Essays on Trade and Institutions

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Essays on Trade and Institutions

Thesis directed by Professor Keith Maskus

My dissertation examines the relationship between trade and institutions. Throughout the chapters of my dissertation, I consider three types of institutions: commercial arbitration regimes, formal institutions, and informal institutions. With an analytical modeling, a computational modeling, and an empirical approach, I offer new insights into trade and institutions.

In the first essay, I provide a new framework for analyzing the effect of the quality of commercial arbitration regimes on sourcing patterns by introducing commercial arbitration into a two-country sourcing model. This model permits each country's final good producers to source a customized intermediate input domestically or globally. In this sourcing process, an intermediate input supplier might shave investment quality, and a final good producer might not pay in full for the investment. When such opportunistic behavior occurs, commercial arbitration may be invoked. Then, an arbitrator, who fully verifies investment value, determines awards. Nonetheless, opportunism is not removed due to the national arbitration regimes' imperfect support for enforcement of awards. I show that relative global sourcing increases (decrease) with each country's quality of international (domestic) commercial arbitration regimes. Relative global sourcing also falls with the degree to which relationship-specific transactions are required to produce the intermediate input. I provide empirical results supporting these predictions using a new measure I construct for the qualities of domestic and international commercial arbitration regimes. Indeed, this essay shows the significance of arbitration regimes in mitigating opportunism in sourcing, which, to date, has been overlooked.

In the second essay, I shed light on the new role of international trade as a channel through which formal institutions of a country with rich informal institutions are developed. In my two-country, two-sector, two-factor computable general equilibrium model, formal institutions endoge-

nously arise based on exogenously endowed informal institutions. This model carries a distinctive view that formal and informal institutions substitute for one another in generating institutional quality, expressed as a CES aggregate form of the two institutions. Institutional quality governs the productivity of the institutionally intensive sector with increasing returns to scale technology and the trade cost coming from imperfect contract enforcement. By comparative statics using simulations, I show that in open economies, formal institutions tend to increase with informal institutions through improving institutional comparative advantage and lowering the trade cost. This creates a contrast in that formal institutions fall with informal institutions under autarky.

In the last essay, I provide new empirical evidence of the positive causal impact of institutional comparative advantage on the quality of institutions. These institutions are measured by the constraints on the behavior of policy makers, which correspond to formal institutions in the second essay. My cross-sectional analysis is based on a novel measure I construct for country-level institutional comparative advantage using the revealed comparative advantage index. To show the causal impact, variation in countries' population densities averaged over the past 30 years is utilized to provide exogenous variation in institutional comparative advantage between the countries. According to the instrumental variable estimates, a 1 percent rise in institutional comparative advantage leads to at least a 0.12-0.22 percent increase in institutional quality. This result shows the importance of exporting institutionally intensive goods in achieving high-quality institutions, which has received little attention in previous studies regarding trade and institutions.

Dedication

To my parents who have guided me to find my own way in life.

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I would like to thank my parents for having taught me the value of hard work and having infinitely trusted my potential, which has given me the strength to overcome challenges during my graduate years.

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Chapter 1

Introduction

Trade and institutions are necessarily tied together in that trade is formed by the relationship between economic agents, and institutions are one of the fundamental sources to constrain the behavior of economic agents. This dissertation attempts to study how they are interrelated to better understand trade patterns and different qualities of institutions across countries. Specifically, this dissertation focuses on uncovering new dimensions of the relationship between trade and institutions by considering three types of country-specific institutions: commercial arbitration regimes, formal institutions, and informal institutions.

Arbitration, a private dispute resolution mechanism, is of growing importance. According to Ali and Huang (2012, p. 79), arbitration cases in China surged from 7,394 to 74,811 between 1999 and 2009. Even though arbitration use has greatly increased in China, one of the main source countries for the world's production, arbitration has never been examined in a sourcing model. In general, institutions have rarely been examined in the literature on global sourcing under the assumption of non-verifiability of investment. Since investment is not contractible under this assumption, there is no room for examining institutions that can resolve incomplete contract enforcement issues.

Therefore, in the first essay of this dissertation, I assume that investment is fully verifiable in order to examine how institutions, specified to national commercial arbitration regimes, affect sourcing patterns. Under this full-verifiability assumption, firm behavior is solely dependent on how fully arbitration regimes support the enforcement of arbitral awards, referred to as the qual-

ity of commercial arbitration regimes. The model predicts that relative global sourcing increases with the quality of international commercial arbitration regimes, while falling with the quality of domestic regimes. The fundamental reason for a firm's opportunistic behavior is that a transaction is relationship-specific. Thus, I additionally consider the degree to which relationship-specific transactions are required for production to explain sourcing patterns. I find that relative global sourcing falls as this degree rises, which captures that firm's preference of domestic sourcing over global sourcing in the presence of a court's partiality towards local firms that deters the enforcement of arbitral awards made in international arbitration. These predictions are empirically supported with my measure of the quality of arbitration regimes, constructed by using the 2010 World Bank's Arbitrating and Mediating Dispute database.

The second and the third essays in this dissertation are closely related in that formal institutions are endogenized through comparative advantage in institutionally intensive industries. These essays are motivated by the history of the Maghribi traders in the 11th century. Specifically, the traders organized a coalition, a private-order institution, to overcome employed agents' opportunistic behavior of embezzling the traders' capital. That is, when there were few legal contracts, informal institutions, supported by a reputation mechanism, were able to substitute for formal counterparts in generating institutional quality. However, the reputation mechanism became insufficient to overcome the opportunism as trade volume grew (Greif, 1989, p. 879-81). This issue created the Law Merchant: "the legal codes governing commercial transactions and administered by private judges drawn from the commercial ranks" (Milgrom et al., 1990, p. 4). Indeed, this story of the Maghribi traders evidences that informal institutions can substitute for formal institutions, and formal institutions can evolve through the growth of trade.

With this motivation in mind, in the second essay, I endogenize formal institutions under the distinctive assumption that informal institutions are exogenously given and formal-informal interaction gives rise to institutional quality. Acting as a public intermediate good, institutional quality governs productivity of the institutionally intensive sector with increasing returns to scale technology and trade cost incurred due to imperfect contract enforcement. Specifically, based on a

given level of informal institutions, the government optimally chooses the level of formal institutions, which are financed by a tax on the labor input. In this setting, I show that under open economies, formal institutions tend to increase with the level of informal institutions through the great scale effect, generated by improving comparative advantage in the institutionally intensive sector, and decreasing the trade cost incurred by imperfect contract enforcement. In contrast, under closed economies, formal institutions fall with the level of informal institutions because of the absence of the institutional comparative advantage. These results show the importance of international trade for the countries with rich informal institutions in developing formal institutions.

In the third essay, I quantify the causal impact of having institutional comparative advantage on the quality of institutions. I exclusively consider political institutions, the quality of which is measured using the variable of executive constraints in the Polity IV dataset. For cross-sectional analysis, I construct a novel measure for country-level institutional comparative advantage by employing the revealed comparative advantage index of Balassa (1965). Using each country's population density averaged over the past 30 years as an instrumental variable for institutional comparative advantage, I find that a 1 percent rise in institutional comparative advantage contributes to at least a 0.12-0.22 percent growth of institutional quality. This shows the significance of trade for the countries that have institutional comparative advantage in achieving high-quality institutions, thereby conveying trade and growth policy implications in that great institutions attained through trade are expected to promote economic growth.

My dissertation, indeed, contributes to literature on trade and institutions by shedding light on several unknown ways in which trade and institutions are interrelated by carefully observing data and by drawing implications from historical events. It not only helps to better understand trade patterns but also derives rich policy implications on international trade and institutions.

Chapter 2

Global Sourcing Patterns, Commercial Arbitration Regimes, and Relationship-Specific Transactions

2.1 Introduction

Arbitration, a private procedure leading to a binding and final resolution, is of growing importance in dispute settlement. The number of requests for arbitration to the International Chamber of Commerce (ICC), which is one of the main institutions administering arbitration processes, increased from 529 to 801 between 1999 and 2015.[1] This growth of arbitration is supported by the 2006 global survey result of the prominent use of arbitration by corporations, which was conducted by the School of International Arbitration at Queen Mary University of London.[2] Specifically, of the 103 surveyed corporations that were engaged in foreign transactions, 54 percent used international arbitration.[3] Seventy-three percent of the same respondents chose international arbitration as their preferred resolution mechanism in cross-border disputes. Transnational litigation was chosen by only 11 percent of them.

Particularly, the number of arbitration cases in China surged from 7,394 to 74,811 between 1999 and 2009 (Ali and Huang 2012, p. 79). Given that China is the main manufacturer in the

[1] See the ICC website: http://www.iccwbo.org.

[2] This survey targeted corporations that engage in cross-border transactions. A total of 143 corporations in various industries participated, which were mainly from the Middle East, Europe, and Asia. Specifically, 103 corporations completed an online questionnaire, and 40 corporations were interviewed. The surveyed corporations whose annual turnovers are more than US$5 billion, between US$500 million and US$ 5 billion, and averaging US$500 million account for 19 percent and 29 percent, and 25 percent of the respondents, respectively. For details, see http://www.arbitration.qmul.ac.uk/research/2006/123975.html.

[3] Nineteen percent of the 103 surveyed corporations did not use dispute resolution mechanisms. Thus, of the corporations that used dispute resolution mechanisms, about 67 percent used international arbitration.

world's production and that a great volume of transactions necessarily entail commercial disputes, this substantial increase might evidence that arbitration has been increasingly used to resolve international commercial disputes in the process of global sourcing. Despite this possibility under the growing significance of arbitration in resolving disputes, arbitration has never been introduced into sourcing models. Moreover, sourcing models have rarely considered institutions under the assumption of non-verifiability of investments.[4] In this paper, I fill these gaps by introducing arbitration into a two-country sourcing model and by considering institutions specified to national arbitration regimes as a solution to opportunism.

To be clear, building on Antràs (2003, 2005), I analyze the effects of international and domestic commercial arbitration regimes' quality on global sourcing patterns in a general-equilibrium framework. Even though arbitration provides for a binding and final resolution, if a resulting arbitral award is not fully and voluntarily paid by a party, then a claimant has to rely on national arbitration regimes to collect the award. In this case, without the national regimes' full support for enforcement of the award, the claimant cannot collect the totality of the award. Thus, national arbitration regimes play a key role in enforcing arbitral awards, which in turn affects a firm's ex-ante opportunistic behavior.

I focus on transactions between an intermediate input supplier (IIS) and a final good producer (FGP). Each FGP in the two countries globally or domestically sources a customized intermediate input. The model permits two opportunistic behaviors, as in Antràs and Foley (2015). The IIS might shave the value of the intermediate input and the FGP might not pay in full after the ordered products arrive. When such opportunism occurs, domestic and international commercial arbitration can proceed under the choices of domestic and global sourcing, respectively. Then, how fully arbitration regimes support the enforcement, which is referred to as the quality of arbitration regimes, determines the firms' ex-ante behaviors. Further, the incomplete enforcement of arbitral awards of countries makes relationship-specificity (rs) intensity matter. The rs intensity refers to the degree in which firms intensively use a component requiring a relationship-specific (rs)

[4] For example, see Grossman and Helpman (2002) and Antràs (2005).

transaction to produce a good. In this setting, I analyze how rs intensity affects sourcing patterns. I also examine how the individual effects of arbitration regimes' quality and rs intensity are related.

This paper builds on the literature on incomplete contract enforcement and relationship-specific investments. Since Williamson (1975, 1979), Goldberg (1976), and Klein et al. (1978) developed a concept of transaction-specific and specialized investments that are linked to opportunism, researchers have combined this concept with comparative advantage. That is, while focusing on contract enforcement as the main role of institutions based on North (1990), researchers have shown that countries with better institutions tend to have comparative advantage in industries for which the relationship between the parties tied up within contracts is important (Levchenko, 2007; Nunn, 2007; Costinot, 2009). My paper takes a different step by considering relationship-specificity and the incomplete enforcement of arbitral awards as a setting for examining global sourcing patterns.

This paper also builds on the literature on firm organization and incomplete contracts. This line of research takes a property rights approach, following Coase (1937). That is, if there are high costs in specifying provisions that are contingent on every possible situation, firm integration is emphasized as a way to reduce transaction costs by obtaining rights to control another party's assets (Grossman and Hart, 1986; Hart and Moore, 1990). This property rights approach has received more development from Antràs (2003, 2005) and Antràs and Helpman (2004), illustrating how incomplete contracts affect a firm's organization mode between vertical integration and outsourcing. This literature tends to assume non-verifiability of investments that leads to non-contractibility. Hence, this non-verifiability assumption does not give room for examining contract enforcement. When partial-verifiability is allowed, verifiable investments are contractible and contract enforcement is assumed to be automatically achieved (Grossman and Helpman, 2005).

This paper focuses on the enforcement problem of arbitral awards by taking a new approach. It assumes full verifiability of investment by a capable arbitrator when commercial disputes occur. This allows the value each party is supposed to receive to be stipulated in a contract. Even in this seemingly non-risky case, a firm's opportunism is not removed due to the imperfect national arbitration regimes' support for enforcement of arbitral awards. Thus, what matters in attenuating

opportunism is the quality of commercial arbitration regimes, which in turn determines a firm's sourcing mode and trade pattern.

To see why the full verifiability assumption is needed, consider the case where partial verifiability of investment is allowed. In this case, a firm's opportunism will be affected by the partial verifiability as well as the quality of commercial arbitration regimes. Specifically, the non-verifiable portion of an investment is non-contractible, which affects the opportunism. Since commercial arbitration hinges on contracts, which I will explain later, this portion is not affected by commercial arbitration regimes. On the contrary, the verifiable portion of the investment is contractible, and hence the opportunism depends on enforcement of an arbitral award, which is ultimately determined by the quality of commercial arbitration regimes. Therefore, the full verifiability assumption ensures that a firm's opportunistic behavior arises solely due to the imperfect arbitration regimes, which simplifies the analysis of the effect of the quality of commercial arbitration regimes on firm behavior.

The enforcement issue matters even in the case where intermediate inputs are sourced from an integrated firm within a multinational firm's boundary. If a country's arbitration regimes do not support enforcing an arbitral award, the financial loss incurred due to opportunism is assumed to become a sunk cost regardless of whether a transaction occurs within a multinational's boundary. The multinational would neither seize nor sell the integrated firm's assets to cover the loss since they belong to the multinational itself. Thus, this assumption allows for concentrating on two modes of sourcing throughout this paper: domestic and global sourcing.

I exclusively discuss commercial arbitration, which is defined as a "private, nongovernmental process, fashioned by contract, which provides for the binding resolution of a dispute through the decision of one or more private individuals selected by the disputants" in Stromberg (2007, p. 1341).[5] According to the footnote in Article (1) of the United Nations Commission on International Trade Law (UNCITRAL) Model Law on International Commercial Arbitration (henceforth,

[5] Actually, this definition is made for "international" commercial arbitration by Stromberg because he only looks at international disputes in his paper. Thus, when both domestic and international disputes are examined, this definition is not limited to international commercial arbitration.

the Model Law), "[T]he term commercial should be given a wide interpretation so as to cover matters arising from all relationships of a commercial nature, whether contractual or not." Commercial arbitration is different from investment arbitration, in that investment arbitration rests on either an investment treaty, bilateral treaty (BIT), investment law of the host state, or investment agreement.[6]

The definition of international arbitration can be understood by Article 1 (3) of the Model Law, which distinguishes international arbitration from domestic arbitration based on the place of business and the place of arbitration.[7] Specifically, there are four conditions under which an arbitration is considered international: i) the places of business of the parties are in different states, ii) the place of arbitration is outside of the state in which their businesses are situated, iii) the place where their obligations are mainly performed or the place in which the dispute's subject matter is mainly involved is outside of the state in which their businesses are situated, and iv) the parties explicitly agreed that more than one country is involved in the subject matter of the arbitration agreement.

Foreign arbitral awards, defined as "arbitral awards made in the territory of a State other than the State where the recognition and enforcement of such awards are sought" in Article I of the Convention on the Recognition and Enforcement of Foreign Arbitral Awards (henceforth, the New York Convention), must be enforced by a signatory of the New York Convention. However, the awards may not be enforced on the grounds of Article V of this convention that permits national courts to refuse rendered foreign awards, either at the request of a party against whom the awards are made or by the court in the country where the enforcement is sought.

Thus, when the respondent's country lacks regimes that enforce a foreign arbitral award, Article V is used as grounds for nullifying the award that is rendered against a local firm. For example, in the case of United World Ltd. Inc. v. Krasny Yakor, the Russian Court of Cassation did not enforce an award rendered by the ICC on the grounds of Russian public policy. That is,

[6] For details, see Böckstiegel (2012) and the fourth footnote of Pouget (2013, pp. 5-6).

[7] In fact, the distinction between domestic and international arbitration depends on national law (Bergsten 2005, p.12).

the award would cause Red Anchor, a Russian respondent, to be bankrupted, which would in turn harm the Russian economy as a whole. It was therefore against the public interest (Glusker 2010, p. 13). As another example, in the case of Forever Maritime v. Masbinoimport, a foreign company could not enforce an arbitral award against a Russian state-owned company because the Russian court ruled that the foreign company did not duly notify the Russian company of the place and time for arbitration hearings. Even though the foreign company presented evidence that they, in fact, sent a notification, the court ruled that it was not certified and refused to enforce it (Budylin 2009, p. 156).[8]

In addition, when the claimant finds it difficult to collect a resulting foreign award from the respondent, she has to rely on the local court to enforce the awards. If the respondent's assets are in the claimant's country, she can confiscate them to collect the award with the confirmation of the local court.[9] Therefore, both countries' international arbitration regimes determine the enforcement of the arbitral awards that are made in international arbitration.[10] Given the assumption of the full verifiability of the investment of an intermediate input, a claimant can fully recover her financial loss as long as a respondent voluntarily pays a resulting award. What determines parties' ex-ante behaviors is the qualities of their countries' commercial arbitration regimes, regardless of the place where arbitration occurs. Likewise, the quality of domestic arbitration regimes determines the enforcement of awards made in domestic arbitration, which also affects parties' ex-ante behaviors.

When an opportunistic behavior occurs, each party may initiate commercial arbitration to cover a financial loss rather than just accepting the loss. With a higher quality of arbitration regime, the loss is more likely to be covered through arbitration proceedings. Since arbitration acts as an outside option for a party who suffers a loss by another party's opportunistic behavior, a higher quality of arbitration regimes (i.e., the higher value of the outside option) of each party

[8] Budylin (2009) shows various cases regarding this protectionism of the Russia court towards local firms. See also Berkowitz et al. (2006, p. 365) for the case of a Brazilian court's partiality towards local firms.

[9] Zawadski (2008, pp.137-39) describes how claimant's court affects the enforcement of a foreign award by giving an example of medical outsourcing, which is based on a pending case.

[10] In fact, domestic arbitral awards may be made in international arbitration. This will be explained in Section 2.6.2. Even in this case, both countries' international arbitration regimes matter in enforcing the awards.

better mitigates opportunism. Thus, as the quality of the international commercial arbitration regime rises, opportunism is reduced, which in turn attracts more global sourcing. Similarly, a higher quality domestic arbitration regime expands domestic sourcing by the FGP.

Under this mechanism in the model, when one country's FGP chooses global sourcing, the other country's FGP chooses domestic sourcing, in equilibrium, with certain conditions. Equilibrium production is derived by backward induction in the presence of a lump-sum transfer from an IIS, which was introduced by Antràs (2003, 2005). The results show that global sourcing relative to the foreign source country's domestic sourcing rises (falls) with the quality of international (domestic) commercial arbitration regimes in each country. In addition, relative global sourcing decreases with the rs intensity of the intermediate input. Intuitively, as rs intensity is higher, an FGP is more exposed to opportunism in both global and domestic sourcing. However, this risk is lower when using domestic sourcing since arbitral awards are better enforced through domestic arbitration than international arbitration due to a court's partiality towards local firms.

To empirically test these results, I construct a new measure for the country-specific domestic and international commercial arbitration regime's quality using the 2010 World Bank's Arbitrating and Mediating Dispute (AMD) survey, which exclusively covers commercial arbitration.[11] Specifically, I choose the 29 survey questions that are related to the enforcement matter of arbitral awards for the construction of this measure. I additionally construct a measure for an industry-specific rs intensity. This construction is based on the classification of internationally traded commodities by Rauch (1999). Specifically, following Nunn (2007), if an input is neither traded on an organized exchange nor reference priced, the input is considered to require an rs transaction. Otherwise, it is considered as an input that does not require an rs transaction. To construct rs intensity measure, I also use the World Input-Output Database (WIOD) that allows for measuring countries' input and output shares for each output industry. Then, an industry-specific rs intensity is measured by the sum of the weighted proportions of the inputs requiring an rs transaction by the shares of these inputs of an industry and by countries' output shares of the industry.

[11] For details about the AMD survey, see Pouget (2013).

The empirical results support the theoretical predictions, while controlling for a substantial portion of variation that may generate reverse causality. Specifically, a 1 percent rise in the quality of the source (destination) country's international commercial arbitration regimes contributes to a 15.53–15.68 percent (15.43–15.68 percent) increase in global sourcing relative to the source country's domestic sourcing. In contrast, a 1 percent rise in the quality of the source (destination) country's domestic commercial arbitration regimes leads to a 12.39–12.50 percent (12.58–12.91 percent) fall in relative global sourcing. In addition, a 1 percent rise in the rs intensity of an input industry leads to a 1.91 percent fall in relative global sourcing.

These results show that the quality of commercial arbitration regimes and rs intensity are important determinants of global sourcing patterns. They further imply that private resolution mechanisms play a key role in determining sourcing patterns, and that firms avoid choosing risky sourcing modes that are subject to opportunism.

The rest of this paper is organized as follows. Sections 2.2 and 2.3 develop a model in which rs intensity and the qualities of domestic and international commercial arbitration regimes determine sourcing patterns. Section 2.4 discusses the general-equilibrium results. Section 2.5 characterizes the empirical model. Section 2.6 describes the data employed and how the measures are constructed, and Section 2.7 discusses empirical results. Section 2.8 concludes.

2.2 General Setting

Consider two countries, i and j, where consumption and production structures are symmetric. Firms produce a continuum of differentiated varieties, ω, of a single good, y. A representative consumer in country j maximizes the following utility function:

$$u_j = \left[\int_{\omega=0}^{n_i} y_{ij}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega + \int_{\omega=0}^{n_j} y_{jj}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}}, \tag{2.1}$$

where $y_{ij}(\omega)$ ($y_{jj}(\omega)$) is the quantity demanded of variety ω in j, which is produced in i (j), n_i (n_j) is the number of differentiated varieties of the good y produced in i (j), and $\sigma > 1$ is the elasticity of substitution between any pair of varieties.

Utility maximization yields the following demand function:

$$y_{ij}(\omega) = \lambda_j p_{ij}(\omega)^{-\sigma}, \quad y_{jj}(\omega) = \lambda_j p_{jj}(\omega)^{-\sigma}, \tag{2.2}$$

where $p_{ij}(\omega)$ ($p_{jj}(\omega)$) is the price of ω in j, which is produced in i (j),

$$\lambda_j = \frac{E_j}{P_j^{1-\sigma}} = \frac{E_j}{\int_{\omega=0}^{n_i} p_{ij}(\omega)^{1-\sigma} d\omega + \int_{\omega=0}^{n_j} p_{jj}(\omega)^{1-\sigma} d\omega}, \tag{2.3}$$

where P_j and E_j are country j's price index and aggregate spending, respectively. Firms take λ_j as exogenously given, implying a constant price elasticity of demand.

To produce one unit of y, a final good producer (FGP) needs to globally or domestically source one unit of customized intermediate input, x, from an intermediate input supplier (IIS). Technology for the production of x follows a Cobb-Douglas function:

$$x(\omega) = \left(\frac{R}{\theta}\right)^{\theta} \left(\frac{N}{1-\theta}\right)^{1-\theta}, \tag{2.4}$$

where R is the component that requires a relationship-specific (rs) transaction, and N is the component that features a non-relationship-specific ($non\text{-}rs$) transaction. The customization of the intermediate input for the FGP's taste comes from R only. $\theta \in (0,1)$ represents the degree to which each IIS intensively uses the R component requiring rs transactions to produce x, which is referred to as rs intensity. Note that R and N are produced by the same IIS.

One way to conceptualize R and N components is using the classification of internationally traded commodities by Rauch (1999). Following Nunn (2007), if a component is neither traded on organized exchanges nor reference priced, then the component is considered as R. Otherwise, the component is considered as N. In Section 2.6.3, rs intensity is empirically measured using this classification.

The R and N components can be either high-quality or low-quality. For the production of each high-quality component, one unit of labor is required. On the contrary, a low-quality component can be produced at a negligible cost and has no value. For example, workers can produce low-quality R and N components with negligible effort at the same time while producing

high-quality R and N components. x can be produced regardless of the qualities of R and N using the technology in equation (2.4). Firms separately measure the value of R and N in terms of the value of the final good produced by using each of them. Thus, even if x is comprised of one low-quality component, the other high-quality component generates some portion of the value that a final good is supposed to have. The technology in equation (2.4) and the input requirements of R and N imply that the marginal cost of x, which is comprised of both high-quality components, is equal to the wage in i, meaning that one unit of labor in i is required to produce one unit of x. Once x is sourced from an IIS, the FGP notices the value of each R and N. The FGP can produce y without further cost. However, for the sales of one unit of y, the FGP should hire one unit of labor.

2.3 Firm Behavior with Commercial Arbitration

2.3.1 Commercial Arbitration

I consider two opportunistic behaviors between the FGP and IIS, as in Antràs and Foley (2015). The FGP might not pay in full for the investment of the IIS after the intermediate inputs arrive, and the IIS might produce low-quality components, which lowers the value of the intermediate inputs. They make a contract including the provision that a party may proceed to arbitration when such opportunistic behavior occurs. They also specify, in the contract, a value of V that a party is supposed to receive. The FGP should pay exactly the value the IIS produces. Thus, V can be the value of the investment of intermediate inputs that are supposed to be produced by the IIS and can be the payment that is supposed to be made by the FGP.

Imagine a situation in which an opportunistic behavior occurs by one party, and the other party initiates arbitration. They agree with the choice of an arbitrator who is fair and fully capable of verifying the quality of x and converting it into value.[12] If the respondent is the FGP who

[12] The arbitrator is one of the labors in either i or j.

initially paid less than V, this full verifiability assumption ensures the following relationship:

$$\text{Resulting arbitral award} + \text{initial payment by a respondent} = V. \tag{2.5}$$

The (perfect) enforcement of an arbitral award refers to the (full) payment of the resulting arbitral award made by an arbitration tribunal's verdict. Thus, only when the resulting arbitral award is equal to the amount of arbitral award actually paid by the FGP is the award perfectly enforced, and the IIS's financial loss is fully recovered. If the respondent does not voluntarily abide by the resulting arbitral award, which constitutes imperfect enforcement of the award, then the claimant should rely on the national regimes to enforce the award.

To see the enforceability of the award under the imperfect arbitration regimes, I introduce the quality of country i's domestic and international commercial arbitration regimes, denoted by $D_i \in (0,1)$ and $A_i \in (0,1)$, respectively. Quality refers to how fully commercial arbitration regimes enforce resulting arbitral awards. In the case of domestic commercial arbitration in which i's FGP is the respondent, the claimant is able to ultimately receive VD_i by recovering the loss through the arbitration proceedings. This implies the following:

$$\text{Arbitral award paid by a respondent} + \text{initial payment by a respondent} = VD_i. \tag{2.6}$$

When two parties engage in international commercial arbitration in which i's FGP is the respondent, both countries' legal systems are assumed to independently exert the enforcement of an arbitral award. Suppose that $A_j = 1$. Even if i's FGP initially pays less than VA_i, j's IIS will be able to finally receive VA_i from i's FGP by relying on i's arbitration regimes. However, if $A_j < 1$, i's FGP will ultimately pay less than VA_i. The FGP knows that even if she pays less than VA_i but more than VA_iA_j, j's IIS will accept the aggregate payment since country j does not have a perfect national arbitration regime to enforce the resulting award more than VA_iA_j. The FGP will cut the payment until it reaches VA_iA_j. Therefore, through the international arbitration proceedings, i's FGP will ultimately pay VA_iA_j to the j's IIS, which is expressed as follows:

$$\text{Arbitral award paid by a respondent} + \text{initial payment by a respondent} = VA_iA_j. \tag{2.7}$$

Equations (2.6) and (2.7) hold only if initial payment by a respondent is less than VD_i and VA_iA_j, respectively. Otherwise, the FGP pays nothing for the arbitral award because she already paid more than or equal to the aggregate amount the IIS is able to collect through the arbitration proceedings.

Note that if the respondent was the IIS, then "initial payment by a respondent" in equations (2.5), (2.6), and (2.7) should be replaced with "initial value of the investment made by a respondent."

Combining the definitions of the enforcement of arbitral awards and the quality of arbitration regimes, the quality refers to how fully arbitration regimes make a respondent pay the resulting arbitral award. This definition is captured by the equations (2.6) and (2.7), in which D_i, A_i, and A_j determine the proportion of the aggregate payment by a respondent, which in turn determines the award actually paid. As they rise, the award paid rises as well.

The reason why D_i, A_i, and A_j are directly linked to V, not the arbitral award actually paid, is that what matters in determining a firm's behavior is the aggregate amount that the firm is able to ultimately receive from another party. By fixing this aggregate amount to be a value that increases with D_i, A_i, and A_j, the model is simplified, which will be shown in Section 2.3.2.

Let us consider a numerical example in which i's FGP was supposed to pay \$100 million for j's investment of intermediate inputs but paid less than that. Then, an international arbitration initiated by j's IIS proceeded in country i, and a resulting arbitral award was made by an arbitration tribunal's verdict.[13] A_i and A_j are given by 0.8 and 0.5, respectively. Now, the IIS in j should collect the resulting arbitral award.

If i's FGP initially paid \$80 million, then the resulting arbitral award is \$20 million under the full verifiability of the quality of intermediate inputs. However, j's IIS will not collect any of the award from i's FGP since the initial payment by i's FGP exceeds \$40 million of VA_iA_j.

If i's FGP initially paid \$30 million, then \$70 million of the resulting arbitral award is made.

[13] Actually, both A_i and A_j matter for the enforcement of the resulting arbitral award regardless of where the award is made.

Since VA_iA_j is \$40 million, the award actually paid by the FGP is \$10 million. Suppose that A_j rises to 0.9, holding other conditions fixed. Then, the resulting arbitral award will stay the same, but VA_iA_j increases to \$72 million. Thus, the award actually paid the FGP rises to \$42 million.

Let us take a close look at what A_i means. A_i not only captures how well country i enforces an award rendered in favor of a local firm, but also captures how well country i enforces an award rendered to a foreign firm in country j against a local firm. I assume that the degree of enforcing an award rendered to a local firm in international arbitration is the same as the degree of enforcing an award made in domestic arbitration in that both awards are rendered in favor of a local firm. However, when an award is rendered against a local firm in international arbitration, the court will be more likely to be partial towards the local firm to protect it, which lowers the arbitral award actually paid. The cases of United World Ltd. Inc. v. Krasny Yakor and Forever Maritime v. Masbinoimport described in the Introduction are examples of this partiality. Then, it is natural to assume that when a party does not voluntarily abide by the arbitral award, a claimant collects the award at a higher degree in a case of domestic arbitration than of international arbitration, which implies a higher enforcement of the domestic arbitral award. Therefore, the quality of domestic arbitration regime is assumed to be greater than or equal to the quality of the international arbitration regime, i.e., $D_i \geq A_i$.

Under this setting, the game between the FGP and IIS proceeds in the following chronological order. At t_0, the FGP and IIS make a contract including the provision of arbitration, which is determined based on the specified V that a party is supposed to receive. The contract also includes the provision ensuring that all revenues that the FGP make accrue to the IIS. In exchange for that, the IIS makes a lump-sum transfer T to the FGP.[14] At t_1, the intermediate input, x, is produced. The IIS separately chooses the value of the investment of R and N. She can lower the value of x by using a low-quality component that has no value. At t_2, the x arrives at the FGP. Then, the FGP

[14] Suppose that the revenue the FGP makes by domestic and international sales is shared with the IIS in such a way that the $\beta \in (0,1)$ portion of the revenue is going into the IIS. In this case, the price will be inflated by $\frac{1}{\beta}$, and the output level will be deflated by β^{σ}, according to the logic that will be described in Section 2.3.2. Then, a rational FGP will choose β equal to 1 because the FGP will receive the lump-sum transfer, which is the same as all profits the IIS makes because of the competition with other potential IISs producing the intermediate input. Therefore, the assumption that all the FGP's revenues accrue to the IIS reflects this FGP's profit maximization process.

separately pays for the investment of R and N to the IIS. At t_3, if a party does not live up to the contract, commercial arbitration may occur. Specifically, an international commercial arbitration proceeds under global sourcing, and a domestic commercial arbitration takes place under domestic sourcing. At t_4, the final good, y, is produced and sold. The equilibrium production and price are derived by backward induction in the presence of the lump-sum transfer following Antràs (2003, 2005).

It is important to note that this game implicitly assumes that litigation and commercial arbitration are perfectly substitutable, and the enforceability of awards made through commercial arbitration is greater than the enforceability of the corresponding awards made through litigation under the full verifiability assumption. This higher enforceability is represented by the following inequalities: $0 < \widehat{D_i} < D_i < 1$ and $0 < \widehat{A_i} < A_i < 1$, where $\widehat{A_i}$ and $\widehat{D_i}$ index country i's quality of international and domestic commercial litigation regimes, respectively. Under this implicit assumption, firms only consider commercial arbitration as a dispute resolution mechanism.

2.3.2 Ex-ante Revenues for the IIS

In equations (2.6) and (2.7), the initial payment and arbitral award paid by a respondent are endogenously determined by a firm's optimal behavior. To examine how this works, I first specify the notation from the perspective of the FGP in j as follows: $x_{ij}(\omega)$ ($x_{jj}(\omega)$) is the quantity of the intermediate input sourced from i (j), which is used to produce the variety of ω by an FGP in j, and $y_j(\omega)$ is the total number of final goods that are produced by the FGP in j and consumed by consumers in both countries, implying that $y_j(\omega) = y_{ji}(\omega) + y_{jj}(\omega)$. x and y are assumed to be freely traded to focus on how imperfect contract enforcement affects firms' behaviors in the presence of commercial arbitration. Accordingly, $p_{ji}(\omega) = p_{jj}(\omega)$ in equation (2.2), and henceforth $p_j(\omega)$, the price of the variety of w charged by an FGP in j, is used to indicate $p_{ji}(\omega)$ and $p_{jj}(\omega)$.

Now, the FGP in j plans to source $x(\omega)$ units of intermediate input to produce $y_j(\omega)$ units of the final good. The unit labor requirement of R, N, and x implies that for the production of $x(\omega)$ units of the intermediate input, the number of labor demanded is $x(\omega)$, which should be the

sum of the quantity demanded of R and N. Under this condition, to produce $x(\omega)$ units of the intermediate input using the technology in equation (2.4), an IIS produces $\theta x(\omega)$ units of R and $(1-\theta)x(\omega)$ units of N. The FGP separately pays for the investments of R and N to the IIS.

Firms measure the value of the investment of a component based on the value of the final good that will be generated by the component's investment. The Cobb-Douglas function in equation (2.4) and $y_j(\omega) = x(\omega)$ imply that when producing $y_j(\omega)$ units of y, the production of $\theta y_j(\omega)$ units of them is contributed by R, while the production of $(1-\theta)y_j(\omega)$ units of them is contributed by N. Thus, without opportunistic behavior, the values of investment of $\theta x(\omega)$ units of R and $(1-\theta)x(\omega)$ units of N are $\theta p_j(\omega)y_j(\omega)$ and $(1-\theta)p_j(\omega)y_j(\omega)$, respectively. Recall that the FGP is supposed to pay exactly the value the IIS invests.

Let us first consider the case where the FGP in j chooses to source the intermediate input from country i. The IIS in i should produce $\theta x_{ij}(\omega)$ units of R. Since the component R requires an rs transaction, the parties are locked into their own relationship and unable to transact their business with another firm. Under this condition, if the FGP pays less than $\theta p_j(\omega)y_j(\omega)A_iA_j$, the IIS will initiate an arbitration. Then, the FGP will have to pay a part of the resulting award, which is the difference between $\theta p_j(\omega)y_j(\omega)A_iA_j$ and the value that was initially paid to the IIS, so that the IIS will ultimately receive $\theta p_j(\omega)y_j(\omega)A_iA_j$ from the FGP. If the FGP pays more than $\theta p_j(\omega)y_j(\omega)A_iA_j$ but less than $\theta p_j(\omega)y_j(\omega)$, then the IIS will just bear the loss and not initiate an arbitration. Even if the IIS initiates an arbitration, she will collect nothing for the resulting award since the FGP already paid more than $\theta p_j(\omega)y_j(\omega)A_iA_j$, which is the aggregate amount that the IIS can collect through arbitration proceedings. Nonetheless, this is not an optimal choice for the FGP in that she will lose a higher profit opportunity. Therefore, for the FGP, the optimal payment for the investment of $\theta x_{ij}(\omega)$ units of R is $\theta p_j(\omega)y_j(\omega)A_iA_j$.

Expecting this payment from the FGP, the IIS determines the value of $\theta x_{ij}(\omega)$ units of R. The IIS can shave the value of the investment by producing low-quality R at a negligible cost. If the IIS produces $\theta x_{ij}(\omega)$ units of R that are worth less than $\theta p_j(\omega)y_j(\omega)A_iA_j$, the FGP will initiate an arbitration. Then, the IIS should pay the difference between the component's value

that is initially produced and $\theta p_j(\omega) y_j(\omega) A_i A_j$ to the FGP. In this way, the FGP will ultimately make a revenue of $\theta p_j(\omega) y_j(\omega) A_i A_j$. If the IIS produces $\theta x_{ij}(\omega)$ units of R that are worth greater than $\theta p_j(\omega) y_j(\omega) A_i A_j$ but less than $\theta p_j(\omega) y_j(\omega)$, the FGP will not initiate an arbitration. Even if the FGP initiates an arbitration, she will collect zero for the resulting award since the IIS's initial investment value already exceeds $\theta p_j(\omega) y_j(\omega) A_i A_j$. However, this value of the investment is not optimal because it is higher than the payment the IIS will receive from the FGP and because the IIS will lose a higher profit opportunity. Hence, the optimal value of the $\theta x_{ij}(\omega)$ units of R that are produced by the IIS is $\theta p_j(\omega) y_j(\omega) A_i A_j$, which is the ex-ante revenue for the IIS.

The probability of a dispute between the parties is endogenously determined based on this discussion. Specifically, when the payment by the FGP or the investment value for R is between 0 and $V A_i A_j$, where $V = \theta p_j(\omega) y_j(\omega)$, arbitration proceeds, implying that a dispute occurs. When the payment or the investment value is between $V A_i A_j$ and V, they do not initiate arbitration since the payment or the investment value already exceeds the capacity a party ultimately receives by the supports of commercial arbitration regimes. Expecting this, they do not start a dispute. Therefore, the probability of a dispute is $V A_i A_j / V = A_i A_j$. Intuitively, as $A_i A_j$ rises, parties have more disputes because a party that suffers a financial loss due to another party's opportunistic behavior is more likely to depend on arbitration, while expecting that her financial loss is better recovered through the higher quality of arbitration regimes. Conversely, as $A_i A_j$ falls, the parties are in less disputes since they know that even if arbitration is initiated to resolve a dispute, they will be less likely to recover their financial loss.

