Market Size and Institutions in a Global Economy[*]

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Abstract

This paper studies the relationship between market size and institutional quality in a global economy. First, we empirically show that a larger effective market size facing the firms in a country leads to higher quality of contracting institutions. Second, we propose a theory of market size and institutions by embedding an incomplete contract model into a general-equilibrium trade environment where national planners optimize their countries' welfare by choosing institutional qualities. Under different types of equilibria, our theory matches the empirical fact that larger real market access leads to higher institutional quality. It also discusses the direction of the scale effect of population, discovers a trade diversion effect on institutional quality when only a subset of countries trade-liberalize, and generates a flying-geese pattern of institutional improvement.

JEL codes: E02, O11, O43, F12, F14

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1 Introduction

Focusing on the Eurasia continent's interconnectedness and conducive geographic environment for early agricultural development, Diamond (1997) explains why it was the Europeans who conquered the New World rather than the other way around. His theory is sometimes interpreted as geographical determinism for explaining human development, but Acemoglu and Robinson (2012) argue that institutions play a more decisive role in explaining the differences in economic development. For example, the geographic theory of Diamond (1997) does not explain the drastic difference in economic development between North and South Koreas.

This paper aims to approach the general question of institution and economic development in a way different from the two above-mentioned theories and yet with a geographic perspective. We ask: what is the role of market size in a global economy in determining a country's institution? By market size, we mean the access of a country's firms to the global market, and one impediment to market access is trade barriers with other countries. Trade barriers can be broadly interpreted beyond tariffs and transport costs, as political relations also matter.

Anecdotal evidence of this is the post-war phenomenal growth of South Korea and Taiwan, both of which have been politically very close to the US and Japan since the Cold War era. After World War II and before the rise of Mainland China, the US had been the largest export destination for Japan, South Korea, and Taiwan. In other words, the market access to the US (and Europe in general) may have substantially contributed to the growth of these three East Asian economies. One can dissect these growth phenomena further as Japan's post-war rapid growth started earlier than South Korea and Taiwan's, which, in turn, started earlier than Mainland China's and Southeast Asian countries (except Singapore's). The market access to Japan may have also substantially contributed to the growth of South Korea and Taiwan. It is thus natural to conjecture that there is a flying geese pattern of economic development. Clearly, these countries improve their economic institutions (not necessarily in terms of political institutions) along the way (Acemoglu and Robinson, 2012). So, our more specific question is: does market access lead to improvement in institutional quality? [1]

This paper does two things. First, using a comprehensive and time-consistent dataset of institutional qualities (International Country Risk Guide; hereafter ICRG), we conduct an empirical analysis to examine whether there is any relationship between market access and institutional quality. For institutional quality, we focus on contracting institutions based on the following intuition. If a country has a larger effective market size accessible to its firms, the government may deem it more beneficial to reform the contractual environment. This is because a well-functioning contracting institution is vital for facilitating business dealings among diverse firms and between producers and their input suppliers, thereby improving aggregate productivity and amplifying the benefits of the larger effective market size. Second, this paper develops a theory to formalize these intuitions and explore the implications of the theory.

Our empirical analysis starts with constructing a measure of real market access using the framework of structural gravity equations (Anderson and Van Wincoop, 2003). The advantages of using this framework are two-fold: (1) the market access so constructed encompasses each market/country's purchasing power, discounted by broadly defined trade frictions; (2) it is consistent with a large set of general equilibrium trade models, including our theoretical model. We look at "real" market access because price indices differ across countries in this framework, for which trade frictions are properly accounted. For the quality of contracting institutions, we use ICRG Law and Order for the baseline regressions and the WGI Rule of Law for robustness checks. Our data period is from 1984 to 2010,

[1] Another important piece of evidence is the Atlantic trade, as shown by Acemoglu et al. (2005). Even though they emphasize the role of the differential medieval institutions among Atlantic traders (England and the Netherlands vs. France, Portugal, and Spain) in their subsequent institutional reforms, the rise of Atlantic trade due to the breakthrough in navigation is the precondition for these institutional reforms. Namely, when the economic benefits of institutional reforms were higher for Atlantic traders than for the rest of Europe, the reforms were more likely to occur there. The fact that non-Atlantic-trader European nations also made their reforms much earlier than the rest of the world may also be due to the growing neighboring markets, in addition to competition and the spread of knowledge.

and we run panel regressions to control for time-invariant country characteristics. To address endogeneity issues, we instrument real market access by the interaction between the geographic centrality of the country and the improvement in transport technology.

In both the OLS and 2SLS results, we find highly significant effects of real market access on institutional quality. We also conduct robustness checks on alternative instruments, alternative measures of real market access, and an alternative measure of institutional quality, and the results remain robust.

We develop a theory to explain how real market access leads to a higher quality in contracting institutions. The theory consists of two steps. The first step is to incorporate an incomplete contract model following Acemoglu et al. (2007) into an international trade environment *á la* Krugman (1980), which belongs to the structural gravity framework.[2] The production process is modeled as two layers of production, the first being differentiated-product firms and the second being the input suppliers to these firms. The inputs for each differentiated product are specialized, and thus there is a relationship specificity between each firm and each supplier. If various contingencies are not well specified in the contract between a firm and its suppliers and if the contracting institutional quality is inadequate, then a hold-up problem arises (Grossman and Hart, 1986). The hold-up problem makes suppliers under-invest in non-contractible activities relative to the efficient levels and thus depress their supply to the firms, resulting in a lower overall productive efficiency. Improvement in institutional quality leads to improvement in overall productive efficiency.

It is important to note that in a closed economy, real market access is the same as the country's real income; thus, real market access does not play a separate role from institutional quality in determining a country's real income. In contrast, in the open economy, real market access differs from a country's real income, which is shown to be jointly determined by institutional quality and real market access in a complementary way.

[2]Relative to Acemoglu et al. (2007), our model simplifies as we are not concerned with technology adoption, but it adds the market size dimension because their incomplete-contract model is now embedded in a full-fledged general-equilibrium trade framework. In this step, institutional quality is taken as given.

The second step is to model a national planner's choice of institutional quality. For simplicity, we assume that national planners are benevolent and seek to maximize their national welfare net of institution building and maintenance costs. We analyze three types of solutions. First, we examine a competitive equilibrium in which the government takes aggregate variables such as price index and market access as given. We show that real market access leads to higher institutional quality when population size is fixed. Second, we examine Nash equilibrium, in which the government considers the impact of institutional quality on its own real market access. The analysis becomes considerably more difficult, but we are able to provide a definite statement on the positive causal relationship between real market access and institutional quality in the case of symmetric countries. Numerical analyses verify that the main prediction withholds in the case of asymmetric countries. Third, we examine a global planner's solution and highlight the institutional externality effect. Such effects exist because a country's improvement in institutional quality leads to an increase in the size of its home market, which is a component of other countries' real market access. We find that institutional quality is the highest in the global planner's solution, followed by the Nash equilibrium and then the competitive equilibrium.

Three additional theoretical findings are worth highlighting. The first concerns the *scale effect of population size*. As this paper argues that larger real market access leads to institutional improvement, our theory features a scale effect of population because a larger population increases real market access. However, we also assume that the costs of building/maintaining institutions increase in population because a larger population usually involves a larger geographic space and more diverse ethnic/religious groups. Therefore, the scale effect of population size depends on the relative strength of the marginal benefits through real market access and the marginal cost through institutional costs.

The second is a *trade diversion effect* on institutional quality. Under the Nash equilibrium and when some but not all countries liberalize their trade relations, those whose bilateral trade costs are reduced increase their institutional qualities, while those whose trade costs remain unchanged choose lower institutional qualities. This is mainly due to trade diversion, which causes the real market access for non-trade-liberalized countries to shrink.

Motivated by the anecdotal evidence described in the opening paragraphs, the third is to show that our model generates a *flying geese pattern of institutional improvement* through continuous enhancement of transport technology in a world geography featuring central and periphery locations. When transport costs decline over time, the first country to implement institutional reform is the central one that enjoys the largest real market access, followed by the slightly less central ones and eventually the peripheral countries. The later reformers' real market access is enlarged not only because of the declining transport costs but also because of the earlier reformers' improved institutional qualities, which increases all countries' real market access.[3]

The literature on the relations between institutions and economic development is extensive. Whereas a substantial portion of the literature focuses on the effect of institutions on economic development, e.g., Acemoglu et al. (2007), Levchenko (2007), Beverelli et al. (2018), and Chor and Ma (2021), several studies have also examined the reverse relationship, such as Acemoglu et al. (2005), Levchenko (2012), Puga and Trefler (2014), Mukoyama and Popov (2015), and Jiao and Wei (2022).

