed variables rather than the true measures, the estimated coefficient is

$$\hat{\beta} = \frac{\sum_{ic} z_i(\gamma_c - \gamma_c')(\ln x_{ic} - \ln x_{ic'})}{\sum_{ic} z_i^2(\gamma_c - \gamma_{c'})^2} \tag{19}$$

Substituting (16), (17) and (18) into (19) and taking the probability limit of $\hat{\beta}$ gives,

$$\text{plim}\,\hat{\beta} = \beta\,\eta\phi \left\{ \frac{\sigma_{z^*}^2 \sigma_{\gamma^*}^2}{\sigma_{z^*}^2 \sigma_{\gamma^*}^2 + \phi^2 \sigma_{z^*}^2 \sigma_w^2 + \eta^2 \sigma_{\gamma^*}^2 \sigma_v^2 + \eta^2 \phi^2 \sigma_v^2 \sigma_w^2} \right\}$$

Two sources of measurement error are apparent. One is classic errors-in-variables. The denominator in the brackets is larger than the numerator. Therefore, there is attenuation bias. The other results because of the existence of informal contract enforcement across countries and vertical-integration across industries. Even if classical measurement error is absent in the data, with $\sigma_w^2 = \sigma_v^2 = 0$, the estimate of β is still asymptotically biased downward: $\text{plim}\,\hat{\beta} = \beta\,\eta\phi < \beta$.

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