Returning to the sourcing problem of the intermediate input, the IIS should produce $(1 - \theta) x_{ij}(\omega)$ units of N, as well. Since the component N does not require rs transactions, traders are expected to easily search for another partner through a public mechanism, such as reference prices and organized exchanges in Rauch (1999). To focus on the difference in terms of relationship-specificity from the component R, traders are assumed to find another partner without any search friction and make a transaction with the new partner without discounting the product value. If the FGP pays less than $(1 - \theta) p_j(\omega) y_j(\omega)$, the IIS will take the component back from the FGP

and sell it to another FGP in the market, rather than relying on arbitration proceedings. This is because the IIS will make a lower revenue of $(1-\theta)p_j(\omega)y_j(\omega)A_iA_j$ through an arbitration than the revenue made by transacting the product with a new partner in the market. Thus, for the FGP, the optimal payment for the investment of $(1-\theta)x_{ij}(\omega)$ units of N is $(1-\theta)p_j(\omega)y_j(\omega)$.

Again, expecting this payment from the FGP, the IIS chooses the value of $(1-\theta)x_{ij}(\omega)$ units of N. If the IIS produces the component that is worth less than $(1-\theta)p_j(\omega)y_j(\omega)$, the FGP will end the transaction with the IIS and buy the component from another firm in the market. The IIS, of course, does not produce a component that is worth more than the payment from the FGP. Therefore, for the IIS, the optimal production value of $(1-\theta)x_{ij}(\omega)$ units of N is $(1-\theta)p_j(\omega)y_j(\omega)$, which is the ex-ante revenue for the IIS.

The fact that arbitration never occurs in the sourcing process of N implies that the probability of a dispute is zero. That is, the presence of a public mechanism that allows the parties to fully recover a financial loss makes disputes and arbitration never happen.

Next, let us consider the case where the FGP in j engages in domestic sourcing. Since her trading partner is in the same country, j, the quality of domestic commercial arbitration regimes affects the firms' behaviors. Using the same techniques, the ex-ante revenue for the IIS from producing $\theta x_{jj}(\omega)$ units of R is $\theta p_j(\omega)y_j(\omega)D_j$, and the probability of a dispute regarding the R component is D_j. The ex-ante revenue from producing $(1-\theta)x_{jj}(\omega)$ units of N is $(1-\theta)p_j(\omega)y_j(\omega)$, and the probability of a dispute regarding the N component is zero.

To summarize these firms' behaviors, arbitration acts as an outside option for a party that suffers a financial loss from its trading partner's breach of contract. Thus, the opportunistic behavior of each party is limited by the presence of the arbitration. More importantly, the role of the effective arbitration regime as a mitigator of the opportunism works only for the investment of R. In such investment, the optimal payment by j's FGP and the optimal investment by the IIS is exactly the same as VA_iA_j and VD_j in global and domestic sourcing, respectively. Therefore, it follows that, in equilibrium, the award actually paid is zero. For the investment of $(1-\theta)x(\omega)$ units of N, an arbitration is not considered as an outside option since the firms have the better

option of making a transaction with another business partner through a public mechanism.

2.3.3 Choice of Sourcing Mode

Let us first consider the case where the FGP in j chooses global sourcing from country i. The ex-ante revenue for the IIS in i by producing $\theta x_{ij}(\omega)$ units of R and $(1-\theta)x_{ij}(\omega)$ units of N is the sum of $\theta p_j(\omega)y_j(\omega)A_iA_j$ and $(1-\theta)p_j(\omega)y_j(\omega)$. By using $y_j(\omega) = y_{ji}(\omega) + y_{jj}(\omega)$, the ex-ante revenue is $(\theta A_iA_j + 1 - \theta)\left[p_j(\omega)y_{ji}(\omega) + p_j(\omega)y_{jj}(\omega)\right]$. Additionally, since $y_j(\omega) = x_{ij}(\omega)$, the choice of $x_{ij}(\omega)$ maximizing the ex-ante profit can be considered as the sum of the $y_{ji}(\omega)$ and $y_{jj}(\omega)$, each of which maximizes the profit for each market according to its own demand structure. On the cost side, the wage in i, w_i, is the IIS's marginal cost. No fixed cost is incurred for the IIS. Then, taking into account the FGP's marginal cost, w_j, profit maximization for the IIS in i yields the following optimal price:

$$p_j^G(\omega) = \frac{w_i + w_j}{1 - \theta(1 - A_iA_j)}\frac{\sigma}{\sigma - 1}, \tag{2.8}$$

where the superscript G denotes the optimal price level of the final good when the FGP uses global sourcing. Note that the quantity demanded in i and j are consistently denoted by $y_{ji}^G(\omega)$ and $y_{jj}^G(\omega)$, respectively, and then $y_j^G(\omega) = y_{ji}^G(\omega) + y_{jj}^G(\omega)$.

Compared to the well-known optimal price level under perfect contract enforcement, which is $(w_i + w_j)\frac{\sigma}{\sigma-1}$, the price is inflated by $\frac{1}{1-\theta(1-A_iA_j)}$ due to the opportunistic behaviors between the FGP and IIS. However, the opportunism is mitigated by the effective international commercial arbitration regime of country i and j: $\frac{\partial p_j^G(\omega)}{\partial A_i} < 0$, and $\frac{\partial p_j^G(\omega)}{\partial A_j} < 0$. Additionally, $\frac{\partial^2 p_j^G(\omega)}{\partial A_i \partial \theta} < 0$, and $\frac{\partial^2 p_j^G(\omega)}{\partial A_j \partial \theta} < 0$, implying that the beneficial effect of the arbitration-friendly legal system on the price increases with rs intensity, θ.

The FGP expects to receive a lump-sum transfer T based on the ex-ante price from the IIS. As Antràs (2003, 2005) points out, the IISs eventually make a zero profit due to competition between them, implying that the lump-sum transfer T equals the IIS's ex-ante revenue minus variable cost.

Taking account of this transfer from the IIS, ex-ante operating profits for the FGP are given by

$$\pi_{ij}(\omega) = (\lambda_i + \lambda_j)\,(\sigma-1)^{\sigma-1}\,\sigma^{-\sigma}(w_i + w_j)^{1-\sigma}\,[1-\theta\,(1-A_iA_j)]^{\sigma}\,. \tag{2.9}$$

Next, consider the case where the FGP in j domestically sources the intermediate input. The profit-maximizing price is

$$p_j^D(\omega) = \frac{2w_j}{1-\theta(1-D_j)}\frac{\sigma}{\sigma-1}, \tag{2.10}$$

where the superscript D denotes the optimal price level of the final good when the FGP chooses domestic sourcing. Note that the quantity demanded in i and j are consistently indexed by $y_{ji}^D(\omega)$ and $y_{jj}^D(\omega)$, respectively, and then $y_j^D(\omega) = y_{ji}^D(\omega) + y_{jj}^D(\omega)$. Similar to the case of the global sourcing, $\frac{\partial p_j^D(\omega)}{\partial D_j} < 0$, and $\frac{\partial^2 p_j^D(\omega)}{\partial D_j \partial \theta} < 0$. The ex-ante operating profits based on this price for the FGP are equal to

$$\pi_{jj}(\omega) = (\lambda_i + \lambda_j)\,(\sigma-1)^{\sigma-1}\,\sigma^{-\sigma}(2w_j)^{1-\sigma}\,[1-\theta\,(1-D_j)]^{\sigma}\,. \tag{2.11}$$

Concerning the choice between the global and domestic sourcing, a mixed equilibrium where both global and domestic sourcing arise in j exists only if $\pi_{ij}(\omega) = \pi_{jj}(\omega)$, implying that $\left(\frac{2w_j}{w_i+w_j}\right)^{1-\frac{1}{\sigma}} = \frac{1-\theta(1-D_j)}{1-\theta(1-A_iA_j)}$. Since this condition is generally not met, I focus on two pervasive cases: the FGP in a country chooses either global or domestic sourcing.

Let us consider the case where the FGP in j chooses to globally source the intermediate input from the IIS in i. This happens if $\pi_{ij}(\omega) > \pi_{jj}(\omega)$, implying that

$$\left(\frac{2w_j}{w_i+w_j}\right)^{1-\frac{1}{\sigma}} > \frac{1-\theta(1-D_j)}{1-\theta(1-A_iA_j)}. \tag{2.12}$$

The left-hand side of this inequality (2.12) shows the benefit of choosing global sourcing, while the right-hand side shows the opportunity cost under this choice. Specifically, a high wage gap is a benefit as the FGP chooses global sourcing. However, this sourcing occurs at the expense of giving up a higher quality of domestic commercial arbitration regime, which mitigates the parties' opportunism, compared to the foreign commercial arbitration regime. Therefore, global sourcing

is preferred to domestic sourcing only when the benefit from the choice outweighs the opportunity cost.[15]

Let $\delta(\cdot) \equiv \left(\frac{2w_j}{w_i+w_j}\right)^{1-\frac{1}{\sigma}} - \frac{1-\theta(1-D_j)}{1-\theta(1-A_iA_j)}$. Then, the FGP in j chooses global sourcing when $\delta(\cdot) > 0$, and the higher $\delta(\cdot)$, the more attractive global sourcing is over domestic sourcing. Since $\frac{2w_j}{w_i+w_j} = \frac{2w_j/w_i}{1+w_j/w_i}$ strictly increases in $\frac{w_j}{w_i}$, the attractiveness of the global sourcing increases as $\frac{w_j}{w_i}$ rises.

Additionally, $\frac{\partial\delta(\cdot)}{\partial\theta} < 0$ with the assumption that $D_i \geq A_i$. This implies that the FGP will outsource less intermediate input for which rs transactions are required to a higher degree because the component share that is vulnerable to the parties' opportunistic behaviors rises more in global sourcing due to the lower quality of arbitration regimes than in domestic sourcing.

Regarding the quality of the international commercial arbitration regime, $\frac{\partial\delta(\cdot)}{\partial A_i} > 0$, and $\frac{\partial\delta(\cdot)}{\partial A_j} > 0$. A higher A_i or A_j attracts more global sourcing. Additionally, $\frac{\partial^2\delta(\cdot)}{\partial A_i\partial\theta} > 0$, and $\frac{\partial^2\delta(\cdot)}{\partial A_j\partial\theta} > 0$.[16] That is, the positive effect of international arbitration regimes of each country on the attractiveness of global sourcing rises with θ. This is because as the greater part of producing the intermediate input is vulnerable to opportunism, the effect of a rise in A_i or A_j on the mitigation of the risk becomes higher. It is straightforward to show that the effect of D_j on $\delta(\cdot)$ is the opposite: $\frac{\partial\delta(\cdot)}{\partial D_j} < 0$, and $\frac{\partial^2\delta(\cdot)}{\partial D_j\partial\theta} < 0$. That is, a higher quality of domestic arbitration regime decreases the attractiveness of the global sourcing, and this impact increases with θ.

Turning to the choice of the FGP in i, it chooses domestic sourcing when the FGP in j

[15] The condition under which global sourcing is chosen over domestic sourcing by j's FGP, $\pi_{ij}(\omega) > \pi_{jj}(\omega)$, also implies the following inequality: $A_iA_j > \frac{\left(1-\theta+\theta D_j\right)\left(\frac{w_i+w_j}{2w_j}\right)^{1-\frac{1}{\sigma}}-1}{\theta}+1$. Since $\frac{w_i+w_j}{2w_j}$ strictly increases in $\frac{w_i}{w_j}$, the right-hand side captures the wage benefit of domestic sourcing, while considering the mitigation of opportunism through D_j. Thus, only when A_iA_j is greater than the benefit of domestic sourcing, under the assumption of $D_j \geq A_j$, j's FGP chooses global sourcing. To put it differently, for the FGP to choose global sourcing, the wage ratio, $\frac{w_j}{w_i}$, should be great enough to cover a lower mitigation of opportunism by $A_iA_j(< D_j)$ in global sourcing than in domestic sourcing, which is implied by equation (2.12).

[16] The proof of these positive joint effects are as follows. $\frac{\partial^2\delta(\cdot)}{\partial A_i\partial\theta} = A_j(1-\theta+\theta A_iA_j)\left[(1-2\theta+2\theta D_j)(1-\theta+\theta A_iA_j)+2\theta(1-\theta+\theta D_j)(1-A_iA_j)\right]/(1-\theta+\theta A_iA_j)^4$. Let the part within the bracket in the numerator be B. Then, since $(1-\theta+\theta D_j) > (1-\theta+\theta A_iA_j)$ with the assumption that $D_j \geq A_j$ and $A_i \in (0,1)$, $B > (1-2\theta+2\theta D_j)(1-\theta+\theta A_iA_j)+2\theta(1-\theta+\theta A_iA_j)(1-A_iA_j)$. Then, the right-hand side can be written as $(1-\theta+\theta A_iA_j)\left[1+2\theta(D_j-A_iA_j)\right]$, which is greater than 0. Thus, B is positive, and hence $\frac{\partial^2\delta(\cdot)}{\partial A_i\partial\theta}$ is positive. With the same method, $\frac{\partial^2\delta(\cdot)}{\partial A_j\partial\theta}$ is positive as well.

chooses global sourcing based on the following Proposition 1.

Proposition 1. *When the FGP in one country chooses global sourcing, the FGP in the other country chooses domestic sourcing.*

Proof. The first piece of this proof comes from the fact that $\frac{2w_i}{w_i+w_j} < \frac{w_i+w_j}{2w_j}$. This is easily shown by replacing $\frac{w_j}{w_i}$ with $x(>0)$; $\frac{w_i+w_j}{2w_j} - \frac{2w_i}{w_i+w_j} = \frac{1+x}{2x} - \frac{2}{1+x} = \frac{(x-1)^2}{2x(x+1)} > 0$. Next, inequality (2.12) implies that $\left(\frac{w_i+w_j}{2w_j}\right)^{1-\frac{1}{\sigma}} < \frac{1-\theta(1-A_iA_j)}{1-\theta(1-D_j)}$. Under the assumption that $D_i \geq A_i$ and $A_j \in (0,1)$, $A_iA_j < D_i$, which implies that $\frac{1-\theta(1-A_iA_j)}{1-\theta(1-D_j)} < \frac{1-\theta(1-D_i)}{1-\theta(1-D_j)}$. Additionally, under the assumption that $D_j \geq A_j$ and $A_i \in (0,1)$, $A_iA_j < D_j$, which implies that $\frac{1-\theta(1-D_i)}{1-\theta(1-D_j)} < \frac{1-\theta(1-D_i)}{1-\theta(1-A_iA_j)}$. Taken together, it is straightforward to draw the following inequality under which the FGP in i chooses the domestic sourcing: $\left(\frac{2w_i}{w_i+w_j}\right)^{1-\frac{1}{\sigma}} < \frac{1-\theta(1-D_i)}{1-\theta(1-A_iA_j)}$. Therefore, $\left(\frac{2w_j}{w_i+w_j}\right)^{1-\frac{1}{\sigma}} > \frac{1-\theta(1-D_j)}{1-\theta(1-A_iA_j)}$ implies that $\left(\frac{2w_i}{w_i+w_j}\right)^{1-\frac{1}{\sigma}} < \frac{1-\theta(1-D_i)}{1-\theta(1-A_iA_j)}$. To put it into words, the FGP in i chooses domestic sourcing when the FGP in j chooses global sourcing. Lastly, by switching i to j and j to i in inequality (2.12) and by following the same logic, the following statement is derived: the FGP in j chooses domestic sourcing when the FGP in i chooses global sourcing.

Intuitively, when a country's wage is high enough relative to the source country's wage to offset the excess cost of imperfect international arbitration regimes over the domestic one, the country's FGP chooses global sourcing. However, with the same condition, the source country's FGP chooses domestic sourcing because its wage relative to destination country's wage is not great enough to cover the higher cost of the imperfect international arbitration regime.

The cutoff condition for the choice of sourcing mode for country j's FGP is, by rearranging $\delta(\cdot) = 0$, $\frac{w_j}{w_i} = c^j(\cdot) \equiv \left[2\left(\frac{1-\theta+\theta A_iA_j}{1-\theta+\theta D_j}\right)^{\frac{\sigma}{\sigma-1}} - 1\right]^{-1}$. To see the shape of this cutoff function in terms of A_j, let us only consider $h^j(\cdot) \equiv (1-\theta+\theta A_iA_j)^{-\frac{\sigma}{\sigma-1}}$, which determines whether $c^j(\cdot)$ is concave upward or downward on A_j. Note that a firm's choice of sourcing mode based on the cutoff

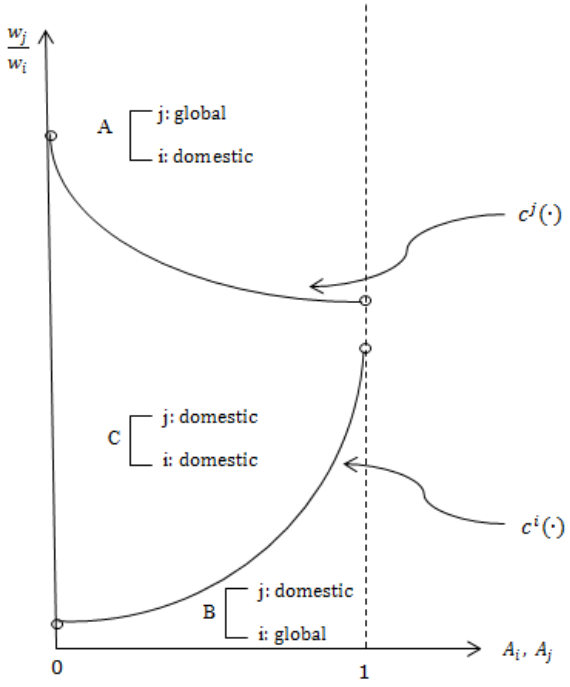
conditions with respect to D_i and D_j is discussed in Appendix A.2. Since $\frac{\partial h^j(\cdot)}{\partial A_j} < 0$ and $\frac{\partial^2 h^j(\cdot)}{\partial A_j^2} > 0$, the cutoff function is downward-sloping and convex on A_j as shown in Figure 2.1. The decreasing pattern over A_j implies that as A_j rises, $\frac{w_j}{w_i}$, which leads to the indifferent choice between the two sourcing modes, decreases. In other words, the fall in the cost of global sourcing with A_j makes the FGP choose global sourcing, even when the benefits of global sourcing, $\frac{w_j}{w_i}$, fall. Under this falling cutoff curve, when $\frac{w_j}{w_i}$ is above the cutoff curve for each A_j, j's FGP chooses global sourcing, and i's FGP chooses domestic sourcing, which is represented by region A in the same Figure. This discussion and the following discussion remain the same with A_i.

Turning to the perspective of the FGP in i, its cutoff curve is shown as follows: $\frac{w_j}{w_i} = c^i(\cdot) \equiv \left[2\left(\frac{1-\theta+\theta A_i A_j}{1-\theta+\theta D_i}\right)^{\frac{\sigma}{\sigma-1}} - 1\right]$. Let us only consider $h^i(\cdot) \equiv (1-\theta+\theta A_i A_j)^{\frac{\sigma}{\sigma-1}}$, which determines the shape of $c^i(\cdot)$ over A_j. Since $\frac{\partial h^i(\cdot)}{\partial A_j} > 0$ and $\frac{\partial^2 h^i(\cdot)}{\partial A_j^2} > 0$, $c^i(\cdot)$ is upward-sloping and convex on A_j, as shown in Figure 2.1. This increasing pattern (i.e., decreasing $\frac{w_i}{w_j}$) of the cutoff curve over A_j implies that the decreasing cost of international arbitration with A_j makes $\frac{w_i}{w_j}$, which generates the indifferent choice between the two sourcing modes, fall. Then, the FGP finds it profitable to choose global sourcing only when the combination of A_j and $\frac{w_j}{w_i}$ is below the cutoff curve, as presented in region B in Figure 2.1.

Next, consider the case where the FGP in j chooses domestic sourcing. In this case, the FGP in i chooses domestic sourcing only if $\frac{w_j}{w_i} > \left[2\left(\frac{1-\theta+\theta A_i A_j}{1-\theta+\theta D_i}\right)^{\frac{\sigma}{\sigma-1}} - 1\right]$. Conversely, in the case where the FGP in i chooses domestic sourcing, the FGP in j chooses domestic sourcing only if $\frac{w_j}{w_i} < \left[2\left(\frac{1-\theta+\theta A_i A_j}{1-\theta+\theta D_j}\right)^{\frac{\sigma}{\sigma-1}} - 1\right]^{-1}$. The region that meets these two conditions is represented by region C in the same Figure, where all FGPs in i and j choose domestic sourcing.

Note that, when A_j or A_i is 1, $c^j(\cdot)$ should be greater than or equal to $c^i(\cdot)$. Otherwise, the two cutoff curves intersect, creating a region in which the choices made by the FGPs in i and j contradict each other. Note, also, that if $\left[2\left(\frac{1-\theta+\theta A_i A_j}{1-\theta+\theta D_j}\right)^{\frac{\sigma}{\sigma-1}} - 1\right]^{-1}$ is less than or equal to 0, the FGP of j chooses global sourcing since $\frac{w_j}{w_i}$ on j's FGP's cutoff curve is always less than $\frac{w_j}{w_i}$, which is greater than 0. Conversely, if $\left[2\left(\frac{1-\theta+\theta A_i A_j}{1-\theta+\theta D_i}\right)^{\frac{\sigma}{\sigma-1}} - 1\right]$ is less than or equal to 0, i's FGP chooses domestic sourcing since $\frac{w_j}{w_i}$ on i's FGP's cutoff curve is less than $\frac{w_j}{w_i}$, which is greater than 0. For

Figure 2.1: Choice of Sourcing Mode



simplicity, I only consider the cases in which a cutoff curve does not intersect the horizontal axis. This requires that the minimum value of $c^i(\cdot)$ with A_j or A_i of 0 should be greater than or equal to 0, implying that $\left(\frac{1-\theta}{1-\theta+\theta D_i}\right)^{\frac{\sigma}{\sigma-1}} \geq \frac{1}{2}$.

These two cutoff conditions for the choice of sourcing mode for j and i show that the region where the FGP in a country chooses global sourcing is expanded as both A_i and A_j rise. This implies the importance of having high-quality international commercial arbitration regimes in both countries to take advantage of less expensive labor for production.

To summarize, there are three cases in this model: two cases where the FGPs in i and j choose a different mode of sourcing and one case where all FGPs in both countries choose domestic sourcing. Since the first two cases are symmetric, I only consider the case where the FGP in j chooses global sourcing, while the FGP in i chooses domestic sourcing, in the following Section 2.4. The third case is discussed in Appendix A.1.

2.4 General Equilibrium

2.4.1 The Coexistence of Global and Domestic Sourcing

Under the choice of the global and domestic sourcing made by the FGPs in j and i, respectively, λ, expressed in equation (2.3), is specified as follows:

$$\lambda_j = \frac{E_j}{\int_{\omega=0}^{n_i} p_i^D(\omega)^{1-\sigma} d\omega + \int_{\omega=0}^{n_j} p_j^G(\omega)^{1-\sigma} d\omega}, \quad \lambda_i = \frac{E_i}{\int_{\omega=0}^{n_j} p_j^G(\omega)^{1-\sigma} d\omega + \int_{\omega=0}^{n_i} p_i^D(\omega)^{1-\sigma} d\omega}. \tag{2.13}$$

By income balance condition, $E_j = w_j L_j$, and $E_i = w_i L_i$, where L_j and L_i are the labor endowment of country j and i, respectively.

Let us consider i's labor market. In i, some IISs produce the intermediate input for i's FGP, and the rest of IISs produce it for j's FGP. Thus, in i, the number of IISs, each of which produces $x_{ij}(\omega)$ units of x, is equal to the number of FGPs in j, n_j, and the number of IISs, each of which produces $x_{ii}(\omega)$ units of x, equals the number of FGPs in i, n_i. Additionally, for the sales of the final good, $y_i^D(\omega)$, both variable and fixed costs are incurred by the n_i FGPs. The fixed cost includes innovation cost such as the number of researchers and designers developing the product. Then, the labor market clearing condition in i imposes that $x_{ij}(\omega)n_j + x_{ii}(\omega)n_i + y_i^D(\omega)n_i + f_i n_i = L_i$. Since $x_{ij}(\omega) = y_j^G(\omega) = y_{ji}^G(\omega) + y_{jj}^G(\omega)$, and $x_{ii}(\omega) = y_i^D(\omega) = y_{ij}^D(\omega) + y_{ii}^D(\omega)$, the labor market clearing condition can be written as follows:

$$(\lambda_i + \lambda_j)\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left[(w_i+w_j)^{-\sigma}(\theta A_i A_j + 1 - \theta)^{\sigma} n_j + 2(2w_i)^{-\sigma}(\theta D_i + 1 - \theta)^{\sigma} n_i\right] + f_i n_i = L_i. \tag{2.14}$$

On the contrary, in j, no IIS is demanded since n_j FGPs source x from i. Considering the variable and fixed cost for the sales of the final good, $y_j^G(\omega)$, the labor market clearing condition in j dictates that $y_j^G(\omega)n_j + f_j n_j = L_j$. Using $y_j^G(\omega) = y_{ji}^G(\omega) + y_{jj}^G(\omega)$, this condition can be expressed as follows:

$$(\lambda_i + \lambda_j)\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}(w_i+w_j)^{-\sigma}(\theta A_i A_j + 1 - \theta)^{\sigma} n_j + f_j n_j = L_j. \tag{2.15}$$

The zero profit condition leading to the free entry of firms requires the operating profits for

the FGP to be equal to the fixed costs. Thus, $\pi_{ij}(\omega) = w_j f_j$, and $\pi_{ii}(\omega) = w_i f_i$, implying

$$(\lambda_i + \lambda_j)(\sigma - 1)^{\sigma-1}\sigma^{-\sigma}(w_i + w_j)^{1-\sigma}[1 - \theta(1 - A_i A_j)]^{\sigma} = w_j f_j, \tag{2.16}$$

$$(\lambda_i + \lambda_j)(\sigma - 1)^{\sigma-1}\sigma^{-\sigma}(2w_i)^{1-\sigma}[1 - \theta(1 - D_i)]^{\sigma} = w_i f_i. \tag{2.17}$$

Then, these two zero profit conditions yield the implicit function of the equilibrium wage ratio:

$$\frac{w_j}{w_i}\left[\frac{1}{2}\left(1 + \frac{w_j}{w_i}\right)\right]^{\sigma-1} = \left(\frac{\theta A_i A_j + 1 - \theta}{\theta D_i + 1 - \theta}\right)^{\sigma}\frac{f_i}{f_j}. \tag{2.18}$$

Meanwhile, j's zero profit condition in equation (2.16) and labor market clearing condition in j in equation (2.15) pin down n_j as follows:

$$n_j = \frac{L_j}{f_j}\left[1 - \frac{\sigma - 1}{\frac{w_i}{w_j} + \sigma}\right]. \tag{2.19}$$

In addition, i's zero profit condition in (2.17), the labor market clearing conditions in i and j in equations (2.14) and (2.15), and n_j in equation (2.19) pin down n_i as follows:

$$n_i = \frac{L_i}{f_i}\left[\frac{L_j(\sigma - 1)^2}{\frac{w_i}{w_j} + \sigma} + 1\right]^{-1}. \tag{2.20}$$

Thus, once $\frac{w_j}{w_i}$ is implicitly determined by the parameters in equation (2.18), n_j and n_i are pinned down. The reason $\frac{w_j}{w_i}$ is determined independently of n_j and n_i is that both countries' FGPs produce the final good, which is consumed in both countries. Hence, the operating profits for the FGPs in i and j are a function of $(\lambda_i + \lambda_j)$, which is canceled out to draw the implicit function of the wage ratio.

Suppose that a change in a parameter leads w_i to fall while leading w_j to stay the same, which causes a rise in $\frac{w_j}{w_i}$. Then, n_j and n_i fall by equations (2.19) and (2.20). This result can be examined using the two labor market clearing conditions. The FGP in j can produce more y with a lower variable cost. That is, $y_j^G(\omega)(= x_{ij}(\omega))$ rises. Since this higher production exhausts more labor per firm than before in selling the final good, n_j decreases with the fixed labor endowment in j. Using j's labor market clearing condition, $y_j^G(\omega)n_j + f_j n_j = L_j$, the rise in $y_j^G(\omega)$ decreases

n_j. This fall further implies that, in j's labor market clearing condition, $y_j^G(\omega)n_j$ rises since $f_j n_j$ falls. Meanwhile, the fall in w_i raises the production for $y_i^D(\omega) = x_{ii}(\omega)$ due to lowered variable cost, which exhausts more labor per firm in i than before. This means a rise in $x_{ii}(\omega)$ $(= y_i^D(\omega))$ in the following i's labor market clearing condition, $x_{ij}(\omega)n_j + x_{ii}(\omega)n_i + y_i^D(\omega)n_i + f_i n_i = L_i$. Combining this result with the rise in $y_j^G(\omega)n_j = x_{ij}(\omega)n_j$, n_i should decrease with the fixed L_i.

2.4.1.1 Wage Ratio and Commercial Arbitration Regimes

The effects of A_i, A_j, and D_i on the wage ratio are analyzed in the implicit function of $\frac{w_j}{w_i}$, expressed in equation (2.18). Since the left-hand side (LHS) in the equation is strictly increasing in $\frac{w_j}{w_i}$, the effects are examined by looking at how the right-hand side (RHS) responds to changes in those parameters. Let the RHS be a function of $q(\cdot)$. Then, it is straightforward to show that $\frac{\partial q(\cdot)}{\partial A_i}$ and $\frac{\partial q(\cdot)}{\partial A_j}$ are greater than 0, while the signs for $\frac{\partial^2 q(\cdot)}{\partial A_i \partial \theta}$ and $\frac{\partial^2 q(\cdot)}{\partial A_j \partial \theta}$ are ambiguous. Similarly, $\frac{\partial q(\cdot)}{\partial D_i}$ is less than 0, while the sign for $\frac{\partial^2 q(\cdot)}{\partial D_i \partial \theta}$ is ambiguous. It is also straightforward to show that $\frac{\partial q(\cdot)}{\partial \theta} < 0$ by using the assumption that $D_i \geq A_i$. These results imply the following Proposition:

Proposition 2. *When the FGP in j chooses global sourcing, and the FGP in i chooses domestic sourcing, the wage ratio, $\frac{w_j}{w_i}$, increases with each country's quality of international commercial arbitration regimes. The wage ratio additionally decreases with the source country's quality of domestic commercial arbitration regimes and the rs intensity of the intermediate input. That is, $\frac{\partial\left(\frac{w_j}{w_i}\right)}{\partial A_i} > 0$, $\frac{\partial\left(\frac{w_j}{w_i}\right)}{\partial A_j} > 0$, $\frac{\partial\left(\frac{w_j}{w_i}\right)}{\partial D_i} < 0$, and $\frac{\partial\left(\frac{w_j}{w_i}\right)}{\partial \theta} < 0$.*

Since the wage ratio is derived by the two zero profit conditions for the FGPs in i and j, these effects are analyzed by looking at the balance between the revenue and cost, i.e., the revenue should be the sum of the fixed cost and variable cost. When A_i or A_j rises, the revenue for j's FGP relative to the revenue for i's FGP rises. Then, the total costs in value terms, including the variable and fixed cost, for j relative to i are also increased by the zero profit conditions. Thus, the wage ratio rises as A_i or A_j increases. In contrast, when D_i rises, the relative revenue for the

FGP in j to i falls, which leads to a decrease in the wage ratio.

The increase in the wage ratio with A_i and A_j implies that the choices of sourcing modes by the FGPs in both countries are not flipped as A_i or A_j rises through general equilibrium effects in region A in Figure 2.1. Similarly, the choices of the sourcing modes by the FGPs are not flipped in region B since $\frac{w_j}{w_i}$ falls with A_i or A_j. Note that in region C, the wage ratio does not depend on A_i and A_j since global sourcing is not chosen. Thus, in this region, only partial equilibrium effects occur as A_i or A_j approaches the cutoffs $c^j(\cdot)$ and $c^i(\cdot)$ given the fixed level of $\frac{w_j}{w_i}$. That is, as A_i or A_j increases, the choice of sourcing mode by j's FGP is more likely to be changed from domestic sourcing in region C to global sourcing in region A. Additionally, the choice of sourcing mode by i's FGP is more likely to be flipped from domestic sourcing in region C to global sourcing in region B, while j's FGP constantly chooses domestic sourcing.

Lastly, $\frac{\partial\left(\frac{w_j}{w_i}\right)}{\partial\theta}$ is consistently negative, which implies that as the risk of opportunism increases with θ, the revenue of j's FGP falls relative to i's FGP. Even though the revenues for both countries' FGPs fall, the higher quality of domestic arbitration regimes relative to international arbitration regimes mitigates opportunism in domestic sourcing more than global sourcing. This leads to the asymmetric impact on the revenues of FGPs in i and j.

2.4.1.2 Trade Flows, Welfare, and Commercial Arbitration Regimes

Let M_{ij} be the total trade flows of x from i to j. This is also interpreted as the total sales of x, produced by country i's IISs, in j. M_{ij} is calculated by the revenue for the IIS in i multiplied by n_j: $(\theta A_i A_j + 1 - \theta)\left[p_j^G(\omega)y_{ji}^G(\omega) + p_j^G(\omega)y_{jj}^G(\omega)\right]n_j$. Similarly, M_{ii}, the total domestic trade flows of x in i, which is also interpreted as total sales of x in i, is calculated by $(\theta D_i + 1 - \theta)\left[p_i^D(\omega)y_{ij}^D(\omega) + p_i^D(\omega)y_{ii}^D(\omega)\right]n_i$. Then, using the equilibrium wage ratio in equation (2.18), the relative trade flows of x, $\frac{M_{ij}}{M_{ii}}$, is summarized as $\frac{n_j w_j}{w_i}\frac{f_j}{f_i}\frac{1}{n_i}$. Using the equilibrium n_j and n_i, expressed in equation (2.19) and (2.20), respectively, $\frac{M_{ij}}{M_{ii}}$ is further simplified as a function of

the wage ratio as follows:

$$\frac{M_{ij}}{M_{ii}} = \frac{L_j}{L_i}\left(\frac{1+\frac{w_j}{w_i}}{\sigma+\frac{w_i}{w_j}}\right)\left[L_j\frac{(\sigma-1)^2}{\frac{w_i}{w_j}+\sigma}+1\right]. \tag{2.21}$$

Thus, this relative global sourcing increases with L_j while decreasing with L_i.

The responses of $\frac{M_{ij}}{M_{ii}}$ to the changes in the main variables are consistent with the responses of $\frac{w_j}{w_i}$ to the corresponding changes since relative global sourcing is a strictly increasing function of the wage ratio. Accordingly, $\frac{M_{ij}}{M_{ii}}$ rises with A_i, A_j, while it falls with D_i and θ. The sign for $\frac{\partial^2\left(\frac{M_{ij}}{M_{ii}}\right)}{\partial A_i \partial\theta}$, $\frac{\partial^2\left(\frac{M_{ij}}{M_{ii}}\right)}{\partial A_j \partial\theta}$, and $\frac{\partial^2\left(\frac{M_{ij}}{M_{ii}}\right)}{\partial D_i \partial\theta}$ are ambiguous. Additionally, $\frac{M_{ij}}{M_{ii}}$ rises with f_i, while it falls with f_j.

Next, let Y_{ij} be the total trade flows for the final good from i to j. This is also interpreted as the total sales of the final good, produced by country i's FGPs, in j. Y_{ij} is calculated by $n_i y_{ij}^D(\omega)p_i^D(\omega)$. Similarly, Y_{jj}, the total sales of y in j, is calculated by $n_j y_{jj}^G(\omega)p_j^G(\omega)$. Then, Y_j, the value of the final goods that the consumers in j enjoy, is the sum of Y_{ij} and Y_{jj}, i.e., $Y_j = Y_{ij} + Y_{jj}$. In the same way, $Y_i = Y_{ji} + Y_{ii}$, where $Y_{ji} = n_j y_{ji}^G(\omega)p_j^G(\omega)$ and $Y_{ii} = n_i y_{ii}^D(\omega)p_i^D(\omega)$. Then, the international sales of the final good relative to the domestic sales by country i's FGPs, i.e., $\frac{Y_{ij}}{Y_{ii}}$, is $\frac{\lambda_j}{\lambda_i}$ because the price indexes of the two countries are the same in the absence of transport cost. This may be further expressed as $\frac{w_j}{w_i}\frac{L_j}{L_i}$. $\frac{Y_j}{Y_i}$ may also be expressed as $\frac{w_j}{w_i}\frac{L_j}{L_i}$. Therefore, the signs for $\frac{\partial\left(\frac{Y_{ij}}{Y_{ii}}\right)}{\partial A_i}$ and $\frac{\partial\left(\frac{Y_j}{Y_i}\right)}{\partial A_i}$ are positive, while the signs for $\frac{\partial\left(\frac{Y_{ij}}{Y_{ii}}\right)}{\partial D_i}$, $\frac{\partial\left(\frac{Y_{ij}}{Y_{ii}}\right)}{\partial\theta}$, $\frac{\partial\left(\frac{Y_j}{Y_i}\right)}{\partial D_i}$, and $\frac{\partial\left(\frac{Y_j}{Y_i}\right)}{\partial\theta}$ are negative. Note that A_j's effects are the same as the A_i's effects. The differential arbitration effects with respect to θ are ambiguous, as in the case of $\frac{w_j}{w_i}$.

The welfare in j, denoted by U_j, is measured by E_j divided by P_j. P_j is presented in equation (2.3). Since the price index of country i and j are the same, $\frac{U_j}{U_i} = \frac{w_j}{w_i}\frac{L_j}{L_i}$. Therefore, the welfare ratio, $\frac{U_j}{U_i}$, rises as A_i or A_j rises, while this ratio falls as D_i or θ increases.[17] Again, the differential arbitration effect across θ is ambiguous.

These arbitration and rs intensity effects on trade flows of intermediate inputs and final

[17] Absolute levels of the variables, such as U_i and U_j, are not analytically pinned down. This is because the parameters determine wage ratio rather than independently determining each wage level in each country. This stems from the fact that both countries' labor is used as a variable cost for the production of y. Thus, the effect of a change in parameter on an absolute level of a variable, such as $\frac{\partial U_i}{\partial A_i}$, is ambiguous.

goods and welfare are summarized as follows:

Proposition 3. *When the FGP in j chooses global sourcing, and the FGP in i chooses domestic sourcing, $\frac{\partial\left(\frac{M_{ij}}{M_{ii}}\right)}{\partial A_i} > 0$, $\frac{\partial\left(\frac{Y_{ij}}{Y_{ii}}\right)}{\partial A_i} > 0$, $\frac{\partial\left(\frac{Y_j}{Y_i}\right)}{\partial A_i} > 0$, and $\frac{\partial\left(\frac{U_j}{U_i}\right)}{\partial A_i} > 0$. The direction of each response stays the same according to a rise in A_j, while it is the opposite according to a rise in D_i or θ.*

2.4.2 Summary of the Main Theoretical Results

To summarize the main theoretical results of commercial arbitration regimes and the impact of rs intensity on relative global sourcing patterns, I show Table 2.1, which lists the directions of these impacts, while accounting for a firm's entry decision.