Puga and Trefler (2014) documents the relationship between long-distance trade and the modern innovations in contracting institutions in medieval Venice, as well as the later retreat from an open and inclusive regime toward political closure and social stratification. This paper is similar to Acemoglu et al. (2005) in terms of the role of trade as a precondition for institutional reforms, but it has a dynamic theory that explains why the concentration of trade and wealth leads to a retreat in institutional quality. Our work differs from these papers as our empirical analysis uses modern and global data (ICRG) and examines the effects of real market access on contracting institutions. Our theory also differs from Puga and Trefler (2014) because we focus on the role of market size and increasing returns,

[3] For a "flying geese pattern of development", see Akamatsu (1962) who coined and popularized this term. Note, however, that the theoretical underpinnings of Akamatsu (1962) is more similar to the product-cycle theory *á la* Antràs (2005), rather than the theory proposed here.

whereas theirs focuses on the dynamics of the political economy.

Levchenko (2012) presents a theory in which trade promotes institutional quality, and his mechanism relies on the competition among countries in the sector subject to the hold-up problem, which reduces the rents available. Thus, interest groups are incentivized to lobby the government to improve institutions to enhance their comparative advantages in this sector. Mukoyama and Popov (2015) study how inadequate contracting institutions may adversely affect capital accumulation in a dynamic setting and how a benevolent government that maximizes social welfare may want to improve contracting institutions. Our study differs because our mechanism focuses on the role of market size rather than comparative advantages or capital accumulation. Jiao and Wei (2022) empirically examine the effect of foreign demand shocks on the institutional quality across regions in Vietnam. Fitting their Vietnam results, their theory explains why trade openness leads to better institutions using a small-open-economy approach. Two key differences are as follows. First, we develop a direct measure of market size based on the gravity-equation framework, and the identification strategy also differs. Second, our theory is richer because we use a multi-country general equilibrium framework to highlight the role of institutional externality, which underlies the trade diversion effect and flying-geese pattern.

The rest of the paper is organized as follows. Section 2 empirically examines the effect of market size on institutional quality. Sections 3 and 4 present a theory of market size and contracting institutions. Section 5 concludes.

2 Empirical Analysis

2.1 Data and Measurement

We first explain how we measure contracting institutions and market access.

2.1.1 Institutional Quality

For institutional quality, we use the International Country Risk Guide (ICRG; Howell (2011)) as in Alesina et al. (2017) and Faccio and Zingales (2022). To focus on contracting institutions, we use Law and Order in the Political Risk Rating in the ICRG. More specifically, a strong and impartial legal system implies a contractual environment conducive to doing business.[4] The ICRG data that we use is from 1984 to 2010. A similar measure is the Rule of Law in the World Governance Indicators (WGI) by the World Bank. However, there is a time-consistency issue with the WGI data because it is a compilation of various data sources, some of which have changed methodology over time. Thus, we will use the ICRG Law and Order for the baseline estimation and the WGI Rule of Law as a robustness check.

2.1.2 Real Market Access

Market access is defined as a country's firms' accessibility to all of the markets in the global economy; it is indeed the "effective market size" from the viewpoint of the firms there. In the trade literature, market access has been used to explain wage inequality (Redding and Venables, 2004) and land value (Donaldson and Hornbeck, 2016). The measure of market access as in Redding and Venables (2004) is nominal. This works for their purpose because their model implies a positive relation between nominal wages and (nominal) market access. However, we need a measure of real market access. The rationale is that when institutional quality is a choice variable for a national planner, what the planner cares about should be real in an environment where price indices vary across countries. Indeed, in our theory presented in Sections 3 and 4.1, we show that a country's real income, which is what our national planner cares about, can be expressed as a function of real market access. To construct a measure of real market access and to be consistent with our trade model, we resort to the structural gravity models in the trade literature (Head and

[4] According to the ICRG documents, the assessment for Law and Order consists of two elements: the Law element refers to the strength and impartiality of the legal system, whereas the Order element refers to the popular observance of the law.

Mayer, 2014; Fally, 2015) as follows.

Trade flows R_{ij} between exporting country i and importing country j are given by

$$R_{ij} = \frac{R_i}{\Pi_i^{-\theta}} \tau_{ij}^{-\theta} \frac{E_j}{P_j^{-\theta}} \equiv s_i \tau_{ij}^{-\theta} d_j, \tag{1}$$

where R_i and E_j refer to country i's total output and country j's total expenditure, τ_{ij} is the trade cost between country i and country j, θ is the elasticity of trade flows to trade costs, and

$$\Pi_i^{-\theta} = \sum_j \frac{E_j \tau_{ij}^{-\theta}}{P_j^{-\theta}}, \qquad P_j^{-\theta} = \sum_i \frac{R_i \tau_{ij}^{-\theta}}{\Pi_i^{-\theta}}. \tag{2}$$

The Π_i and P_j are the outward and inward multilateral resistance, as coined in the trade literature (Anderson and Van Wincoop, 2003). In (1), $s_i \equiv \frac{R_i}{\Pi_i^{-\theta}}$ can be referred to as the supply capacity of country i, capturing factors (such as production costs and the number of exporters) that determine country i' propensity to supply exports to all partners; $d_j \equiv \frac{E_j}{P_j^{-\theta}}$ can be referred to as the demand capacity of country j, capturing factors (such as expenditure and aggregate price index) that determine country j' propensity to import from all partners. In other words, trade flows between two countries depend on three factors: the supply capacity that measures the competitiveness of the exporting country i, the demand capacity that reflects the purchasing power of the importing country j, and the trade frictions.

Following Redding and Venables (2004), each country i's market access is defined by

$$M_i \equiv \Pi_i^{-\theta} = \sum_j \tau_{ij}^{-\theta} d_j. \tag{3}$$

Namely, it is inversely related to country i's outward multilateral resistance and given by the sum of demand capacity d_j across countries, weighted by the bilateral trade openness ($\tau_{ij}^{-\theta}$). Note that the market access M_i is a nominal variable (in terms of the numeraire) to an order of $\theta + 1$. Thus, the *real market access* is obtained by deflating M_i by $P_i^{\theta+1}$.

To calculate real market access, we estimate the gravity equation (1) by the Pseudo Poison Maximum Likelihood (PPML) as in Santos Silva and Tenreyro (2006). The regression equation is specified as follows:

$$R_{ijt} \quad = \quad \exp\left(\ln s_{it} + \ln d_{jt} + \ln \tau_{ijt}^{-\theta}\right) + \epsilon_{ijt}, \tag{4}$$

where $\ln \tau_{ijt}^{-\theta} = \delta_1 ldist_{ij} + \delta_2 cont_{ij} + \delta_3 com\_lang_{ij} + \delta_4 colony_{ij} + \delta_5 WTO\_both_{ijt} + \delta_6 RTA_{ijt}$, where $ldist_{ij}$ refers to the log of great-circle distance between capital cities of countries i and j, $cont_{ij}$ takes 1 when the two countries are contiguous and 0 otherwise, com_lang_{ij} takes 1 when at least one language is spoken by more than 9% of the population in both countries and 0 otherwise, $colony_{ij}$ takes 1 if they were ever in a colonial relationship and 0 otherwise, WTO_both_{ijt} takes 1 when both belong to GATT/WTO and 0 otherwise, and RTA_{ijt} takes 1 when the two countries are in a regional trade agreement. The above-mentioned trade and geographic variables are obtained from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).

Equation (4) is estimated in the panel setting from 1984 to 2014, and $\ln s_{it}$ and $\ln d_{jt}$ are treated as time-varying exporter and importer fixed effects.[5] As our data set does not contain intranational trade flows, (4) is estimated with "international" trade flows only. To compute the intranational trade cost τ_{ii} in order to calculate real market access, we follow Redding and Venables (2004), to approximate $\hat{\tau}_{ii}^{-\theta} = \text{dist}_{ii}^{\hat{\delta}_1/2}$, where $\text{dist}_{ii} = 0.66\sqrt{\text{area}_i/\pi}$ and area_i is country i's area. As argued by Redding and Venables (2004), the elasticity of trade to intranational distance, $\hat{\delta}_1/2$, should be lower than that to international distance. We will run a robustness check in which the main regressor is changed from real market access (including home and foreign real market access) to foreign real market access. The results remain robust and alleviate the concerns of not having direct data on intranational trade flows.

To construct *Real Market Access* $RMA_{it} = \frac{M_{it}}{P_{it}^{\theta+1}}$ at year t, we need to estimate both the nominal market access M_{it} and price index P_{it}. Denote the estimated importer and

[5] We use commands taken from Larch et al. (2019) for fast estimation.

exporter fixed effects by $\widehat{\text{IFE}}_{jt}$ and $\widehat{\text{EFE}}_{it}$, respectively. The demand and supply capacity, d_{jt} and s_{it}, are thus proxied by $\exp\left(\widehat{\text{IFE}}_{jt}\right)$ and $\exp\left(\widehat{\text{EFE}}_{it}\right)$, respectively. By (3), we calculate the nominal market access by $\widehat{M}_{it} = \sum_j \hat{\tau}_{ijt}^{-\theta} \exp\left(\widehat{\text{IFE}}_{jt}\right)$. From (2) and the definition of supply capacity $s_i = \frac{R_i}{\Pi_i^{-\theta}}$, we calculate $\hat{P}_{jt}^{-\theta} = \sum_i \hat{\tau}_{ijt}^{-\theta} \exp(\widehat{\text{EFE}}_{it})$. With a known value of θ, $\hat{P}_{jt}$ and $\widehat{RMA}_{it}$ can be calculated. We take $\theta = 3.78$ so that the trade elasticity θ matches the median value estimated in structural gravity models surveyed by Head and Mayer (2014). All of the results are robust to other values of θ.