I consider both partial and general equilibrium effects. In partial equilibrium, I assume that the wage ratio is exogenous to the firm. Firms choose global sourcing over domestic sourcing in this scenario. The directions of these effects are determined by $\delta(\cdot)$ function, which measures the attractiveness of global sourcing relative to domestic sourcing. This function is from the condition under which global sourcing is chosen over domestic sourcing by j's FGP, expressed as inequality (2.12). In general equilibrium, I allow firms to respond to the wage ratio when the quality of arbitration regimes changes. The directions of these effects are based on equations (2.18) and (2.21), the equations for the wage ratio and relative global sourcing, respectively.

Concerning an increase in A_i or A_j, the general equilibrium effects do not flip the sourcing modes of the firms, as discussed in Section 2.4.1.1. Only the partial equilibrium effects change the sourcing modes of the firms. Conversely, regarding an increase in D_i or D_j, by both partial and general equilibrium effects, the firms switch sourcing modes, as discussed in Appendix A.2. However, as explained in this Appendix, the firms are more likely to choose domestic sourcing as D_i or D_j increases, even when considering general equilibrium effects. As such, the impact of an increase in D_i or D_j on relative global sourcing through the firms' shifts in sourcing modes, channeled by general equilibrium effects, is consistent with the prediction in Table 2.1. This implies that this shift in sourcing modes through the general equilibrium effects reinforces the predictions

Table 2.1: The directions of the main variables' effects on M_{ij}/M_{ii}

Two situations determining M_{ij}/M_{ii} $\Rightarrow$	1. j's FGP's entry into global sourcing	2. M_{ij}/M_{ii} upon j's FGP's entry into global sourcing
Partial or general equil. $\Rightarrow$	Partial equilibrium effects	General equilibrium effects
Related eq. or ineq. $\Rightarrow$	$\delta(.)$ from ineq. (2.12)	Eqs. (2.18) and (2.21)
θ	$-$	$-$
A_i	$+$	$+$
A_j	$+$	$+$
D_j	$-$	n/a
D_i	n/a	$-$
$A_i\theta$	$+$	ambiguous
$A_j\theta$	$+$	ambiguous
$D_j\theta$	$-$	n/a
$D_i\theta$	n/a	ambiguous

Notes: The effect of a variable that does not exist in a related equation is reported as n/a. For example, D_j is not in the equation for M_{ij}/M_{ii}. This is because this equation characterizes relative global sourcing after j's FGP chooses global sourcing and i's FGP chooses domestic sourcing.

regarding D_i and D_j in this table. Therefore, the predictions in this table provides sufficient information to summarize the effects of the main variables on sourcing patterns.

Let us consider the individual effects of the main variables. Taking into account both the partial and general equilibrium effects, relative global sourcing increases with A_i or A_j, while decreasing with D_i or D_j. θ also decreases relative global sourcing, capturing that domestic sourcing is less exposed to opportunism than global sourcing through a higher quality of domestic arbitration regimes than international ones.

Next, consider the first three interaction terms, $A_i\theta$, $A_j\theta$, and $D_j\theta$. Their partial equilibrium effects show that global sourcing is increasingly attractive as A_i and A_j grow and D_j shrinks. These effects are larger as the risk of opportunism, represented by θ, grows. The interaction terms of $A_i\theta$, $A_j\theta$, and $D_i\theta$ additionally affect $\frac{M_{ij}}{M_{ii}}$ through general equilibrium impacts after j's FGP chooses global sourcing and i's FGP chooses domestic sourcing.

Taken together, the directions of the individual terms' effects on $\frac{M_{ij}}{M_{ii}}$ are clear. Among the four joint effects, the direction of the effect of $D_j\theta$ is clearly expected since it affects relative global sourcing only through a firm's entry decision. The directions of the effects of $A_i\theta$, $A_j\theta$, and $D_i\theta$ are ambiguous through general equilibrium effects.

2.5 Empirical Specification

In this section, and the following sections, I focus on empirically examining the effects of the quality of arbitration regimes and rs intensity on relative global sourcing patterns, $\frac{M_{ij}}{M_{ii}}$. Since global sourcing patterns, described in equation (2.21), are determined upon j's FGP's entry into global sourcing, the entry decision, as shown in Table 2.1, is also considered for the empirical analysis.

The estimation equation is as follows:

$$\begin{aligned} ln\left(\frac{M_{ij}}{M_{ii}}\right)^z =& \beta_0 + \beta_1\theta^z + \beta_2 lnA_i + \beta_3 lnA_j + \beta_4 lnD_i + \beta_5 lnD_j + \beta_6\theta^z lnA_i + \beta_7\theta^z lnA_j \\ &+ \beta_8\theta^z lnD_j + \beta_9\theta^z lnD_i + \beta_{10} ln\left(\frac{w_j}{w_i}\right) + \beta_{11} lnL_i + \beta_{12} lnL_j + \beta_{13} ln\, f_i \\ &+ \beta_{14} ln\, f_j + \Phi^z + \Phi_{ij} + \sum_l \beta_l\, controls + \varepsilon_{ij}^z, \end{aligned} \tag{2.22}$$

where the superscript z denotes an input industry, and subscript i and j denote the source country and destination country, respectively, and $i \neq j$. Then, $\left(\frac{M_{ij}}{M_{ii}}\right)^z$ is the trade flows of input z from i to j relative to i's local sales of that input. Variable θ^z is my measure of industry-specific rs intensity, which indicate the degree to which rs transactions are required for the IISs to produce z. Variables A_i and D_i are country i's quality of international and domestic commercial arbitration regimes. Variables A_i, A_j, D_i, D_j, θ^z, and their interaction terms are the main variables, and thus the empirical results will be analyzed while focusing on the coefficients of β_1 through β_9.

Variables w_i, L_i,and f_i denote country i's wage, labor, and fixed cost. The fixed cost is captured by the research and development (R&D) expenditure share of GDP. Variables Φ^z and Φ_{ij} are input-industry and country pair fixed effects, respectively. The input-industry fixed effect Φ^z controls for a possibility that unobservable features of an industry affect sourcing patterns. Note that in the estimation, one input-industry is omitted to avoid the perfect multicollinearity between θ^z and Φ^z. The country pair fixed effect Φ_{ij} captures the average difference in trade flows between country pairs regardless of who exports or imports a good. In a country pair in Φ_{ij}, which country is an exporter or importer does not matter. For example, a pair of countries (Korea, US) are treated as the same regardless of whether Korea is an exporter or importer. Thus, the number of

omitted country pairs in the estimation is the number of country-level variables divided by 2.

The set of control variables, such as real GDP and whether a country is landlocked, is given by *controls*. To control for a possibility that the coefficients on A_i and D_i seize the effects of the quality of other types of institutions, I add formal and informal institutions as a control variable. The former is defined as political constraints on government behavior, and the latter is defined as private constraints on individual behavior following Williamson (2009). In some estimations, the variable of formal institutions is alternately used by the 'rule of law' index in Kaufman et al. (2010), measuring agents' perception about contract enforcement and property rights. Human capital is also considered as a control variable since the coefficients on A_i and D_i could capture the impact of human capital abundance that is a potential determinant for constructing arbitration regimes. Finally, financial development is included as a control variable since financial development can be achieved based on high-quality legal institutions in which arbitration regimes exist. Additionally, IISs in the financially developed countries could export intermediate inputs more by overcoming high fixed costs, and FGPs in the financially developed countries could take better advantage of cheaper inputs from a foreign country by financing the payment more easily.

2.6 Data and Measures for the Main Variables

In this section, I describe data sources and the measures for the main variables in the empirical analysis. Concerning other variables that are not explained in this section, see Appendix A.4.

2.6.1 Sourcing Patterns

Data on trade flows of intermediate inputs are from the 2010 World Input-Output Database (WIOD) constructed by Timmer et al. (2015). I use the trade flows that occur when goods are used as intermediates for an industry, not when goods are used as final goods. The values of the trade flows are expressed in millions of US dollars. The dataset covers all such flows across 40

countries in 35 industries, including the service sector.[18] Even though the number of countries is limited, the quality of this dataset is considered high. It was constructed using official data from statistical institutions, while following the accounting concepts of the International System of National Accounts.

2.6.2 The Quality of Commercial Arbitration Regimes

To construct the measure of the quality of arbitration regimes, I employ the World Bank Group's Arbitrating and Mediating Disputes (AMD) database that exclusively covers commercial arbitration.[19] The dataset, which was collected in 2009, is based on a survey of legal experts, such as lawyers and law professors in each of the 87 economies.

In accordance with the definition of the quality of arbitration regimes that is made in the theory section, I focus on the enforceability of arbitral awards. As the regimes support a higher enforcement of arbitral awards, the quality of the regimes is considered higher. To capture this quality, three aspects of enforcement regime are considered: enforcement frame, the enforcement regime itself, and the efficiency of enforcement. Specifically, the enforcement frame refers to the basic legal framework that is a prerequisite for the enforcement of arbitral awards. Twelve questions, including whether or not a country enacted a specific statute on commercial arbitration, are chosen to measure the quality of the frame. The enforcement regime measures how directly the enforcement of arbitral awards can occur. Seven questions, including whether or not a country ratified the New York Convention, are selected to measure the quality of enforcement regime itself. Lastly, the efficiency of enforcement refers to the degree to which arbitral awards are effectively enforced. Ten questions, including the estimated period from the first hearing of the arbitration tribunal to the rendering of the arbitration award, are selected to capture this efficiency.

Table A.1 in Appendix A.3 lists the selected 29 questions out of the total survey questions.[20]

[18] According to Timmer et al. (2015), the 40 countries' GDP accounted for over 85 percent of the world GDP in 2008. Thus, I consider the 40 countries as a world economy.

[19] See Pouget (2013, pp. 5-6).

These questions are selected since they are related to the enforcement of arbitral awards.[21] Each question is categorized into the three broad aspects of the enforcement regimes noted above. The second column in the table indicates whether a question is about domestic arbitration (DA) or international arbitration (IA). When a question is related to both domestic and international arbitration, I indicate the question by DA/IA. The third column shows how to score each question.

This scoring system is based on the original scoring system in the AMD database. However, they are not exactly the same in that the answer of N/A scores 0 in my scoring system. Additionally, I change the original scoring system for a few questions. For example, in question 17, I combine two questions and change the score for the answer of "Yes" to each question from 1 to 0.5. This is to prevent double-weighting one subject in that both of them are about the ratification of a convention for the enforcement of arbitral awards. Lastly, I score some questions that were originally not scored in the AMD database. For instance, I score question 15 since this question gives important information to assess the degree of the enforcement of arbitral awards.

How international arbitration is distinguished from domestic arbitration relies on national law (Bergsten 2005, p.12). However, since many states based their arbitration laws on the Model Law, I distinguish international arbitration based on Article 1 (3) of the Model Law that stipulates the conditions under which an arbitration is considered as international. According to the article, if the state that a place of business belongs to is different from the state where the arbitration is situated, then arbitration is international. Meanwhile, according to Article I of the New York Convention, foreign awards are arbitral awards made in the territory of a state other than the one where the recognition and enforcement of such awards are sought. A place where the enforcement of arbitral awards is sought is more likely to be a place of business. Taken together, I consider a foreign arbitral award in the questionnaire as an award that is made in an international arbitration.

A domestic arbitral award can be made in international arbitration since the distinction

[20] The total survey questions are found at: http://iab.worldbank.org/methodology.

[21] I did not choose some questions that many countries did not answer (or answered N/A) even if they are related to the enforcement matter. Additionally, when some questions are repeated in some sense, I chose the one that is more comprehensive. For example, when a question provides a case study about an arbitration between a multinational and a local company, I chose another question regarding an international arbitration that encompasses the case study scenario. This step is to prevent double-weighting of one question.

between foreign and domestic arbitral awards is based on the places where awards are made and sought. Imagine an arbitration case between a local company and a foreign-owned multinational in a local territory. If an arbitral award is made within the local territory, it is considered as a domestic arbitral award. However, the arbitration is considered international. According to Article 1 (3) of the Model law, if the parties have expressly agreed that the subject matter of the arbitration agreement relates to more than one country, the arbitration is international. In fact, according to the survey answers, many countries, including China, Indonesia, the UK, and Vietnam, legally or practically distinguish international arbitration from domestic arbitration based on the parties' nationality, place of permanent residence, or the place of the head office of the parties. Therefore, a domestic arbitral award in the questionnaire is considered as an award that can be made in both international and domestic arbitrations.

To calculate the country-specific aggregate index for each domestic and international arbitration regimes' quality, for each category, I first average the scores for questions indicated by DA and IA, respectively. In the case of questions indicated by DA/IA, the corresponding scores account for the qualities of both domestic and international arbitration. Then, the three country-specific averages for each D and A are averaged again over the categories. Thus, equal weighting is applied for the three categories of enforcement frame, enforcement regime itself, and the efficiency of enforcement.[22]

Of the 87 countries in the AMD database, 22 countries are in the WIOD, which will be used for the empirical analysis to illustrate the effects of an industry's rs intensity and the quality of commercial arbitration regimes on global sourcing patterns. The indices for the 22 countries are listed in Table 2.2 in the order of the average of D and A. With these 22 countries, the correlation between the measures of D and A is 0.92.[23] Note that D and A are not comparable in that questions surveyed are not symmetric for domestic and international arbitration. Some questions are only for international arbitration, and there are no corresponding questions for domestic arbitration.

[22] In Section 2.7.2, I apply a 0.4:0.4:0.2 weighting scheme for the three categories so that the legal system itself is more weighted than its efficiency.

[23] Section 2.7.2 shows that this multicollinearity does not cause a serious issue in the estimation.

Table 2.2: The index for the quality of commercial arbitration regimes

Country	D	A	Average	Country	D	A	Average
China	0.833	0.843	0.838	Ireland	0.667	0.707	0.687
Romania	0.835	0.753	0.794	Poland	0.678	0.643	0.660
UK	0.778	0.771	0.775	India	0.666	0.648	0.657
Canada	0.789	0.753	0.771	Greece	0.641	0.672	0.657
Mexico	0.761	0.765	0.763	Slovakia	0.639	0.649	0.644
South Korea	0.761	0.721	0.741	Bulgaria	0.640	0.647	0.644
Spain	0.724	0.721	0.722	Japan	0.613	0.649	0.631
Austria	0.733	0.711	0.722	Turkey	0.631	0.575	0.603
Czech Republic	0.735	0.708	0.721	Indonesia	0.613	0.592	0.602
USA	0.733	0.694	0.713	Russia	0.529	0.516	0.523
Brazil	0.724	0.697	0.710				
France	0.733	0.680	0.707	Average	0.639	0.624	0.632

Notes: D and A in the heading denote the quality of domestic and international arbitration regimes, respectively.

Recall that my measure only captures the matter of enforcement of arbitral awards. Thus, even though my measure is constructed from the World Bank's AMD database, the scores in Table 2.2 are not perfectly correlated with the AMD scores that analyze arbitration proceedings under these three categories: the strength of laws to regulate arbitrations, the ease of process, and the extent of judicial assistance for arbitration proceedings.[24] For the 87 countries in the database, the correlation between the averages of D and A and the averages of the scores over the AMD three categories is 0.72.

2.6.3 Relationship-Specificity Intensity

To illustrate the calculation of θ^z, consider a Chilean firm producing a jam gift collection. Now, the firm needs to source a jar of grape jam to complete its jam collection. As Table 2.3 shows, the firm can source it either from a domestic fruit jam firm or a French jam firm. No matter who produces the jar of grape jam, for the production of one unit of it, a firm is assumed to need Chilean and French fresh grapes and sugar, a Korean glass jar, Chilean pectin, and a Korean metal lid. Following Nunn (2007), who uses the classification of commodities by Rauch (1999), the sugar (SITC 0619), jar (SITC 6651), and pectin (SITC 0730) are classified as R input requiring an rs

[24] For example, I exclude the question asking if a party may freely choose the number of arbitrators, which is categorized in the ease of process.

Table 2.3: A hypothetical example of rs intensity

Input	SITC	1 if input is R, o.w., 0 (A)	Source country	The Chilean firm Input share (B)	(A)×(B)	The French firm Input share (C)	(A)×(C)
Fresh grapes	0579	0	Chile	0.4	0	0.05	0
			France	0.1	0	0.35	0
Sugar	0619	1	Chile	0.1	0.1	0.1	0.1
			France	0.1	0.1	0.1	0.1
Jar	6651	1	Korea	0.1	0.1	0.2	0.2
Pectin	0730	1	Chile	0.1	0.1	0.1	0.1
Metal lid	6996	0	Korea	0.1	0	0.1	0
Sum				(D) ⇒	0.4	(E)⇒	0.5
Output share				(F)⇒	0.6	(G) ⇒	0.4
rs intensity				(D)×(F)+(E)×(G) ⇒			**0.44**

transaction since they are traded neither on organized exchanges nor reference priced. In contrast, the fresh grapes (SITC 0579) and lid (SITC 6996) are classified as N input since they are reference priced or traded on organized exchanges.[25]

Even though the two firms use the same inputs, the French jam firm more intensively uses a jar and less intensively uses fresh grapes than the Chilean firm. Then, the sum of the values in column (A) weighted by the input shares in column (B) and column (C) for the Chilean and French firm are 0.4 and 0.5, respectively. Now, assume that only Chile and France produce a jar of grape jam, and their output shares are 0.6 and 0.4, respectively. Then, the rs intensity of a jar of grape jam is summarized as 0.44, which is the sum of 0.4 and 0.5 weighted by the country's output shares, which are 0.6 and 0.4.

To employ this idea of a product-country level to measure industry level rs intensity, let z' be an output industry. Since an rs intensity for an industry is the same regardless of whether the industry is an input industry or an output industry, rs intensity for an input industry z whose

[25] This is based on Rauch's liberal classification that minimizes the number of commodities that are classified as differentiated. This classification is listed in the 4-digit Standard International Trade Classification (SITC) revision 2 level.

industry classification is the same as z' is

$$\theta^z = \theta^{z'} = \sum_i \sum_p \sum_s \xi_i^{z'} \alpha_{si}^{pz'} r_p, \tag{2.23}$$

where $\alpha_{si}^{pz'}$ is the share of input industry p, sourced from country s, within an output industry z' of country i. The subscript s can be the same as i. $\alpha_{si}^{pz'}$ is calculated by the value of p, sourced from s, in z' divided by the total value of all inputs in z' of country i, using the WIOD in 2010. As a robustness check, I use the 2005 WIOD, which is presented in Section 2.7.2. $\xi_i^{z'}$ is country i's output share in industry z'. r_p is the degree of relation-specificity for the transaction of input p. Based on the classification of Rauch (1999), if an input is neither traded on organized exchanges nor reference priced, then the input is defined as an input that requires an rs transaction.[26] Rauch's data, which I obtained from his homepage, were revised in 2007.

To construct θ^z, Rauch's data need to be merged with the WIOD. Rauch's commodity codes are organized by the 4-digit Standard International Trade Classification (SITC) revision 2, and the WIOD is listed in the 1-2-digit International Standard Industrial Classification (ISIC) revision 3. To link the two datasets, I use the concordance between SITC revision 2 and SITC revision 3 and the concordance between SITC revision 3 and ISIC revision 3. The former is given by the United Nations Statistics Division (UNSD), and the latter is from Eurostat.

To build a concordance between the 4-digit SITC revision 2 and 1-2-digit ISIC revision 3, I first truncate the 5-digit SITC codes to the 4-digit in the UNSD's concordance. These truncated SITC codes are mapped to Rauch's data.[27] Then, I link these SITC codes to the codes of the ISIC revision 3 using Eurostat's concordance. The linked set of codes (SITC revision 2, ISIC revision 3) can be repeated since the SITC revision 2 is matched to the ISIC revision 3 through the SITC revision 3. Specifically, there can be two or more identical combinations of codes (SITC revision 2, ISIC revision 3), but each SITC revision 3 code that is matched to each combination is unique. What matters in calculating r_p is the share of SITC revision 2 codes requiring an rs transaction

[26] I use Rauch's liberal classification for the empirical analysis.

[27] Due to the truncation to the 4-digit SITC level, some pairs of the set of codes (SITC revision 2, SITC revision 3) are duplicated. Thus, the linking process proceeds after adjusting data in such a way that the set of codes (SITC revision 2, SITC revision 3) is uniquely identified.

for an ISIC code in the WIOD, regardless of the share of industries listed in SITC revision 3 for an ISIC level. In other words, since the information about rs transactions is listed in the SITC revision 2, the shares of other industry levels for an ISIC code do not matter. Thus, I use the uniquely classified set of industries (SITC revision 2, ISIC revision 3). These 2-4-digit ISIC revision 3 codes are further linked to the 1-2-digit ISIC revision 3 codes in which the trade flows in the WIOD are organized. After adjusting repeated codes for the same reason, I have the uniquely classified set of codes (4-digit SITC revision 2, 2-digit ISIC revision 3).[28] Through these steps, Rauch's commodity codes are mapped to 19 industries of the total of the 35 industries in the WIOD.[29]

Based on this concordance with the 19 industries, $r_p \in (0,1)$ is built. Specifically, r_p is calculated by the number of the SITC codes that require an rs transaction divided by the total number of SITC codes for each 1-2-digit ISIC revision 3 industry. Note that $\alpha_{si}^{pz'}$ is calculated based on the trade flows of the total 35 industries and 40 countries in the WIOD. However, to construct $\theta^{z'}$, I consider only 19 output industries in the WIOD that are used to construct r_p. Otherwise, rs intensity for the industries that are not included in the concordance tend to be significantly lowered. In particular, without this adjustment, $\theta^{z'}$ for the service industries whose inputs are also heavily related to service activity tends to be considerably decreased. This is because most of the service-related input-industries do not exist in the concordance, which makes the values of r_p for those input-industries missing.

This measure is an improvement over the contract intensity measure in Nunn (2007), in that it relaxes his assumption that every country has the same input share for each industry. By using the WIOD, the average industry characteristic of the rs intensity across countries is summarized.

The measure of rs intensity is reported in Table 2.4.[30] Even though this dataset comprises less disaggregated industry categories, the pattern of rs intensity is quite similar with the contract

[28] In the uniquely classified set of codes (4-digit SITC revision 2, 2-digit ISIC revision 3), an SITC code can be matched to multiple ISIC codes in the WIOD, and an ISIC code can be matched to multiple SITC codes.

[29] This is because most of the ISIC revision 3 codes of service industries such as transport, telecommunications, and education, do not have the matching SITC Revision 2 and Revision 3 codes. The 19 industries are listed in Table 2.4.

[30] Even when only using the input share of the US, while not considering the output share of world production, the rankings of rs intensities remain very similar. The correlation between the rs intensity measures in Table 2.4 and the rs intensity measures obtained only using the US input share is 0.94.

Table 2.4: Industry-level rs intensity

ISIC code	ISIC description	θ^z
23	Coke, Refined Petroleum and Nuclear Fuel	0.183
AtB	Agriculture, Hunting, Forestry and Fishing	0.249
15t16	Food, Beverages and Tobacco	0.270
E	Electricity, Gas and Water Supply	0.324
24	Chemicals and Chemical Products	0.345
C	Mining and Quarrying	0.377
20	Wood and Products of Wood and Cork	0.396
26	Other Non-Metallic Mineral	0.408
25	Rubber and Plastics	0.409
27t28	Basic Metals and Fabricated Metal	0.416
21t22	Pulp, Paper, Paper , Printing and Publishing	0.449
36t37	Manufacturing, Nec; Recycling	0.481
O	Other Community, Social and Personal Services	0.514
17t18	Textiles and Textile Products	0.519
19	Leather, Leather and Footwear	0.531
71t74	Renting of M&Eq and Other Business Activities	0.575
29	Machinery, Nec	0.598
30t33	Electrical and Optical Equipment	0.662
34t35	Transport Equipment	0.700

intensity measure in Nunn (2007). In particular, petroleum, agriculture, hunting, and food industries tend to require less rs transactions, while electrical and transport equipment industries tend to require more rs transactions.

2.7 Empirical Results

The regression presented in equation (2.22) is based on 19 input industries and 22 source and destination countries. With missing values, a total of 8,532 observations are employed for the analysis. In this dataset, five types of data exist according to data level: country level (i or j level), importer-exporter-level (j-i level), industry level (z level), country-industry level (i-z or j-z level), and exporter-importer-industry level (i-j-z level). To address potentially correlated error terms at the country-industry level, error terms are clustered at the i-z level. Note that when error terms are clustered at the j-z level, the estimates in the following section show a higher overall significance level than when they are clustered at the i-z level, implying that error terms are more correlated at the i-z level than the j-z level. Variable definition and descriptive statistics for each type of data are shown in Table 2.5.

Table 2.5: Variable definition and descriptive statistics

		1. Country level				
Variable	Variable definition	obs	mean	sd	min	max
lnD_i	Ln qlty. of dom. arbitration regimes	22	-0.359	0.112	-0.636	-0.180
lnA_i	Ln qlty. of int'l arbitration regimes	22	-0.381	0.108	-0.662	-0.170
$lnINF_i$	Ln informal institutions	22	0.479	0.135	0.218	0.708
$lnFOR_i$	Ln formal institutions	22	1.851	0.203	1.099	1.946
$lnROL_i$	Ln rule of law	22	1.089	0.308	0.482	1.477
RD_i	R&D expenditure as a % of GDP	22	1.427	0.951	0.083	3.466
$LLOCKED_i$	Landlocked status	22	0.136	0.351	0	1
$lnPOP_i$	Ln population	22	3.998	1.609	1.497	7.184
$lnHC_i$	Ln index of human capital per person	22	1.063	0.160	0.657	1.286
$lnGDP_i$	Ln GDP	22	13.800	1.370	11.440	16.380
$lnFD_i$	Ln financial development	22	4.290	0.748	3.020	5.392
		2. Importer-exporter level				
$ln(W_j/W_i)$	Ln wage ratio	462	0.000	1.718	-4.154	4.154
		3. Industry level				
θ^z	Industry z's rs intensity	19	0.442	0.138	0.183	0.7
		4. Country-industry level				
$\theta^z lnA_i$	$\theta^z \times lnA_i$	416	-0.168	0.071	-0.464	-0.031
$\theta^z lnD_i$	$\theta^z \times lnD_i$	416	-0.159	0.070	-0.445	-0.033
		5. Exporter-importer-industry level				
$ln(M_{ij}/M_{ii})^z$	Ln relative global osurcing	8,532	-6.855	3.052	-22.370	14.260

Notes: In the estimation, error terms are clustered at the country-industry level.

2.7.1 Estimation

Table 2.6 shows the OLS results of the estimation equation (2.22). Column (1) only includes the individual terms without controlling other types of institutions. The estimates for the main variables from θ^z to lnD_j are statistically significant and consistent with expectations. When controlling for formal and informal institutions in column (2), the magnitude of the estimated coefficients on the quality of commercial arbitration regimes falls as expected, but they are still statistically significant. The effects of the main variables and the statistical significance remain similar when the rule of law index is used instead of formal institutions in column (3).

I include all interaction terms in columns (4) and (5). Concerning the interaction terms, they are all insignificant except $\theta^z lnA_j$. However, the signs of the insignificant interactions terms, $\theta^z lnA_i$ and $\theta^z lnA_j$, are consistent with the predicted directions of their effects on relative global sourcing through a firm's entry decision, as presented in Table 2.1.

Table 2.6: OLS estimates

Variable	Dependent variable is $ln(M_{ij}/M_{ii})^z$ (1)	(2)	(3)	(4)	(5)
θ^z	-2.809**	-2.821**	-2.819**	3.829*	3.836*
	(1.269)	(1.256)	(1.248)	(2.079)	(2.079)
lnA_i	29.839***	26.497***	26.595***	25.214***	25.331***
	(4.711)	(3.302)	(3.435)	(4.633)	(4.669)
lnA_j	36.807***	32.290***	32.352***	30.103***	30.153***
	(3.536)	(2.196)	(2.182)	(2.504)	(2.488)
lnD_i	-23.600***	-19.831***	-20.007***	-24.634***	-24.839***
	(5.292)	(3.503)	(3.603)	(4.674)	(4.668)
lnD_j	-29.371***	-24.646***	-24.351***	-24.373***	-24.063***
	(3.868)	(2.383)	(2.332)	(2.612)	(2.566)
$\theta^z lnA_i$				2.968	2.936
				(10.198)	(10.211)
$\theta^z lnA_j$				4.867*	4.882*
				(2.706)	(2.707)
$\theta^z lnD_i$				10.798	10.849
				(10.489)	(10.499)
$\theta^z lnD_j$				-0.547	-0.565
				(2.490)	(2.491)
$ln(W_j/W_i)$	-0.017	-0.000	-0.000	-0.000	-0.000
	(0.064)	(0.064)	(0.067)	(0.064)	(0.066)
$lnPOP_i$	-5.709***	-8.948***	-7.869***	-8.947***	-7.868***
	(2.183)	(3.180)	(3.035)	(3.148)	(3.004)
$lnPOP_j$	-6.183***	-9.532***	-8.626***	-9.526***	-8.622***
	(2.077)	(3.067)	(2.942)	(3.040)	(2.917)
RD_i	0.464***	0.157	0.098	0.156	0.097
	(0.171)	(0.270)	(0.265)	(0.274)	(0.269)
RD_j	0.649***	0.351	0.311	0.350	0.311
	(0.152)	(0.259)	(0.252)	(0.262)	(0.256)
$lnGDP_i$	4.582**	8.163**	7.119**	8.164**	7.120**
	(2.004)	(3.193)	(3.083)	(3.160)	(3.051)
$lnGDP_j$	6.199***	9.821***	8.980***	9.815***	8.976***
	(1.866)	(3.050)	(2.952)	(3.025)	(2.929)
$LLOCKED_i$	-3.914***	-2.750***	-2.692***	-2.748***	-2.690***
	(0.847)	(0.633)	(0.544)	(0.635)	(0.546)
$LLOCKED_j$	-4.595***	-3.434***	-3.210***	-3.432***	-3.207***
	(0.891)	(0.623)	(0.530)	(0.622)	(0.528)
$lnFD_i$	-2.809***	-5.625***	-5.334***	-5.624***	-5.334***
	(0.790)	(1.662)	(1.536)	(1.646)	(1.520)
$lnFD_j$	-3.647***	-6.393***	-5.914***	-6.387***	-5.908***
	(0.780)	(1.673)	(1.521)	(1.657)	(1.505)
$lnHC_i$	-7.859***	-13.435***	-12.821***	-13.453***	-12.836***
	(2.018)	(4.439)	(4.463)	(4.397)	(4.426)
$lnHC_j$	-5.780***	-11.717***	-11.533***	-11.708***	-11.526***
	(1.507)	(4.079)	(4.178)	(4.055)	(4.153)
$lnFOR_i$		1.824		1.823	
		(1.420)		(1.403)	
$lnFOR_j$		0.874		0.872	
		(1.318)		(1.316)	
$lnINF_i$		11.824**	10.726**	11.831**	10.735**
		(4.702)	(4.568)	(4.710)	(4.574)
$lnINF_j$		11.251**	10.498**	11.240**	10.486**
		(4.897)	(4.670)	(4.890)	(4.666)
$lnROL_i$			1.533		1.537
			(1.108)		(1.090)
$lnROL_j$			0.427		0.421
			(0.958)		(0.959)
Country pair FE	Y	Y	Y	Y	Y
Input-industry FE	Y	Y	Y	Y	Y
No. of countries	22	22	22	22	22
No. of input-industries	19	19	19	19	19
No. of clusters	416	416	416	416	416
Observations	8,532	8,532	8,532	8,532	8,532
R-squared	0.614	0.615	0.615	0.619	0.619

Notes: Error terms are clustered at the *i-z* level. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the levels of 1%, 5%, and 10%, respectively. Estimates for a constant are not reported.

The individual effects can also be quantified using the estimates in column (4) by holding other variables fixed at their mean values. For instance, the association of θ^z and relative global sourcing is -2.836 $(= 3.829+(2.968+4.867)\times(-0.381)+(10.798-0.547)\times(-0.359))$. The signs of the effects of other variables, which are obtained using the same method, are consistent with expectations, and the magnitudes of the effects are close to their corresponding magnitudes in column (2). These results support the theoretical results that relative global sourcing rises with the quality of international arbitration regimes, while falling with the quality of domestic arbitration regimes. These results also support the theoretical prediction of a firm's avoidance of global sourcing as the rs intensity of input industry rises.

It is interesting that the estimates on financial development and human capital are negative and statistically significant in every column. That is, as a source country and destination country have a better financial system and more skilled labor, global sourcing relative to the source country's domestic sourcing tends to decrease. The estimation results might imply that firms are more attracted to domestic sourcing than global sourcing, as an economy saves extra costs by using a high-quality financial system and human capital. This might be because financial development and human capital are not directly related to reducing opportunism. Without institutions mitigating opportunism, a higher risk of opportunism in transacting with foreign parties rather than local parties can hinder costs for global sourcing from falling. Thus, as an economy saves extra costs through financial development and human capital, costs for domestic sourcing can become cheaper relative to global sourcing, attracting more domestic sourcing.

Concerning formal and informal institutions and the rule of law index, the signs on their estimated coefficients are all positive, but the estimated coefficients on them are not statistically significant. Setting aside the statistical significance matter, these positive signs of the estimates imply that foreign transactions require a higher quality of formal and informal institutions and parties' greater confidence in rule of law than domestic transactions. These institutions are more directly related to mitigating opportunism than human capital and financial development. Since foreign transaction involves a higher risk than domestic transactions due to cultural and geograph-

ical distance, the role of institutions, which mitigate opportunism in both domestic and foreign transactions, can become more important in foreign transactions.

Even though these results, overall, are as expected, the magnitudes and statistical significance might be affected by the bias arising from the omitted variable of how much relative global sourcing occurred in the past. For instance, if the value of relative global sourcing in the past is high, policy makers of a country would develop the quality of international arbitration regimes to support and foster foreign transactions. Conversely, if the past performance of relative global sourcing is poor, the policy makers might enhance the quality of domestic arbitration regime to protect local traders.

Controlling the past level of relative global sourcing considerably addresses the potential reverse causality. The current performance of relative global sourcing could influence the current level of the quality of domestic and international arbitration regimes based on the past performance of relative global sourcing. It would be unlikely for the policy makers to develop the quality of arbitration regimes based on only the current performance due to the high cost of constructing better arbitration regimes. Accordingly, the reverse causality effect is expected to be close to the effect of the past performance of relative global sourcing on the current quality of arbitration regimes. Thus, including the past performance of global sourcing as a control variable helps estimate true effects of the quality of arbitration regimes by disentangling the effect of the past performance of global sourcing on the quality, which is expected to be close to the reverse causality effect. That is, by utilizing variation in global sourcing that is not related to the past level of global sourcing, the main channel through which the reverse causation could run is controlled.

Institutions, in which arbitration regimes are included, feature path-dependence and increasing returns, which makes institutions stable over time. According to North (1990, pp. 92-104), the Northwest Ordinance, passed in 1787, epitomizes this feature of institutions. The ordinance provided for the fundamental structure of inheritance and fee-simple ownership of the vast land area in the West, while trying to create new states by integrating the area. In fact, the basic structure of the provisions, including the fee-simple land ownership, in the ordinance originated from the rules of the colonies of Great Britain. After the ordinance was constructed, it governed

basic land ownership, while the US expanded its territories over the next century. In addition, based on the ordinance, the framework of property rights and political rules in the new territories was determined. This, in turn, promoted the emergence of the entrepreneurs who were trying to take advantage of the new institutions politically and economically, which made land policies more efficient.

This example indeed evidences that arbitration regimes, as a specific type of legal institution, do not easily respond to the current economic situation due to the characteristics of path-dependence and increasing returns, which results from a high set-up cost. That is, arbitration regimes are more likely to be developed when the volume of global sourcing in the past is high enough to offset the frictions from path-dependence and the high set-up cost. Hence, this example supports the use of the past level of global sourcing as a control variable to address the potential reverse causality.

Even though this strategy might not fully address the reverse causality, I do not employ the instrumental variables (IV) estimation. It is doubtful that it is possible to find proper instrumental variables for the qualities of domestic and international arbitration regimes. As explained in Section 2.6.2, some regimes apply to a general commercial arbitration that encompasses both domestic and international arbitrations, while other regimes solely apply domestic or international arbitration. Additionally, the regimes on domestic arbitral awards support enforcing the awards made in international arbitration, as well as the awards made in domestic arbitration. This stems from the fact that the distinction between domestic and foreign arbitral awards is based on geographical distance between places in which an award is made and sought, while the distinction between domestic and international arbitration rests not only on this geographical distance but also on the existence of more than one country that is related to the subject matter of arbitration.[31] Finding an exogenous variable that captures this nature of arbitration regimes and affects relative global sourcing only through arbitration regimes seems unrealistic. Therefore, I rely on controlling the past performance

[31] See the Introduction to find the definition of foreign arbitral awards and Article 1 (3) of the Model law that makes the distinction between domestic and international arbitration.

of relative global sourcing to address the reverse causality.

Table 2.7 shows the estimates obtained by including the average of $\left(\frac{M_{ij}}{M_{ii}}\right)^z$ over the years of 1995, 1999, 2003 and 2007 as an independent variable. As can be seen in this table, the magnitudes of the estimates on the main variables from θ^z to $\theta^z lnD_j$ tend to be substantially decreased compared to the corresponding estimates in Table 2.6. Without the 4 interaction terms, the estimated coefficients on the individual variables from θ^z to lnD_j through columns (1)–(3) are statistically significant. However, with the interaction terms in columns (4) and (5), the estimated coefficient on θ^z loses statistical significance, while the effects of A_i, A_j, D_i, and D_j are still significant.

To quantify the individual effects of rs intensity and the quality of arbitration regimes, the estimates in columns (2) and (3), in which other types of institutions are controlled, are used. Beginning with θ^z, a 1 percent increase in the rs intensity in input z leads to a 1.91 percent fall in j's global sourcing of z from i relative to i's domestic sourcing.[32] Additionally, a 1 percent rise in the quality of international arbitration regimes of i and j raises the relative global sourcing by 15.53–15.68 percent and 15.43–15.68 percent, respectively. In contrast, a 1 percent increase in the quality of domestic arbitration regimes of i and j reduces relative global sourcing by 12.39–12.50 percent and 12.58–12.91 percent, respectively.[33]

These effects remain similar when quantifying the estimates in column (4), while holding other variables fixed at their mean values. For example, the magnitude of the effect on A_i on relative global sourcing is 15.639 (=15.512+0.287×0.442), which is very similar to the corresponding value of 15.526 in column (2). Using the same method, the effects of other variables, A_j, D_i, D_j, and θ^z, on relative global sourcing are 15.545, -12.481, -12.988, and -1.922, respectively, which are close to the corresponding values in column (2).

[32] Notice that rs intensity is a share measuring the degree of rs transactions for production. Thus, to quantify its effect as an elasticity, the estimated coefficient on rs intensity does not need to be multiplied by 100.

[33] To get a sense of the effects of A_i in a nominal value, an ad-hoc method can be used by employing the median of $\left(\frac{M_{ij}}{M_{ii}}\right)^z$, 0.00134. The values of $\left(\frac{M_{ij}}{M_{ii}}\right)^z$ after the increase in A_i by 15.53–15.68 percent are about 0.00155. Since M_{ii}^z and M_{ij}^z are 4155.869 and 5.5728 millions of dollars when $\left(\frac{M_{ij}}{M_{ii}}\right)^z$ is 0.00134, fix M_{ii}^z at 4155.869 to see how much M_{ij} changes. Then, M_{ij}^z that corresponds to 0.00155 of $\left(\frac{M_{ij}}{M_{ii}}\right)^z$ is 6.4416. Thus, at the median of the relative global sourcing, M_{ij} increases by 0.869 (=6.4416-5.5728) millions of US dollars with a 1 percent increase in A_i, holding M_{ii} fixed.

Table 2.7: OLS estimates with the control of reverse causality

Variable	Dependent variable is $ln(M_{ij}/M_{ii})^z$ (1)	(2)	(3)	(4)	(5)
$ln(avg.past(Mij/Mii)^z)$	0.488***	0.493***	0.492***	0.489***	0.488***
	(0.169)	(0.169)	(0.168)	(0.169)	(0.168)
θ^z	-1.882**	-1.911**	-1.908**	1.603	1.620
	(0.874)	(0.853)	(0.849)	(1.644)	(1.647)
lnA_i	14.938**	15.526***	15.676***	15.512***	15.682***
	(6.601)	(4.800)	(4.860)	(4.295)	(4.343)
lnA_j	16.818**	15.432***	15.678***	15.626***	15.852***
	(7.102)	(5.648)	(5.500)	(5.104)	(4.971)
lnD_i	-10.486*	-12.391***	-12.498***	-16.317***	-16.460***
	(6.259)	(3.771)	(3.829)	(4.057)	(4.077)
lnD_j	-12.430*	-12.911***	-12.575***	-13.444***	-13.091***
	(6.495)	(4.337)	(4.292)	(4.258)	(4.221)
$\theta^z lnA_i$				0.287	0.253
				(7.376)	(7.438)
$\theta^z lnA_j$				-0.184	-0.148
				(2.534)	(2.525)
$\theta^z lnD_i$				8.678	8.746
				(7.305)	(7.367)
$\theta^z lnD_j$				1.032	1.002
				(2.150)	(2.154)
$ln(W_j/W_i)$	0.039	0.072	0.070	0.071	0.069
	(0.046)	(0.046)	(0.048)	(0.046)	(0.048)
$lnPOP_i$	-6.058***	-5.783**	-3.545	-5.807**	-3.576
	(1.811)	(2.858)	(2.881)	(2.836)	(2.859)
$lnPOP_j$	-5.778***	-5.794**	-3.752	-5.819**	-3.785
	(1.730)	(2.828)	(2.871)	(2.809)	(2.853)
RD_i	0.041	0.188	0.071	0.188	0.070
	(0.197)	(0.212)	(0.214)	(0.213)	(0.216)
RD_j	0.144	0.218	0.121	0.218	0.122
	(0.202)	(0.200)	(0.199)	(0.201)	(0.201)
$lnGDP_i$	5.259***	5.341*	3.192	5.364*	3.220
	(1.679)	(2.824)	(2.850)	(2.801)	(2.828)
$lnGDP_j$	5.549***	5.824**	3.914	5.851**	3.948
	(1.569)	(2.855)	(2.911)	(2.836)	(2.894)
$LLOCKED_i$	-2.818***	-2.035***	-1.824***	-2.041***	-1.832***
	(0.787)	(0.530)	(0.487)	(0.532)	(0.490)
$LLOCKED_j$	-3.186***	-2.486***	-2.082***	-2.494***	-2.091***
	(0.879)	(0.599)	(0.592)	(0.598)	(0.590)
$lnFD_i$	-2.533***	-3.847**	-3.119**	-3.861**	-3.138**
	(0.653)	(1.507)	(1.451)	(1.497)	(1.440)
$lnFD_j$	-2.955***	-4.276***	-3.340**	-4.291***	-3.356**
	(0.681)	(1.597)	(1.565)	(1.587)	(1.554)
$lnHC_i$	-5.462***	-5.809	-4.733	-5.874	-4.799
	(1.800)	(4.202)	(4.292)	(4.177)	(4.270)
$lnHC_j$	-3.585**	-5.241	-4.642	-5.275	-4.681
	(1.567)	(4.159)	(4.261)	(4.137)	(4.240)
$lnFOR_i$		3.538***		3.527***	
		(1.322)		(1.315)	
$lnFOR_j$		2.305**		2.297**	
		(1.127)		(1.130)	
$lnINF_i$		6.325	4.082	6.376	4.142
		(4.200)	(4.201)	(4.194)	(4.193)
$lnINF_j$		6.988	5.247	7.016	5.279
		(4.555)	(4.479)	(4.537)	(4.462)
$lnROL_i$			2.768***		2.764***
			(0.994)		(0.986)
$lnROL_j$			1.465*		1.454*
			(0.818)		(0.822)
Country pair FE	Y	Y	Y	Y	Y
Input-industry FE	Y	Y	Y	Y	Y
No. of countries	22	22	22	22	22
No. of input-industries	19	19	19	19	19
No. of clusters	416	416	416	416	416
Observations	8,518	8,518	8,518	8,518	8,518
R-squared	0.730	0.733	0.732	0.735	0.734

Notes: Error terms are clustered at the *i-z* level. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the levels of 1%, 5%, and 10%, respectively. Estimates for a constant are not reported.

In addition, the magnitude of the estimated coefficients on human capital and informal institutions falls, compared to the corresponding estimates in Table 2.6, and the estimates tend to lose statistical significance. However, the effects of formal institutions and the rule of law increase and become significant. Concerning other control variables, the magnitudes of their impacts tend to decrease, and the directions of these impacts stay the same.

2.7.2 Robustness Check

As a robustness check, I examine how the estimates change when the legal system itself is more heavily weighted when constructing the measures for A and D. Specifically, instead of equal weighting, I use a 0.4:0.4:0.2 weighting for the categories of enforcement frame, enforcement regime itself, and the efficiency of enforcement, respectively, in the survey questions. That is, after calculating the three averages of the scores for the three categories, I obtain country-specific A and D by averaging them with the 0.4:0.4:0.2 weighting scheme. By doing so, how efficiently the regimes act is less weighted in capturing the quality of arbitration regimes.

Table 2.8 shows the OLS estimates that are obtained using this measure. As can be seen, compared to the estimates in Table 2.7, the magnitudes of the estimated coefficients on A_i, A_j, D_i, and D_j tend to remain similar, while being statistically significant. Even when using a 0.45:0.45:0.1 weighting scheme, their estimates remain similar and statistically significant, even though I do not report the result. Other control variables tend to be not far away from the estimates with the original measures for A and D.

As another robustness check, I use the 2005 WIOD instead of the 2010 WIOD to calculate the input and output shares, expressed as $\alpha_{si}^{pz'}$ and $\xi_i^{z'}$ in equation (2.23), in the process of measuring θ^z. I still use Rauch's 2007 classification to get r_p. As can be seen in Table 2.9, the signs and the statistical significance of the estimated coefficients on the main variables from θ^z to $\theta^z lnD_j$ stay the same, compared to the signs of these in Table 2.7. Their magnitudes also remain similar.

Lastly, I examine whether the multicollinearity between A and D causes a serious issue in the estimation. With the 22 countries, their correlation is 0.92. This stems from the fact that some

Table 2.8: Robustness check with a 0.4:0.4:0.2 weighting scheme

Variable	Dependent variable is $ln(M_{ij}/M_{ii})^z$ (1)	(2)	(3)	(4)	(5)
$ln(avg.past(Mij/Mii)^z)$	0.487***	0.493***	0.492***	0.489***	0.488***
	(0.169)	(0.170)	(0.168)	(0.170)	(0.168)
θ^z	-1.886**	-1.912**	-1.908**	1.356	1.376
	(0.872)	(0.853)	(0.849)	(1.634)	(1.636)
lnA_i	14.880**	14.826***	15.003***	14.828***	15.021***
	(6.123)	(4.525)	(4.629)	(3.909)	(3.990)
lnA_j	17.295**	14.889***	15.316***	15.164***	15.571***
	(6.827)	(5.612)	(5.454)	(5.091)	(4.946)
lnD_i	-10.236*	-12.113***	-12.127***	-15.966***	-16.012***
	(5.660)	(3.632)	(3.683)	(3.798)	(3.808)
lnD_j	-12.678**	-12.799***	-12.497***	-13.247***	-12.927***
	(6.084)	(4.369)	(4.292)	(4.250)	(4.182)
$\theta^z lnA_i$				0.220	0.199
				(6.669)	(6.717)
$\theta^z lnA_j$				-0.400	-0.367
				(2.313)	(2.304)
$\theta^z lnD_i$				8.537	8.596
				(6.668)	(6.718)
$\theta^z lnD_j$				0.859	0.833
				(1.992)	(1.995)
$ln(W_j/W_i)$	0.032	0.068	0.067	0.068	0.066
	(0.045)	(0.044)	(0.047)	(0.044)	(0.047)
$lnPOP_i$	-7.567***	-6.998**	-4.019	-7.031**	-4.052
	(1.985)	(3.118)	(3.009)	(3.098)	(2.991)
$lnPOP_j$	-7.333***	-7.002**	-4.227	-7.036**	-4.264
	(1.945)	(3.132)	(3.021)	(3.115)	(3.005)
RD_i	-0.311**	-0.069	-0.247	-0.071	-0.249
	(0.144)	(0.231)	(0.230)	(0.233)	(0.232)
RD_j	-0.212	-0.030	-0.194	-0.032	-0.195
	(0.135)	(0.231)	(0.227)	(0.231)	(0.228)
$lnGDP_i$	6.671***	6.618**	3.771	6.650**	3.803
	(1.819)	(3.080)	(2.992)	(3.059)	(2.973)
$lnGDP_j$	7.015***	7.092**	4.500	7.128**	4.538
	(1.800)	(3.195)	(3.097)	(3.178)	(3.081)
$LLOCKED_i$	-3.447***	-2.132***	-1.809***	-2.139***	-1.816***
	(0.880)	(0.540)	(0.479)	(0.543)	(0.482)
$LLOCKED_j$	-3.822***	-2.589***	-2.076***	-2.597***	-2.084***
	(0.981)	(0.620)	(0.589)	(0.620)	(0.588)
$lnFD_i$	-2.688***	-4.520***	-3.514**	-4.539***	-3.534**
	(0.669)	(1.630)	(1.530)	(1.622)	(1.521)
$lnFD_j$	-3.129***	-4.941***	-3.753**	-4.961***	-3.772**
	(0.713)	(1.765)	(1.677)	(1.755)	(1.667)
$lnHC_i$	-6.163***	-6.977	-5.712	-7.050	-5.782
	(2.009)	(4.572)	(4.587)	(4.550)	(4.568)
$lnHC_j$	-4.356**	-6.404	-5.602	-6.447	-5.649
	(1.813)	(4.565)	(4.576)	(4.545)	(4.556)
$lnFOR_i$		4.690***		4.688***	
		(1.206)		(1.199)	
$lnFOR_j$		3.459***		3.459***	
		(1.108)		(1.111)	
$lnINF_i$		9.044*	6.258	9.113*	6.330
		(4.730)	(4.674)	(4.726)	(4.670)
$lnINF_j$		9.644*	7.410	9.694*	7.458
		(5.225)	(5.019)	(5.208)	(5.003)
$lnROL_i$			3.612***		3.615***
			(0.932)		(0.923)
$lnROL_j$			2.352***		2.347***
			(0.804)		(0.808)
Country pair FE	Y	Y	Y	Y	Y
Input-industry FE	Y	Y	Y	Y	Y
No. of countries	22	22	22	22	22
No. of input-industries	19	19	19	19	19
No. of clusters	416	416	416	416	416
Observations	8,518	8,518	8,518	8,518	8,518
R-squared	0.731	0.733	0.732	0.735	0.734

Notes: Error terms are clustered at the *i-z* level. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the levels of 1%, 5%, and 10%, respectively. Estimates for a constant are not reported.

Table 2.9: Robustness check with θ^z obtained using the 2005 WIOD

Variable	Dependent variable is $ln(M_{ij}/M_{ii})^z$ (1)	(2)	(3)	(4)	(5)
$ln(avg.past(Mij/Mii)^z)$	0.488***	0.493***	0.492***	0.490***	0.489***
	(0.169)	(0.169)	(0.168)	(0.169)	(0.168)
θ^z	-1.974**	-2.006**	-2.002**	1.340	1.358
	(0.917)	(0.895)	(0.891)	(1.645)	(1.649)
lnA_i	14.938**	15.526***	15.676***	15.385***	15.550***
	(6.601)	(4.800)	(4.860)	(4.316)	(4.373)
lnA_j	16.818**	15.432***	15.678***	15.655***	15.881***
	(7.102)	(5.648)	(5.500)	(5.116)	(4.982)
lnD_i	-10.486*	-12.391***	-12.498***	-16.012***	-16.149***
	(6.259)	(3.771)	(3.829)	(4.042)	(4.074)
lnD_j	-12.430*	-12.911***	-12.575***	-13.368***	-13.014***
	(6.495)	(4.337)	(4.292)	(4.255)	(4.216)
$\theta^z lnA_i$				0.559	0.536
				(7.164)	(7.231)
$\theta^z lnA_j$				-0.292	-0.256
				(2.592)	(2.584)
$\theta^z lnD_i$				8.168	8.226
				(6.851)	(6.923)
$\theta^z lnD_j$				0.902	0.872
				(2.189)	(2.192)
$ln(W_j/W_i)$	0.039	0.072	0.070	0.072	0.070
	(0.046)	(0.046)	(0.048)	(0.046)	(0.048)
$lnPOP_i$	-6.058***	-5.783**	-3.545	-5.804**	-3.572
	(1.811)	(2.858)	(2.881)	(2.841)	(2.864)
$lnPOP_j$	-5.778***	-5.794**	-3.752	-5.815**	-3.780
	(1.730)	(2.828)	(2.871)	(2.814)	(2.857)
RD_i	0.041	0.188	0.071	0.188	0.070
	(0.197)	(0.212)	(0.214)	(0.213)	(0.216)
RD_j	0.144	0.218	0.121	0.218	0.122
	(0.202)	(0.200)	(0.199)	(0.201)	(0.201)
$lnGDP_i$	5.259***	5.341*	3.192	5.361*	3.216
	(1.679)	(2.824)	(2.850)	(2.807)	(2.833)
$lnGDP_j$	5.549***	5.824**	3.914	5.847**	3.943
	(1.569)	(2.855)	(2.911)	(2.841)	(2.898)
$LLOCKED_i$	-2.818***	-2.035***	-1.824***	-2.041***	-1.832***
	(0.787)	(0.530)	(0.487)	(0.532)	(0.490)
$LLOCKED_j$	-3.186***	-2.486***	-2.082***	-2.493***	-2.090***
	(0.879)	(0.599)	(0.592)	(0.598)	(0.590)
$lnFD_i$	-2.533***	-3.847**	-3.119**	-3.860**	-3.136**
	(0.653)	(1.507)	(1.451)	(1.499)	(1.443)
$lnFD_j$	-2.955***	-4.276***	-3.340**	-4.289***	-3.354**
	(0.681)	(1.597)	(1.565)	(1.589)	(1.557)
$lnHC_i$	-5.462***	-5.809	-4.733	-5.866	-4.790
	(1.800)	(4.202)	(4.292)	(4.184)	(4.276)
$lnHC_j$	-3.585**	-5.241	-4.642	-5.268	-4.673
	(1.567)	(4.159)	(4.261)	(4.142)	(4.245)
$lnFOR_i$		3.538***		3.530***	
		(1.322)		(1.317)	
$lnFOR_j$		2.305**		2.298**	
		(1.127)		(1.130)	
$lnINF_i$		6.325	4.082	6.371	4.135
		(4.200)	(4.201)	(4.199)	(4.199)
$lnINF_j$		6.988	5.247	7.011	5.273
		(4.555)	(4.479)	(4.543)	(4.467)
$lnROL_i$			2.768***		2.766***
			(0.994)		(0.987)
$lnROL_j$			1.465*		1.456*
			(0.818)		(0.822)
Country pair FE	Y	Y	Y	Y	Y
Input-industry FE	Y	Y	Y	Y	Y
No. of countries	22	22	22	22	22
No. of input-industries	19	19	19	19	19
No. of clusters	416	416	416	416	416
Observations	8,518	8,518	8,518	8,518	8,518
R-squared	0.730	0.733	0.732	0.734	0.734

Notes: Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the levels of 1%, 5%, and 10%, respectively. Estimates for a constant are not reported.

Table 2.10: Robustness check by subsample

	Dependent variable is $ln(M_{ij}/M_{ii})^z$				
	(1)	(2)	(3)	(4)	(5)
Variable	Full sample	First half of random sample	Second half of random sample	First half of different random sample	Second half of different random sample
θ^z	-1.911**	-1.578*	-2.356**	-2.056**	-1.494*
	(0.853)	(0.934)	(0.950)	(1.005)	(0.883)
lnA_i	15.526***	15.268***	16.043***	14.715***	15.167**
	(4.800)	(5.820)	(4.372)	(4.457)	(6.221)
lnA_j	15.432***	15.990**	14.803***	14.501***	15.434**
	(5.648)	(6.438)	(5.213)	(5.232)	(6.884)
lnD_i	-12.391***	-11.548**	-13.390***	-11.851***	-11.648**
	(3.771)	(5.057)	(3.630)	(3.822)	(5.594)
lnD_j	-12.911***	-13.220**	-12.539***	-12.109***	-12.782**
	(4.337)	(5.172)	(4.414)	(4.409)	(5.804)
Country pair FE	Y	Y	Y	Y	Y
Input-industry FE	Y	Y	Y	Y	Y
Full set of controls	Y	Y	Y	Y	Y
No. of clusters	416	416	416	416	416
Observations	8,518	4,259	4,259	4,259	4,259
R-squared	0.733	0.725	0.759	0.748	0.735

Notes: No interaction terms are included in the regressions. Other estimates are not reported. The estimates in column (2) come from Table 2.7. The estimates in columns (2)-(3) are obtained using the two sub-samples from a uniform distribution on (0,1). The estimates in columns (4)-(5) are obtained using the different two sub-samples from a newly drawn uniform distribution. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the level of 1%, 5%, and 10%, respectively.

regimes enforce both domestic and international arbitrations. One of the methodologies that check if multicollinearity causes a serious issue, which increases the standard errors, is to examine how sensitively estimates change between sub-samples. When the estimates are considerably different between the sub-samples, multicollinearity can be a serious issue. Adopting this methodology, I analyze the sensitivity of the estimates using the two different random sub-samples from a uniform distribution on (0,1).

Specifically, the estimates in columns (2) and (3) in Table 2.10 are obtained with the two sub-samples from a uniform distribution. The estimates in columns (4) and (5) are obtained with the different two sub-samples from a newly drawn uniform distribution. As can be seen in Table 2.10, compared to the estimates from the full sample in column (1), the estimates tend to be stable across different samples, which implies that the multicollinearity does not cause a serious concern for the estimation.

2.8 Concluding Remarks

This paper identifies that differences in the qualities of domestic and international commercial arbitration regimes between countries are an important determinant of global sourcing patterns. The theoretical and empirical results show that relative global sourcing increases with each country's quality of international commercial arbitration regimes, while falling with each country's quality of domestic commercial arbitration regimes.

This paper also identifies that differences in the degree to which relationship-specific transactions are required for production between industries are another important determinant of global sourcing patterns. The theoretical and empirical results show that a rise in an input industry's rs intensity decreases relative global sourcing, capturing a firm's avoidance of global sourcing exposed to a higher level of opportunism than domestic sourcing.

The results of this paper fundamentally evidence that a firm's avoidance of opportunism is one of the important determinants of global sourcing patterns. Opportunism arises in the presence of relationship-specific transactions and is reduced by high-quality national commercial arbitration regimes, which creates the significance of the quality of arbitration regimes in determining sourcing patterns. Future promising research regarding relationship-specificity should include exploring a firm's use of litigation and/or arbitration as a dispute resolution mechanism in international trade.

Chapter 3

The Interrelation between Formal and Informal Institutions through International Trade

3.1 Introduction

Formal institutions have currently received considerable attention in international trade literature because of their ability to mitigate holdup problems between suppliers (Acemoglu et al., 2007; Levchenko, 2007; Nunn, 2007). Similar holdup problems arise between traders across borders, and informal institutions enforced through social norms and culture between countries have been stressed as a solution. That is, trust and reputation formed through repeated interaction and networks between trade partners can lower trade barriers (Gould, 1994; Rauch, 1999, 2001; Rauch and Trindade, 2002; Guiso et al., 2009; Chaney, 2014).

Historical evidence shows that there is an interaction between formal and informal institutions, whether as complements or substitutes. North et al. (2000) argue that shared beliefs among U.S. citizens are complementary to the U.S. Constitution and encourage compliance with formal rules. Even where formal institutions are not well developed, informal counterparts can substitute for them by enforcing a customary rule. For example, Greif (1993) shows that a reputation mechanism supported contract enforcement among Maghribi traders in the 11th century when there were few legal contracts.

From such evidence, it seems important to take account for the interaction between institutions when examining institutional quality that mitigates holdup problems in international trade. Thus, in this paper, I assume that their interaction gives rise to institutional quality, which governs

institutional comparative advantage. Specifically, under this assumption, I theoretically examine how country-specific formal institutions are interrelated with informal counterparts through comparative advantage in institutionally intensive goods and through trade cost incurred due to imperfect contract enforcement.

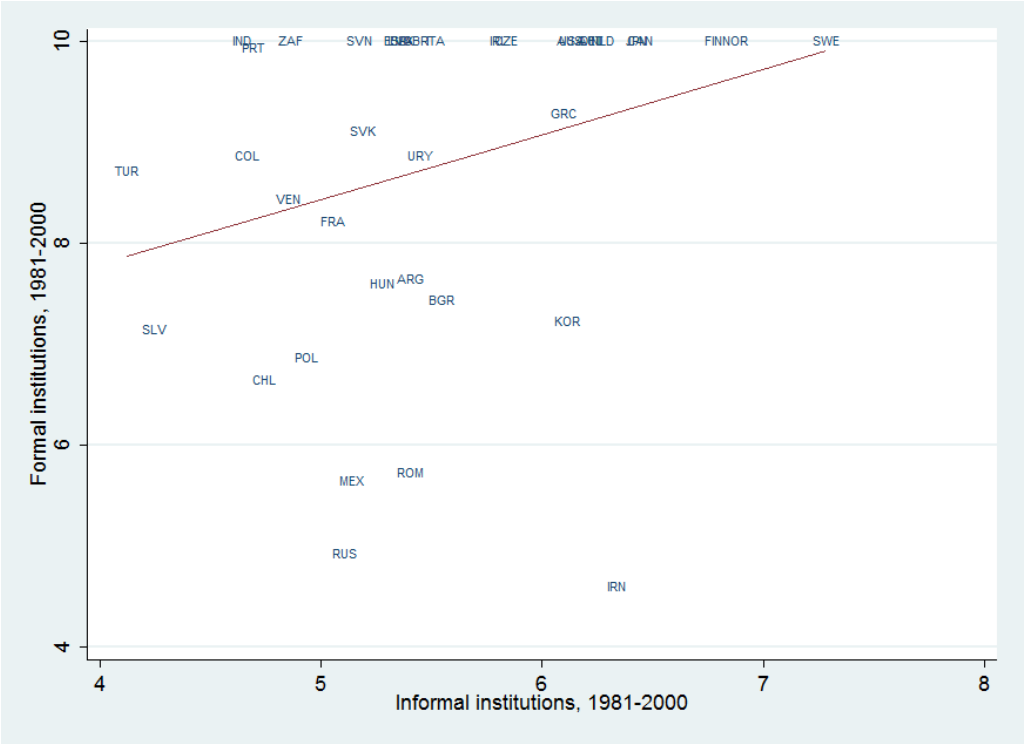
In fact, the story of the Maghribi traders epitomizes that formal institutions evolve through trade in such a way that the rich informal institutions work more efficiently in lowering trade barriers. Maghribi traders employed overseas agents who supplied trade-related services, which involved a high level of uncertainty in that the employed agent could embezzle the merchants capital. To resolve the commitment problem, the 11th century Maghribi traders organized a coalition, a private-order institution, rather than relying on ineffective legal system (Greif 1989, pp. 865-6; Greif 1993, p. 529).

Within the coalition, a reputation mechanism was supported by implicit contract and information transmission mechanism. According to the implicit contract, the coalition merchant was not supposed to hire an agent who cheated, which discouraged agents from cheating and encouraged them to maintain a trustworthy reputation (Greif 1989, p. 868). Additionally, the member merchant was supposed to provide trade-related information for other members, which helped reveal who cheated (Greif 1989, p. 880). This information transmission was based on the fact that the traders shared a social network through an emigration process; they were the descendants of Jewish traders.[1] With the same ethnic and religious ties, the member traders were able to convey the trade-related information more effectively.

However, growing trade made monitoring the behaviors of member agents more difficult, and the reputation mechanism was not sufficient to overcome the commitment problem. Milgrom et al. (1990, p. 4) explain that this problem led to the evolution of the Law Merchant: "the legal codes governing commercial transactions and administered by private judges drawn from the commercial ranks."In fact, the Law Merchant was developed out of the cultural rules of transaction, and

[1] The Jewish traders emigrated to Tunisia in the 10th century. In the 11th century, to expand trade, they emigrated to the Muslim world such as Spain, Sicily, Egypt, and Palestine (Greif 1989, p. 879; Greif 1993, pp. 535-6).

Figure 3.1: Formal and informal institutions

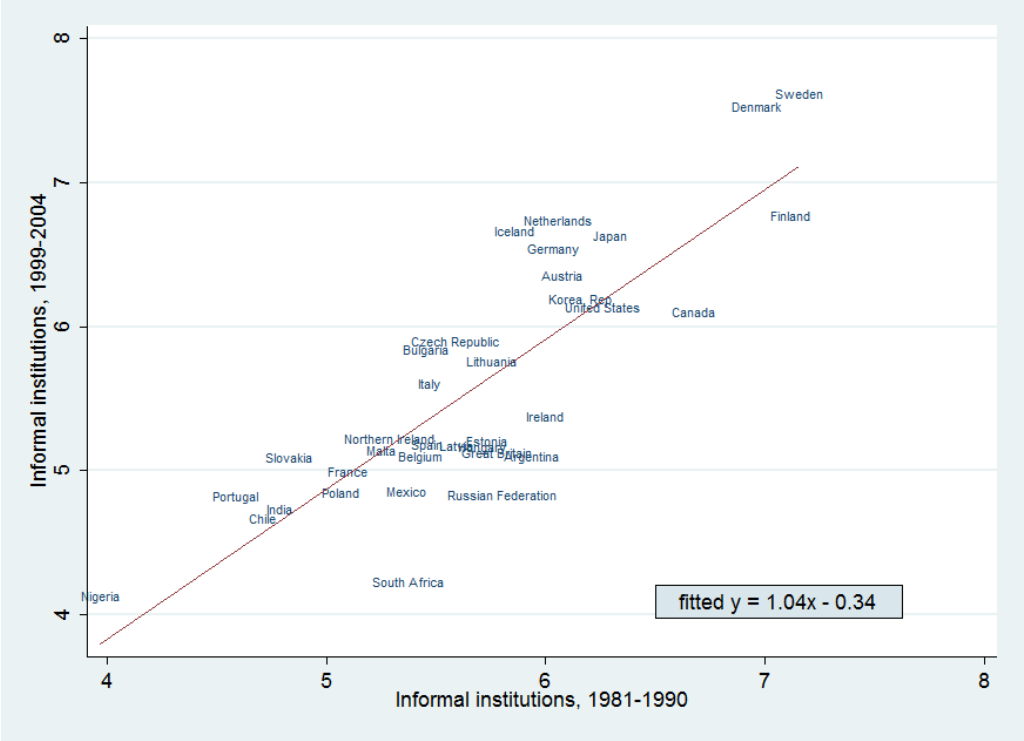


Notes: The measure for formal institutions is constructed by averaging observations from 1981–2000. The measure for informal institutions is constructed by using the value survey data, which are not observed for each year during the same time period. Section 3.3.1 describes data sources and how to measure formal and informal institutions.

specified the honest behavior of agents (Greif 1993, p. 543). This implies that the Law Merchant played a role as a complement to the reputation mechanism (Milgrom et al. 1990, p. 19). In the late middle ages, the Law eventually evolved to state enforcement, which again made the reputation mechanism more effective by lowering information costs under centralized enforcement (Milgrom et al., 1990, pp. 20-1). Indeed, this historical evidence implies the development of formal institutions with rich informal counterparts through trade, involving the formal-informal complementarity. This is supported by Figure 3.1, where a positive correlation is shown between the 1981–2000 formal and informal institutions.

To build a theoretical model to examine this implication, I first define formal institutions as political constraints on government behavior and define informal institutions as private constraints on individual behavior, following Williamson (2009). Then, I assume that informal institutions

Figure 3.2: The persistence of informal institutions



Notes: This regression is based on 35 countries. R-squared is 0.70. Robust standard errors for the coefficients on informal institutions over 1981–1990 and the constant term are 0.10 and 0.56, respectively. The measure for informal institutions, used on the horizontal and vertical axis, is constructed by using observations from 1981–1990 and 1999–2004. The number of observations for a country is mostly one during each time span of 1981–1990 and 1999-2004. Section 3.3.1 describes how to construct the measure for informal institutions.

are exogenously given. North (1990) explains that informal institutions constrain our behavior, which is habitual because it is transmitted from our ancestors. Therefore, they have persistent and durable characteristics, which makes the change in informal institutions incremental. This persistent characteristic of informal institutions is supported by Figure 3.2, where the measure of informal institutions is constructed by using data from 1981–1990 and 1999-2004. Since the observation number for most countries during each time period is one, this figure implies that during this 9–23 year period, informal institutions tended to stay still. Of course, informal institutions can be affected by economic performance, but I assume that it tends to happen in the long run due to this persistent feature of informal institutions.

Given exogenous informal institutions, I endogenize formal institutions in a Cournot com-

petition computable general equilibrium model, comprising two goods that differ by institutional intensity, two factors, and two countries, based on the framework of Markusen and Venables (1998). Allowing for potential substitutability and complementarity between them, country-specific institutional quality is defined as a CES aggregate form of formal and informal institutions. This quality then acts as a public intermediate good for the production of an institutionally intensive good. Specifically, the institutional quality determines trade pattern through institutional comparative advantage and trade cost that is incurred by the risk of falling through of planned contracts. Based on the exogenously given level of informal institutions, the government optimally chooses the level of formal institutions, which are financed by a tax on the labor input. In this setting, I analyze how formal institutions respond to changes in the level of informal institutions, while organically examining the responses of other variables.

Comparative statics using simulations show that formal institutions under open economies tend to increase with the level of informal institutions, which is a stark comparison to their decreasing trends under autarky. This is explained by the balance between scale effect and the substitution of informal institutions for formal ones. Specifically, in open economies, the degree of comparative advantage in the institutionally intensive sector, which features an increasing returns to scale technology, rises with informal institutions, leading to specialization of the sector. This, in turn, drastically increases the marginal product of formal institutions in producing the institutional intensive sector in the presence of the increasing returns to scale, resulting in a great level of scale effect. Since this high scale effect dominates the substitution effect, formal institutions tend to rise with informal institutions. The effect of the institutional comparative advantage on formal institutions is accelerated by a lowered trade cost, which arises from imperfect contract enforcement between trading partners, due to the increasing informal institutions. In contrast, the absence of the comparative advantage under autarky makes the substitution effect outweigh the scale effect, leading to a decreasing trend for formal institutions over informal institutions.

In fact, the non-linear least squares (NLS) estimate, 2.4, for the elasticity of substitution between informal and formal institutions is used for the comparative statics using simulations. Since

the elasticity of substitution between institutions has never been estimated before, this paper fills this gap by providing a baseline value. In addition, this paper is the first to consider institutional quality as a result of the formal-informal interaction in a general equilibrium framework. Taking institutional quality as an outcome of their interaction allows for endogenizing formal institutions in a comparative advantage framework. Furthermore, theoretical evidence sheds light on the importance of having better informal institutions but also on the significant role of international trade in developing formal institutions. Indeed, international trade allows countries with superior informal institutions to foster the development of their formal institutions.

The remainder of this paper is organized as follows. Section 3.2 develops a theory endogenizing formal institutions based on exogenously given informal institutions. Section 3.3 estimates the elasticity of substitution between formal and informal institutions. Using this estimation result, Section 3.4 conducts comparative statics. Section 3.5 concludes.

3.2 The Theory

Building on Markusen and Venables (1998), the theory aims at providing a theoretical framework under which formal institutions endogenously arise according to a given level of informal institutions under a Cournot competition.[2]

There are two countries (1,2) indexed by subscripts (i,j), and two kinds of homogeneous goods (X,Y) are produced in each country. The Y sector is numeraire in the model. For the production of the goods, two factors are used: L, labor, and K, capital. L is perfectly mobile across industries but immobile across countries. K is only used for production of good Y, and immobile across countries.

Production for good Y in country i is assumed to be a Cobb-Douglas production function:

$$Y_i = L_{iy}^{\nu} K_i^{1-\nu}, \quad i = 1, 2, \tag{3.1}$$

where K_i is the capital endowment of country i, and L_{iy} is the labor used in the Y sector. Then,

[2] Markusen and Venables (1998) construct a general equilibrium model in which multinational firms arise endogenously in the presence of fixed costs and different factor endowments across countries.

the values of the marginal products of L and K in country i are expressed by the wage rate, w_i^p, and the rental rate, r_i:

$$w_i^p = \nu \left(\frac{K_i}{L_{iy}} \right)^{1-\nu}, \qquad r_i = (1-\nu) \left(\frac{L_{iy}}{K_i} \right)^{\nu}, \quad i = 1, 2. \tag{3.2}$$

Note that a non-distortionary tax rate, t_i, is introduced later; under the existence of t_i, w_i^p is the price of labor paid by a producer, which equals $w_i(1+t_i)$, where w_i is the price of labor received by a consumer.

As Markusen and Venables (1998, p.187) point out, this setting makes the wage rate increase with the supply of labor to the X from the Y sector during the growth of X sector. In particular, the fixed factor, K, prevents corner solutions while the X sector grows.

Formal and informal institutions are denoted by F and I, respectively. The elasticity of substitution between institutions is indexed by $\sigma = \frac{1}{1-\theta} (\geq 0)$. F interacts with I to some degree of substitutability, which gives rise to country-specific institutional quality, $E_i (\geq 0)$. Allowing for potential substitutability and complementarity between F and I, the institutional quality of country i is defined as a CES aggregate of them:

$$E_i \equiv \left(F_i^{\theta} + I_i^{\theta} \right)^{\frac{1}{\theta}}, \quad i = 1, 2, \tag{3.3}$$

where $\theta (\leq 1)$ denotes the degree of substitutability between F and I.

For the production of X goods, only labor is used:

$$X_i = \alpha_i L_{ix}, \quad i = 1, 2, \tag{3.4}$$

where L_{ix} is the labor used by each firm in the X sector in country i. The unit cost of the good X is $\frac{1}{\alpha_i}$ units of L. Meanwhile, α_i is defined as follows:

$$\alpha_i \equiv 1 + \left(F_i^{\theta} + I_i^{\theta} \right)^{\frac{1}{\theta}}, \quad i = 1, 2. \tag{3.5}$$

Since $\alpha_i = 1 + E_i$, E_i directly governs the productivity of X. Then, considering E_i as a public intermediate good, each firm takes α_i as given.[3]

[3] This setting is motivated by Markusen's teaching material for ECON 8858 at the University of Colorado: Ch.6.5, Public intermediate (infrastructure) good with optimal provision. It is found at: http://spot.colorado.edu/~markusen/teaching.html.

Even though this economy has only two final goods, the implication of the positive relationship between α_i and E_i is derived by assuming that there are intermediate input suppliers under final good X's producer.[4] Under this assumption, α_i captures the degree to which institutional quality resolves the potential holdup problem between the intermediate input suppliers and producer of the final good X; as the institutional quality rises, the risk that the intermediate input suppliers make an underinvestment is lowered, resulting in a more efficient level of production of the good X.[5]

Each country is endowed with a specific amount of informal institutions, I_i. On the contrary, formal institutions are produced from labor input. One unit of formal institutions is assumed to be produced by one unit of labor input. The government levies a tax on the labor input of all goods and spends the tax collected constructing formal institutions. Then, the government budget constraint is given by

$$G_i = w_i L_i t_i = F_i P_{F_i}, \quad i = 1, 2, \tag{3.6}$$

where w_i, L_i, and t_i are the wage rate received by a consumer, labor endowment, and the tax rate of country i. Tax collected is equal to the total value of formal institutions, $F_i P_{F_i}$, in which P_{F_i} denotes the private valuation of the formal institutions. As the firms take the country's institutional quality as given, the government considers labor in the private firms as exogenous. Then, holding L_i fixed, the marginal product of F_i in producing good X is $\frac{\partial X_i}{\partial F_i} = \left(F_i^\theta + I_i^\theta\right)^{\frac{1}{\theta}-1} L_{ix} F_i^{\theta-1}$. Replacing L_{ix} with $\frac{X_i}{\alpha_i}$, the value of the marginal product of F_i in producing X_i goods is $P_{ix}\left(F_i^\theta + I_i^\theta\right)^{\frac{1}{\theta}-1} \frac{X_i}{\alpha_i} F_i^{\theta-1}$. For the optimal government provision of formal institutions, the value of the marginal product of F_i in X_i should be the same as the price of one unit of F_i:

$$P_{F_i} = P_{ix}\left(F_i^\theta + I_i^\theta\right)^{\frac{1}{\theta}-1} \frac{X_i}{\alpha_i} F_i^{\theta-1}, \quad i = 1, 2. \tag{3.7}$$

Equation (3.7) determines the optimal level of non-distortionary endogenous tax rate, t_i. Indeed, P_{F_i} is the marginal cost for the provision of formal institutions.

[4] To focus on the relationship between formal and informal institutions through international trade, I do not introduce the intermediate input suppliers.

[5] A theoretical approach on how institutional quality resolves the holdup problem is presented by Acemoglu et al. (2007) and Levchenko (2007).

Each country's institutional quality determines contract enforceability between trading partners. Let the probability that country i's firm follows the contract be $e^{-\frac{1}{E_i}}$.[6] When $E_i = 0$, the value of the probability goes to zero. When E_i goes to infinity, by contrast, the probability converges to one. For the contract to be enforced, both trading firms must follow the contract. Under the assumption that firms in each country independently follow the contract, the probability that the contract for international trade is enforced by any two firms in each country is given by $e^{-\left(\frac{1}{E_i}+\frac{1}{E_j}\right)}$. This setting allows the function of the probability of reaching the planned trade to monotonically increase with the contract enforceability of one country, holding the other country's enforceability fixed.

Under the presence of the risk that the originally-planned international trade falls through, the firms need to produce more than one unit of output to export one unit of goods, which requires firms to hire more workers due to the uncertainty of contract enforcement. I define δ as a trade cost incurred by imperfect contract enforcement:[7]

$$\delta \equiv e^{\left(\frac{1}{E_i}+\frac{1}{E_j}\right)} - 1 \quad (>0)\,, \quad i,j = 1,2,\, i \neq j. \tag{3.8}$$

Specifically, δ is defined as the amount of extra labor needed for one unit of foreign sales, incurred due to imperfect contract enforcement.