2.2 Empirical Strategy

As our ICRG data covers from 1984 to 2010, we follow Campante and Do (2014) to take five-year averages of the Law and Order variable to mitigate the concerns of measurement errors. We define the years from 1984 to 1990 as period 1 and every five years as a new period thereafter; thus, there are five periods in total. We will run panel regressions as follows

$$\text{LO}_{it} = \beta_0 + \beta_1 \ln \text{RMA}_{it} + \text{Controls} + \gamma_i + \iota_t + \epsilon_{it}, \tag{5}$$

where LO_{it} is the ICRG Law and Order in country i at period t, RMA_{it} is country i's real market access, Controls are an array of control variables, γ_i is the country fixed effect, ι_t is the period fixed effect, and ϵ_{it} is the error term. Our coefficient of interest is β_1, which captures how changes in real market access induce changes in the ICRG Law and Order.

Considering that institutional variables may change slowly over time, we run three-period and two-period panel regressions. In particular, the three-period one includes periods 1, 3 (1996-2000), and 5 (2006-2010), whereas the two-period one includes periods 1 and 5 and is equivalent to a long-difference specification. Obviously, an advantage of these specifications is to account for the country fixed effects, which absorb various time-invariant country characteristics and the historical background prior to 1984.

We control for country-level time-varying variables that are potentially important for determining institutional quality besides the role of real market access. First, initial institutional quality may play an important role, as indicated by Acemoglu et al. (2005). We control for the time trend interacted with the initial LO, as there may be a persistent or catching-up effect of initial institutional quality on later ones. We also control the population size of a country, which contributes to real market access but may also affect institutional quality beyond real market access. For example, people within a country are likely to be more heterogeneous when the population size is larger, and this increases the communication costs among different groups for building and agreeing on institutional arrangements (Alesina and Spolaore, 1997). Moreover, we control human capital because it may serve as a channel through which a country may benefit from institutional diffusion from neighboring countries, as higher human capital implies higher learning ability. The human capital data is obtained from Barro and Lee (2013) and measured as the total years of schooling. In addition, we control for the time trends interacted with initial values of population size and human capital in period 1. Note that these time trend effects differ from the controls of human capital and population size. For example, whereas human capital accounts for the effect of its increase on institutional quality, the time trend interacting with initial human capital reflects how a higher initial capital induces changes in institutional quality over time. To reduce endogeneity concerns, we lag ten years for population and human capital in these controls.

The OLS estimation indicates only the conditional correlation between real market access and institutional quality, as the conditional independence assumption is likely to fail. Two standard sources of endogeneity may emerge from the OLS estimation. First, reverse causality is likely because better contracting institutions may contribute to higher productive efficiency and hence higher real income, thereby contributing to a larger real market access as home market access increases (as we show in our theory sections). Second, some relevant time-varying country characteristics might still be omitted. To have a causal interpretation, we adopt an instrumental variable (IV) approach to estimate (5). Motivated by Head and Mayer (2014), we exploit the exogenous variation in real market access that stems from a country's geographic centrality interacting with transport technology. A country's geographic centrality is measured by the sum of the inverse of the distance to each country in the world, weighted by the initial population. Formally, the geographic centrality is calculated by $\sum_{j=1}^{J} \text{pop\_share}_j/\text{dist}_{ij}$, where pop_share_j is the population share of country j in the initial period, and the self distance dist_{ii} is calculated in the same way as Section 2.1. For transport technology, we use the average vessel size of container ships.[6] Our geographic centrality measure is closely related to real market access, the sum of demand capacities discounted by bilateral trade costs. When interacting geographic centrality with transport technology, the more central countries during the periods with large improvements in transport technology are more likely to see larger increases in real market access. Thus, the relevance condition is likely to hold.

The exclusion restriction is also likely to hold, conditional on the controls discussed above. Several widely recognized important determinants for institutions, such as legal origins, early disease environment, and colonial history (Acemoglu et al., 2001; La Porta et al., 2008; Auer, 2013), have been controlled for as they are time-invariant characteristics. Also, a higher geographic centrality may induce higher institutional spillovers from neighboring countries, but this channel is controlled as country-level human capital and its time trend effect are controlled. Moreover, the changes in the average capacity of container ships reflect the improvement in seaborne transport technology that is available to all countries. In the robustness checks, we also experiment with area-weighted and unweighted geographic centrality (interacting with the improvement in transport technology) as alternative instruments.

2.3 Empirical Results

Table 1 shows the main results. Columns 1 to 3 show the results under the three-period panel regressions, where Column 1 reports the simple OLS results with country and period fixed effects, Column 2 the OLS results with all of the controls and the same fixed effects,

[6] The data is taken from Table 2.2 in the Review of Maritime Transport 2010, published by the United Nations Conference on Trade and Development (UNCTAD).

Table 1: Main Results

	Dependant variable: ICRG Law and Order					
	Three periods			Two periods (Long difference)		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	IV	OLS	OLS	IV
ln(RMA)	0.089***	0.063**	0.501***	0.145***	0.109***	0.515***
	(0.034)	(0.028)	(0.137)	(0.045)	(0.035)	(0.144)
Initial institution x trend		-0.166***	-0.152***		-0.167***	-0.156***
		(0.016)	(0.020)		(0.016)	(0.020)
Population		0.119	0.181		0.089	0.091
		(0.075)	(0.120)		(0.081)	(0.129)
Human capital		0.069***	0.044		0.068***	0.030
		(0.022)	(0.037)		(0.025)	(0.044)
Population x trend		-0.001	-0.003		-0.002	-0.004
		(0.002)	(0.004)		(0.002)	(0.004)
Human capital x trend		0.023***	0.031***		0.023***	0.029***
		(0.004)	(0.007)		(0.004)	(0.007)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	396	327	327	244	218	218
First-stage F			11.83			11.54
Anderson-Rubin Wald test			28.73***			28.06***
Stock-Wright LM S statistic			21.93***			21.24***
R-squared	0.810	0.872		0.811	0.907	

Note: Standard errors clustered at the country level are shown in parentheses. The data are taken from the year 1984 to the year 2010. We define the years from 1984 to 1990 as period 1 and every five years as a new period thereafter. "Three periods" refers to period 1,3 and 5; "Long difference" refers to period 1 and 5. The average across the years within the period is used for each variable. The instrument is $\ln(\text{capacity}_t) \times \text{centrality}_i$, where capacity_t is the capacity of container ships in seaborne trade in period t, and centrality_i is the geographic centrality measured as the sum of the inverse distance to each country in the world (including itself), weighted by the population in period 1. Here, ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

and Column 3 the IV results. Columns 4 to 6 are parallel to Columns 1 to 3, but they are under the long-difference specification. Across all these specifications, the results strongly indicate the significant effect of real market access on institutional quality. Our IV regressions pass weak instrument tests, as shown by the first-stage F, Anderson-Rubin Wald, and Stock-Wright LM S tests. The large gap between the OLS and IV results suggests

Table 2: Robustness Checks

Dependant variable:	ICRG Law and Order								WGI Rule of Law	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Area-weighted IV	Unweighted IV	FMA^{RV}	FMA^{DH}	$\theta = 10$	$\theta = 3$	Regional Clustering	Exclude China	Three Periods	Two Periods
ln(RMA)	0.444**	0.543*	0.473***	3.706**	0.550***	0.442***	0.501**	0.531***	0.159*	0.160*
	(0.213)	(0.309)	(0.121)	(1.629)	(0.151)	(0.119)	(0.206)	(0.155)	(0.086)	(0.087)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	327	327	327	327	327	327	327	324	381	254

Note: Standard errors clustered at the country level are shown in parentheses. The data are taken from the year 1984 to the year 2010. We define the years from 1984 to 1990 as period 1 and every five years as a new period thereafter. "Three periods" refers to period 1,3 and 5; "Long difference" refers to period 1 and 5. The average across the years within the period is used for each variable. The instrument is $\ln(\text{capacity}_t) \times \text{centrality}_i$, where capacity_t is the capacity of container ships in seaborne trade in period t, and centrality_i is the geographic centrality measured as the sum of the inverse distance to each country in the world (including itself), weighted by the population in period 1. Here, ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

that the endogeneity issues should not be ignored. The estimates are relatively similar between Columns 3 and 6; we slightly prefer Column 3 because of its larger sample size.

For our preferred specifications (Columns 3 and 6), the coefficients on population size and its time trend effect are both insignificant. The coefficient on human capital is also insignificant. We find highly significant time trend effects from the initial institutional quality and initial human capital. Countries with higher initial human capital tend to improve their institutional quality more rapidly than those with lower quality. This likely reflects the learning effects, as higher human capital means higher learning ability. Moreover, countries with higher initial institutional quality tend to improve their institutional quality more slowly than those with lower quality. This suggests that improving institutional quality may become more difficult when a country's initial institutional quality is higher. Our theory will capture this by assuming a convex cost function for improving institutional quality.