Beginning foreign sales requires firms in both countries to share a fixed cost, $f(>0)$, measured in units of labor. For example, f includes labor needed to set up a formal trade contract. In addition, for domestic sales, all firms in both countries share a fixed cost, $h(>0)$, measured in units of labor.[8] Since the government's provision of F relies on the productivity of the X sector, these fixed costs capture the increasing returns to institutions. As North (1990) points out, the large setup costs to form new institutions make them a durable property.

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[6] I assume that exporter and importer have the same probability of following a contract, $e^{-\frac{1}{E_i}}$, in order to make the model more general and simple. This probability is motivated by Costinot (2009) who allows for the risk incurred by incomplete contract enforcement in the process of production.

[7] The definition of δ comes from the rearrangement of $1/e^{-\left(\frac{1}{E_i}+\frac{1}{E_j}\right)} - 1$.

[8] Comparative statics, which are discussed later, begin with autarky. In the analysis under autarky, h plays a role in determining the number of firms in the X sector.

The labor used by trading firms that serve both domestic and foreign markets for good X is expressed by $n_i\left[c_i X_{ii} + (c_i + \tau + \delta) X_{ij} + f + h\right]$, where n_i denotes the number of firms in the X sector in country i. c_i, equal to $\frac{1}{\alpha_i}$ units of labor, is the marginal cost of producing the good X measured in units of labor. τ is the extra labor needed for one unit of foreign sales, incurred by the transportation of exports.[9] The number of units of goods sold in country j, which are produced by a firm in country i, is indexed by X_{ij}. The labor market clearing condition requires

$$L_i = n_i\left[c_i X_{ii} + (c_i + \tau + \delta) X_{ij} + f + h\right] + F_i + L_{iy}, \quad i, j = 1, 2,\ i \neq j, \tag{3.9}$$

where L_i is the labor endowment of country i, and L_{iy} is the labor used for the Y sector in country i. Income balance condition in equilibrium requires

$$M_i = w_i L_i + r_i K_i, \quad i = 1, 2, \tag{3.10}$$

where M_i denotes national income in country i.

A representative consumer in country i has a Cobb-Douglas utility function:

$$u_i = X_{ic}^{\beta} Y_{ic}^{1-\beta}, \quad i = 1, 2, \tag{3.11}$$

where X_{ic} and Y_{ic} are the consumption level of X and Y goods. Corresponding demands are

$$X_{ic} = \beta M_i \frac{1}{P_{ix}}, \qquad Y_{ic} = M_i(1-\beta), \quad i = 1, 2, \tag{3.12}$$

where $X_{ic} = n_i X_{ii} + n_j X_{ji}$, and $Y_{ic} = Y_{ii} + Y_{ji}$.

Pricing equations are written as complementary-slackness conditions with respect to the corresponding complementary variables in brackets:

$$P_{ix}\left(1 - \eta_{ii}\right) \leq w_i c_i (1 + t_i), \qquad [X_{ii}] \tag{3.13}$$

$$P_{jx}\left(1 - \eta_{ij}\right) \leq w_i\left(c_i + \tau + \delta\right)(1 + t_i), \qquad [X_{ij}] \tag{3.14}$$

$$P_{F_i} \leq w_i (1 + t_i), \qquad [F_i] \tag{3.15}$$

[9] No transportation cost is assumed for the good Y. This is to make the model simpler by setting the price of good Y as 1.

$i, j = 1, 2,\ i \neq j$, where c_i equals $\frac{1}{\alpha_i}$ units of labor, and η_{ij} is the markup for country i's firm in country j. Assuming Cournot competition between the X sector firms, the markup is expressed by a firm's market share divided by the price elasticity of demand. Since the price elasticity of demand is 1 from equation (12), the markup of the firm is exactly its market share. It follows that $\eta_{ii} = \frac{X_{ii}}{X_{ic}}$ and $\eta_{ij} = \frac{X_{ij}}{X_{jc}}$. Combining these markup equations with equation (3.12),

$$\eta_{ii} = \frac{P_{ix}}{\beta M_i} X_{ii}, \qquad \eta_{ij} = \frac{P_{jx}}{\beta M_j} X_{ij}, \quad i, j = 1, 2,\ i \neq j. \tag{3.16}$$

Substituting (3.16) into (3.13) and (3.14) yields

$$X_{ii} \geq \frac{\beta M_i}{P_{ix}^2} \left(P_{ix} - w_i c_i (1 + t_i)\right), \ X_{ij} \geq \frac{\beta M_j}{P_{jx}^2} \left(P_{jx} - w_i \left(c_i + \tau + \delta\right)(1 + t_i)\right), \tag{3.17}$$

where $\quad i, j = 1, 2,\ i \neq j.$

The zero profit condition requires fixed costs to be greater than or equal to markup revenues. This condition is also written as complementary-slackness condition with respect to the complementary variable in bracket.

$$P_{ix}\eta_{ii}X_{ii} + P_{jx}\eta_{ij}X_{ij} \leq w_i(1 + t_i)(f + h), \qquad [n_i] \tag{3.18}$$

$i, j = 1, 2,\ i \neq j$. When the output level is greater than zero, substituting (3.16) and (3.17) into the zero profit condition gives the following free entry condition, which is associated with the number of firms in each country:

$$\left[M_i \left(\frac{P_{ix} - w_i c_i (1 + t_i)}{P_{ix}}\right)^2 + M_j \left(\frac{P_{jx} - w_i \left(c_i + \tau + \delta\right)(1 + t_i)}{P_{jx}}\right)^2\right] \leq w_i(1 + t_i)(f + h), \ [n_i] \tag{3.19}$$

$i, j = 1, 2,\ i \neq j.$

To sum up, this theory provides a setting that allows for the analysis of how formal institutions arise along with other variables, such as the production, trade flows, institutional quality, trade cost arising from imperfect contract enforcement, markup rate, number of firms, and non-distortionary tax rate under the given level of informal institutions.[10] These variables are simultaneously determined in the general equilibrium framework while being adjusted through the behaviors of consumer, firm, and government under the input constraints.

[10] Indeed, Markusen and Venables (1998) provide a basic framework that allows for building a theory under which formal institutions endogenously arise according to the fixed costs capturing increasing returns to institutions and informal institutions that determine institutional comparative advantage as an endowment.

3.3 Estimation of the Elasticity of Substitution between Formal and Informal Institutions

Since the theory does not produce reduced form solutions, I rely on simulations for comparative statics. To conduct the simulations, I first estimate the elasticity of substitution between formal and informal institutions, $\sigma(= \frac{1}{1-\theta} \geq 0)$.

This estimation is based on an equation constructed by combining equations (3.4) and (3.5) in the theory, replacing θ with σ, and applying the logarithm. Based on this equation, σ is estimated by the non-linear least squares (NLS) estimation:[11]

$$\min_{\sigma} \sum_{i} \epsilon_i^2 \qquad s.t. \quad ln\frac{X_i}{L_i} = ln\left[1 + \left(F_i^{\frac{\sigma-1}{\sigma}} + I_i^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}\right] + \epsilon_i. \tag{3.20}$$

To estimate σ, I use the data on value added in thousand dollars and the number of employees of each sector in the Trade, Production, and Protection Database (production database) organized by 3-digit International Standard Industrial Classification (ISIC) revision 2 collected by Nicita and Olarreaga (2006). The data cover up to 100 countries and 28 manufacturing industries from 1976 to 2004. I use 2000 as a base year. If the data are not available, I employ the data from 1998 or 1999.

In equation (3.20), X_i is a production level in the institutionally intensive sector. To screen which industries need institutions more, I rely on Nunn's contract intensity measure. This is constructed by $\sum_k \theta_{dk} R_k^{neither}$, where $\theta_{dk} \equiv u_{dk}/u_d$. Specifically, u_{dk} is input k's value used in industry d and u_d is the total value of all inputs used in industry d. $R_k^{neither}$ indicates the share of input k that is neither traded on an organized exchange nor reference priced in trade publications. I obtained the 1997 data on contract intensity, which are organized by the 3-digit ISIC revision 2, from Nunn's homepage.

[11] Another standard method to estimate the elasticity of substitution between inputs in CES function is to use Kmenta's approximation. Kmenta (1967) presents an approximation of the CES function by taking a second-order Taylor expansion around θ= 0 (i.e., a case of Cobb-Douglas function) to the logarithmed CES function. Therefore, this can be expressed by translog function with some restrictions on parameters. However, Kmenta's approximation involves some problems from using Taylor expansion around $\theta = 0$; Thursby and Lovell (1978) point out that when the linear approximation is truncated, there is omitted variable bias from its remainder terms. In addition, they show that the approximation does not provide reliable estimates when underlying function is not Cobb-Douglas.

The dataset of production, combined with Nunn's data, contains 28 different contract intensities listed by the ISIC levels. I will examine how σ changes while limiting X_i/L_i to the production per worker for the institutional intensive industries, which are defined as the industries that are ranked in the top 50%, 40%, 30%, and 20% of the contract intensities. In this way, we can see how substitution effect tends to change as institutional intensity rises.

3.3.1 Measures and Data for Institutions

One issue in estimating σ is that institutions are not quantitatively measured. Nonetheless, qualitative measures of institutions in the form of indices help to choose the parameter of σ in conducting simulations in the absence of the literature on the estimates for σ and help to examine how the estimates change as institutional intensity increases. Assuming that formal and informal institutions have the same unit in terms of quality, the measures for formal and informal institutions will be constructed with the same scale of 0 to 10. In this way, we can control for the possibility that the NLS estimates are affected by the difference between absolute variation in formal institutions among countries and absolute variation in informal institutions among the same set of countries.

To construct formal institutions, I employ the Polity IV dataset constructed by Marshall et al. (2014). I use the variable of the executive constraints, which refers to "the extent of institutionalized constraints on the decision making powers of chief executives, whether individuals or collectivities." The variable has the observations ranging from 1 to 7, which measures the degree of constraints on chief executives. The assignment of 1 to 7 is based on the observation of a variety of evidence. One piece of evidence supporting the assignment of 7 is that an accountability group, such as legislatures, chooses an executive and its support matters for the executive in remaining in office.[12]

To measure the quality formal institutions, the observations are averaged by each country over the time span of 1981-2000, and they are scaled so that the maximum value reaches 10. This index represents the ability of institutions enforced through political channels in resolving the potential holdup problem. As the political system provides better constraints against possible government

[12] See the Polity IV Manual pp. 24-5 and 62-6 for the list of evidence for each category.

predation, a country is more likely to have institutional comparative advantage, and the contracts between traders are more likely to be followed.

For a proxy for endowment of country-specific informal institutions, I focus on culture formed through history within a country following Williamson (2009) and Williamson and Kerekes (2011). This is based on the evidence that culture persists over a long time period, which provides durable private constraint on individual behavior. Tabellini (2008) empirically shows that trust, as a proxy for culture, is persistent over time, which supports that our ancestors' culture is transmitted over history.

A measure of culture comprises three components: trust, control, and obedience.[13] The measures are constructed by using the European Value Survey and the World Value Survey (EVS and WVS, 2006), covering 85 regions over the period of 1981-2004.[14] I use the time span of 1981-2000. Since not every region was surveyed every year, most regions were surveyed twice or three times during this time period.

Trust can promote economic development in that it derives more efficient outcomes. Zak and Knack (2001) show that countries with higher trust levels can achieve greater economic performance because trust lowers transaction costs. This mechanism holds in international trade. The holdup problem between trading partners can be resolved through trust with each other, which eventually lowers transaction cost. The efficient production through a high trust level allows countries to achieve a comparative advantage in institutionally intensive goods. This is supported by the empirical result of Tabellini (2008); he presents that domestic trust interacted with institutional intensity is positively and significantly correlated with exports.

For a measure of trust, the following question from the survey is employed: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" Regarding this question, there are two options: "Most people can be trusted" and

[13] Williamson (2009), Tabellini (2010), and Williamson and Kerekes (2011) use these measures to quantify culture.

[14] For some countries, regions under the countries have been surveyed. For example, in the UK, Great Britain and Northern Island have been individually surveyed. For such cases, I use all information of regions under a country to calculate country-specific measure for informal institutions.

"Can't be too careful." The measure of trust of each country is constructed by the number of respondents who answered "Most people can be trusted" divided by the sum of the respondents who answered "Most people can be trusted" and "Can't be too careful" multiplied by 10.

Control refers to how individuals feel about their ability to control their lives. If they feel that their determination derives the direction of their lives, they will be more likely to make efforts to reach their goals, which may make them care more about economic profits. Then, the individuals may cooperate better with others, which can be a solution to the holdup problem. In contrast, if individuals feel that their lives rely more on luck or things that they cannot control than on their determination, then they will be more likely to be passive in their lives and have less interest in pursuing their economic profits. In this case, the holdup problem will become more aggravated.

In order to measure control, the following question is used: "Some people feel they have completely free choice and control over their lives, while other people feel that what we do has no real effect on what happens to them. Please use this scale where 1 means 'none at all' and 10 means 'a great deal' to indicate how much freedom of choice and control you feel you have over the way your life turns out." The measure of control for each country is calculated by averaging the answers of respondents.

Obedience is mainly stressed in a coercive and hierarchical country where the levels of trust and respect for others are low. In such societies, citizens are considered as ones who behave based on instinct rather than rationale. Therefore, suppressing a negative instinct of each individual by coercion is emphasized to draw a good behavior (Tabellini, 2010, p. 685). Such a coercive society can discourage individuals from pursuing innovation and economic profits. Less interest in seeking economic profits, as well as the deficiency of trust and respect between individuals of the societies, can make the individuals less cooperative, which worsens the holdup problem.

To capture the trait, I employ the following question: "Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important?" The measure of obedience is constructed by the number of the respondents who chose "obedience"

Table 3.1: Institutions of the countries that are used for the estimation of σ

Country	Trust	Control	Obedience	Agg. Informal	Formal
Sweden	6.233	7.296	1.670	7.287	10.000
Norway	6.389	7.013	2.777	6.875	10.000
Finland	5.531	7.602	2.818	6.772	10.000
Canada	4.550	7.535	2.753	6.444	10.000
Japan	4.220	5.713	0.650	6.427	10.000
Iran, Islamic Rep.	6.535	6.618	4.143	6.336	4.586
Netherlands	5.257	6.256	2.689	6.275	10.000
Germany	3.405	6.976	1.706	6.225	10.000
Austria	3.266	7.529	2.147	6.216	10.000
United States	4.153	7.591	3.330	6.138	10.000
Australia	4.306	7.402	3.336	6.124	10.000
Korea, Rep.	3.379	6.492	1.530	6.114	7.218
Greece	2.373	7.000	1.082	6.097	9.286
Czech Republic	2.669	6.660	1.820	5.836	10.000
Ireland	4.146	7.104	3.847	5.801	10.000
Bulgaria	2.864	5.564	1.796	5.544	7.429
Italy	3.216	6.231	2.892	5.518	10.000
Uruguay	2.164	7.020	2.830	5.451	8.857
United Kingdom	3.817	7.050	4.581	5.429	10.000
Romania	1.504	6.426	1.721	5.403	5.714
Argentina	2.024	7.210	3.035	5.400	7.643
Belgium-Lux	3.011	6.584	3.505	5.363	10.000
Latvia	2.059	5.874	1.855	5.359	10.000
Spain	3.438	6.651	4.094	5.332	10.000
Hungary	2.691	6.526	3.389	5.276	7.594
Slovak Republic	2.131	6.456	3.018	5.190	9.107
Slovenia	1.820	6.814	3.110	5.175	10.000
Mexico	2.905	7.618	5.109	5.138	5.643
Russian Federation	2.791	5.690	3.170	5.104	4.921
France	2.279	6.352	3.479	5.051	8.214
Poland	2.422	6.189	3.810	4.934	6.857
South Africa	2.219	6.802	4.444	4.859	10.000
Venezuela	1.485	8.136	5.071	4.850	8.429
Chile	2.245	7.132	5.141	4.745	6.643
Portugal	1.737	6.692	4.360	4.690	9.929
Colombia	1.080	7.888	4.972	4.665	8.857
India	3.648	6.491	6.218	4.640	10.000
El Salvador	1.463	7.496	6.236	4.241	7.143
Turkey	0.706	4.817	3.166	4.119	8.714

Notes: Countries are listed in the order of the aggregate measure of informal institutions, which is the sum of trust, control, and 10 less obedience. To construct each measure, 1981-2000 data are used.

as an important quality divided by the total number of the respondents multiplied by 10.[15]

To construct an aggregate index for informal institutions, I first adjust the original measure of obedience by 10 less that for each country since a higher level of obedience is expected to aggravate the holdup problem. Then, the aggregate measure is the sum of the measures of trust, control, and adjusted obedience. Each component of informal institutions and this aggregate measure range from 0 to 10. The level of this index represents the degree to which the holdup problem is mitigated by informal institutions.

The data on institutions are combined with the data on production listed by ISIC codes. This comprehensive dataset covers 39 countries, which are used to estimate σ. Table 3.1 summarizes the levels of informal and formal institutions in the order of the aggregate measure of informal institutions.

3.3.2 Estimation Results

The estimation results for σ are shown in Table 3.2. The columns with the headings of Top 20%, Top 30%, Top 40%, and Top 50% present the NLS estimates when the data on production of the industries whose institutional intensities are ranked in the top 20%, 30%, 40%, and 50% are used to calculate X/L, respectively. The column with the heading of Total presents the NLS estimates when the data on production of the all industries are employed for the calculation of X/L. In the first row, aggregate informal institutions are used with formal institutions to estimate σ. In the second, third, and last row, trust, control, and 10 less obedience are used as a proxy for informal institutions.

The estimates show that $\hat{\sigma}$ tends to increase as higher ranked industries in terms of institutional intensity are considered regardless of which component of informal institutions is used for the estimation. This implies that formal and informal institutions tend to be more substitutive for each other to produce more institutional intensive goods. This captures that production per worker

[15] The other options in the list are: independence, hard work, feeling of responsibility, imagination, tolerance and respect for other people, thrift saving money and things, determination, perseverance, religious faith, and unselfishness.

Table 3.2: NLS estimation results for σ

Informal inst.		X/L Top 20%	Top 30%	Top 40%	Top 50%	Total
Agg. Informal	$\hat{\sigma}$	2.402***	2.210***	2.265***	2.257***	2.158***
	Robust s.e.	(0.524)	(0.377)	(0.409)	(0.403)	(0.329)
	R-squared	0.901	0.910	0.910	0.908	0.916
Trust	$\hat{\sigma}$	1.901***	1.819***	1.845***	1.837***	1.791***
	Robust s.e.	(0.215)	(0.171)	(0.181)	(0.178)	(0.153)
	R-squared	0.911	0.919	0.919	0.917	0.924
Control	$\hat{\sigma}$	2.719***	2.439***	2.516***	2.519***	2.377***
	Robust s.e.	(0.791)	(0.533)	(0.589)	(0.590)	(0.467)
	R-squared	0.898	0.908	0.908	0.906	0.914
10 - Obedience	$\hat{\sigma}$	2.698***	2.426***	2.501***	2.484***	2.349***
	Robust s.e.	(0.781)	(0.531)	(0.586)	(0.570)	(0.454)
	R-squared	0.897	0.906	0.906	0.905	0.912
Observations		38	38	38	39	39
Average		2.430	2.224	2.282	2.274	2.169

Notes: For the columns with the headings of Top 20%, 30%, 40%, and 50%, the data on production of the industries that belong to the top 20%, 30%, 40%, and 50% of the 28 institutional intensities are employed to calculate X/L. For the column with the heading of Total, the data on production for all industries are used. Table 3.1 shows which countries' data are employed for the estimation of σ. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the level of 1%, 5%, and 10%, respectively.

tends to decrease with institutional intensity of industries in the fixed level of institutions for each country. In fact, only 14 countries out of the 39 countries show the increase in X/L when the industries ranking in the top 20% in terms of institutional intensity, compared to the case where all industries are considered.[16]

Comparing $\hat{\sigma}$ across the cases where trust, control, and 10 less obedience are used as a proxy for informal institutions, trust shows the least substitutability with formal institutions, while control shows the highest substitutability with them.

To choose a parameter of σ in conducting simulations, I consider the NLS estimate of σ used to produce the most institutional intensive goods. Thus, as the parameter of σ, I select 2.4, which is the average of the estimates when the industries ranking in the top 20% of institutional intensity are used to construct X/L.

[16] The 14 countries include Austria, Belgium-Luxembourg, Canada, Finland, France, Germany, Hungary, India, Iran, Korea, Mexico, Poland, Slovenia, and the United States.

3.4 Comparative Statics

In this section, how the government's provision of formal institutions of country i responds to the changes in informal institutions of country i is explored, given that other conditions of two countries are equal. These responses are organically explained, while examining the optimal tax rate, labor, production, trade cost incurred by imperfect contract enforcement, and welfare. The analysis begins with autarky and is expanded to open economies. Note that, in Appendix B.1, the corresponding responses of markup rate and number of firms are discussed. The responses of formal institutions in country i according to the changes in labor endowment in country i are additionally discussed in Appendix B.2.

The comparative statics are performed using GAMS solver MCP (Mixed Complementarity Problem). For calibration, the goods in the utility function are assumed to have equal shares of 0.5. In the production function for the good Y in equation (3.1), a labor share, ν, and a capital share, 1-ν, are given by 0.8 and 0.2, respectively. Under autarky, a fixed cost for domestic sales is given by 4. In the open economies, the fixed costs for domestic and foreign sales are assumed to be equal to 8, and the transport cost, τ, is given by 1.7. According to the NLS estimates, σ is given by 2.4.

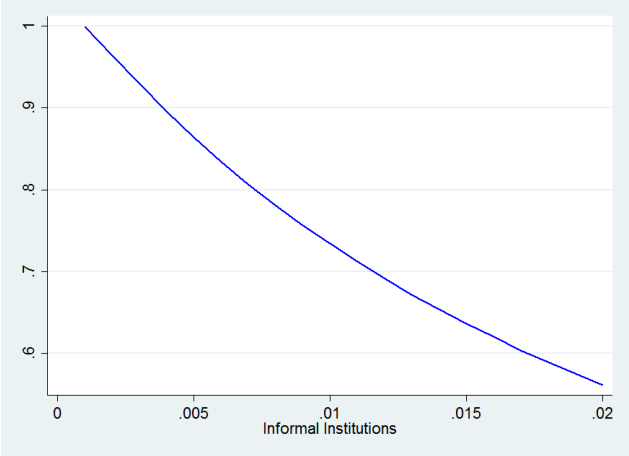
3.4.1 Autarky

The simulations for autarky are conducted by varying the level of informal institutions, I, over the range of 0.001, 0.002,...,0.02.

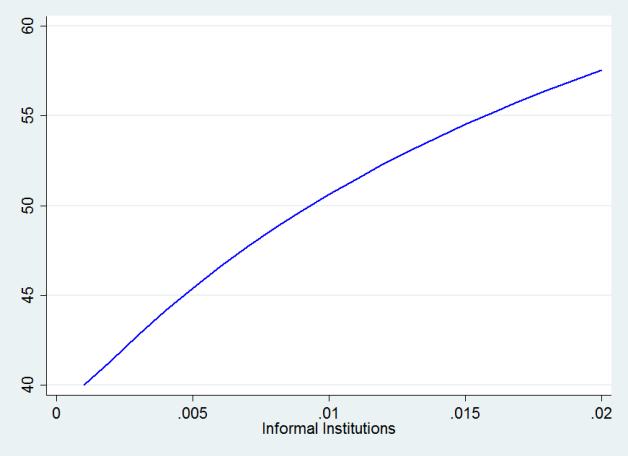
Sub-figure (a) in Figure 3.3 shows the responses of the government's provision of formal institutions, F, to the changes in I under autarky. F tends to fall as I rises. This trend is explained by two effects working in opposing forces: scale effect that increases F and the substitution effect that decreases F. Recall that country i's productivity of X sector is represented by $\alpha_i = 1 + \left(F_i^{\theta} + I_i^{\theta}\right)^{\frac{1}{\theta}}$. Since $\frac{\partial \alpha_i}{\partial I_i} > 0$, the productivity of the X sector rises with I. This boosts the marginal product of F in producing X, leading to the scale effect. That is, F jumps to the upper isoquant

Figure 3.3: Comparative statics under autarky

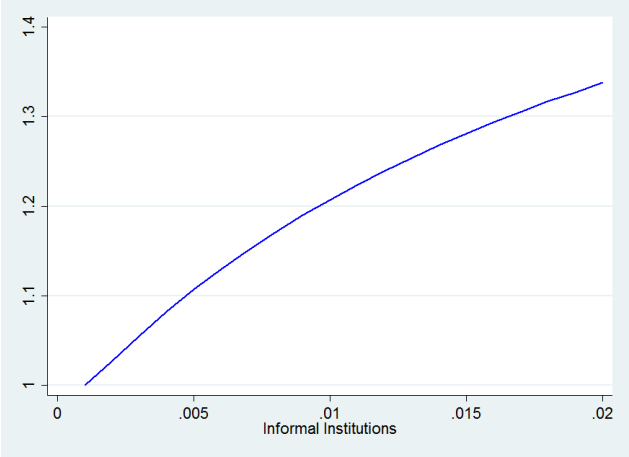
(a) Formal institutions under autarky



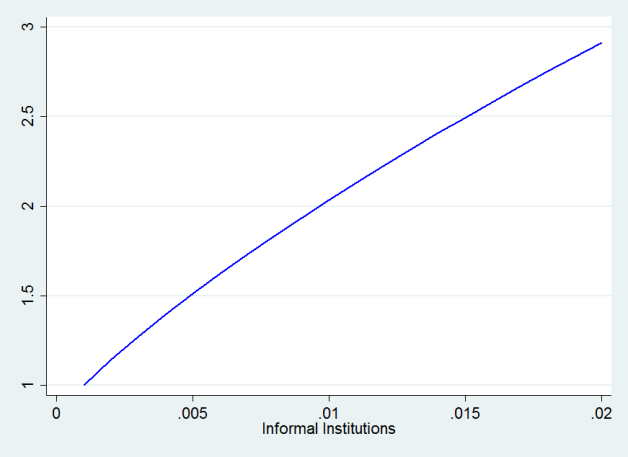
(b) Labor in Y sector under autarky



(c) Price of labor under autarky



(d) Welfare under autarky



while I increases. On the contrary, the increasing substitution effect of I for F with I gives a downward force of F.

Thus, the decreasing trend of F with I implies that, under autarky, the scale effect is dominated by the substitution effect as I rises. That is, the marginal product of F in producing X is not great enough to offset the substitution effect, eventually resulting in the fall in F. In fact, the price of formal institutions, which is the value of marginal product of formal institutions, tends to decrease. The dominance of the substitution effect is supported by sub-figure (b) in Figure 3.3 showing that the number of labor in the Y sector rises with I, even with the increased productivity

of X. This tendency is the opposite of the simulation under open economies, where there is a decreasing number of labor in Y sector, as I show later.

The pattern of tax rate responding to the changes in I is the same as F because F is financed by tax on the labor input. Under the fixed total labor in a country, say $\bar{L}$, labor for providing formal institutions, say L_f, is positively related with t, since $t = \frac{L_f}{\bar{L}}$. Thus, a larger share of labor going into F (i.e., diminishing labor in the X and Y sector) increases the optimal tax rate, which raises F. In fact, the labor employed in the X and Y sectors presents the opposite trend to F.

Welfare is calculated by the aggregate income, $(wL + rK)$, divided by the price index, $P_x^{\beta} P_y^{(1-\beta)}$. As expressed in equation (3.2), the increasing labor in Y sector, arising from the increase in I, causes r to rise and $w^p (= w(1+t))$ to fall. However, the falling t allows w to rise, as shown in sub-figure (c) in Figure 3.3. Additionally, since P_x decreases with I, so does the price index. Therefore, as sub-figure (d) shows, welfare of this closed economy improves as I rises.

3.4.2 Open Economies

The comparative statics under open economies is performed by changing I_i over the range of 0.001, 0.002,...,0.02, while fixing I_j as 0.01. Thus, the simulation results show how the equilibriums change with the varying values from 0.1 to 2 of I_i relative to I_j, i.e., $\frac{I_i}{I_j}$.

Sub-figure (a) in Figure 3.4 shows the optimal levels of F_i under open economies. F_i decreases at the very first part, but begins increasing when $\frac{I_i}{I_j}$ passes around 0.4. This pattern is explained by comparative advantage in the institutionally intensive good X and the decreasing trade cost incurred by imperfect contract enforcement, represented by δ in equation (3.8).

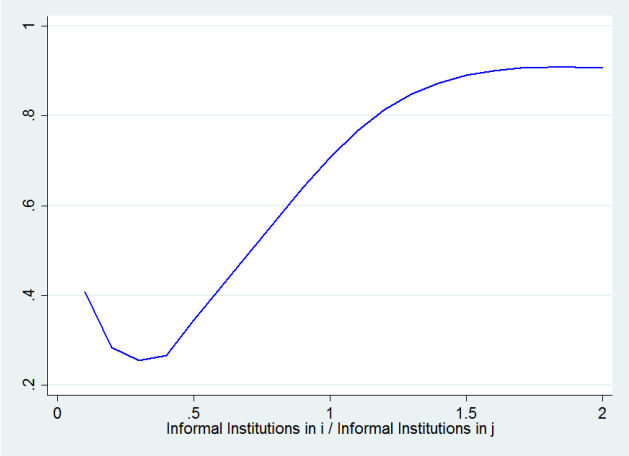
Country i's level of institutional comparative advantage is directly measured by $\frac{\alpha_i}{\alpha_j}$ in that the unit cost of good X is $\frac{1}{\alpha_i}$ units of labor. This measure rises with $\frac{I_i}{I_j}$, as shown in sub-figure (b) in Figure 3.4, since the increase in I_i leads to the development of the productivity of the good X.[17]

This rise in the comparative advantage, which entails the specialization of the good X, makes the marginal product of F_i in producing X soar in the presence of the increasing returns to scale

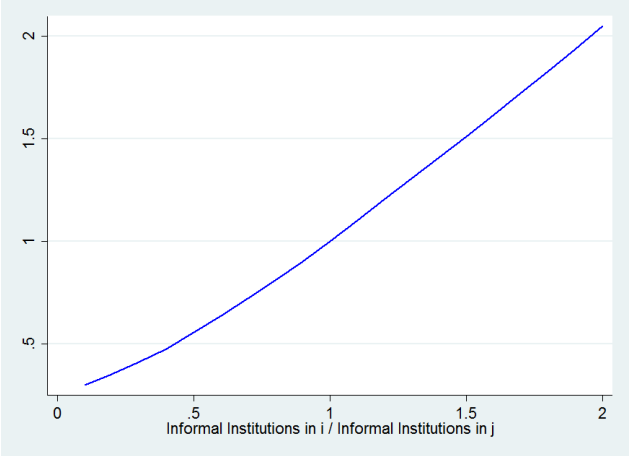
[17] The net exports of X in i, calculated by $(X_{ij} n_i - X_{ji} n_j)(1 + \tau + \delta) P_{ix}$, also rises with $\frac{I_i}{I_j}$.

Figure 3.4: Formal institutions and institutional comparative advantage under open economies

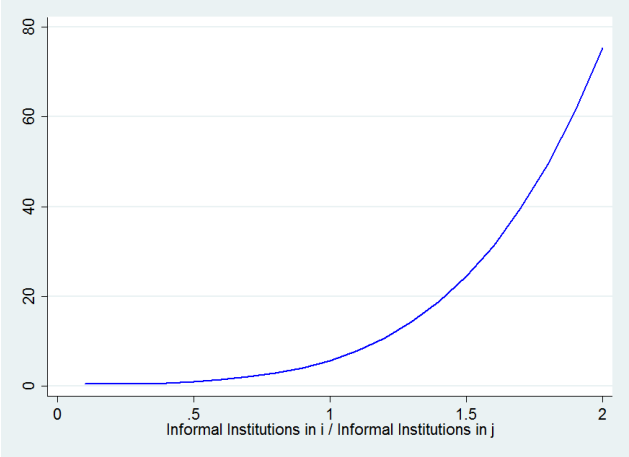
(a) Formal institutions in country i



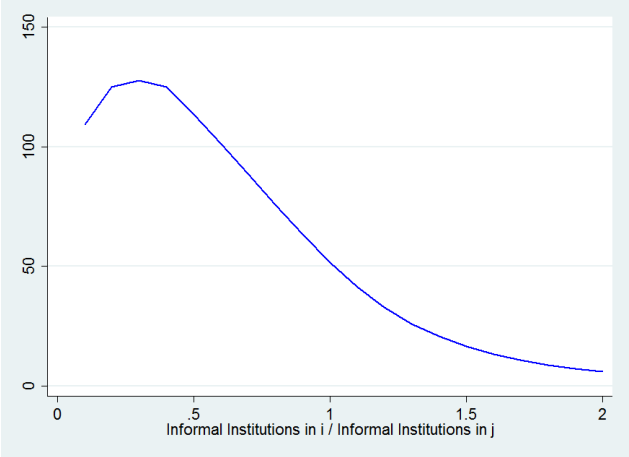
(b) Institutional comparative advantage for country i



(c) $\frac{X}{Y}$ in country i



(d) Country i's labor in Y

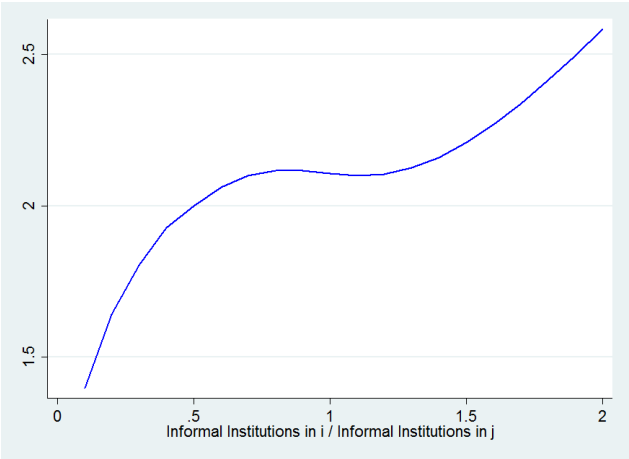


technology of X, leading to a greater level of scale effect. In fact, over I_i from 0.001 to 0.02, holding I_j fixed to 0.01, the marginal product of F_i in X increases by 457% under open economies, which is greater than the corresponding rise of 340% under autarky.

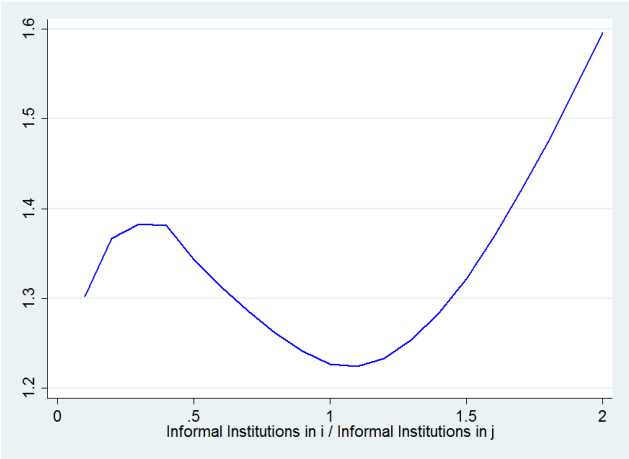
Specifically, in the very first part of $\frac{I_i}{I_j}$, there are no country i's exports of X due to the low level of comparative advantage in this good, with the presence of the transport cost. Thus, the scale effect is dominated by the substitution effect, which leads to the fall in F_i with $\frac{I_i}{I_j}$, as shown in sub-figure (a). However, the further increase in $\frac{I_i}{I_j}$ allows the country i to have institutional comparative advantage in X under open economies and δ of the trade costs to falls, which in turn

Figure 3.5: Welfare and price of labor under open economies

(a) Welfare of country i



(b) Price of labor



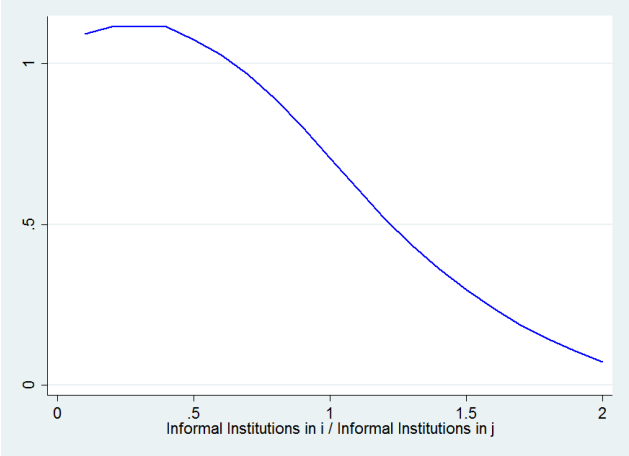
makes the scale effect stronger. Thus, F_i tends to increase as $\frac{I_i}{I_j}$ grows further. However, the increasing rate of F_i falls as country i approaches to a perfect specialization since it decreases the labor for producing F_i. Additionally, the rising substitution effect with $\frac{I_i}{I_j}$ decreases the increasing rate of t_i. As $\frac{I_i}{I_j}$ approaches to 2, F_i starts falling.

The specialization of the X sector is supported by the radical growth of the production of X relative to Y, shown in sub-figure (c) in Figure 3.4. $\frac{X_i}{Y_i}$ increases from about 0.5 to 75.4 over the entire range of $\frac{I_i}{I_j}$, which is a substantial rise compared to the corresponding change from about 1 to 4.7 under autarky. This specialization towards the X sector entails the substantial drop in labor in the Y sector, as presented in sub-figure (d).

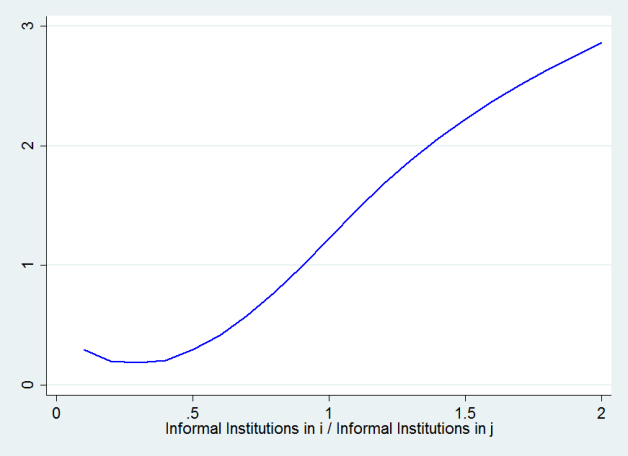
Under the development of F_i through this comparative advantage in the X sector, welfare tends to improve as shown in sub-figure (a) in Figure 3.5. While a fall in r_i, due to the drop in labor in Y sector, provides a decreasing force of welfare, the falling price index provides an increasing force of it. Meanwhile, w_i shows overall a U-shape curve over $\frac{I_i}{I_j}$, as presented in sub-figure (b), even though the decrease in labor in Y raises $w_i(1+t_i)$. After w_i passes the very first part, w_i tends to decrease over the first half of the region of $\frac{I_i}{I_j}$, while t_i, showing the same pattern with F_i, rises drastically, but it starts rising while the increasing rate of t_i diminishes with $\frac{I_i}{I_j}$.