2.4 Robustness Checks

We conduct robustness checks based on Column 3 of Table 1; the results are shown in Table 2. First, we experiment with area-weighted and unweighted geographic centrality (interacting with the improvement in transport technology) as alternative instruments, as mentioned in Section 2.2. The results are shown in Columns 1 and 2. The rest of the robustness checks return to using the baseline instrument.

Similar to Redding and Venables (2004) and Donaldson and Hornbeck (2016), we also experiment with "foreign market access" (FMA) as an alternative measure for real market access by excluding the home part of the real market access to alleviate endogeneity concerns. We construct two versions for this measure. The first is simply to exclude the home part of the real market access, dubbed FMA^{RV}, where RV annotates Redding and Venables (2004) as their approach is our baseline approach for constructing real market access. The second follows the reduced-form approach in Donaldson and Hornbeck (2016) and calculates $\text{FMA}_{it}^{\text{DH}} \equiv \sum_{j \neq i} \text{pop}_j / \hat{\tau}_{ijt}^{\theta}$, where pop_j is the population of country j.[7] Correspondingly, the home country is also excluded when calculating geographic centrality for these two IV estimations. The results are shown in Columns 3 and 4. As the trade-elasticity parameter θ is required for constructing real market access, we examine the results under alternative values of θ, as shown in Columns 5 and 6.

Column 7 shows the results when the standard errors are clustered at the regional level instead of at the country level.[8] There may be a concern about the main result being driven by China as an outlier. During the sample period, China's real market access increased 28 times, and institutional quality improved from 0.50 to 0.74. Column 8 reports the result when China is excluded from the sample. Lastly, we use the WGI's Rule of Law as an alternative measure of the quality of contracting institutions and show the results under the three-period and two-period specifications.[9]

The main result, i.e., larger real market access leads to higher institutional quality, is robust to all these checks. Note that the preferred estimates in Table 1 are around 0.5,

[7] Here, we use the same value of trade elasticity $\theta = 3.78$. The results are robust to different values of θ.

[8] More specifically, the world is divided into the following regions: North Africa, Sub-Saharan Africa, Caribbean, Central America, North America, South America, Central Asia, Eastern Asia, Middle East, Southern Asia, Central Europe, Eastern Europe, Northwestern Europe, Scandinavia, Southern Europe, and Oceania.

[9] As WGI is available from 1996 onwards, the three periods here are periods 3, 4, and 5, whereas the two-period specification includes periods 3 and 5.

and the quantitative magnitudes of the estimates in these robustness checks remain in the same ballpark except Columns 4, 9, and 10. The estimate in Column 4 is quite different because how real market access is constructed is drastically different from our baseline approach. The estimates in Columns 9 and 10 are quite different because it is a different measure of institutional quality.

3 Theory: Contracting Institution and Global Economy

We propose a theory to explain the link between real market access and contracting institutions. First, Section 3 incorporates an incomplete-contract model following Acemoglu et al. (2007) into an international trade context *à la* Krugman (1980) to establish the links between contracting institutions and market size in a global economy, taking institutional qualities as given. Then, Section 4 endogenizes the choices of institutional qualities by solving national planners' problems and studies how real market access affects these choices. Note that we choose Krugman (1980) for our general equilibrium trade model for its tractability. The theory generally works in other general equilibrium trade models.

3.1 Model Setup

3.1.1 Consumption

There are J countries with each having population L_j, $j \in \{1, 2, ..., J\}$. Consumer preferences are the same and given by the CES utility function over a continuum of goods $U_j = \left(\int_\omega q_j(\omega)^\beta \, d\omega\right)^{\frac{1}{\beta}}$, where $\beta \in (0, 1)$ and $q_j(\omega)$ is the quantity consumed for the good ω. The elasticity of substitution is given by $\sigma \equiv 1/(1-\beta) > 1$. Each individual is endowed with one unit of labor, which is inelastically supplied. The wage rate is denoted as w_j, and each individual pays a lump-sum tax t_j to the government. Each country's representative consumer chooses the utility-maximizing consumption bundle subject to the budget constraint $\int_\omega p_j(\omega) \, q_j(\omega) \, d\omega \leq L_j \left(w_j - t_j\right)$, where $p_j(\omega)$ is the price of differentiated good ω facing country j's consumers. As is standard, country j's price index is given by $P_j = \left(\int_\omega p_j(\omega)^{1-\sigma}\, d\omega\right)^{\frac{1}{1-\sigma}}$.

3.1.2 Production

Labor is the only fundamental input of this economy. There are two layers of production: differentiated goods and specialized inputs. The market for differentiated goods is monopolistically competitive. The production of each differentiated good requires specialized inputs procured from various suppliers. As will be described shortly, contract incompleteness (i.e., the inverse of institutional quality) between a firm and its suppliers results in a hold-up problem and causes underinvestment and inefficiency.

Each differentiated-good firm ω in country i demands specialized inputs $X_i(s)$ from domestic suppliers $s \in [0,1]$. For tractability, firm heterogeneity is abstracted away from the model. For notational convenience, the use of a specialized input is simply denoted as $X_i(s)$ even though each specialized input is specific to each differentiated good ω. The production function for every good ω is given by

$$y_i(\omega) = \left(\int_0^1 X_i(s)^\alpha\, ds\right)^{\frac{1}{\alpha}}, \tag{6}$$

where $\alpha \in (0,1)$. To produce specialized input $X_i(s)$, a continuum of specific investments $x_i(m,s)$, where $m \in [0,1]$, by supplier s are required; the production function of the specialized input is given by the Cobb-Douglas form:

$$X_i(s) = \exp\left[\int_0^1 \ln\left[x_i(m,s)\right] dm\right]. \tag{7}$$

Any specific investment $x_i(m,s)$ is made of labor using a one-to-one mapping: $x = l$ with labor l. The cost of investment x in country i is thus the wage w_i.

Assume that the offer from the monopolist firm to any supplier is take-it-or-leave-it. As the input $X_i(s)$ is specialized, its outside option is 0. The firm needs to sign a contract with each of its suppliers s, designating the investment level $x_i(m,s)$ for each $m \in [0,1]$.

If the contract is complete and specifies fully the terms and conditions about the amounts of the investment $x_i(m,s)$ that supplier s should make for each m, then supplier s will abide by the contract and make corresponding investments. Otherwise, if part of the investments is not contractible (i.e., cannot be covered/specified/enforced by the contract), then the supplier will only follow the contract to make the designated investments for the contractible part and determine the remaining investments at its discretion. Let $\mu_i \in [0,1]$ reflect the degree of the contracting institution in country i such that μ_i fraction of the types of investment is contractible, whereas the remaining $1-\mu_i$ fraction is not. Without loss of generality, we can denote that $m \in [0,\mu_i]$ is contractible and $[\mu_i, 1]$ is not.

The timeline of the model is that each country's government chooses its contracting institutional quality in an environment that will be detailed in Section 4. There is a large pool of potential entrants in each country, and given institutional qualities $\{\mu_i\}_{i=1}^{J}$, the potential entrants decide whether or not to enter, and if yes, an entry cost f denominated in terms of labor units must be paid. Upon entry, each entrant obtains a distinct product and becomes a monopolist for it. For each monopolistic firm, there is a unit continuum of input suppliers.[10] The four stages of the game between each firm and its suppliers are given as follows:

1. The firm ω in country i offers a contract $\left[\{x_{i,c}(m,s)\}_{m=0}^{\mu_i}, \kappa_s\right]$ to every supplier s. Here $x_{i,c}(m,s)$ is the contractible investment level and κ_s is an upfront payment to each supplier s, which could be either positive or negative;

2. For m in $[0,\mu_i]$, the suppliers invest $x_i(m,s) = x_{i,c}(m,s)$ as specified in the contract. For m in $(\mu_i, 1]$, the suppliers determine investments in anticipation of the ex-post distribution of the total revenue between the firm and the suppliers;

3. The firm and suppliers bargain over the division of the revenue, and at this stage, suppliers could withhold their specific services in non-contractible activities;

[10] In Acemoglu et al. (2007), the firm also chooses the number of suppliers, but this choice is shut down here. We normalize the number of suppliers for each firm to create unity and abstract away technology adoption, which is not our focus.

4. Output is produced and sold, and the revenue is distributed according to the bargaining agreement made in Stage 3.

3.2 Equilibrium given Institutional Quality

This subsection derives the equilibrium given institutional qualities $\{\mu_i\}_{i=1}^{J}$. For the above-described game between a firm and its suppliers, we focus on the symmetric sub-game perfect equilibrium (SSPE), following Acemoglu et al. (2007). Since the suppliers are not the full residual claimants, they tend to under-invest in non-contractible activities. The overall production efficiency and welfare can be shown to increase in institutional quality.