Figure 3.6: Country j's responses under open economies

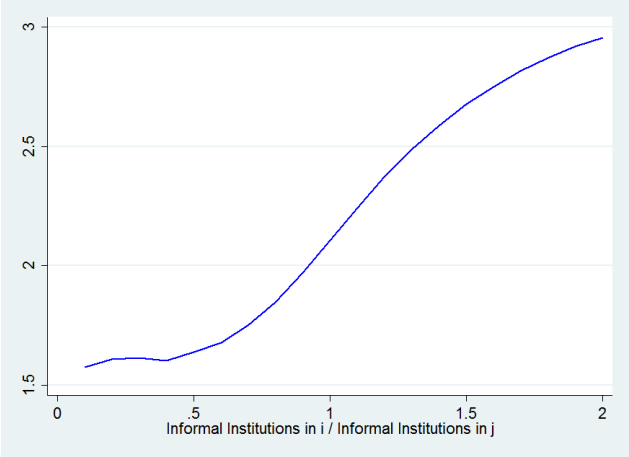
(a) Formal institutions in country j



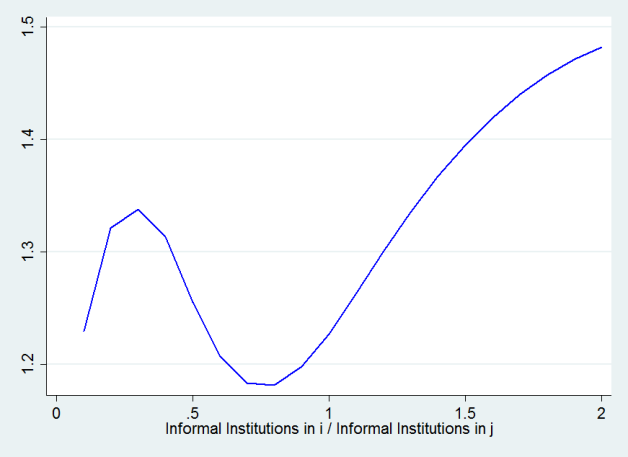
(b) Production of Y in country j



(c) Welfare in country j



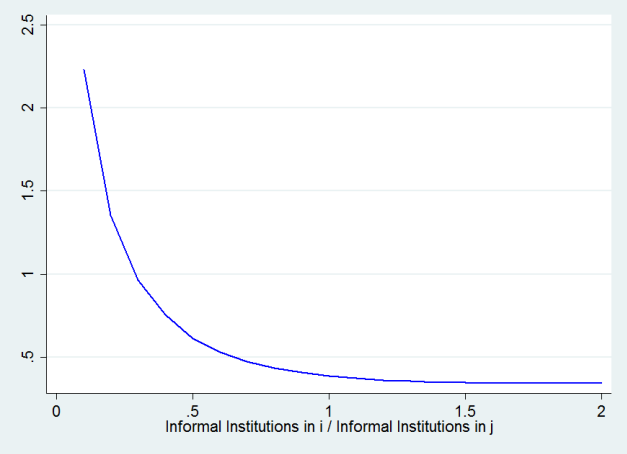
(d) Price of labor in j



Turning to the country j's perspective, the increase in I_i makes the country j to have comparative advantage in Y sector, which is supported by increasing production of Y, shown in sub-figure (b) in Figure 3.6. Since the production of Y does not require institutions, the increasing level of the comparative advantage in Y does not contribute to raising the marginal product of F in producing X. In fact, the falling level of the comparative advantage in X decreases the value of marginal product of F in j, which is equalized to the price of formal institutions in j. Therefore, formal institutions in country j tend to fall as presented in sub-figure (a).

The comparative advantage in Y moves labor from the X to Y sector, which raises r_j. This

Figure 3.7: Trade cost incurred due to imperfect contract enforcement



adds the increasing force of welfare with the falling price index. Additionally, w_j shows overall a U-shape, as shown in sub-figure (d) in Figure 3.6. In the very first part, w_j increases due to the fall in the production of Y while country i's production of Y increases. Then, it falls as $\frac{I_i}{I_j}$ further increases while the production of Y starts to grow. However, w_j starts rising again because the falling t_j allows w_j to rise, while the rise in labor in Y reduces $w_j(1+t_j)$. Combining with the growing r_j, the welfare of country j in sub-figure (c) tends to increase with $\frac{I_i}{I_j}$.

The rise in F_i and the fall in F_j, arising from the increase in I_i, affect the institutional quality of country i and j, E_i and E_j, respectively. Since the institutional quality is the aggregate CES form of F and I, holding I_j fixed, the rise in I_i increases E_i and decreases E_j. The rise in E_i and the fall in E_j, in turn, affect institutional comparative advantage in X, reinforcing the exports pattern.

They additionally affect the trade cost incurred by imperfect contract enforcement, δ. As a simulation result, E_i increases more than E_j falls. This is because both I and F rise in country i, while only F falls with holding I fixed in country j. This higher increase in E_i than the fall in E_j leads to a decrease in δ, as shown in Figure 3.7. Again, the reduced δ reinforces the exports pattern.

3.5 Concluding Remarks

This paper focuses on how formal and informal institutions are interrelated through international trade given that countries are endowed with a certain level of informal institutions formed through their own history. This interrelation stems from the assumption that, in the presence of the substitution between formal and informal institutions, both play a role in giving rise to institutional quality, which mitigates the potential holdup problem.

The simulation results convey important implications concerning institutions and international trade. First, international trade allows countries with rich informal institutions to develop their formal institutions. Second, this evolution of formal institutions is achieved through institutional comparative advantage and the lowered trade cost incurred by imperfect contract enforcement. What matters for having better formal institutions is the institutional intensity of the industry in which a country has a comparative advantage. When a country has a comparative advantage in a good that does not require institutions, the quality of formal institutions is not improved. In essence, these results show that better informal institutions allow people to enjoy a stable political system through international trade.

Chapter 4

The Causal Effect of Institutional Comparative Advantage on the Quality of Institutions

4.1 Introduction

Countries with high export performance in institutionally intensive goods tend to have high-quality institutions. Thus, two-way causation is possible. Better institutions can cause a country to export more of institutionally intensive goods, and high export performance in institutionally intensive goods can lead a country to have better institutions. Yet, studies have focused only on the former causation in arguing the importance of having high-quality institutions in trade, while treating institutions as exogenously given (Acemoglu et al., 2007; Levchenko, 2007; Nunn, 2007; Costinot, 2009).

In this paper, I fill this gap by examining the causal effect of having comparative advantage in institutionally intensive goods (i.e., institutional comparative advantage) on achieving high-quality institutions. Showing this causal impact is significant in that it conveys important trade policy implications by uncovering the contribution of trade to achieving high-quality institutions. It further conveys implications of trade and institutions for economic growth since high-quality institutions attained by trade can induce economic growth. This view is supported by the influential study of Acemoglu et al. (2005), showing the positive effect of Atlantic trade on the economic growth of Western Europe by promoting high-quality political institutions. In fact, this paper complements their study by shedding light on the institutional comparative advantage mechanism in enhancing institutional quality and by conducting cross-sectional analysis using variation in

country characteristics.

A mechanism through which institutional comparative advantage develops the quality of institutions can be understood through the historical evidence of the Maghribi traders in the 11th century. The traders organized a coalition, which is a private-order institution, to overcome the risk of the embezzlement of the their capital by overseas employed agents. To support the coalition, the coalition merchant did not hire an agent who had cheated (Greif 1989, p. 867-8). The information on who cheated was delivered by the member traders (Greif 1989, p. 879-81). However, as trade volume grew, this monitoring mechanism in the coalition became insufficient to address the commitment problem. According to Milgrom et al. (1990, p. 4), this issue led to the development of the Law Merchant: "the legal codes governing commercial transactions and administered by private judges drawn from the commercial ranks."

This story of the Maghribi traders implies that the reason a rise in trade volume leads to the development of institutions lies in the need for resolving the higher risk of cheating by another party. This mechanism holds for the development of institutions through institutional comparative advantage. When trade volume increases with institutional comparative advantage, better institutions are required to tackle a higher risk of opportunism.

To empirically test this role of trade as a catalyst for institutional development, I first limit institutions to political constraints on government behavior.[1] The quality of institutions is proxied by the variable of executive constraints, measuring the degree to which the behavior of government executives is constrained, in the Polity IV dataset, constructed by Marshall et al. (2014).

Then, I develop a novel measure for country-level institutional comparative advantage. I employ the contract intensity index in Nunn (2007), constructed based on the concept of relationship-specificity, developed by Williamson (1975, 1979) and Goldberg (1976), and on the classification of internationally traded commodities in Rauch (1999). To be clear, I use the ranking of industries in terms of institutional intensity, represented by the contract intensity index. I choose the industries that rank in the top 20%, 30%, or 40% of the list of all institutional intensities. With these chosen

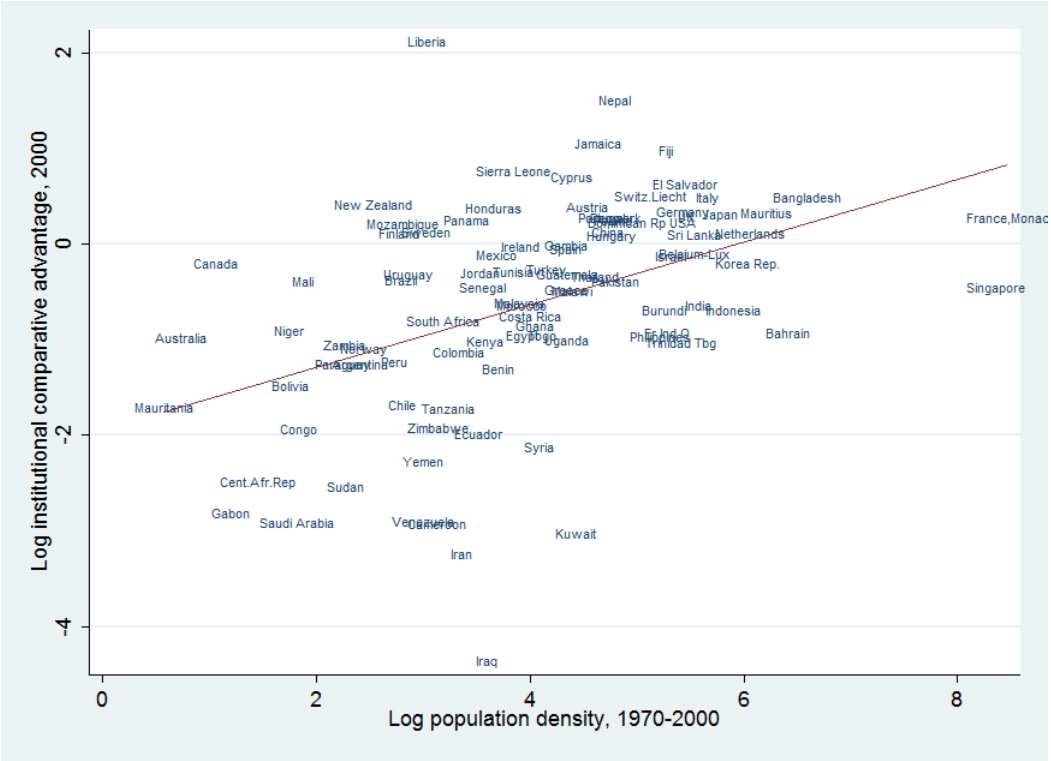
[1] These types of institutions are referred to as formal institutions in Williamson (2009).

industries, I calculate the average of revealed comparative advantage indices, introduced by Balassa (1965), over all industries for each country. This is a country's institutional comparative advantage index.

To show the causal impact of institutional comparative advantage on the quality of institutions, I adopt the instrumental variable (IV) approach. Specifically, a potential endogeneity issue of institutional comparative advantage is addressed by using population density, averaged over the past 30 years, as an IV for institutional comparative advantage. This is based on the beneficial effect of dense population on having institutional comparative advantage, as implied in Figure 4.1. To be specific, as a country is more densely populated, firms can more easily observe trade partner's opportunistic behavior. Moreover, firms can communicate with each other more effectively by having enough in-person relationships to produce a customized good. Therefore, countries with dense populations tend to have comparative advantage in an industry where institutions are required to mitigate opportunism.

The causal impact of institutional comparative advantage on institutional quality is supported by IV estimation results, which are robust with a variety of sets of controls and a different ranking of industries in terms of institutional intensity. Caution is given in the interpretation of the IV estimates. As Acemoglu et al. (2002) argue, data show that indigenous population density negatively affects current institutional quality. Additionally, it is positively correlated with current institutional comparative advantage. Thus, without controlling for indigenous population density, the estimated coefficient on the variable of institutional comparative advantage is downward biased. However, when controlling for it, the explanatory power of population density, averaged over the past 30 years, falls in the first-stage estimation. This is because the full variation in population density in explaining institutional comparative advantage is not employed while disentangling some variation coming from the persistence of indigenous population density. Thus, I rely on the IV estimates without controlling for indigenous population density and interpret them as a lower bound of the causal impact. The IV estimates imply that a 1 percent increase in institutional comparative advantage develops institutional quality by at least 0.12-0.22 percent.

Figure 4.1: Institutional comparative advantage and population density



Notes: This figure consists of 95 countries. Data on population density, calculated as people per sq. km of land area, are from the World Bank. Each country's population density is averaged from 1970 to 2000. In this figure, $insrca_i^{30}$ is used as a proxy for institutional comparative advantage. The construction of $insrca_i^{30}$ is explained in Section 4.3.1.

This is the first empirical evidence of the causal effect of institutional comparative advantage on institutional quality, which is based on two methodological novelties: summarizing institutional comparative advantage to a country-level value and finding a proper IV for institutional comparative advantage to address simultaneity problems. Through these distinctive approaches, this paper sheds light on the significance of international trade in having high-quality institutions.

The remainder of this paper is organized as follows. Section 4.2 sets up empirical specifications, and Section 4.3 describes the construction of measures and data sources. Section 4.4 discusses the empirical results, including robustness checks. Section 4.5 concludes.

4.2 Estimation Strategy

To test the causal effect of institutional comparative advantage on the quality of institutions, I set up the cross-sectional structural equation as follows:

$$ln\, INS_i = \beta_0 + \beta_1\, ln(ica_i) + \beta_2' C_i + \varepsilon_i, \tag{4.1}$$

where INS_i is country i's institutional quality, and ica_i denotes country i's institutional comparative advantage. C_i indicates the set of country-level control variables, which contains years of schooling, real GDP per capita, ethnic and religious fractionalization, legal origin dummies, percentage of adherents to Protestantism, and latitude. Controls, except legal origin dummies, are expressed as natural logarithms.

A potential endogeneity issue of institutional comparative advantage in equation (4.1) is addressed by using population density as an instrument variable (IV) for institutional comparative advantage. Then, the first-stage estimation is as follows:

$$ln(ica_i) = \gamma_0 + \gamma_1\, ln(pd_i) + \gamma_2' C_i + \nu_i, \tag{4.2}$$

where pd_i is country i's population density. Data on population density, expressed as people per sq. km of land area, are from the World Bank, and they are averaged over the time span of 1970-2000.

To understand the mechanism through which population density affects institutional comparative advantage, imagine a final good producer who needs to source an input from a local input supplier. In a transaction between them, they both face each other's opportunistic behaviors. For example, as in Antràs and Foley (2015), the input supplier might produce a low-quality input, and the producer might not pay in full after the ordered input arrives. In particular, the scope for opportunism increases when an input is more specialized. In this case, each party is aware that the other party lacks an outside option even if opportunism occurs because it cannot be traded in a thick market in which products are standardized. If their businesses are located close together, it would be easier to observe each other's behaviors, mitigating opportunism. In addition, a specialized input can be more efficiently produced because their proximity can make in-person com-

munication easier. Therefore, as people are more densely populated, a country can have a higher level of comparative advantage in an industry for which institutions are important, as shown in Figure 4.1 in the Introduction.

4.3 Measures and Data

4.3.1 Institutional Comparative Advantage

To measure the degree to which countries have institutional comparative advantage, I first use institutional intensity, which is denoted by d_z. It is assumed to be fixed across countries.[2] Specifically, industry structure is assumed to be driven by technology, and the difference in technology across sectors holds regardless of country. To have a representative d_z, I rely on data for U.S. industries.[3]

For a proxy for d_z, I employ the contract intensity constructed by Nunn (2007).[4] He uses two indicators built by Rauch (1999) to figure out which inputs require relationship-specific investments: whether the transaction of an input takes place in an organized exchange and whether the input is reference priced in trade publications. If the transaction does not occur in both situations, it is considered to need relationship-specific investments for which institutions are important in resolving the potential holdup problem. The data I adopt were measured by $\sum_k \theta_{jk} R_k^{neither}$, where θ_{jk} denotes the proportion of input k's value in industry j. Specifically, $\theta_{jk} \equiv u_{jk}/u_j$, where u_{jk} is input k's value used in industry j and u_j is all inputs' total value used in industry j. $R_k^{neither}$ indicates the proportion of input k transacted in neither case.[5]

I secondly use the revealed comparative advantage index, rca_{iz}, where subscript z and i are industry and country, which is suggested by Balassa (1965). rca_{iz} is measured by $(\frac{X_{iz}}{X_{wz}})/(\frac{X_{i.}}{X_{w.}})$, where X_{iz} is exports of industry z from country i, X_{wz} is world exports of industry z, $X_{i.}$ is total

[2] This assumption has been used by Rajan and Zingales (1998), Romalis (2004), Cowan and Neut (2007), Levchenko (2007), and Nunn (2007).

[3] The use of U.S. industries is justified by Romalis (2004, p.79) based on not only the fact that the U.S. economy is one of the largest and has the most diverse industrial structure, but also data availability.

[4] As a robustness check, I use the Herfindahl index (HI) of intermediate input use in Section 4.4.3.2.

[5] The measure was already calculated by Nunn, and the data organized in the I-O codes are available at his homepage.

exports from country i, and $X_{w.}$ is world exports. To calculate rca_{iz}, I use the data on bilateral world trade flows in 2000, constructed by Feenstra et al. (2005). Trade flows are arranged by the 4-digit Standard International Trade Classification (SITC) revision 2, and they are expressed in thousands of US dollars.

For baseline analyses, I choose a dominant I-O code for each SITC level, so that the analyses will be conducted based on the I-O codes. This is because d_z is originally organized by I-O classification, and because the values of d_z are not split throughout SITC levels. The mapping methodology between the I-O codes and SITC revision 2 is presented in Appendix C.1.1. Another mapping methodology that considers the share of industry within a SITC level is applied for robustness checks. The data on trade flows, which are combined with Nunn's measure, contain 215 industries.

Let $insrca_i^{\alpha}$ be country i's average of rca_{iz} over z, where z belongs to the top α% in the list of all d_zs. When α is low enough, $insrca_i^{\alpha}$ can be a proxy for institutional comparative advantage. To get a sense of the maximum α in which industries are considered as institutionally intensive, I employ studies, such as Levchenko (2007) and Nunn (2007), showing that institutional quality leads to institutional comparative advantage. Since these studies imply the positive correlation between $insrca_i^{\alpha}$ and institutions, I first calculate these variables' correlation, where $\alpha = 10, 20, ..., 100$. Then, I consider the industries in the top α%, which generates a high positive correlation, as institutionally intensive, and consider $insrca_i^{\alpha}$ constructed from such industries as a proxy for ica_i.

Table 4.1: Correlation between $ln(insrca_i^{\alpha})$ and institutional quality

	$ln(insrca_i^{10})$	$ln(insrca_i^{20})$	$ln(insrca_i^{30})$	$ln(insrca_i^{40})$	$ln(insrca_i^{50})$
$ln(INS_i)$	0.3535	0.4379	0.409	0.3898	0.1701
	$ln(insrca_i^{60})$	$ln(insrca_i^{70})$	$ln(insrca_i^{80})$	$ln(insrca_i^{90})$	$ln(insrca_i^{100})$
$ln(INS_i)$	0.1437	0.1601	0.0713	0.0446	-0.0581

Notes: This correlation is obtained with 151 observations. INS_i denotes country i's quality of institutions. Data sources are described in Section 4.3.

As can be seen in Table 4.1, the correlations tend to decrease with α. Specifically, they are about 0.4 when α is 10, 20, 30, and 40, but fall considerably when α is 50. Based on this result, I consider the industries that belong to the top 40% of institutional intensities as institutionally

intensive industries, and choose $insrca_i^{10}$, $insrca_i^{20}$, $insrca_i^{30}$, and $insrca_i^{40}$ as a proxy for ica_i.

4.3.2 Institutions

To measure the quality of institutions, I use the Polity IV dataset, which covers 167 countries from 1800 to 2013, developed by Marshall et al. (2014). The variable I employ is executive constraints, which measures the degree of constraints on the decision making behavior of executives of the government. Compared to the 'rule of law' index of Kaufmann et al. (2010), which has been popularly used as a proxy for institutional quality, this variable better captures institutions as a 'constraint' defined by North (1981). The rule of law index is a subject measure capturing the efficiency of institutions rather than capturing the political constraint itself in that it measures the perception of agents about property rights, the courts, and the likelihood of crime.

Seven categories regarding the degree of political constraints exist, and a score from 1 to 7 is given to them accordingly. The 7 categories that classify the degree are as follows: unlimited authority, intermediate category, slight to moderate limitation on executive authority, intermediate category, substantial limitations on executive authority, intermediate category, and executive parity or subordination. As this extent is higher, the quality of institutions is considered higher. Thus, the variable of the quality of institutions in each country is constructed by averaging the observations from 2000 to 2010.

However, as Glaeser et al. (2004) point out, the variable of executive constraints captures the result of recent elections, even though it was supposed to, in principle, reflect actual political constraints on executives. Despite this flaw that they point out, I use this variable for the analysis, in that it not only covers many countries but also directly measures the constraints on policy makers by observing a variety of evidence. One example of evidence that supports the assignment of 1 representing unlimited authority of executives is that executives are frequently able to revise or suspend constitutions at their initiative. On the contrary, one piece of evidence that supports scoring 7, which represents that "accountability groups have effective authority equal to or greater than the executive in most areas of activity," is that important legislation is initiated by a legislature,

ruling party, or council of nobles.[6] Thus, the variable of executive constraints in the Polity IV dataset assesses the political constraints on government behavior by taking into account a variety of evidence.

4.3.3 Controls

Countries with abundant human capital might have high-quality institutions. This is supported by the empirical result in Barro (1999), showing the positive relationship between primary schooling and the degree of democracy measured by electoral rights. Human capital also might be a factor in having institutional comparative advantage. Thus, I control for the 2010 human capital measured by the average years of schooling for the population of ages 25 and over. The data are from Barro and Lee (2013a).

Countries with institutional comparative advantage might be richer than other countries. To disentangle the effect of a country's wealth on institutions from the effect of institutional comparative advantage, I add real GDP per capita in 2000 as a control variable. The data come from the Penn World Table 8.0, constructed by Feenstra et al. (2013).

In addition, I consider ethnic and religious heterogeneity as a control variable. Ethnically diverse societies are more likely to develop extractive institutions by a group that seizes power, which is supported by many empirical studies. For example, Mauro (1995) shows that ethnolinguistic fractionalization is negatively correlated with institutional efficiency indices. Additionally, La Porta et al. (1999) show that ethnolinguistic fractionalization tends to be significantly and inversely associated with government performance. Conversely, religious heterogeneity does not tend to negatively affect the quality of government, which is evidenced by Alesina et al. (2003). The data on ethnic and religious fractionalization come from Montalvo and Reynal-Querol (2005). The fractionalization index is calculated as $1 - \sum_i^N \phi_i^2$, where ϕ_i is the proportion of ethnic or religious group i within a country.

[6] See Polity IV Manual pp. 24-5 and 63-6 for the list of evidence for each category corresponding to each score for the variable of executive constraints, except intermediate categories.

I also control for legal origin, which is classified as British, French, Socialist, German, and Scandinavian. In particular, the British common law tradition has been formed and developed by Parliament and the aristocracy, and it constrained the sovereign from exerting power. The tradition eventually led property rights to be protected while restraining the government's potential predatory behavior and was applied within its colonies (La Porta et al. 1999, p.232). La Porta et al. (1998, 1999) show that the major features of legal origin have persisted over time, and Djankov et al. (2003) present that legal origin has played a key role in forming current institutions. Data on legal origin is from La Porta et al. (1999).

Next, following Weber (1930), the possibility of Protestantism's contribution to economic performance is considered. Economic development might lead to constructing more constraints on the behavior of policy makers in order to protect property rights. Thus, I include the percentage of adherents to Protestantism in 2000 as a control variable. The data are from the World Religion Dataset, constructed by Maoz and Henderson (2013).[7]

Lastly, I control for latitude. Temperate zones provide more favorable climate for agriculture than tropical and semitropical deserts, resulting in better economic performance (Landes, 1998). This might, in turn, present a higher demand for better institutions. La Porta et al. (1999) show that latitude, which is positively correlated with per capita income, is significantly and positively associated with government performance measures that can capture institutional quality. Data on latitude, measured by the absolute value of the latitude of a capital city, are from La Porta et al. (1999).

4.4 Estimation Results

In this section, I first justify that population density is a proper IV for institutional comparative advantage. Then, I present OLS and IV estimation results. Descriptive statistics of data that are employed in the estimation are listed in Table 4.2.

[7] I obtained this dataset from the Association of Religion Data Archives, www.TheARDA.com.

Table 4.2: Descriptive statistics

Variable	Obs.	mean	sd	min	max
Ln $insrca^{10}$	148	-1.46	1.57	-6.29	2.86
Ln $insrca^{20}$	149	-0.75	1.43	-5.26	2.41
Ln $insrca^{30}$	150	-0.60	1.31	-4.36	2.76
Ln $insrca^{40}$	150	-0.47	1.27	-4.45	2.67
Ln institutions	150	1.47	0.53	0.00	1.95
Ln real GDP per capita	139	8.42	1.32	5.36	10.98
British legal origin	149	0.26	0.44	0	1
French legal origin	149	0.46	0.50	0	1
Socialist legal origin	149	0.22	0.41	0	1
German legal origin	149	0.03	0.18	0	1
Scandinavian legal origin	149	0.03	0.16	0	1
Ln latitude	149	2.96	0.95	0.00	4.16
Pct. of adherents to Protestantism	150	10.49	17.09	0.00	86.00
Ln years of schooling	129	1.82	0.57	-0.10	2.56
Ln ethnic fractionalization	114	-1.10	0.99	-4.61	-0.04
Ln religious fractionalization	115	-1.91	1.64	-6.91	-0.25
Ln population density, 1970-2000	150	3.79	1.44	0.20	8.47

4.4.1 Justification of the IV Strategy

Table 4.3 shows the first-stage estimation result. Population density, averaged from 1970 to 2000, is positively and significantly correlated with $ln(insrca_i^{10})$, $ln(insrca_i^{20})$, $ln(insrca_i^{30})$, and $ln(insrca_i^{40})$, as shown in columns (1)–(4). However, their association drastically falls and becomes insignificant as the dependent variable changes from $ln(insrca_i^{40})$ to $ln(insrca_i^{50})$, and this insignificance remains over columns (5)–(10). This result implies that under the choice of $insrca_i^{10}$, $insrca_i^{20}$, $insrca_i^{30}$, and $insrca_i^{40}$, as a proxy for institutional comparative advantage, population density is a proper candidate as an IV for the ica_i variable. However, when $insrca_i^{10}$ is used as a proxy for ica_i, the F-statistic on population density variable is below 10, which causes a weak instrument problem according to Staiger and Stock (1997). Accordingly, even though the industries ranking in the top 10% of d_zs are considered institutionally intensive, $insrca_i^{10}$ that is constructed with those industries is not employed as a proxy for ica_i in an IV estimation. In fact, the F-statistic is high when $ln\, insrca_i^{\alpha}$ and institutions show a high level of association. This is shown in Table 4.4, where $ln\, insrca_i^{\alpha}$ from α=10 to 100 is included one at a time with the full set of controls in the OLS regression of $ln\, INS_i$. This implies that population density better captures institutional comparative advantage only when the comparative advantage measure shows a high

Table 4.3: First-stage estimation results

Variable	Dependent variable is: ln $insrca_i^{10}$ (1)	ln $insrca_i^{20}$ (2)	ln $insrca_i^{30}$ (3)	ln $insrca_i^{40}$ (4)	ln $insrca_i^{50}$ (5)	ln $insrca_i^{60}$ (6)	ln $insrca_i^{70}$ (7)	ln $insrca_i^{80}$ (8)	ln $insrca_i^{90}$ (9)	ln $insrca_i^{100}$ (10)
Ln population density, 1970-2000	0.233**	0.417***	0.356***	0.332***	0.0542	0.109	0.113	0.0541	0.0289	0.0547
	(0.0975)	(0.0677)	(0.0619)	(0.0635)	(0.0788)	(0.0739)	(0.0783)	(0.0862)	(0.0797)	(0.0729)
Ln years of schooling	-0.181	0.00936	-0.229	-0.186	-0.229	-0.105	0.427	0.131	0.101	0.0162
	(0.504)	(0.379)	(0.308)	(0.344)	(0.434)	(0.434)	(0.500)	(0.528)	(0.486)	(0.429)
Ln real GDP per capita	0.209	-0.200	-0.120	-0.202	-0.302*	-0.468**	-0.775***	-0.754***	-0.729***	-0.726***
	(0.236)	(0.189)	(0.156)	(0.157)	(0.168)	(0.186)	(0.248)	(0.259)	(0.248)	(0.218)
Ln ethnic fractionalization	0.0718	0.0615	0.0758	0.140	0.213	0.184	0.128	0.199	0.199	0.135
	(0.170)	(0.145)	(0.131)	(0.136)	(0.145)	(0.145)	(0.136)	(0.159)	(0.151)	(0.139)
Ln religious fractionalization	-0.283**	-0.247**	-0.238***	-0.197**	-0.263***	-0.258***	-0.331***	-0.335***	-0.314***	-0.234***
	(0.111)	(0.102)	(0.0848)	(0.0909)	(0.0958)	(0.0926)	(0.104)	(0.114)	(0.111)	(0.0836)
British legal origin	-0.583	0.193	0.130	-0.0209	-0.104	0.0772	0.553	0.591	0.631*	0.684**
	(0.579)	(0.449)	(0.360)	(0.325)	(0.320)	(0.313)	(0.405)	(0.372)	(0.338)	(0.293)
French legal origin	-1.026*	-0.373	-0.427	-0.482	-0.432	-0.0495	0.496	0.520	0.506	0.599*
	(0.542)	(0.432)	(0.342)	(0.302)	(0.299)	(0.315)	(0.431)	(0.406)	(0.382)	(0.323)
Scandinavian legal origin	-1.794	-1.244	-1.547**	-1.095	-1.330	-2.047***	-1.260	-0.919	-0.985	-0.719
	(1.347)	(0.903)	(0.754)	(0.752)	(0.811)	(0.774)	(0.817)	(0.802)	(0.777)	(0.682)
German legal origin	0.283	0.437	0.305	0.283	0.711*	0.708	1.165**	1.285**	1.242**	1.042***
	(0.644)	(0.528)	(0.439)	(0.399)	(0.416)	(0.443)	(0.496)	(0.499)	(0.478)	(0.388)
Pct. of adherents to Protestantism	0.0229	0.0197**	0.0206**	0.0157*	0.0176*	0.0302***	0.0234***	0.0198**	0.0198**	0.0184**
	(0.0159)	(0.00956)	(0.00785)	(0.00831)	(0.00885)	(0.00819)	(0.00816)	(0.00800)	(0.00760)	(0.00700)
Ln latitude	-0.219	0.177	0.198*	0.245**	-0.195	-0.187	-0.138	-0.0542	-0.0148	-0.0166
	(0.163)	(0.135)	(0.105)	(0.109)	(0.133)	(0.123)	(0.124)	(0.124)	(0.119)	(0.101)
Observations	93	94	95	95	96	96	96	96	96	96
R-squared	0.256	0.373	0.402	0.317	0.251	0.369	0.420	0.416	0.439	0.529
F-statistic	5.705	37.84	33.05	27.29	0.473	2.156	2.094	0.393	0.131	0.563

Notes: Socialist legal origin category is omitted. Estimated constants are not reported. F-statistics on the excluded instrumental variable are reported in the row of F-statistic. Robust standard errors are in parentheses. ***, **, and * indicate that estimates are significant at the levels of 1%, 5%, and 10%, respectively.

Table 4.4: The association between $ln\, insrca_i^{\alpha}$ and the quality of institutions

Variable	Dependent variable is log institutional quality, 2000-2010 (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ln $insrca_i^{10}$	0.105***									
	(0.038)									
Ln $insrca_i^{20}$		0.176***								
		(0.031)								
Ln $insrca_i^{30}$			0.225***							
			(0.038)							
Ln $insrca_i^{40}$				0.218***						
				(0.037)						
Ln $insrca_i^{50}$					0.111**					
					(0.048)					
Ln $insrca_i^{60}$						0.108*				
						(0.054)				
Ln $insrca_i^{70}$							0.107**			
							(0.052)			
Ln $insrca_i^{80}$								0.092*		
								(0.050)		
Ln $insrca_i^{90}$									0.105**	
									(0.051)	
Ln $insrca_i^{100}$										0.083
										(0.061)
Ln years of	0.254**	0.204*	0.236**	0.229**	0.262**	0.245*	0.188	0.225*	0.227*	0.236*
schooling	(0.119)	(0.112)	(0.110)	(0.111)	(0.130)	(0.134)	(0.131)	(0.124)	(0.124)	(0.127)
Ln real GDP	-0.036	0.016	0.007	0.025	0.021	0.037	0.069	0.057	0.064	0.048
per capita	(0.054)	(0.047)	(0.048)	(0.046)	(0.051)	(0.052)	(0.061)	(0.061)	(0.063)	(0.067)
Ln ethnic	0.069	0.082*	0.071*	0.055	0.042	0.048	0.054	0.047	0.043	0.054
fractionalization	(0.047)	(0.043)	(0.039)	(0.038)	(0.042)	(0.044)	(0.046)	(0.045)	(0.045)	(0.048)
Ln religious	-0.047*	-0.046*	-0.038	-0.046**	-0.042	-0.045	-0.038	-0.040	-0.038	-0.052
fractionalization	(0.027)	(0.025)	(0.024)	(0.023)	(0.027)	(0.029)	(0.031)	(0.031)	(0.031)	(0.033)
British	0.142	0.064	0.059	0.089	0.081	0.064	0.014	0.015	0.003	0.013
legal origin	(0.202)	(0.212)	(0.207)	(0.195)	(0.187)	(0.186)	(0.199)	(0.191)	(0.192)	(0.185)
French	0.283	0.277	0.309	0.311*	0.206	0.168	0.110	0.110	0.103	0.107
legal origin	(0.191)	(0.202)	(0.200)	(0.186)	(0.171)	(0.168)	(0.177)	(0.168)	(0.167)	(0.159)
Scandinavian	-0.210	-0.191	-0.091	-0.196	-0.223	-0.152	-0.240	-0.289	-0.270	-0.312
legal origin	(0.310)	(0.332)	(0.337)	(0.322)	(0.291)	(0.308)	(0.297)	(0.293)	(0.291)	(0.293)
German	0.322	0.273	0.274	0.286	0.280	0.279	0.229	0.237	0.224	0.270
legal origin	(0.209)	(0.221)	(0.214)	(0.203)	(0.190)	(0.188)	(0.201)	(0.194)	(0.192)	(0.190)
Pct. of adherents	0.005	0.005	0.005	0.006*	0.005	0.004	0.005	0.005	0.005	0.006*
to Protestantism	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Ln latitude	0.097*	0.040	0.018	0.009	0.092	0.091	0.086	0.076	0.072	0.072
	(0.057)	(0.056)	(0.051)	(0.051)	(0.060)	(0.059)	(0.059)	(0.058)	(0.058)	(0.058)
Observations	94	95	96	96	97	97	97	97	97	97
R-squared	0.403	0.503	0.520	0.523	0.354	0.347	0.348	0.339	0.345	0.320

Notes: Socialist legal origin category is omitted. Estimated constants are not reported. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the level of 1%, 5%, and 10%, respectively.

level of association with the quality of institutions. This indeed confirms that a dense population helps a country have institutional comparative advantage that is conducive to constructing high-quality institutions.

The reason the estimated coefficient on $ln\, insrca_i^{\alpha}$ increases with α from column (1) to (3) in Table 4.4 presumably lies in the fact that constructing institutions requires a high set-up cost. The increase in the revealed comparative advantage index, which implies an increase in revenue from using higher-quality institutions to address increasing holdup problems, in the industries ranking in the top 10% or 20% with respect to institutional intensity might not be as great as the corresponding rise in the industries ranking in the top 30%. Thus, it seems that for profits, realized by using better institutions, to be maximized, the range of industries classified as institutionally intensive needs to be wider to some degree.

Let us return to the requirement for an IV. For population density to be a proper IV, it should meet the exclusion restriction condition. Even though population density is expected to be randomly assigned to a country, it could be a determinant of other variables that affect institutions. Hence, for the exclusion restriction to be met, if some determinants of institutions are correlated with population density, they should always be included as control variables in an IV estimation. To examine which determinants of institutions are correlated with population density, I include control variables individually in the following reduced form regression:

$$ln\, INS_i = \lambda_0 + \lambda_1\, ln(pd_i) + \lambda_2' C_i + u_i. \tag{4.3}$$

Table 4.5 shows the estimation results. In upper panel (A), different samples are used, while in the lower panel (B), the same samples are used. That is, I use all available countries for each estimation in the upper panel (A), while I limit samples to the countries with the full set of control variables in the lower panel (B). In the both panels, the estimated coefficient on population density in column (1) falls with the controls of years of schooling and real GDP per capita, while it tends to stay still when other control variables are individually included. This implies that a country with a more dense population is more likely to have better educated people and achieve a higher

Table 4.5: Reduced form regression results

	Dependent variable is log institutional quality, 2000-2010							
	A. Different samples							
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln population	0.108***	0.061*	0.079**	0.085**	0.104***	0.118***	0.102***	0.072*
den., 1970-2000	(0.032)	(0.034)	(0.035)	(0.033)	(0.034)	(0.032)	(0.032)	(0.038)
Ln years of		0.307***						0.188
schooling		(0.078)						(0.129)
Ln real GDP			0.092***					-0.019
per capita			(0.034)					(0.055)
Ln ethnic				0.033				0.084
fractionalization				(0.057)				(0.059)
Ln religious				-0.114***				-0.090***
fractionalization				(0.024)				(0.032)
British					0.029			0.087
legal origin					(0.131)			(0.159)
French					0.006			0.208
legal origin					(0.119)			(0.145)
Scandinavian					0.569***			-0.451
legal origin					(0.118)			(0.326)
German					0.317***			0.324
legal origin					(0.117)			(0.196)
Pct. of adherents						0.010***		0.009**
to Protestantism						(0.002)		(0.004)
Ln latitude							0.084**	0.063
							(0.040)	(0.058)
N	150	129	139	114	149	150	149	95
	B. Same samples							
Ln population	0.066*	0.035	0.040	0.079**	0.064*	0.077**	0.057*	0.072*
density, 1970-2000	(0.035)	(0.035)	(0.037)	(0.038)	(0.037)	(0.035)	(0.031)	(0.038)
Ln years of		0.308***						0.188
schooling		(0.077)						(0.129)
Ln real GDP			0.118***					-0.019
per capita			(0.031)					(0.055)
Ln ethnic				0.047				0.084
fractionalization				(0.066)				(0.059)
Ln religious				-0.114***				-0.090***
fractionalization				(0.028)				(0.032)
British					-0.133			0.087
legal origin					(0.253)			(0.159)
French					-0.066			0.208
legal origin					(0.246)			(0.145)
Scandinavian					0.379			-0.451
legal origin					(0.246)			(0.326)
German					0.211			0.324
legal origin					(0.242)			(0.196)
Pct. of adherents						0.007***		0.009**
to Protestantism						(0.002)		(0.004)
Ln latitude							0.128***	0.063
							(0.039)	(0.058)
N	95	95	95	95	95	95	95	95

Notes: Socialist legal origin category is omitted. Estimated constants are not reported. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the level of 1%, 5%, and 10%, respectively.