3.2.1 Firm's Sales

Let the factory-gate price be denoted by p_i (for cleaner exposition, index ω is suppressed). Selling differentiated goods from country i to country j incurs iceberg trade costs such that to deliver one unit of a good to j, $\tau_{ij} \geq 1$ units need to be shipped from country i. In this model with monopolistic competition and the CES preference, the price facing consumers at country j for a good originated from country i is $p_j(\omega) \equiv p_{ij} = p_i\tau_{ij}$. The revenue for any firm in i is $r_{ij} = \left(\frac{p_{ij}}{P_j}\right)^{1-\sigma} E_j$, where P_j and E_j are the price index and the expenditure in country j, respectively. Let the number of firms in country i be denoted by n_i. The trade flow $R_{ij} \equiv n_i r_{ij}$ between exporting country i and importing country j can be rewritten as

$$R_{ij} = s_i \tau_{ij}^{1-\sigma} d_j, \tag{8}$$

where $s_i = n_i p_i^{1-\sigma}$ is the supply capacity of country i and $d_j = E_j P_j^{\sigma-1}$ the demand capacity of country j as defined in Section 2.1.2 with $\theta = \sigma - 1$. As (8) is the same as (1) with $\theta = \sigma - 1$, the model fits the structural gravity framework used to construct our empirical measure of real market access.

Total revenue of a firm in country i is $r_i \equiv \sum_{j=1}^{J} r_{ij} = p_i^{1-\sigma} M_i$, where the market access

M_i for firms in country i is

$$M_i \equiv \sum_j \tau_{ij}^{1-\sigma} d_j = \sum_j \tau_{ij}^{1-\sigma} \frac{E_j}{P_j^{1-\sigma}}. \tag{9}$$

The larger the market access M_i, the more revenue for firms in country i. Combining the definition of revenue, $r_i \equiv p_i y_i$, with $r_i = p_i^{1-\sigma} M_i$ entails

$$r_i = y_i^{\beta} M_i^{1-\beta}. \tag{10}$$

The total revenue in country i is $R_i = \sum_j R_{ij} = n_i p_i^{1-\sigma} M_i$. The price index P_j satisfies

$$P_j^{1-\sigma} = \sum_i n_i p_{ij}^{1-\sigma} = \sum_i \frac{R_i}{M_i} \tau_{ij}^{1-\sigma}. \tag{11}$$

Moreover, the total revenue R_i equals to workers' total income:

$$R_i = w_i L_i. \tag{12}$$

Assume trade is balanced, and thus the total expenditure equals the total revenue, i.e.,

$$E_i = R_i. \tag{13}$$

3.2.2 Incomplete Contracts

For the SSPE in the incomplete-contract case, first consider the bargaining stage. As in Acemoglu et al. (2007), the Shapley value is used as the bargaining solution for the firm and its suppliers. For any supplier s, she follows the contract and make investment level $x_c(m, s)$ for $m \in [0, \mu_i]$ and determines at her discretion the non-contractible investment level $x_n(m, s)$ for $m \in (\mu_i, 1]$. Meanwhile, the firm's other suppliers make investment level $x_c(m, -s)$ for $m \in [0, \mu_i]$ and the non-contractible investment level $x_n(m, -s)$ for $m \in (\mu_i, 1]$.

In the setting of symmetric equilibrium, let $x_c(m, s) = x_c(m, -s) = x_c$, $x_n(m, s) = x_n(s)$, and $x_n(m,-s) = x_n(-s)$. Using (6), (7) and (10), the Shapley value of supplier s is given by

$$SV_s = (1-\gamma)\left[x_c^{\mu_i} x_n(-s)^{1-\mu_i}\right]^{\beta} M_i^{1-\beta} \left(\frac{x_n(s)}{x_n(-s)}\right)^{(1-\mu_i)\alpha},$$

where $\gamma \equiv \frac{\alpha}{\alpha+\beta}$. In equilibrium, $x_n(s) = x_n(-s) = x_n$, and $SV_s = (1-\gamma)\left(x_c^{\mu_i} x_n^{1-\mu_i}\right)^{\beta} M_i^{1-\beta} = (1-\gamma)\, r_i$. That is, suppliers share a $1-\gamma$ fraction of the firm's revenue, and the firm keeps a γ fraction of its revenue. Thus, γr_i is the Shapley value of the firm; γ increases in α but decreases in β. This is intuitive since a larger α means a greater elasticity of substitution among specialized inputs and, hence, smaller bargaining power for the suppliers. A higher β corresponds to a larger elasticity of substitution among differentiated goods, which reduces the firm's marginal contribution to the production relationship and thus lowers the firm's bargaining power.

Taking the upfront payment κ_s, the contractible investment x_c, and others' non-contractible investments $x_n(-s)$ as given, each supplier decides the optimal non-contractible investment by solving

$$x_n = \arg\max_{x_n(s)} (1-\gamma)\left[x_c^{\mu_i} x_n(-s)^{1-\mu_i}\right]^{\beta} M_i^{1-\beta} \left(\frac{x_n(s)}{x_n(-s)}\right)^{(1-\mu_i)\alpha} + \kappa_s - \mu_i x_c w_i - (1-\mu_i)\, x_n(s)\, w_i.$$

Therefore, this incentive compatibility constraint, together with the symmetry requirement, entails

$$x_n = \left[\frac{\alpha(1-\gamma)\, x_c^{\mu_i\beta} M_i^{1-\beta}}{w_i}\right]^{\frac{1}{1-\beta(1-\mu_i)}}. \tag{14}$$

The firm determines the level of contractible investment by solving the following problem:

$$\pi = \max_{x_c} \gamma\left(x_c^{\mu_i} x_n^{1-\mu_i}\right)^{\beta} M_i^{1-\beta} - \kappa_s,$$

subject to the participation constraint of suppliers:

$$(1-\gamma)\left[x_c^{\mu_i} x_n^{1-\mu_i}\right]^{\beta} M_i^{1-\beta} + \kappa_s \geq \left(\mu_i x_c + (1-\mu_i)\, x_n\right) w_i.$$

The firm can extract all the surplus from its suppliers so that the participation constraint holds with equality. Therefore, the firm's problem can be written as

$$\pi = \max_{x_c} \left(x_c^{\mu_i} x_n^{1-\mu_i} \right)^{\beta} M_i^{1-\beta} - \left[\mu_i x_c + (1-\mu_i)\, x_n \right] w_i,$$

and the solution is

$$x_c = \left[\alpha\,(1-\gamma) \right]^{\frac{\beta(1-\mu_i)}{1-\beta}} B\,(\mu_i)^{1-\beta(1-\mu_i)}\, w_i^{-\frac{1}{1-\beta}} M_i, \tag{15}$$

where $B\,(\mu_i) \equiv \left[\left(\frac{1-\gamma}{1-\beta(1-\mu_i)} + \gamma \right) \beta \right]^{\frac{1}{1-\beta}}$ is a decreasing function in μ_i. Plugging (15) into (14) entails

$$x_n = \left[\alpha\,(1-\gamma) \right]^{\frac{1-\beta\mu_i}{1-\beta}} B\,(\mu_i)^{\beta\mu_i}\, w_i^{-\frac{1}{1-\beta}} M_i. \tag{16}$$

When $\mu_i = 1$ (complete contract), the middle two stages of the game are removed, and the resulting investment is efficient and denoted as x^*. It is easy to show that $x^* = \beta^{\frac{1}{1-\beta}} w_i^{-\frac{1}{1-\beta}} M_i$. When $\mu_i < 1$, the above formulation applies, and $x_n < x_c$, i.e., the suppliers always under-invest for the non-contractible portion. However, the ratio, x_n/x_c, increases in μ_i, indicating that higher institutional quality leads to smaller distortion. From (15) and (16), $x_n \longrightarrow \gamma x_c < x_c \longrightarrow x^*$ when $\mu_i \longrightarrow 1$. That is, the distortion does not fully disappear even in the limit, highlighting the role of the middle two stages of the game in creating it.

The output for each differentiated good $y(\omega)$, which is equal to the output for each supplier $X(s)$, is given by

$$y_i = X_i = x_{c,i}^{\mu_i} x_{n,i}^{1-\mu_i} = I\,(\mu_i)\, w_i^{-\frac{1}{1-\beta}} M_i, \tag{17}$$

where $I\,(\mu) = \left[\alpha\,(1-\gamma) \right]^{\frac{1-\mu}{1-\beta}} B\,(\mu)^{\mu}$. For any firm in country i, the price charged for a differentiated good, the revenue, and the profit are

$$p_i = y_i^{-\frac{1}{\sigma}} M_i^{\frac{1}{\sigma}} = I(\mu_i)^{\beta-1} w_i, \qquad r_i = I\,(\mu_i)^{\beta}\, w_i^{-\frac{\beta}{1-\beta}} M_i, \qquad \pi_i = D\,(\mu_i)\, w_i^{-\frac{\beta}{1-\beta}} M_i, \tag{18}$$

where

$$D(\mu) = \left[1 - (1-\gamma)\left(\frac{\beta\mu}{1-\beta+\beta\mu} + \alpha\right)\right] I(\mu)^{\beta}.$$

Lemma 1. $I(\mu)$ and $D(\mu)$ are both strictly increasing and concave in μ.

The proof is relegated to Appendix A.1. Lemma 1 and (17) imply that conditioned on wages w_i and market access M_i, *the higher the institutional quality, the higher the overall production efficiency*, which is captured by $I(\mu_i)$ term. Lemma 1 and (18) imply that conditional on wages and market access, *firm profits increase in institutional quality.*

Combining with (18), the free entry condition, $\pi = w_i f$, becomes

$$M_i = \frac{w_i^{\sigma} f}{D(\mu_i)}. \tag{19}$$

Thus, the real market access is $\frac{M_i}{P_i^{\sigma}} = \left(\frac{w_i}{P_i}\right)^{\sigma} \frac{f}{D(\mu_i)}$, and the real income in country i is

$$\frac{w_i L_i}{P_i} = \left(\frac{M_i}{P_i^{\sigma}} \frac{D(\mu_i)}{f}\right)^{\frac{1}{\sigma}} L_i. \tag{20}$$

That is, *the real income of a country increases in both its institutional quality and its real market access, and the two are complementary to each other.* As in Acemoglu et al. (2007), the term $D(\mu_i)^{1/\sigma}$ can be called the *derived efficiency* because the larger the derived efficiency, the higher the real income, conditioned on real market access. In a closed economy, it is readily verified that real market access and real income are the same (see Appendix A.6); thus, real income is solely determined by the derived efficiency, and real market access does not play a separate role. In an open economy, however, real market access and real income of a country are generally different.

Note that total labor supply L_i equals to total labor demand, which comprises of the entry cost f in terms of labor units, the employment $\mu_i x_c$ for contractible investments, and the employment $(1-\mu_i)x_n$ for non-contractible investments. Under the labor market clearing condition, the number of firms in country i is

$$n_i = \frac{L_i}{f}\left[1 - \beta\left(\frac{(1-\gamma)\,\mu_i}{1-\beta+\beta\mu_i} + \gamma\right)\right]. \tag{21}$$

Intuitively, the number of firms is proportional to the population size and inversely proportional to entry cost. Moreover, *the number of firms decreases (and hence the firm size increases) in institutional quality.* This is because worse institutional quality results in more severe hold-up problems and smaller firm size; given the fixed population size, there must be more firms. This relationship resonates with the findings by Hsieh and Olken (2014) that developing countries like Indonesia and India have relatively more small firms compared with the US, and this model serves as a microfoundation for explaining this phenomenon by the distortions arising from contract incompleteness.

The following definition defines an equilibrium given institutional qualities $\{\mu_i\}$. The following proposition summarizes the results of this section.

Definition 1. An equilibrium given a vector of institutional quality $\{\mu_i\}_{i=1}^J$ is a market access vector $\{M_i\}_{i=1}^J$, a price index vector $\{P_i\}_{i=1}^J$, an expenditure vector $\{E_i\}_{i=1}^J$, an income vector $\{R_i\}_{i=1}^J$ and a wage vector $\{w_i\}_{i=1}^J$ that satisfy equilibrium conditions (9), (11), (12), (13) and (19) for each country i.

Proposition 1. In an equilibrium given a vector of institutional quality $\{\mu_i\}_{i=1}^J$, the real income of a country is given by (20); it increases in both institutional quality and real market access, and the two are complementary to each other. Moreover, the number of firms decreases (and hence the firm size increases) in institutional quality. Conditional on wages and market access, overall production efficiency and firm profits increase in institutional quality.

4 Theory: National Planners and Institutional Qualities

This section studies how institutional qualities are determined and how real market access matters. For tractability, we focus on benevolent governments who choose institutional qualities subject to the costs of building and/or maintaining the institutions.

For each country i, the cost of building and maintaining the contracting institutional quality μ_i is in terms of the final goods and takes the form $C_i(\mu_i, L_i) = A_i \mu_i^\rho L_i^\eta$, where $\rho > 1$ and $\eta \geq 1$. The institutional cost is therefore $P_i C_i(\mu_i, L_i) = P_i A_i \mu_i^\rho L_i^\eta$. Examples of building/maintenance costs include communication costs and investments in legislative procedure, public and compulsory education, law enforcement, and the legal system. Naturally, these costs increase in institutional quality and population size. The convexity in institutional quality reflects the decreasing returns in the institutional building when the institution gets closer to the frontier. The convexity in population size is assumed to reflect that a larger population is likely to be associated with a more heterogeneous or geographically dispersed population, resulting in more-than-proportional communication and implementation costs. The parameter A_i captures country-specific factors in institution building/maintenance, such as the country's geography, demography, and history.

The model consists of two stages. In the first stage, each country's government chooses its institutional quality. The second stage is the model described in Section 3.

4.1 National Planners' Problems

For tractability, assume that these costs are raised by levying lump-sum taxes t_i from each individual and that the government runs a balanced budget. For each country i, the total government revenue is given by $T_i = t_i L_i$, and balanced budget implies that $T_i = P_i C_i(\mu_i, L_i)$. Welfare is defined as the real income net of the taxes: $W_i \equiv (w_i L_i - T_i)/P_i$. By choosing institutional quality, the benevolent government solves

$$\max_{\mu_i} W_i = \frac{w_i L_i}{P_i} - C_i(\mu_i, L_i). \tag{22}$$

Using (20), (22) becomes

$$\mu_i^* = \arg\max_{\mu_i} W_i = \left(\frac{M_i}{P_i^\sigma} \frac{D(\mu_i)}{f} \right)^{\frac{1}{\sigma}} L_i - A_i \mu_i^\rho L_i^\eta. \tag{23}$$

4.1.1 Competitive Equilibrium

We first consider a simpler equilibrium concept in which each national planner takes all of the market accesses and price indices as given. This can be justified if there are numerous countries, and each country is small. Under this concept, an equilibrium is referred to as a *competitive equilibrium*, which is formally defined as follows.

Definition 2. Given institutional qualities $\{\mu_i\}$, an equilibrium is given by Definition 1. A competitive equilibrium of institutional qualities $\{\mu_i^*\}$ is such that each national planner's choice of μ_i is the solution to (23), given the equilibrium $\{M_i\}$ and $\{P_i\}$.

Under a competitive equilibrium, real market access M_i/P_i^σ is taken as given by national planners. To ensure that (23) entails a unique solution, a sufficient condition is that the derived efficiency, $D(\mu_i)^{1/\sigma}$, is strictly concave in μ_i such that W_i is also strictly concave in μ_i. The following lemma provides such a sufficient condition.

Lemma 2. Given any $\beta \in (0, 1)$, for any x such that $x \in \left[\beta, \frac{\beta}{1-\beta}\right]$, let $\alpha_0(x)$ denote the unique solution to $\left(\sqrt{x}+1\right)\frac{x}{\alpha_0+x} - \ln\left(1+\frac{x}{\alpha_0}\right) = 0$ with the constraint that $0 \le \alpha_0 \le 1$. Define

$$\bar{\alpha}_0(\beta) \equiv \max_{x\in\left[\beta, \frac{\beta}{1-\beta}\right]} \alpha_0(x).$$

If $\alpha > \bar{\alpha}_0(\beta)$, then $D(\mu)^{\frac{1}{\sigma-1}}$ is strictly concave, which, in turn, implies that the derived efficiency $D(\mu)^{\frac{1}{\sigma}}$ is also strictly concave.

The proof of Lemma 2 is relegated to Appendix A.2. Essentially, Lemma 2 asks that, for any given β, the substitutability among different specialized inputs, α, be sufficiently large. To see the intuition, first note that contract incompleteness results in larger distortions when different inputs are more complementary. This is because if the inputs are more complementary, the weaker competition among input suppliers induces these suppliers to offer lower investments for non-contractible activities in the bargaining stage, resulting in larger distortion. If the complementarity is too strong (α too low), it could be possible that improving institutional quality exhibits increasing returns in improving the derived efficiency for some parts of the domain $\mu \in [0, 1]$. Lemma 2 indicates that such potential increasing returns can be suppressed if there exists sufficient substitutability among specialized inputs to induce sufficient competition among input suppliers.

Because real market access is complementary to institutional quality, which is embodied in the derived efficiency $D(\mu_i)^{1/\sigma}$, larger real market access increases the marginal benefit of improving institutional quality. When the population size L_i is held fixed, real market access does not affect the marginal cost. We reach the following proposition:

Proposition 2. Under the regularity condition in Lemma 2, there exists a unique competitive equilibrium. Moreover, a country's institutional quality increases when its real market access increases with its population size held fixed.

The formal proof of Proposition 2 is relegated to Appendix A.3. Proposition 2 establishes a positive causal relationship from real market access to institutional quality, holding population size fixed. This explains our main empirical results in which the population size of the country is controlled. Changes in a country's real market size when its population size is held fixed can be due to changes in trade costs and the population size of other countries.