Table 4.6: Evidence of exclusion restriction

Variable	Dependent variable is log institutional quality, 2000-2010									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ln population	0.043	-0.009	-0.011	-0.000	0.061**	0.056*	0.056*	0.062**	0.064**	0.063**
den., 1970-2000	(0.031)	(0.031)	(0.030)	(0.029)	(0.030)	(0.031)	(0.031)	(0.030)	(0.030)	(0.031)
Ln $insrca_i^{10}$	0.096***									
	(0.029)									
Ln $insrca_i^{20}$		0.180***								
		(0.035)								
Ln $insrca_i^{30}$			0.232***							
			(0.041)							
Ln $insrca_i^{40}$				0.217***						
				(0.038)						
Ln $insrca_i^{50}$					0.105**					
					(0.040)					
Ln $insrca_i^{60}$						0.095**				
						(0.042)				
Ln $insrca_i^{70}$							0.094**			
							(0.042)			
Ln $insrca_i^{80}$								0.086**		
								(0.039)		
Ln $insrca_i^{90}$									0.101**	
									(0.041)	
Ln $insrca_i^{100}$										0.074
										(0.049)
Ln years of	0.226*	0.207*	0.241**	0.228**	0.234*	0.220*	0.169	0.198	0.199	0.208
schooling	(0.128)	(0.118)	(0.114)	(0.114)	(0.128)	(0.129)	(0.130)	(0.129)	(0.128)	(0.131)
Ln real GDP	-0.039	0.017	0.009	0.025	0.010	0.023	0.052	0.043	0.052	0.032
per capita	(0.058)	(0.053)	(0.052)	(0.052)	(0.060)	(0.062)	(0.067)	(0.066)	(0.066)	(0.070)
Ln ethnic	0.082	0.078	0.066	0.053	0.068	0.073	0.078	0.073	0.070	0.080
fractionalization	(0.052)	(0.048)	(0.047)	(0.047)	(0.053)	(0.054)	(0.053)	(0.054)	(0.054)	(0.054)
Ln religious	-0.061*	-0.044	-0.035	-0.047	-0.060	-0.063*	-0.057	-0.059	-0.056	-0.071*
fractionalization	(0.035)	(0.033)	(0.032)	(0.032)	(0.037)	(0.037)	(0.038)	(0.038)	(0.038)	(0.038)
British	0.152	0.063	0.057	0.092	0.109	0.091	0.046	0.048	0.035	0.048
legal origin	(0.243)	(0.223)	(0.218)	(0.217)	(0.247)	(0.250)	(0.251)	(0.251)	(0.250)	(0.256)
French	0.306	0.275	0.307	0.313	0.254	0.213	0.162	0.164	0.158	0.164
legal origin	(0.240)	(0.219)	(0.215)	(0.214)	(0.243)	(0.245)	(0.246)	(0.246)	(0.245)	(0.251)
Scandinavian	-0.252	-0.197	-0.092	-0.213	-0.242	-0.186	-0.263	-0.302	-0.282	-0.328
legal origin	(0.448)	(0.412)	(0.404)	(0.400)	(0.451)	(0.460)	(0.455)	(0.454)	(0.452)	(0.461)
German	0.304	0.252	0.253	0.262	0.262	0.269	0.227	0.227	0.212	0.260
legal origin	(0.298)	(0.275)	(0.268)	(0.267)	(0.305)	(0.308)	(0.310)	(0.311)	(0.309)	(0.315)
Pct. of adherents	0.007	0.005	0.005	0.006	0.007	0.006	0.006	0.007	0.006	0.007*
to Protestantism	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Ln latitude	0.092*	0.040	0.017	0.009	0.094*	0.091*	0.086	0.078	0.075	0.074
	(0.052)	(0.048)	(0.047)	(0.047)	(0.052)	(0.052)	(0.052)	(0.052)	(0.051)	(0.052)
Observations	93	94	95	95	96	96	96	96	96	96
R-squared	0.414	0.501	0.519	0.521	0.382	0.370	0.370	0.369	0.377	0.350

Notes: Socialist legal origin category is omitted. Estimated constants are not reported. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the level of 1%, 5%, and 10%, respectively.

income level, which positively affects the quality of institutions. Hence, for the exclusion restriction condition, I add these two variable in every IV regression.

It is possible that high population density leads the trust level between people to rise. This might substitute for formal institutions directly, not through institutional comparative advantage. In fact, the reduced form regression results with 62 countries that have trust data from 1981 to 2000 show that the estimated coefficient on population density stays the same as 0.001 with the robust standard error of 0.019 when adding the independent variable of trust. This implies that population density does not affect institutional quality through trust.[8]

The exclusion restriction condition also requires the effect of population density on institutions to be fully mediated through institutional comparative advantage. However, there is a concern that population density directly influences institutions. To examine this possibility, I include a population density variable as well as ica_i with the full set of controls in equation (4.1). If population density affects institutions only through institutional comparative advantage, the coefficient on population density should be zero.

This expectation is supported by Table 4.6 that shows the OLS estimates when $insrca_i^{10}$, $insrca_i^{20}$,...,$insrca_i^{100}$ are individually included in the regression. When $insrca_i^{20}$, $insrca_i^{30}$, and $insrca_i^{40}$ are used as a proxy for ica_i, the estimates on population density are nearly zero and not significant, which is shown in columns (2)–(4). However, when $insrca_i^{10}$ is included, there is a direct impact on institutional quality, as shown in column (1). Combining the OLS estimates in Table 4.4, which shows the association between institutional comparative advantage and the quality of institutions, and the fist-stage estimates in Table 4.3, it is confirmed that population density is an adequate IV for institutional comparative advantage when the association between ica_i and institutional quality is strong.

[8] The country-specific trust level is measured using the European Value Survey and the World Value Survey (EVS and WVS, 2006), which cover 85 regions from 1981-2004. For my analysis, I use the data from 1981-2000. Following Williamson (2009) and Tabellini (2010), I select the following question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" Then, the trust measure is calculated by the ratio of the number of respondents who answered "Most people can be trusted" to the total number of respondents who answered "Most people can be trusted" and "Can't be too careful."

4.4.2 The IV Estimation Results

4.4.2.1 Baseline Estimation

Table 4.7 presents OLS and the second stage IV estimation results using $insrca_i^{30}$ as a proxy for ica_i. The countries that are employed for this estimation are listed in Appendix C.2. In each estimation, I control for years of schooling and real GDP per capita according to the reduced form regression results in Table 4.5. By addressing a potential endogeneity problem for ica_i, every IV estimate on $ln(ica_i)$ is less than the corresponding OLS estimate.

Some of the estimates for the control variables, such as religious fractionalization and the percentage of adherents to Protestantism, are statistically significant from column (3) to (8), but with all controls and with smaller sample size, they all become insignificant, as shown in columns (11) and (12). In contrast, the estimates for ethnic fractionalization become marginally significant with all the controls. Only institutional comparative advantage and years of schooling variables consistently and significantly affect the quality of institutions. The results imply that a 1 percent rise in institutional comparative advantage leads to a 0.15–0.20 percent increase in the quality of institutions.

These OLS and IV estimation results are quite consistent with respect to magnitude and significance when $insrca_i^{40}$ is employed as a proxy for ica_i instead of $insrca_i^{30}$. Specifically, the institutional comparative advantage effect in terms of the elasticity of institutional quality is 0.16-0.22%. In contrast, when $insrca_i^{20}$ is used as a proxy for ica_i, the institutional comparative advantage effect on the quality of institutions is lowered, as shown in Table 4.8. Quantifying this effect, a 1 percent increase in institutional comparative advantage raises the quality of institutions by 0.12–0.16 percent. Additionally, in columns (2) and (4), the IV estimates are not statistically significant at the 10% level. The likely reason the estimates are lowered and become insignificant in some cases when $insrca_i^{20}$ is employed is in the high set-up cost for constructing institutions, which was discussed in Section 4.4.1.

Table 4.7: OLS and the second-stage estimation results I

	Dependent variable is log institutional quality, 2000-2010, ln ica_i = ln $insrca_i^{30}$											
Variable	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV	(9) OLS	(10) IV	(11) OLS	(12) IV
Ln ica_i	0.200***	0.150*	0.203***	0.159*	0.248***	0.179**	0.197***	0.175**	0.216***	0.158*	0.225***	0.202**
	(0.039)	(0.086)	(0.039)	(0.089)	(0.035)	(0.086)	(0.037)	(0.082)	(0.037)	(0.083)	(0.038)	(0.080)
Ln years of	0.204**	0.224**	0.220**	0.229**	0.300**	0.298**	0.191*	0.199**	0.177*	0.198*	0.235**	0.234**
schooling	(0.101)	(0.107)	(0.105)	(0.105)	(0.116)	(0.116)	(0.096)	(0.099)	(0.099)	(0.105)	(0.110)	(0.102)
Ln real GDP	0.022	0.021	0.012	0.010	-0.002	-0.001	0.015	0.015	0.041	0.032	0.007	0.005
per capita	(0.049)	(0.049)	(0.043)	(0.042)	(0.056)	(0.057)	(0.048)	(0.048)	(0.048)	(0.051)	(0.048)	(0.045)
Ln ethnic			0.057	0.052							0.070*	0.068*
fractionalization			(0.038)	(0.042)							(0.040)	(0.039)
Ln religious			-0.050**	-0.054**							-0.038	-0.042
fractionalization			(0.020)	(0.023)							(0.024)	(0.026)
British					0.036	0.006					0.061	0.061
legal origin					(0.099)	(0.102)					(0.206)	(0.188)
French					0.279**	0.205					0.310	0.294
legal origin					(0.106)	(0.128)					(0.198)	(0.185)
Scandinavian					0.286**	0.271**					-0.104	-0.138
legal origin					(0.130)	(0.121)					(0.344)	(0.327)
German					0.165	0.179*					0.256	0.262
legal origin					(0.103)	(0.102)					(0.216)	(0.198)
Pct. of adherents							0.004**	0.004***			0.005	0.005
to Protestantism							(0.002)	(0.001)			(0.004)	(0.003)
Ln latitude									0.006	0.026	0.018	0.022
									(0.043)	(0.051)	(0.051)	(0.049)
Observations	119	119	95	95	118	118	119	119	118	118	95	95
R-squared	0.385	0.371	0.453	0.443	0.470	0.447	0.404	0.401	0.416	0.399	0.518	0.516
First-stage F-stat		22.046		28.258		20.645		22.655		31.502		33.047

Notes: Socialist legal origin category is omitted. Estimated constants are not reported. F-statistics on the excluded instrumental variable are reported in the row of first-stage F-stat. Robust standard errors are in parentheses. ***, **, and * indicate that estimates are significant at the levels of 1%, 5%, and 10%, respectively.

Table 4.8: OLS and the second-stage estimation results II

	Dependent variable is log institutions over 2000-2010, ln ica_i = ln $insrca_i^{20}$											
Variable	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV	(9) OLS	(10) IV	(11) OLS	(12) IV
Ln ica_i	0.172***	0.116	0.164***	0.124	0.202***	0.138*	0.169***	0.137*	0.178***	0.122*	0.175***	0.159**
	(0.031)	(0.076)	(0.031)	(0.080)	(0.030)	(0.078)	(0.031)	(0.073)	(0.031)	(0.072)	(0.031)	(0.073)
Ln years of	0.216**	0.243**	0.199*	0.218*	0.289**	0.294**	0.204**	0.219**	0.190*	0.215**	0.203*	0.208**
schooling	(0.102)	(0.110)	(0.110)	(0.113)	(0.122)	(0.121)	(0.099)	(0.101)	(0.103)	(0.108)	(0.112)	(0.106)
Ln real GDP	0.022	0.022	0.025	0.021	0.003	0.004	0.016	0.015	0.032	0.024	0.016	0.013
per capita	(0.048)	(0.049)	(0.044)	(0.043)	(0.057)	(0.058)	(0.048)	(0.048)	(0.048)	(0.050)	(0.047)	(0.044)
Ln ethnic			0.066	0.060							0.081*	0.079*
fractionalization			(0.040)	(0.045)							(0.043)	(0.043)
Ln religious			-0.057**	-0.060***							-0.047*	-0.049*
fractionalization			(0.022)	(0.023)							(0.025)	(0.026)
British					-0.002	-0.022					0.065	0.067
legal origin					(0.103)	(0.101)					(0.210)	(0.193)
French					0.214**	0.151					0.279	0.268
legal origin					(0.105)	(0.120)					(0.200)	(0.186)
Scandinavian					0.231*	0.228**					-0.205	-0.223
legal origin					(0.120)	(0.114)					(0.338)	(0.315)
German					0.128	0.152					0.254	0.261
legal origin					(0.104)	(0.105)					(0.224)	(0.205)
Pct. of adherents							0.003**	0.004***			0.006	0.006*
to Protestantism							(0.001)	(0.001)			(0.004)	(0.003)
Ln latitude									0.032	0.049	0.040	0.043
									(0.044)	(0.047)	(0.056)	(0.052)
Observations	118	118	94	94	117	117	118	118	117	117	94	94
R-squared	0.384	0.361	0.443	0.432	0.447	0.422	0.400	0.392	0.410	0.389	0.500	0.499
First-stage F-stat		25.575		34.439		24.206		26.263		33.050		0.778

Notes: Socialist legal origin category is omitted. Estimated constants are not reported. F-statistics on the excluded instrumental variable are reported in the row of first-stage F-stat. Robust standard errors are in parentheses. ***, **, and * indicate that estimates are significant at the levels of 1%, 5%, and 10%, respectively.

4.4.2.2 Indigenous Population Density

According to Acemoglu et al. (2002), when an area was highly populated with native people, Europeans were more likely to develop extractive institutions to take advantage of the labor without settling themselves. When an area was scarcely populated, on the other hand, Europeans settled themselves and developed property rights institutions. This argument is supported by the estimation results in Table 4.9, which is conducted to test the exclusion restriction requirement of population density as an IV. Specifically, the results of the OLS regression of institutional quality where $insrca_i^{\alpha}$ and population densities in 1500 and 1970–2000 are all included as regressors show that the coefficient on population density in 1500 is negative in every case, which is shown in Table 4.9.[9] Meanwhile, with 158 observations, the correlation between log population density in 1500 and $ln\, insrca_i^{30}$ is 0.096. This is because the patterns of population density are persistent for a long time; with 145 observations, the correlation between indigenous and current population density is 0.36. Therefore, without including the indigenous population density as a control, the estimate for ica_i will be downward biased.

When the indigenous population density is controlled, OLS and IV estimates are raised, as expected, by fixing the downward bias, as shown in Table 4.10. However, there is a direct impact of population density on institutional quality, leading the ratios of OLS to IV estimates to fall, compared to the corresponding ratios without the population density in 1500. Notice that in columns (2)-(4) of Table 4.9, the coefficients on current population density are 0.02-0.03, even though they are not significant. Recall that they were nearly zero without adding indigenous population density as a control, as shown in Table 4.6. The direct impact stems from the fact that the variations in population density in 1500 include not only the variation that negatively affects current institutions but also the variation conducive to institutions through the current institutional comparative advantage.

As implied by the positive correlation between log population density in 1500 and $ln\, insrca_i^{30}$, some variation in population density in 1500 contributes to a positive effect on current institutional

[9] Data on population density in 1500 are downloadable at Acemoglu's homepage.

Table 4.9: Checking exclusion restriction with indigenous population density

Variable	Dependent variable is log institutional quality, 2000-2010 (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ln population den., 1970-2000	0.079**	0.026	0.022	0.033	0.103***	0.098***	0.095***	0.099***	0.100***	0.100***
	(0.035)	(0.035)	(0.035)	(0.033)	(0.034)	(0.035)	(0.035)	(0.035)	(0.035)	(0.036)
Ln population den. in 1500	-0.067**	-0.049	-0.044	-0.047	-0.071**	-0.071**	-0.064*	-0.062*	-0.061*	-0.063*
	(0.032)	(0.030)	(0.029)	(0.029)	(0.032)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Ln $insrca_i^{10}$	0.090***									
	(0.029)									
Ln $insrca_i^{20}$		0.171***								
		(0.035)								
Ln $insrca_i^{30}$			0.223***							
			(0.041)							
Ln $insrca_i^{40}$				0.209***						
				(0.038)						
Ln $insrca_i^{50}$					0.104**					
					(0.040)					
Ln $insrca_i^{60}$						0.092**				
						(0.042)				
Ln $insrca_i^{70}$							0.080*			
							(0.042)			
Ln $insrca_i^{80}$								0.074*		
								(0.039)		
Ln $insrca_i^{90}$									0.086**	
									(0.041)	
Ln $insrca_i^{100}$										0.055
										(0.049)
Ln years of schooling	0.235*	0.210*	0.239**	0.227**	0.234*	0.220*	0.176	0.200	0.201	0.209
	(0.126)	(0.116)	(0.112)	(0.111)	(0.124)	(0.126)	(0.127)	(0.126)	(0.126)	(0.128)
Ln real GDP per capita	-0.082	-0.017	-0.021	-0.009	-0.035	-0.024	-0.001	-0.007	0.001	-0.024
	(0.059)	(0.055)	(0.053)	(0.053)	(0.060)	(0.063)	(0.069)	(0.068)	(0.068)	(0.072)
Ln ethnic fractionalization	0.068	0.065	0.054	0.041	0.051	0.057	0.064	0.060	0.058	0.067
	(0.051)	(0.047)	(0.046)	(0.046)	(0.052)	(0.053)	(0.053)	(0.053)	(0.053)	(0.054)
Ln religious fractionalization	-0.080**	-0.057*	-0.046	-0.060*	-0.077**	-0.082**	-0.078**	-0.080**	-0.077**	-0.093**
	(0.036)	(0.033)	(0.033)	(0.032)	(0.037)	(0.037)	(0.039)	(0.038)	(0.038)	(0.038)
British legal origin	0.110	0.044	0.042	0.072	0.065	0.046	0.014	0.016	0.007	0.020
	(0.240)	(0.221)	(0.216)	(0.214)	(0.242)	(0.245)	(0.248)	(0.248)	(0.247)	(0.252)
French legal origin	0.258	0.254	0.290	0.291	0.217	0.174	0.135	0.138	0.133	0.141
	(0.236)	(0.217)	(0.212)	(0.211)	(0.238)	(0.240)	(0.243)	(0.243)	(0.242)	(0.247)
Scandinavian legal origin	-0.162	-0.252	-0.175	-0.283	-0.202	-0.138	-0.254	-0.303	-0.286	-0.328
	(0.481)	(0.437)	(0.428)	(0.423)	(0.472)	(0.485)	(0.480)	(0.478)	(0.476)	(0.485)
German legal origin	0.429	0.327	0.314	0.334	0.381	0.393	0.352	0.347	0.332	0.389
	(0.298)	(0.276)	(0.270)	(0.267)	(0.302)	(0.306)	(0.311)	(0.312)	(0.311)	(0.316)
Pct. of adherents to Protestantism	0.007	0.007*	0.007	0.008*	0.008*	0.006	0.008	0.008*	0.008*	0.009*
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
Ln latitude	0.107**	0.057	0.034	0.026	0.111**	0.107**	0.099*	0.092*	0.089*	0.088*
	(0.052)	(0.048)	(0.047)	(0.047)	(0.051)	(0.052)	(0.052)	(0.052)	(0.051)	(0.052)
Observations	90	91	92	92	93	93	93	93	93	93
R-squared	0.458	0.536	0.551	0.558	0.436	0.421	0.414	0.413	0.419	0.396

Notes: Socialist legal origin category is omitted. Estimated constants are not reported. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the level of 1%, 5%, and 10%, respectively.

Table 4.10: OLS and the second-stage estimation results with indigenous population density

	Dependent variable is log institutional quality, 2000-2010, ln ica_i = ln $insrca_i^{30}$											
Variable	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV	(9) OLS	(10) IV	(11) OLS	(12) IV
Ln ica_i	0.224***	0.181	0.217***	0.214**	0.258***	0.239**	0.220***	0.225*	0.222***	0.190*	0.235***	0.278***
	(0.036)	(0.132)	(0.039)	(0.109)	(0.035)	(0.116)	(0.035)	(0.119)	(0.038)	(0.108)	(0.039)	(0.088)
Ln years of	0.197*	0.221*	0.240**	0.240**	0.324***	0.324***	0.188*	0.186	0.195*	0.209*	0.248**	0.252**
schooling	(0.101)	(0.131)	(0.103)	(0.104)	(0.117)	(0.113)	(0.098)	(0.118)	(0.102)	(0.117)	(0.106)	(0.100)
Ln real GDP	0.036	0.030	-0.003	-0.004	-0.014	-0.015	0.025	0.026	0.033	0.027	-0.014	-0.011
per capita	(0.049)	(0.056)	(0.045)	(0.045)	(0.058)	(0.056)	(0.049)	(0.053)	(0.051)	(0.059)	(0.047)	(0.048)
Ln population	-0.022	-0.015	-0.036*	-0.035	-0.035*	-0.032	-0.022	-0.023	-0.023	-0.019	-0.035*	-0.039*
density in 1500	(0.018)	(0.031)	(0.020)	(0.025)	(0.019)	(0.026)	(0.018)	(0.028)	(0.018)	(0.023)	(0.021)	(0.023)
Ln ethnic			0.032	0.032							0.049	0.050
fractionalization			(0.043)	(0.042)							(0.041)	(0.037)
Ln religious			-0.050**	-0.051*							-0.039	-0.031
fractionalization			(0.022)	(0.028)							(0.025)	(0.029)
British					0.074	0.066					0.044	0.041
legal origin					(0.101)	(0.109)					(0.201)	(0.197)
French					0.300***	0.280*					0.290	0.318*
legal origin					(0.106)	(0.146)					(0.194)	(0.193)
German					0.272**	0.270***					0.295	0.285
legal origin					(0.108)	(0.104)					(0.211)	(0.206)
Scandinavian					0.370***	0.362***					-0.180	-0.101
legal origin					(0.136)	(0.133)					(0.334)	(0.366)
Pct. of adherents							0.004***	0.004***			0.006*	0.006
to Protestantism							(0.001)	(0.001)			(0.004)	(0.004)
Ln latitude									0.011	0.021	0.029	0.023
									(0.045)	(0.056)	(0.052)	(0.050)
Observations	114	114	92	92	114	114	114	114	114	114	92	92
R-squared	0.429	0.419	0.476	0.476	0.487	0.485	0.449	0.449	0.429	0.424	0.549	0.541
First-stage F-stat		13.405		20.043		11.736		14.095		25.119		23.905

Notes: Socialist legal origin category is omitted. Estimated constants are not reported. F-statistics on the excluded instrumental variable are reported in the row of first-stage F-stat. Robust standard errors are in parentheses. ***, **, and * indicate that estimates are significant at the levels of 1%, 5%, and 10%, respectively.

comparative advantage. Additionally, the indigenous population density is positively correlated with the current population density. Thus, variation in current population density includes variation in indigenous population density that positively affects institutional comparative advantage. Accordingly, such variation is disentangled when controlling for indigenous population density, which hinders using full variation in current population density to explain variation in institutional comparative advantage across countries. This causes two issues for the IV estimation. First, the effect of population density is not perfectly mediated through the comparative advantage. Secondly, the explanatory power of population density in the first-stage IV estimation becomes weak.

Therefore, I rely on the OLS and IV results without the control of indigenous population density, which are presented in Tables 4.7 and 4.8, and interpret the IV estimates as a lower bound of the causal impact of institutional comparative advantage on the quality of institutions. Reinterpreting the causal impacts when using $insrca_i^{20}$, $insrca_i^{30}$, and $insrca_i^{40}$ as proxies for ica_i, a 1% rise in institutional comparative advantage contributes to at least a 0.12–0.22% development of the quality of institutions.

4.4.3 Robustness Checks

4.4.3.1 Institutional Intensity Organized by the SITC

For a robustness check, I compute the ranking of d_z across product groups in the SITC, which is used to build the institutional comparative advantage measure. For this purpose, I use the share of I-O codes within a SITC level so that all institutional intensity information in the I-O codes is used. However, this methodology has a potential critical limitation; it is possible that the recalculated institutional intensities organized by the SITC levels do not capture the right ones, in that the original information on the intensities in the I-O classification is split throughout the SITC levels. The construction of d_z based on the SITC levels is described in Appendix C.1.2.

With this approach, the variable d_z contains 532 observations in the SITC categories. $insrca_i^{\alpha}$ is calculated based on the new ranking of d_z and trade flows data listed in the SITC. Table 4.11

Table 4.11: Robustness check I: Correlation between $ln(insrca_i^{\alpha})$ and institutional quality

	$ln(insrca_i^{10})$	$ln(insrca_i^{20})$	$ln(insrca_i^{30})$	$ln(insrca_i^{40})$	$ln(insrca_i^{50})$
$ln(INS_i)$	0.3298	0.3351	0.3343	0.1816	-0.0085
	$ln(insrca_i^{60})$	$ln(insrca_i^{70})$	$ln(insrca_i^{80})$	$ln(insrca_i^{90})$	$ln(insrca_i^{100})$
$ln(INS_i)$	-0.0279	-0.0362	-0.0732	-0.0952	-0.1534

Notes:$insrca_i^{\alpha}$ is constructed using d_z listed in the SITC levels. This correlation is obtained with 151 observations. INS_i denotes country i's quality of institutions. Data sources are described in Section 4.3.

shows the strong positive correlation between $ln\, insrca_i^{\alpha}$ and $ln\, INS_i$ until α reaches 30. Recall that there was a considerable fall in the corresponding correlation with the I-O classification when α is 40, as shown in Table 4.1. This is probably because the industries in the top 40% in terms of d_z organized by the I-O classification are mainly matched to the industries in the top 30% of the list of d_z in the SITC levels.

The first-stage F-statistics on the population density variable when $ln\, insrca_i^{10}$, $ln\, insrca_i^{20}$,..., $ln\, insrca_i^{100}$ are used one at a time as a proxy for ica_i with the full set of controls are 8.6, 26.5, 28.5, 7.6, 0.7, 1.3, 1.0, 1.2, 0.9, and 0.9, respectively. Thus, when using population density as an IV, $insrca_i^{20}$ and $insrca_i^{30}$ are good candidates for a proxy for ica_i.

Table 4.12 shows the OLS estimates when both $ln\, insrca_i^{\alpha}$ and population density are included as regressors. As can be seen in columns (2) and (3), the direct effect of population density on institutional quality is nearly zero when α is 20 and 30, implying the exclusion restriction is satisfied. However, when α is 10, there is a direct impact on institutions, as in the corresponding baseline results, shown in Table 4.6. In fact, the OLS estimate for $ln\, insrca_i^{10}$ with the full controls in the structural equation in (4.1) is less than the corresponding estimates for $ln\, insrca_i^{20}$ and $ln\, insrca_i^{30}$. Thus, population density is an appropriate IV only when the association between institutional comparative advantage and institutional quality is high, which is consistent with the baseline results. Accordingly, for the robustness check, I use the new measure of $ln\, insrca_i^{20}$ and $ln\, insrca_i^{30}$ as proxies for ica_i in the IV estimations.

Table 4.13 shows the OLS and the second-stage IV estimates when $insrca_i^{30}$ is used as a proxy for ica_i. Accounting for the downward bias due to the absence of the control of population density in 1500, the results imply that a 1% rise in institutional comparative advantage develops

Table 4.12: Robustness check I: Evidence of exclusion restriction

	Dependent variable is log institutional quality, 2000-2010									
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ln population density, 1970-2000	0.032	-0.007	-0.015	0.043	0.060**	0.060*	0.062**	0.061*	0.063**	0.064**
	(0.031)	(0.031)	(0.030)	(0.030)	(0.030)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Ln $insrca_i^{10}$	0.134***									
	(0.036)									
Ln $insrca_i^{20}$		0.160***								
		(0.032)								
Ln $insrca_i^{30}$			0.183***							
			(0.033)							
Ln $insrca_i^{40}$				0.119***						
				(0.035)						
Ln $insrca_i^{50}$					0.104***					
					(0.037)					
Ln $insrca_i^{60}$						0.063*				
						(0.037)				
Ln $insrca_i^{70}$							0.051			
							(0.040)			
Ln $insrca_i^{80}$								0.055		
								(0.040)		
Ln $insrca_i^{90}$									0.053	
									(0.041)	
Ln $insrca_i^{100}$										0.038
										(0.044)
All controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	93	94	96	96	96	96	96	96	96	96
R-squared	0.431	0.498	0.511	0.413	0.391	0.354	0.345	0.347	0.345	0.338

Notes: $insrca_i^{\alpha}$ is constructed using d_z listed in the SITC levels. Socialist legal origin category is omitted. Estimated constants are not reported. Robust standard errors are in parentheses. ***, **, and * represent the estimates that are significant at the level of 1%, 5%, and 10%, respectively.

institutions by at least 0.12-0.15%. The tendency for the signs and statistical significances of the estimates is similar to the baseline results in Table 4.7. One difference is that the estimates for ethnic fractionalization and the percentage of adherents to Protestantism become significant with all the controls. It is interesting to see that ethnic diversity contributes to having better institutions, while religious diversity harms the quality of institutions. This is different from Alesina et al. (2003), who show that ethnic fractionalization negatively affects institutional quality, while religious fractionalization has no impact on it. When using $insrca_i^{20}$ as a proxy for ica_i, the signs, magnitudes, and statistical significances of the estimates remain constant.[10]

[10] The OLS and IV estimates when using $insrca_i^{20}$ are not reported but can be provided on request.

Table 4.13: Robustness check I: OLS and the second-stage estimation results

	Dependent variable is log institutional quality, 2000-2010, ln ica_i = ln $insrca_i^{30}$											
Variable	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV	(9) OLS	(10) IV	(11) OLS	(12) IV
Ln ica_i	0.167***	0.119	0.172***	0.122*	0.188***	0.135*	0.169***	0.141**	0.178***	0.128*	0.175***	0.149**
	(0.032)	(0.073)	(0.034)	(0.071)	(0.029)	(0.072)	(0.031)	(0.071)	(0.031)	(0.068)	(0.032)	(0.064)
Ln years of	0.217*	0.238**	0.188	0.211*	0.274**	0.280**	0.201*	0.213**	0.188*	0.207*	0.166	0.176*
schooling	(0.113)	(0.112)	(0.116)	(0.113)	(0.132)	(0.127)	(0.107)	(0.105)	(0.113)	(0.111)	(0.113)	(0.105)
Ln real GDP	0.071	0.056	0.083*	0.061	0.060	0.044	0.063	0.055	0.088*	0.065	0.082*	0.068
per capita	(0.052)	(0.053)	(0.045)	(0.054)	(0.060)	(0.060)	(0.051)	(0.050)	(0.052)	(0.057)	(0.046)	(0.050)
Ln ethnic			0.066	0.058							0.082*	0.079*
fractionalization			(0.041)	(0.045)							(0.043)	(0.044)
Ln religious			-0.052**	-0.057**							-0.048*	-0.051**
fractionalization			(0.022)	(0.024)							(0.025)	(0.025)
British					0.018	-0.007					0.009	0.018
legal origin					(0.104)	(0.107)					(0.197)	(0.182)
French					0.164*	0.121					0.173	0.171
legal origin					(0.098)	(0.109)					(0.185)	(0.168)
Scandinavian					0.283**	0.268**					-0.318	-0.328
legal origin					(0.128)	(0.125)					(0.329)	(0.299)
German					0.194*	0.199*					0.229	0.244
legal origin					(0.110)	(0.108)					(0.216)	(0.198)
Pct. of adherents							0.005***	0.005***			0.007*	0.007**
to Protestantism							(0.002)	(0.002)			(0.004)	(0.003)
Ln latitude									0.021	0.037	0.028	0.034
									(0.038)	(0.045)	(0.044)	(0.043)
Observations	120	120	96	96	119	119	120	120	119	119	96	96
R-squared	0.370	0.353	0.460	0.441	0.424	0.405	0.397	0.391	0.399	0.382	0.509	0.505
First-stage F-stat		20.409		26.080		20.226		19.752		29.512		28.479

Notes: $insrca_i^{\alpha}$ is constructed using d_z listed in the SITC levels. Socialist legal origin category is omitted. Estimated constants are not reported. F-statistics on the excluded instrumental variable are reported in the row of first-stage F-stat. Robust standard errors are in parentheses. ***, **, and * indicate that estimates are significant at the levels of 1%, 5%, and 10%, respectively.

4.4.3.2 Herfindahl Index

For another robustness check, I use the Herfindahl index (HI) of intermediate input use in constructing d_z, as in Levchenko (2007). The HI is calculated as the sum of squares of the shares of inputs within an industry using the 1997 U.S. I-O Use Table from the Bureau of Economic Analysis (BEA).

The HI has been used to measure the degree of dependence on institutions of an industry (Cowan and Neut, 2007; Levchenko, 2007). The HI measures the complexity of a good (Tirole, 1988; Blanchard and Kremer, 1997). Specifically, the HI decreases with the complexity of a good. If a good is dominated by only a few intermediate inputs (i.e., low complexity), then the index will be close to 1. In contrast, if a large number of intermediate goods account for the production of the good in relatively equal proportion (i.e., high complexity), the index will be close to zero. Production of an industry with a high level of complexity is expected to require a high level of institutional quality to overcome holdup problems. The reason to use the HI rather than the number of intermediate goods is that the proportion of inputs matters to final good suppliers in relieving the potential holdup problem, as Levchenko (2007, p. 809) points out. If a good is comprised of 99 percent of the one or two intermediate inputs and 1 percent of the many other intermediate inputs, then institutions would not be that important because only one or two relationships with the dominant input suppliers would matter.

Since the HI is organized by the I-O classification, to combine trade flows data, I use the mapping methodology between the SITC revision 2 and I-O classification, which is used for the baseline estimations. In the combined dataset, there are 248 industries organized by the I-O codes. Since HI falls with the complexity of a good, following Blanchard and Kremer (1997), I use (1-HI) to measure institutional intensity. Note that this variable and Nunn's measure of contract intensity are positively correlated with each other. The correlation between them is 0.317 with 215 observations.

When HI is used, the correlations between $ln\, insrca_i^{\alpha}$ and $ln(INS_i)$ tend to be stable until α

Table 4.14: Robustness check II: Correlation between $ln(insrca_i^{\alpha})$ and institutional quality

	$ln(insrca_i^{10})$	$ln(insrca_i^{20})$	$ln(insrca_i^{30})$	$ln(insrca_i^{40})$	$ln(insrca_i^{50})$
$ln(INS_i)$	0.4463	0.4564	0.3779	0.3095	0.2938
	$ln(insrca_i^{60})$	$ln(insrca_i^{70})$	$ln(insrca_i^{80})$	$ln(insrca_i^{90})$	$ln(insrca_i^{100})$
$ln(INS_i)$	0.2108	0.2149	0.0313	-0.0301	-0.0466

Notes: $insrca_i^{\alpha}$ is constructed using the HI listed by the I-O classification. This correlation is obtained with 149 observations. INS_i denotes country i's quality of institutions. Data sources are described in Section 4.3.

reaches 70 and falls drastically when α is 80, as shown in Table 4.14. This implies that the institutionally intensive industries according to Nunn's measure are spread across α by the classification of HI. This is presumably because Nunn's measure captures input characteristics concerning the holdup problems by using input shares and Rauch's data, while the HI does not. Classifying goods according to whether they are traded in an organized exchange and are reference priced in trade publications provides crucial information on an input regarding holdup problems. As an extreme case, according to Nunn's measure, if all inputs are neither traded in an organized exchange nor reference priced, institutional intensity should be 1 regardless of the input complexity. However, (1-HI) will be low if the degree of input complexity of this good is low since the HI does not capture input characteristics.

The first-stage F-statistics for population density also show the similar stable pattern across α. Recall that this F statistic tends to be higher as the association between $ln\, insrca_i^{\alpha}$ and $ln(INS_i)$ rises when Nunn's measure is employed. With this new measure, the first-stage F statistics for population density variable when $ln\, insrca_i^{10}$, $ln\, insrca_i^{20}$,...,$ln\, insrca_i^{100}$ are individually used as a proxy for ica_i with the full controls are 14.6, 14.8, 8.6, 7.1, 5.7, 2.9, 4.5, 2.0, 1.7, and 1.2, respectively. Thus, compared to the baseline results in Table 4.3, the association between population density and institutional comparative advantage is relatively low when α is 10 and 20, and their association is relatively high even when α is 70, 80, 90, and 100.

When the population density variable and ica_i are simultaneously included in the OLS regression of institutional quality with the full controls, the estimates for the population density variable are 0.013 and 0.010 and insignificant when $ln\, insrca_i^{10}$ and $ln\, insrca_i^{20}$ are used as a proxy for ica_i, respectively. This suggests there is little direct impact of population density on institutional

Table 4.15: Robustness check II: OLS and the second-stage estimation results

	Dependent variable is log institutional quality, 2000-2010, ln ica_i = ln $insrca_i^{20}$											
Variable	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV	(9) OLS	(10) IV	(11) OLS	(12) IV
Ln ica_i	0.182***	0.150*	0.173***	0.164*	0.188***	0.162*	0.181***	0.174**	0.185***	0.159*	0.170***	0.196**
	(0.033)	(0.090)	(0.033)	(0.091)	(0.033)	(0.088)	(0.032)	(0.088)	(0.033)	(0.084)	(0.032)	(0.085)
Ln years of	0.257**	0.263***	0.288***	0.286***	0.287**	0.288**	0.244**	0.245**	0.235**	0.238**	0.258**	0.261**
schooling	(0.098)	(0.100)	(0.107)	(0.103)	(0.119)	(0.116)	(0.095)	(0.095)	(0.098)	(0.099)	(0.119)	(0.116)
Ln real GDP	-0.015	-0.009	-0.017	-0.016	-0.021	-0.018	-0.022	-0.020	-0.007	-0.005	-0.021	-0.022
per capita	(0.052)	(0.053)	(0.049)	(0.047)	(0.060)	(0.059)	(0.050)	(0.051)	(0.053)	(0.052)	(0.054)	(0.052)
Ln ethnic			0.046	0.045							0.050	0.048
fractionalization			(0.036)	(0.037)							(0.042)	(0.039)
Ln religious			-0.041**	-0.043*							-0.044*	-0.040
fractionalization			(0.021)	(0.026)							(0.025)	(0.027)
British					0.048	0.032					0.204	0.224
legal origin					(0.109)	(0.116)					(0.205)	(0.204)
French					0.088	0.077					0.271	0.289
legal origin					(0.107)	(0.106)					(0.197)	(0.197)
Scandinavian					0.183	0.190*					-0.289	-0.273
legal origin					(0.114)	(0.111)					(0.286)	(0.274)
German					0.104	0.119					0.259	0.248
legal origin					(0.101)	(0.107)					(0.217)	(0.211)
Pct. of adherents							0.004***	0.004***			0.007**	0.007***
to Protestantism							(0.001)	(0.001)			(0.003)	(0.003)
Ln latitude									0.023	0.031	0.044	0.040
									(0.038)	(0.047)	(0.043)	(0.042)
Observations	120	120	96	96	119	119	120	120	119	119	96	96
R-squared	0.397	0.389	0.451	0.451	0.419	0.415	0.418	0.418	0.415	0.411	0.487	0.483
First-stage F-stat		15.832		14.700		15.952		15.920		20.209		14.791

Notes: $insrca_i^{\alpha}$ is constructed using the HI. Socialist legal origin category is omitted. Estimated constants are not reported. F-statistics on the excluded instrumental variable are reported in the row of first-stage F-stat. Robust standard errors are in parentheses. ***, **, and * indicate that estimates are significant at the levels of 1%, 5%, and 10%, respectively.

quality, implying that exclusion restriction is satisfied.