4.1.2 Nash Equilibrium

We now consider a more realistic and complex scenario in which countries do not take their market accesses and price indices as given. This is relevant when a country is large in terms of population because the effects of its choice of institutional quality on its and others' market accesses and prices, through the mechanism illustrated in Section 3.2.2, are no longer negligible. We consider a Nash equilibrium in which each national planner chooses its institutional quality given other national planners' choices.

Definition 3. Given institutional qualities $\{\mu_i\}$, an equilibrium is given by Definition 1. A Nash equilibrium of institutional qualities $\{\mu_i^*\}$ is such that each national planner's choice μ_i^* is the solution to (23) given other national planners' choices $\{\mu_j^*\}_{j \neq i}$.

Analyzing problem (23) under a Nash equilibrium is considerably more difficult than under competitive equilibrium because the choices of $\{\mu_i\}$ affect the general equilibrium objects $\{M_i, P_i\}$, of which the interactions are highly nonlinear, in addition to the complex nature of a Nash equilibrium. Nevertheless, we can provide a definite statement for symmetric countries. We will shortly provide numerical analyses for asymmetric countries.

Proposition 3. Suppose that the regularity condition in Lemma 2 holds and that there are J symmetric countries; i.e., $L_j = L$ for all j, and the trade costs for any pair of countries is $\tau \geq 1$. Then, there exists a unique Nash equilibrium. Moreover, larger real market access, either induced by a decrease in trade cost τ or an increase in the number of trading partners $J - 1$, leads to a higher institutional quality when the population size L is held fixed.

The proof of Proposition 3 is relegated to Appendix A.4. As real market access is endogenous to a country's choice institutional quality μ_i, Proposition 3 states the effects of exogenous shocks that induce changes in the real market access and the ensuing effect on equilibrium institutional qualities. Holding population size fixed, Proposition 3 captures the same spirit as Proposition 2 that when the real market access increases (due to positive exogenous shocks), the institutional quality increases, hence lending support for our empirical result. Indeed, real market access is the only channel through which trade openness affects institutional qualities in our model. Next, we study the effect of population size.

Proposition 4. Suppose that the regularity condition in Lemma 2 holds. Under the Nash equilibrium in the symmetric world, the equilibrium institutional quality increases (decreases) in the population size $\eta < \frac{\sigma}{\sigma-1}$ ($\eta > \frac{\sigma}{\sigma-1}$). Institutional quality is independent of population size when $\eta = \frac{\sigma}{\sigma-1}$.

The proof of Proposition 4 is relegated to Appendix A.5, which shows that the marginal benefit of institutional quality is proportional to $L^{\frac{\sigma}{\sigma-1}}$ while the marginal cost is proportional to L^{η}. Thus, when $\eta < \frac{\sigma}{\sigma-1}$, the increase in marginal benefit outweighs the increase in marginal cost, leading to higher institutional quality. We have the following corollary.

Corollary 1. Suppose that the regularity condition in Lemma 2 holds. Under autarky, the equilibrium institutional quality increases (decreases) in the population size $\eta < \frac{\sigma}{\sigma-1}$ ($\eta > \frac{\sigma}{\sigma-1}$). Institutional quality is independent of population size when $\eta = \frac{\sigma}{\sigma-1}$.

The proof of Corollary 1 is relegated to Appendix A.6. In the case of autarky, trade does not play any role, and the scale effect of real market access on institutional quality is reduced to the scale effect due to population size. This corollary says that the scale effect exists but is ambiguous. While larger countries have larger market access, the institutional quality is not necessarily higher.

4.1.3 Welfare Properties

In both competitive and Nash equilibria, national planners' choices of institutional qualities are not optimal in a global sense because they do not account for institutional externality effects. To see why there is an externality, first consider the fully integrated world ($\tau_{ij} = 1$ for all ij pairs), in which each country's price index is the same and can be normalized to 1. Hence, the real market access is

$$M \equiv M_i = \sum_j \tau_{ij}^{1-\sigma} E_j P_j^{\sigma-1} = \sum_j w_j L_j.$$

The equation above and the free entry condition entail

$$M^{\frac{\sigma-1}{\sigma}} = \sum_j \left(\frac{D\left(\mu_j\right)}{f} \right)^{\frac{1}{\sigma}} L_j. \tag{24}$$

Equation (24) reveals an *institutional externality effect*, which we explain as follows. From (24), the (real) market access increases in each country's population size L_j with the term $D(\mu_j)^{1/\sigma}$ acting as the weight of the influence of each country's population size. In other words, *a country's investment to improve its own institutional quality is indeed a public* *good for global welfare* because it increases the real market access for all countries. Moreover, the larger the country's size, the larger its own marginal benefit of improving its institutional quality. When the parameter η is small, the effect of population size on the marginal cost will be smaller than that on the marginal benefit of improving institutional quality. Thus, the larger countries have higher institutional qualities in spite of the equalized market access across countries. This corresponds to the free-rider problem as there is no global government, and each country decides its own institutional quality. From a global viewpoint, there is insufficient provision for institutional qualities. The fact that each country's institutional quality is a public good is most transparent in this case of zero trade frictions, but its logic generally applies to situations where trade is costly.

The global optimal solution of institutional qualities is obtained by solving $\max_{\{\mu_i\}} \sum_i W_i$. We have the following proposition.

Proposition 5. In the symmetric world with J countries, there exists a unique global planner's solution. Denote country j's institutional quality as μ_j^g, μ_j^n, μ_j^c and welfare as W_j^g, W_j^n, W_j^c under the global optimal solution, Nash equilibrium, and competitive equilibrium, respectively. Then, $\mu_i^g > \mu_i^n > \mu_i^c$ and $W_i^g > W_i^n > W_i^c$. In addition, $\mu_i^n \longrightarrow \mu_i^c$ and $W_i^n \longrightarrow W_i^c$ as $J \longrightarrow \infty$, whereas the gap between μ_i^g and μ_i^n and hence that between W_i^g and W_i^n remain.

The proof is relegated to Appendix A.7. To see the intuition, first observe (23) and recall the key difference between a competitive equilibrium and a Nash equilibrium. In a competitive equilibrium, a national planner takes the real market access (M_i/P_i^σ) as given when choosing institutional qualities. In contrast, the incentives for a national planner to improve institutional quality in a Nash equilibrium are larger because there is now an additional channel for improving the national welfare through real market access, as higher institutional quality leads to higher productive efficiency and, hence, higher home market access. As a result, $\mu_i^n > \mu_i^c$ and hence $W_i^n > W_i^c$. As mentioned, institutional externality effects exist in both competitive equilibrium and Nash equilibrium, and thus $\mu_i^g > \mu_i^n$ and hence $W_i^g > W_i^n$.

The fact that the Nash equilibrium outcomes are in between the global optimal solution and the competitive equilibrium can be comprehended by varying the number of countries J for $J \geq 2$. When $J \longrightarrow \infty$, every country is minuscule and has little influence over its real market access; thus, Nash equilibrium outcomes become the same as the competitive equilibrium outcomes. However, increasing the number of countries does not eliminate the institutional externality effects, and hence, the outcomes under the two types of equilibria remain suboptimal. When J becomes small, the difference between Nash and competitive equilibria becomes large, but as argued before, Nash equilibrium is a better solution concept in this case.

4.2 Asymmetric Countries

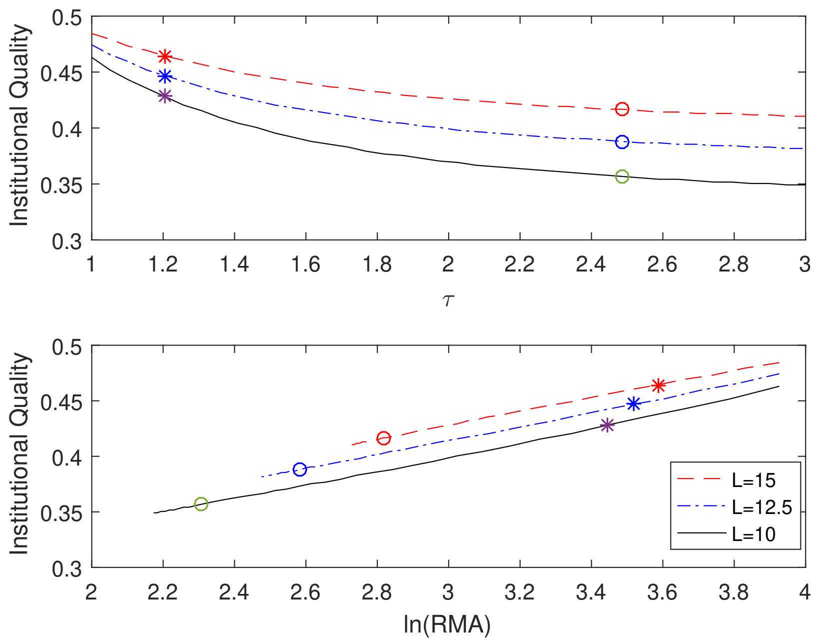
Propositions 3 to 5 show the results on institutional qualities under symmetric countries. To investigate the cases of asymmetric countries further, we resort to numerical simulations. We first study the cases where population sizes differ and then study the case of differential trade costs. As the number of countries in the simulations is small, all simulations are done under Nash equilibrium.