Table 4.15 presents the OLS and the IV estimates when HI is used to calculate d_z and $insrca_i^{20}$ is used as a proxy for ica_i. The IV estimates imply that a 1 percent increase in institutional comparative advantage leads to at least a 0.15-0.20 percent rise in institutional quality, which is very similar to the corresponding effect in the baseline estimation. However, the ratios of OLS to IV estimates are raised, compared to the corresponding ratios in the baseline estimation. This is due to the weakened explanatory power of population density for institutional comparative advantage, which is captured in the lower first-stage F-statistics on the excluded instrument.

4.5 Concluding Remarks

This paper empirically shows that there is a causal impact of institutional comparative advantage in trade on national institutional quality. This result relies on the use of revealed comparative advantage to summarize a country's degree of comparative advantage in institutionally intensive industries. It also relies on employing variation in population density to instrument institutional comparative advantage.

Indeed, data on population density provide exogenous variation in explaining the difference in institutional comparative advantage between countries. The high correlation between population density and institutional comparative advantage implies the importance of a dense population in observing trade partner's opportunism and the effective communication between firms to produce customized goods.

Since institutional comparative advantage measure is constructed using actual export performance, robust empirical results of the causal effect of institutional comparative advantage on the quality of institutions implies the significance of international trade in inducing better institutions. Thus, this paper conveys the important policy implication that international trade matters in achieving a higher quality of institutions, as measured by political constraints on policy makers.

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Appendix A

Global Sourcing Patterns, Commercial Arbitration Regimes, and Relationship-Specific Transactions

A.1 Pervasive Domestic Sourcing

In this Appendix A.1, I examine the case where the FGPs in country j and i choose domestic sourcing, which is represented by region C in Figure 2.1. As can be seen in this figure, this case is more likely to occur when the level of A_i is low.

Without loss of generality, let us consider country j's general equilibrium. Labor market clearing condition imposes that $y_j^D(\omega)n_j + x_{jj}(\omega)n_j + f_j n_j = L_j$. Since $x_{jj}(\omega) = y_j^D(\omega) = y_{ji}^D(\omega) + y_{jj}^D(\omega)$, this condition is expressed as

$$2^{1-\sigma}(\lambda_i + \lambda_j)(\theta D_j + 1 - \theta)^{\sigma} \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma} w_j^{-\sigma} n_j + f_j n_j = L_j. \tag{A.1}$$

The zero profit condition requires the operating profits expressed in equation (2.11) to equal the fixed cost. The ratio of this condition for country j to country i gives the following equilibrium wage ratio:

$$\frac{w_j}{w_i} = \frac{1 - \theta + \theta D_j}{1 - \theta + \theta D_i} \left(\frac{f_i}{f_j}\right)^{\frac{1}{\sigma}}. \tag{A.2}$$

Since the firms in both countries engage in domestic sourcing, only the quality of domestic commercial arbitration regimes determine the wage ratio.

It is straightforward to show that $\frac{\partial\left(\frac{w_j}{w_i}\right)}{\partial D_j} > 0$, and $\frac{\partial\left(\frac{w_j}{w_i}\right)}{\partial D_i} < 0$. Additionally, $\frac{\partial\left(\frac{w_j}{w_i}\right)}{\partial \theta}$ is negative if $D_i > D_j$ and positive if $D_i < D_j$. Regarding joint effects, $\frac{\partial^2\left(\frac{w_j}{w_i}\right)}{\partial D_j \partial \theta} > 0$, and $\frac{\partial^2\left(\frac{w_j}{w_i}\right)}{\partial D_i \partial \theta} < 0$.

These contrast with the ambiguous differential effects of the quality of arbitration regimes across rs intensity when a country's FGP chooses global sourcing.

Combining the wage ratio with the zero profit condition pins down n_j as follows:

$$n_j = \frac{L_j}{f_j \sigma}. \tag{A.3}$$

Again, in comparison to the equilibrium n_j that depends on $\frac{w_j}{w_i}$ when global sourcing exists, which is expressed in equation (2.19), this n_j is independent of $\frac{w_j}{w_i}$. This is because the effect of a change in revenue on n_j is fully offset through the wage ratio in the process of free entry and labor market clearing. In contrast, when a change in revenue occurs in the case of global sourcing, the wage ratio is not fully adjusted. Specifically, the operating profits and the number of labor used for sales are a function of $(w_i + w_j)$ due to the use of labor in i, while the fixed cost in value is expressed as $f_j w_j$; this asymmetric wage structure causes the wage ratio not to be fully adjusted when the revenue changes, leading to the lingering effect of altering n_j.

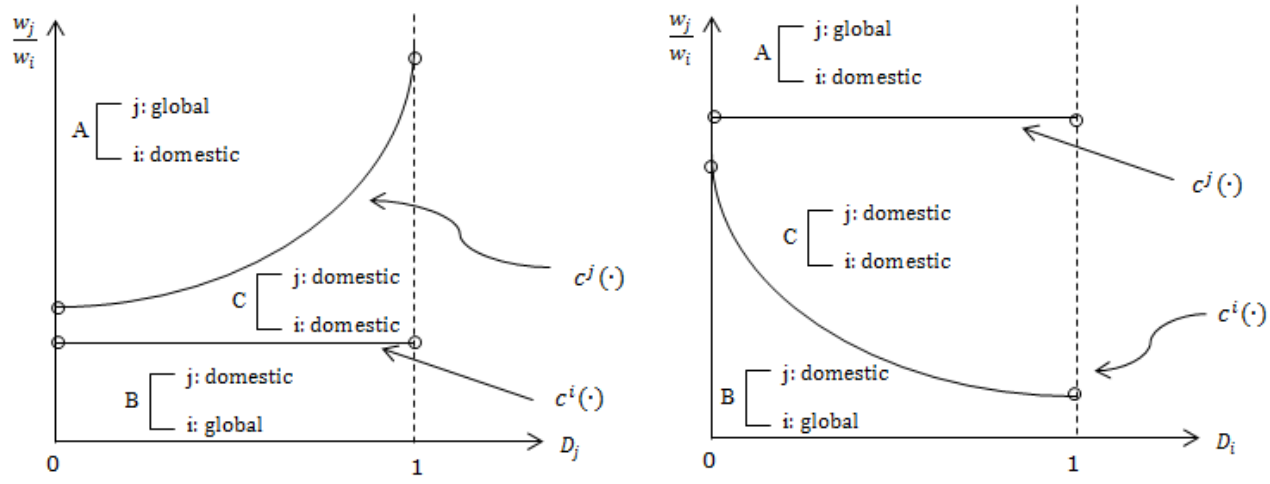
The ratios of the total trade flows for the intermediate input and final good and the ratios of the total sales and welfare are calculated using the same methodologies described in Section 2.4.1.2. Then, $\frac{M_{jj}}{M_{ii}}, \frac{Y_{ij}}{Y_{ii}}, \frac{Y_j}{Y_i}$, and $\frac{U_j}{U_i}$ are all simplified as $\frac{w_j}{w_i}\frac{L_j}{L_i}$. Thus, the effects of domestic arbitration regimes on these ratios are the same as their effects on $\frac{w_j}{w_i}$.

Thus, in the case where the FGPs in i and j choose domestic sourcing, $\frac{\partial\left(\frac{M_{jj}}{M_{ii}}\right)}{\partial D_j} > 0$, $\frac{\partial\left(\frac{Y_{ij}}{Y_{ii}}\right)}{\partial D_j} > 0$, $\frac{\partial\left(\frac{Y_j}{Y_i}\right)}{\partial D_j} > 0$, and $\frac{\partial\left(\frac{U_j}{U_i}\right)}{\partial D_j} > 0$. Additionally, $\frac{\partial^2\left(\frac{M_{jj}}{M_{ii}}\right)}{\partial D_j \partial\theta} > 0$, $\frac{\partial^2\left(\frac{Y_{ij}}{Y_{ii}}\right)}{\partial D_j \partial\theta} > 0$, $\frac{\partial^2\left(\frac{Y_j}{Y_i}\right)}{\partial D_j \partial\theta} > 0$, and $\frac{\partial^2\left(\frac{U_j}{U_i}\right)}{\partial D_j \partial\theta} > 0$. The direction of each individual response according to a rise in D_i and the direction of each differential effect of D_i across θ are the opposite. Lastly, $\frac{\partial\left(\frac{M_{jj}}{M_{ii}}\right)}{\partial\theta} > 0$, $\frac{\partial\left(\frac{Y_{ij}}{Y_{ii}}\right)}{\partial\theta} > 0$, $\frac{\partial\left(\frac{Y_j}{Y_i}\right)}{\partial\theta} > 0$, and $\frac{\partial\left(\frac{U_j}{U_i}\right)}{\partial\theta} > 0$ if $D_i < D_j$. The opposite responses exist if $D_i > D_j$.

A.2 Choice of Sourcing Mode in Terms of the Quality of Domestic Commercial Arbitration Regimes

Figure A.1: Choice of Sourcing Mode

(a) Regarding D_j (b) Regarding D_i



In this Appendix, I discuss how the sourcing mode choice responds to changes in the quality of domestic commercial regimes.

Beginning with sub-figure (a) in Figure A.1, the cutoff function for j's FGP, $c^j(\cdot)$, is upward-sloping and convex on D_j, implying that for j's FGP to choose global sourcing, i's labor needs to be relatively cheaper as the cost of domestic sourcing falls with D_j. When the wage ratio, $\frac{w_j}{w_i}$, is above the cutoff function of $c^j(\cdot)$, represented by region A, the FGPs of j and i choose global and domestic sourcing, respectively. The cutoff function for i's FGP, $c^i(\cdot)$, is the horizontal line over D_j since D_j does not affect the choice of i's FGP between domestic and global sourcing. When the wage ratio is low enough so that it is below $c^i(\cdot)$, indicated by region B, j's FGP chooses domestic sourcing and i's FGP chooses global sourcing over the whole range of D_j. In region C between the two cutoff functions, all FGPs choose domestic sourcing. Note that the cutoff function of $c^j(\cdot)$ exists above $c^i(\cdot)$ at each level of D_j. If $c^i(\cdot)$ is above the minimum value of the wage ratio on the $c^j(\cdot)$ within a certain subset of D_j, there will be a region where both countries' FGPs choose global

sourcing, contradicting Proposition 1.

In region A, the equilibrium wage ratio in equation (2.18) does not rely on D_j since j's FGP chooses global sourcing. Thus, only partial equilibrium effects happen as D_j approaches $c^j(\cdot)$. That is, as D_j rises given a fixed level of the wage ratio, j's FGP is more likely to change her sourcing mode from global sourcing in region A to domestic sourcing in region C. Once j's FGP enters region C, the wage ratio increases with D_j, as shown in Appendix A.1. Therefore, as D_j rises in the neighborhood of $c^j(\cdot)$ in region C, it is possible for j's FGP to change her sourcing mode from domestic sourcing to global sourcing in region A. However, as D_j further rises, j's FGP can go back to domestic sourcing in region C through the partial equilibrium effect. This implies that the effect of D_j on the firms' choices in the neighborhood of $c^j(\cdot)$ is ambiguous. In the majority of areas in region C, the choices of firms are not flipped. In region B, the wage ratio rises with D_j according to the comparative statics result in Section 2.4.1.1, and hence the choice of i's FGP is more likely to change from global sourcing to domestic sourcing in region C, while j's FGP still chooses domestic sourcing. Taken together, as D_j rises, the firms tend to choose domestic sourcing through partial and general equilibrium effects.

Next, consider the choice of sourcing mode with respect to D_i. As shown in sub-figure (b) in Figure A.1, $c^i(\cdot)$ is downward-sloping and convex on D_i, implying that for i's FGP to choose global sourcing, the wage level of i relative to j should increase with D_i as the cost of domestic sourcing falls as D_i rises. When the wage ratio is below $c^i(\cdot)$, i's FGP chooses global sourcing, and j's FGP chooses domestic sourcing. The cutoff function for j's FGP, $c^j(\cdot)$, is horizontal over D_i because D_i does not come into play in the choice of sourcing mode by j's FGP. When the relative wage is high enough to be above the $c^j(\cdot)$ function, j's FGP chooses global sourcing, and i's FGP chooses domestic sourcing, regardless of what value D_i has. In region C, which is between two cutoff curves, domestic sourcing is pervasive. Note that if there is an area, in which $c^j(\cdot)$ is below $c^i(\cdot)$, both countries' FGPs will choose global sourcing in this area, contradicting Proposition 1.

In region A, the wage ratio decreases with D_i, so the choice of sourcing mode by j's FGP is more likely to change from global sourcing to domestic sourcing. In region B, the wage ratio is

independent of D_i, causing only partial equilibrium effects to occur. That is, as D_i increases at the fixed level of the wage ratio in this region, the choice of i's FGP is more likely to be flipped from global sourcing to domestic sourcing. In region C, the increase in D_i leads the wage ratio to fall through the general equilibrium effects, and hence the FGP can switch to global sourcing in region B. However, through the partial equilibrium effects, i's FGP can return to domestic sourcing as D_i further increases. This process makes the firms' choices in the neighborhood of $c^i(\cdot)$ ambiguous. Therefore, as in the firms' choices with regard to D_j in sub-figure (a), domestic sourcing is more likely to be a dominant choice of the firms as D_i rises.

A.3 AMD Survey Questions

Table A.1: Selected Questions

Question	DA or IA	Scoring
A. Enforcement Frame		
1. Does your national law recognize arbitration as a means of dispute resolution between private parties in commercial transactions?	DA/IA	Yes = 1, No or N/A = 0
2. Has your country enacted a specific statute on commercial arbitration?	DA/IA	Yes = 1, No or N/A = 0
3. Are the following types of disputes arbitrable under your countrys national law? (a) Disputes involving rights over immoveable property located within your country (b) Any intra-company disputes (c) Disputes involving shareholder arrangements (d) Disputes involving patents/trade marks (excluding administrative actions)	DA/IA	Sum of the following scores: (a) Yes = 0.25, No orN/A = 0 (b) Yes = 0.25, No or N/A = 0 (c) Yes = 0.25, No or N/A = 0 (d) Yes = 0.25, No or N/A = 0
4. Under your national law, is an arbitration agreement severable from the main contract? In other words, if one party alleges that the main contract is invalid, may the arbitration agreement included in that contract nevertheless be deemed valid?	DA/IA	Yes = 1, No or N/A = 0
5. Can an arbitration agreement be incorporated by reference (when the arbitration agreement is set out in a separate document that is referred to in the main agreement)?	DA/IA	Yes = 1, No or N/A = 0
6. Can the following method of concluding an agreement constitute a binding arbitration agreement? (a) by electronic communication, including email (b) by fax (c) by oral agreement (d) by conduct	DA/IA	Sum of the following scores: (a) Yes = 0.25, No or N/A = 0 (b) Yes = 0.25, No or N/A = 0 (c) Yes = 0.25, No or N/A = 0 (d) Yes = 0.25, No or N/A = 0
7. Have the courts in your country stated a pro-arbitration policy, i.e., a general policy in favor of enforcing arbitration agreements and arbitration awards, in applying your national law of arbitration in domestic/international arbitrations taking place in your country?	DA/IA	Yes = 1, No or N/A = 0
8. Does your national law expressly provide that all arbitrators must be independent and impartial in a domestic arbitration?	DA	Yes = 1, No or N/A = 0
9. Does your national law provide for your courts to assist the arbitrators or parties by granting interim relief to prevent immediate and irreparable injury while the arbitration is pending or before the arbitration has commenced in domestic arbitrations taking place in your country?	DA	Yes = 1, No or N/A = 0
10. Under your national law, are the state and state entities allowed to enter into arbitration with foreign owned companies in connection with the following? (a) Concession agreements (b) Infrastructure contracts (c) Contracts dealing with natural resources	IA	Sum of the following scores: (a) Yes = 0.33, No or N/A = 0 (b) Yes = 0.33, No or N/A = 0 (c) Yes = 0.33, No or N/A = 0
11. Does your national law expressly provide that all arbitrators must be independent and impartial in an international arbitration?	IA	Yes = 1, No or N/A = 0
12. Does your national law provide for your courts to assist the arbitrators or parties by granting interim relief to prevent immediate and irreparable injury while the arbitration is pending or before the arbitration has commenced in international arbitrations taking place in your country?	IA	Yes = 1, No or N/A = 0

Question	DA or IA	Scoring
B. The Enforcement Regime		
13. If the parties have expressly agreed (i.e., in writing) that the arbitration tribunal can rule on its own jurisdiction, will that be upheld by your national courts?	DA/IA	Yes = 1, No or N/A = 0
14. May a judgment of that court enforcing the award be appealed to a higher court or courts?	DA/IA	No = 1, Yes or N/A = 0
15. Under your national law, can a domestic award rendered in favor of a local company be denied confirmation or enforcement, or be set aside, annulled, or vacated by a court in your country on the following grounds? (a) Invalidity of the underlying arbitration agreement or lack of capacity of a party (b) Lack of a fair hearing (c) Award deals with matters outside the scope of the arbitraton agreement (d) Arbitration procedures not in accordance with the parties' s agreement or the governing arbitration law (e) Subject matter of the dispute not subject to arbitration (f) Enforcement of the award would be contrary to country's public policy (g) Error of law (h) Award not supported by substantial evidence	DA/IA	Sum of the following scores: (a) No = 0.125, Yes or N/A = 0 (b) No = 0.125, Yes or N/A = 0 (c) No = 0.125, Yes or N/A = 0 (d) No = 0.125, Yes or N/A = 0 (e) No = 0.125, Yes or N/A = 0 (f) No = 0.125, Yes or N/A = 0 (g) No = 0.125, Yes or N/A = 0 (h) No = 0.125, Yes or N/A = 0
16. In arbitrations involving a state or state entity, can your court(s) review the arbitration award on its merits in connection with recognition and enforcement proceedings?	DA/IA	No = 1, Yes or N/A = 0
17. Has your country ratified the following Conventions? (a) The New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards (b) The ICSID Convention	IA	Sum of the following scores: (a) Yes = 0.5, No or N/A = 0 (b) Yes = 0.5, No or N/A = 0
18. Under your national law, may a foreign arbitral award be denied recognition or enforcement by a court in your country on the following grounds? (a) Invalidity of the underlying arbitration agreement or lack of capacity of a party (b) Lack of a fair hearing (c) Award deals with matters outside the scope of the arbitraton agreement (d) Arbitration procedures not in accordance with the parties' agreement or the governing arbitration law (e) Subject matter of the dispute not subject to arbitration (f) Enforcement of the award would be contrary to country's public policy (g) Error of law (h) Award not supported by substantial evidence	IA	Sum of the following scores: (a) No = 0.125, Yes or N/A = 0 (b) No = 0.125, Yes or N/A = 0 (c) No = 0.125, Yes or N/A = 0 (d) No = 0.125, Yes or N/A = 0 (e) No = 0.125, Yes or N/A = 0 (f) No = 0.125, Yes or N/A = 0 (g) No = 0.125, Yes or N/A = 0 (h) No = 0.125, Yes or N/A = 0
19. May a judgment of that court enforcing or denying enforcement of the foreign award be appealed to a higher court?	IA	No = 1, Yes or N/A = 0
C. The Efficiency of Enforcement		
20. Are there any arbitration institutions administering commercial arbitrations in your country?	DA/IA	Yes = 1, No or N/A = 0
21. Is there a public authority designated to handle administrative, logistical and other issues related to investors disputes with the state or a state entity (e.g., specific agency, office of the Prime Minister, etc.)?	DA/IA	Yes = 1, No or N/A = 0
22. If an immediate need can be shown, how often do courts grant interim relief requests for assistance?	DA/IA	In nearly all cases = 1, Usually = 0.5, Rarely or N/A = 0
23. How long, typically, would you estimate the period to be from the filing of the request for arbitration to the constitution of the arbitration tribunal in a domestic arbitration?	DA	Under 30 days = 1, 31-180 days = 0.66, 181-1 year = 0.33, Over 1 year or N/A = 0

Question	DA or IA	Scoring
24. How long, typically, would you estimate the period to be from the first hearing of the arbitration tribunal to the rendering of the arbitration award in a domestic arbitration in your country?	DA	Under 30 days = 1, 31-180 days = 0.66, 181-1 year = 0.33, Over 1 year or N/A = 0
25. If a party brings an action in a court of your country with respect to a dispute that the parties have agreed should be arbitrated, how frequently would the courts in your country decline to hear the case and refer the parties to arbitration in domestic arbitrations taking place in your country?	DA	In nearly all cases = 1, Usually = 0.5, Rarely or N/A = 0
26. How long, typically, would you estimate the period to be from the filing of the request for arbitration to the constitution of the arbitration tribunal in an international arbitration?	IA	Under 30 days = 1, 31-180 days = 0.66, 181-1 year = 0.33, Over 1 year or N/A = 0
27. How long, typically, would you estimate the period to be from the first hearing of the arbitration tribunal to the rendering of the arbitration award in an international arbitration in your country?	IA	Under 30 days = 1, 31-180 days = 0.66, 181-1 year = 0.33, Over 1 year or N/A = 0
28. If a party brings an action in a court of your country with respect to a dispute that the parties have agreed should be arbitrated, how frequently would the courts decline to hear the case and refer the parties to arbitration in international arbitrations taking place in your country?	IA	In nearly all cases = 1, Usually = 0.5, Rarely or N/A = 0
29. What is the likelihood that your courts would enforce a foreign arbitral award if no objection to agreement were filed?	IA	In nearly all cases = 1, Usually = 0.5, Rarely or N/A = 0

A.4 Data and Measure

A.4.1 Formal Institutions, Rule of Law, and Informal Institutions

Formal institutions are measured using the Polity IV dataset, developed by Marshall et al. (2014), covering 167 countries during the time span of 1800–2013. I use the variable of the executive constraints, which refers to "the extent of institutionalized constraints on the decision making powers of chief executives, whether individuals or collectivities." For this analysis, the values of this variable that ranges from 1 to 7 are averaged from 2005 to 2010. When an executive's behavior is well-constrained by formal institutions, extortion by government can occur less, and property rights can be more protected. Thus, as this measure is higher, the enforcement of a contract between traders is expected to be strengthened.

The rule of law index, ranging from -2.5 to 2.5, was constructed by Kaufman et al. (2010). It captures the degree to which agents have confidence in the rule of their society, including contract enforcement and property rights. To employ this index for estimation, I average each country's indices from 2005–2010. I also add 2.5 to the original measure so that the index ranges from 0 to 5, allowing for converting it into natural logarithm form.

Informal institutions are captured by culture following Williamson (2009) and Williamson and Kerekes (2011), since culture, formed over generations, constrains individual behavior. To construct the measure for culture, I consider three aspects: trust, control, and obedience.[1]

A higher trust in others, a stronger belief in controlling the direction of life, and a lower obedience can contribute to the higher enforcement of a contract. When people trust each other, the opportunism of the parties can be overcome, leading a contract to be more respected. When people feel that they have more ability to control the way life turns out, they might make more effort to reach their goals, which can make them cooperate better. Even if a trader pursues opportunism to maximize profit, individuals who engage in arbitration can take more care to resolve commercial disputes and enforce a contract. Obedience tends to be considered as a virtue in a coercive and

[1] These three aspects of culture have been considered by previous research, such as Tabellini (2010) and Williamson and Kerekes (2011).

hierarchical society (Tabellini, 2010, p. 685). In such an environment, people might not be less interested in innovation and pursuing economic profit, which can lead them to be more passive in cooperating.

These three aspects are measured using the 2005–2009 World Value Survey (WVS) and the 2005-2008 European Value Survey (EVS).[2] First, trust is measured using the following question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" Then, the measure for trust is calculated as the number of respondents who answered "Most people can be trusted" divided by the sum of the respondents who answered "Most people can be trusted" and "Can't be too careful." Secondly, control is measured based on the following question: "Some people feel they have completely free choice and control over their lives, while other people feel that what we do has no real effect on what happens to them. Please use this scale where 1 means 'none at all' and 10 means 'a great deal' to indicate how much freedom of choice and control you feel you have over the way your life turns out." The measure for control is the average of the answers of respondents divided by 10. Lastly, obedience is measured using the following question: "Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important?" Then, obedience is measured as the share of the number of the respondents who chose "obedience" out of the number respondents. Other options are independence, hard work, feeling of responsibility, imagination, tolerance and respect for other people, thrift saving money and things, determination and perseverance, religious faith, and unselfishness.

The comprehensive measure for informal institutions is constructed by the sum of trust, control, and '1 less obedience.' Thus, a higher level of this measure is expected to lead to stronger contract enforcement.

[2] The following selected questions have been used by many researchers, e.g., see Tabellini (2010).

A.4.2 Other Variables

The 2010 wage data come from the ILO Global Wage Database underlying the ILO (2015) Global Wage Report 2014/15, which were downloaded at http://www.ilo.org/travail/info/db/lang–en/index.htm. I use the wage data that were calculated by the average nominal monthly earnings expressed in local currency based on all employees regardless of hours worked. The nominal values are converted into US dollars by market exchange rates that were used by Timmer et al. (2015) to construct the WIOD. The exchange rates were obtained at http://www.wiod.org. The 2010 data on population (in millions) and output-side real GDP are from the Penn World Table (PWT) 8.1 constructed by Feenstra et al. (2015). The GDP is adjusted at the current PPP. The 2010 data on the index of human capital per person also come from the PWT 8.1. Specifically, the human capital index is calculated as $e^{\phi(s_{it})}$, where s_{it} is the average years of schooling for the population aged 15 and older from Barro and Lee (2013b). The function $\phi(s)$ was chosen based on Psacharopoulos (1994). The fixed cost that captures innovation cost is measured by the 2010 capital expenditure share for R&D out of GDP, which is from the World Bank's World Development Indicators (WDI). Data on the landlocked status are from the CEPII's GeoDist database, constructed by Mayer and Zignago (2011). The measure for financial development is the 2008 private credit by financial intermediaries scaled by GDP following Beck (2003). This measure exists as a variable of "private credit by deposit money banks and other financial institutions to GDP" in the Financial Development and Structure Dataset constructed by Beck et al. (2000, 2009) and Cihak et al. (2012).

Appendix B

The Interrelation between Formal and Informal Institutions through International Trade

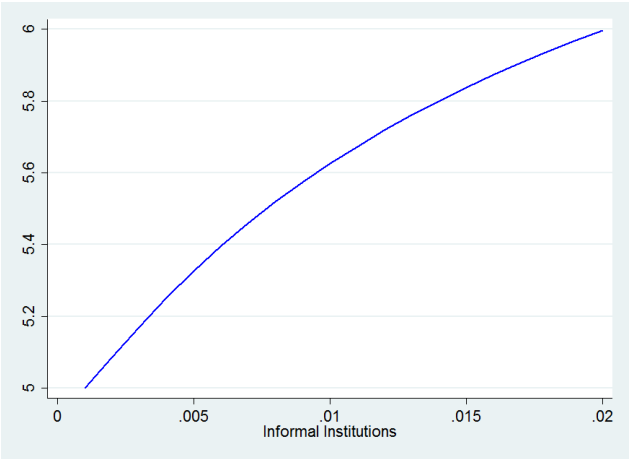
B.1 Equilibrium Markup Rate and the Number of Firms

Under autarky, the markup rate of a firm, η, decreases with I. This result's implication can be derived by using the pricing equation (3.13). When the equality holds, the pricing equation is written as follows: $(1-\eta) = \frac{w(1+t)}{\alpha P_x}$, which implies that $d\,ln(1-\eta) = d\,ln\,w(1+t) - d\,ln\,\alpha - d\,ln\,P_x$. Since F rises with I, so does α. Combining this rising α with the fact that $w(1+t)$ decreases with I, $d\,ln\,w(1+t) - d\,ln\,\alpha$ is less than 0. Thus, to make $d\,ln\,(1-\eta)$ positive, i.e., to make η decrease with I, P_x should drop more than the absolute value of $d\,ln\,w(1+t) - d\,ln\,\alpha$. In fact, the price of good X falls more under autarky than open economies, even with the lower supply of X. Intuitively, exports to another country that demands good X prevents its price from falling extremely, even with the higher supply of good X from specialization. Finally, the decreasing markup implies an increasing number of firms, as shown in sub-figure (a) of Figure B.1. This comes from the fact that the markup rate is exactly market share under the Cournot competition; under autarky, the market share is 1 over the number of firms for the X sector.

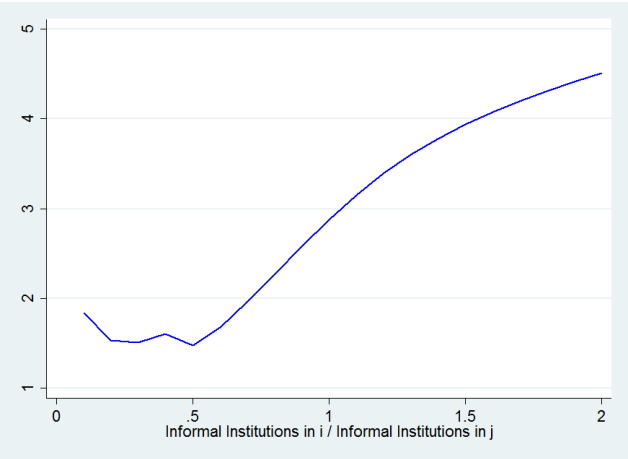
Under open economies, the optimal markup rates of country i's firm for domestic sales follow a U-shape curve over $\frac{I_i}{I_j}$. The pricing equation (3.13) regarding domestic sales implies that $d\,ln(1-\eta_{ii}) = d\,ln\,w_i(1+t_i) - d\,ln\,P_{ix} - d\,ln\,\alpha_i$. Given that $d\,ln\,w_i(1+t_i)$ and $d\,ln\,\alpha_i$ are positive and $d\,ln\,P_{ix}$ is negative, the balance of the first two terms and the last term determine the sign of $d\,ln\,(1-\eta_{ii})$. In fact, $w_i(1+t_i)$ and α_i increase at a fairly constant rate. However, the rate of the falling P_{ix}

Figure B.1: The number of firms in the X sector

(a) Under autarky



(b) Under open economies



diminishes with $\frac{I_i}{I_j}$. This is because, while the degree to which country i specializes in good X rises, the considerably increasing exports prevents the price from falling extremely. Therefore, in the first part, the drastically falling price leads to a positive $d\,ln\,(1-\eta_{ii})$, i.e., decreasing η_{ii}. However, as $\frac{I_i}{I_j}$ further increases, the effect on price is weakened, resulting in a negative $d\,ln\,(1-\eta_{ii})$, i.e., increasing η_{ii}.

The optimal markup rates for country i's firm in j, η_{ij}, as a function of $\frac{I_i}{I_j}$, is overall increasing with $\frac{I_i}{I_j}$ and is concave-down. The pricing equation (3.14) implies that $d\,ln\,(1-\eta_{ij}) = d\,ln\,w_i(1+t_i) - d\,ln\,P_{jx} + d\,ln\,(\frac{1}{\alpha_i}+\delta)$, holding τ fixed. Since P_{jx} falls with $\frac{I_i}{I_j}$, the first two terms in the right hand side are positive. Additionally, since both $\frac{1}{\alpha_i}$ and δ decrease with $\frac{I_i}{I_j}$, $d\,ln\,(\frac{1}{\alpha_i}+\delta)$ is negative. Thus, the increasing pattern of η_{ij}, i.e., decreasing (1-η_{ij}), implies that the fall in $(\frac{1}{\alpha_i}+\delta)$ dominates the other two forces that increase (1-η_{ij}). In other words, the fall in the unit cost of X and the trade cost related to institutional quality dominate the increase in the price of labor paid by the producer and the fall in the price of good X in j.

Finally, the number of firms in the X sector in country i increases with $\frac{I_i}{I_j}$, as shown in sub-figure (b) of Figure B.1. η_{ij} is calculated by $\frac{\text{aggregate}\,X_{ij}/n_i}{\text{aggregate}\,X_{ij}+\text{aggregate}\,X_{jj}}$. Given the increasing η_{ij} with $\frac{I_i}{I_j}$, the rising n_i implies that the substantial drop in aggregate X_{jj} allows for arising more

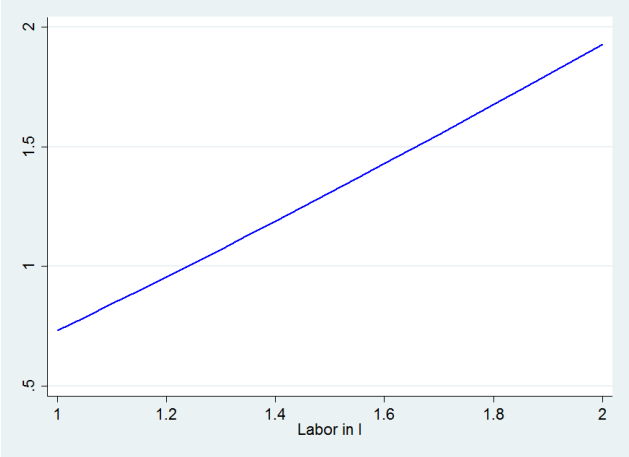
firms in i. Note that in the very first part of this figure, n_i shows a decreasing pattern while X_{ij} is zero.

Comparing the growth rate of N_i between autarky and open economies, N_i shows a much higher growth rate under open economies. Over the whole range of I_i from 0.001 to 0.02, it increases by 145.4% under open economies, while it only increases by 19.9% under autarky.

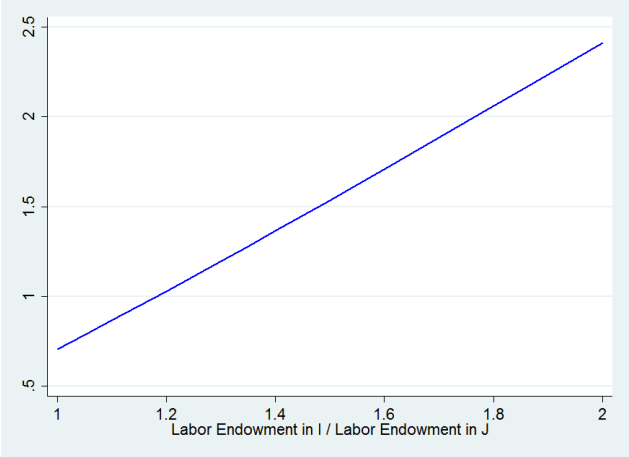
B.2 Changes in Labor Endowment

Figure B.2: Responses of F_i to the changes in L_i

(a) F_i under autarky



(b) F_i under open economies



I additionally present how F_i responds to the changes in L_i over the range of 1, 1.05,...,2. Specifically, under open economies, I hold L_j fixed as 1, and I_i and I_j fixed as 0.001. Other parameters stay the same, as in Section 3.4.

As shown in sub-figure (a) in Figure B.2, F_i rises with L_i under autarky, which contrasts with the decreasing pattern of F_i with I_i under autarky. This is explained by the lack of the substitution effect, as no I_i varies. That is, only the scale effect, which provides an increasing force of F_i, exists as L_i rises; in the presence of increasing returns technology for the production of X, the rise in L_i boosts the marginal productivity of F_i in X. In open economies, this increasing tendency is rather strengthened by comparative advantage effect, as shown in sub-figure (b); the richer endowment of labor causes country i to have a comparative advantage in X, which is the labor intensive good. Nonetheless, this effect does not lead to a drastic change in F_i, in that there is no direct effect in boosting productivity. That is, α_i is only indirectly increased by the rise in F_i through the comparative advantage effect in the presence of the scale effect.

Appendix C

The Causal Effect of Institutional Comparative Advantage on the Quality of Institutions

C.1 Mapping between the I-O Classification and 4-digit SITC Rev.2

C.1.1 Baseline Methodology

I use the Bureau of Economic Analysis (BEA)'s concordance between 10-digit Harmonized System (HS10) and I-O classification and the concordance between HS10 and SITC revision 2 given by Feenstra (1996). The mapping is constructed through the following steps: I truncate the 5-digit SITC in Feenstra's concordance, which maps the HS10 to the 5-digit SITC, to the 4-digit SITC. This truncated 4-digit SITC codes are linked with I-O codes by the concordance between the 1997 I-O classification and HS10, as given by BEA. Since each HS10 code has a corresponding I-O and SITC code by these two concordances, I can count the number of HS10 codes that are matched to each I-O code. When one or more I-O codes are mapped to the one SITC category, I choose one I-O code that contains the highest number of HS categories.

C.1.2 Additional Mapping for Robustness Checks

The methodology for the robustness checks is based on the mapping across HS10, SITC, and I-O codes, which is presented in the previous Appendix C.1.1. In this mapping, each HS10 is matched to a SITC and I-O code, allowing for counting the number of HS10 for each I-O code. To deal with the issue that two or more I-O levels are matched to a SITC code, I first calculate the portion of each number of HS10, corresponding to each I-O code, out of the total number of

HS10 within a SITC code. Then each Nunn's contract intensity in an I-O code is multiplied by its corresponding portion. To get a institutional intensity measure for each SITC, I add up these weighted contract intensities.

C.2 Country List

Albania	Egypt	Lao P.Dem.R	Senegal
Argentina	El Salvador	Latvia	Sierra Leone
Armenia	Estonia	Liberia	Singapore
Asia NES	Fiji	Lithuania	Slovakia
Australia	Finland	Malawi	Slovenia
Austria	Fr Ind O	Malaysia	South Africa
Bahrain	France,Monac	Mali	Spain
Bangladesh	Gabon	Mauritania	Sri Lanka
Belgium-Lux	Gambia	Mauritius	Sudan
Benin	Germany	Mexico	Sweden
Bolivia	Ghana	Mongolia	Switz.Liecht
Brazil	Greece	Morocco	Syria
Bulgaria	Guatemala	Mozambique	Tajikistan
Burundi	Honduras	Nepal	Tanzania
Cambodia	Hungary	Netherlands	Thailand
Cameroon	India	New Zealand	Togo
Canada	Indonesia	Niger	Trinidad Tbg
Cent.Afr.Rep	Iran	Norway	Tunisia
Chile	Iraq	Pakistan	Turkey
China	Ireland	Panama	UK
Colombia	Israel	Paraguay	USA
Congo	Italy	Peru	Uganda
Costa Rica	Jamaica	Philippines	Ukraine
Croatia	Japan	Poland	Uruguay
Cyprus	Jordan	Portugal	Venezuela
Czech Rep	Kazakhstan	Qatar	Viet Nam
Dem.Rp.Congo	Kenya	Rep Moldova	Yemen
Denmark	Korea Rep.	Romania	Zambia
Dominican Rp	Kuwait	Russian Fed	Zimbabwe
Ecuador	Kyrgyzstan	Saudi Arabia	

Notes: These 119 countries are employed in the baseline OLS and IV estimation in columns (1) and (2) in Table 4.7.