4.2.1 Effects of asymmetric population sizes

Figure 1 plots the case where the three countries are identical except that they differ in population size. Countries 1, 2, and 3 have $L = 15, 12.5$, and 10, respectively. Trade costs between any pair of countries are symmetric and denoted by τ. We choose $\beta = 0.7$ and $\eta = 1.01$ so that $\eta < \frac{\sigma}{\sigma-1}$.[11] The upper panel depicts the equilibrium relationship between institutional quality and trade cost for each country; here, it is clear that the lower the trade cost, the higher the institutional quality. The lower panel depicts the equilibrium relationship between real market access and institutional quality for each country. In both panels, we highlight the equilibrium values for the three countries within the same equilibrium. In particular, the circles and the asterisks denote the two equilibria where the

[11]Recall that $\sigma = 1/(1-\beta)$. The remaining parameters are $\alpha = 0.25$ and $f = 1$.

Figure 1: Effects of Population Size on Institutional Quality

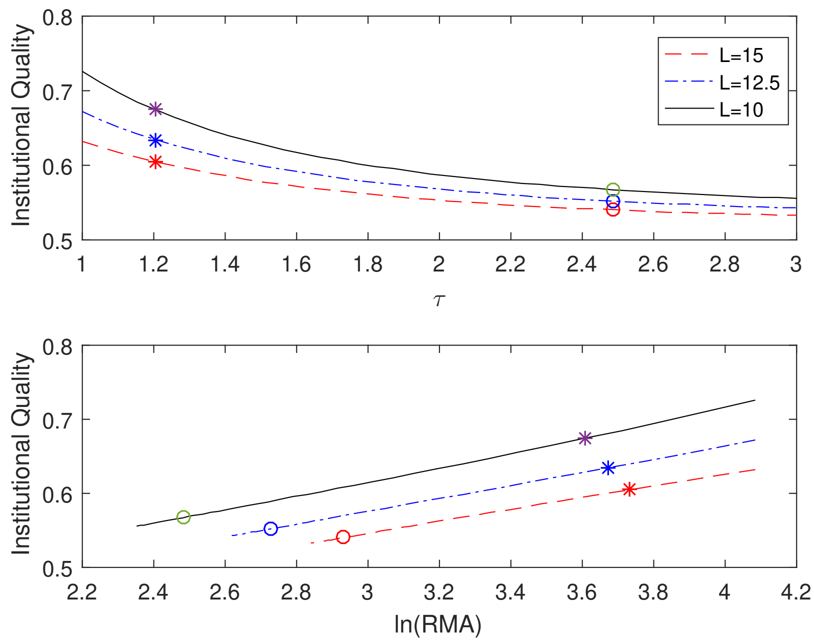


Notes: Three countries differ in their population sizes. The price index in country 1 is normalized to be 1. η is set to be 1.01 so that $\eta < \frac{\sigma}{\sigma-1}$.

trade costs $\tau = 2.5$ and $\tau = 1.2$, respectively. The lower panel shows clearly that when real market access becomes higher due to a lower trade cost, institutional quality improves. Taken together, Figure 1 shows that Proposition 3 holds even when countries differ in population size; that is, the lower the trade cost, the higher the real market accesses and institutional qualities, holding each country's population size fixed. Moreover, for each given τ, a country with a larger population size has better institutional quality. As $\eta < \frac{\sigma}{\sigma-1}$, this verifies Proposition 4 in an asymmetric-country setting. This result will change if $\eta < \frac{\sigma}{\sigma-1}$ fails to hold, as we shall see shortly.

Observe that in the fully integrated world where $\tau = 1$, larger countries enjoy higher institutional qualities even though all countries have the same market access and price index and, hence, the same real market access. This is, indeed, the reflection of the institutional externality effects as explained in Section 4.1.3. Again, the smaller countries here free-ride the higher institutional qualities provided by the larger countries, who have

Figure 2: Effects of Population Size on Institutional Quality



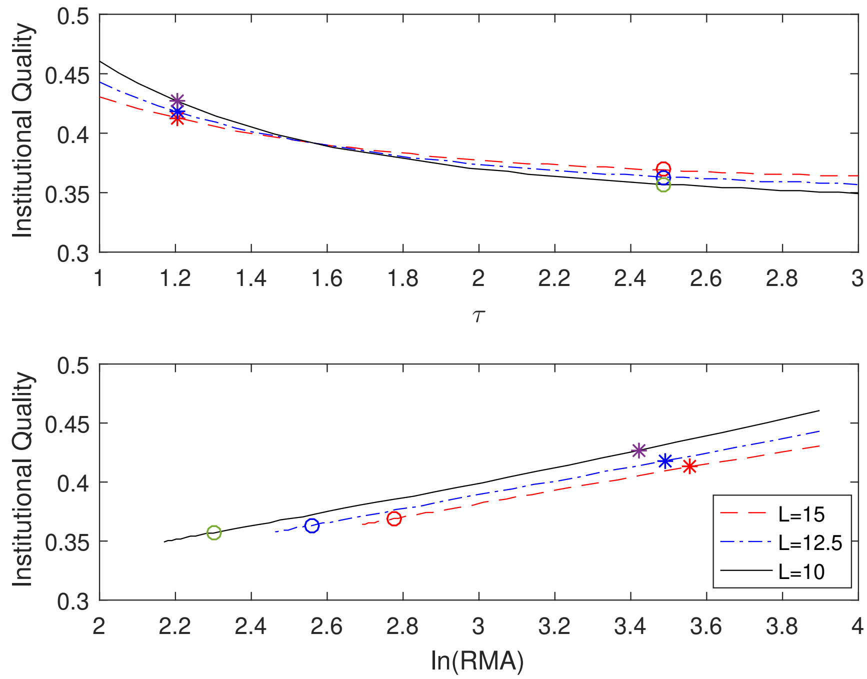
Notes: Three countries differ in their population sizes. The price index in country 1 is normalized to be 1. η is set to be 1.5 such that $\eta > \frac{\sigma}{\sigma-1}$.

incentives to provide higher qualities because it improves their home market access.

Figure 2 plots the case where all parameters are the same as Figure 1 except that η is increased from 1.01 to 1.5 such that $\eta > \frac{\sigma}{\sigma-1}$. Again, this figure shows that Proposition 3 holds under this asymmetric-country setting with a higher value of η. In contrast with Figure 1, Figure 2 shows that the larger the population size, the lower the institutional quality, and this again verifies Proposition 4 in an asymmetric-country setting. In this case, the marginal cost of institutional quality sharply increases with population size and hence outpaces the increase in the marginal benefit through real market access.

Figure 3 plots the case where η takes an intermediate value at 1.3 with all of the other parameters being the same as the previous two figures. Again, Proposition 3 also holds under this asymmetric-country setting with an intermediate value of η. Observe that when $\tau > 1.5$, the larger the population size, the higher the institutional quality, which is the pattern seen in Figure 1. When $\tau < 1.5$, the larger the population size, the lower

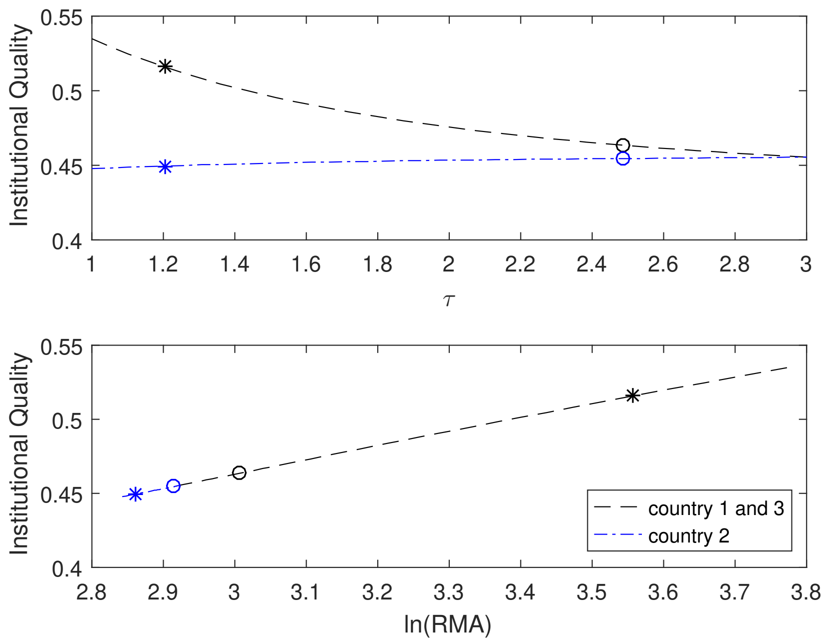
Figure 3: Effects of Population Size on Institutional Quality



Notes: Three countries differ in their population sizes. The price index in country 1 is normalized to be 1. η is set to be 1.3.

the institutional quality, which is the pattern seen in Figure 2. To understand this flip, it is easier to consider the two extreme cases. First, when the trade cost goes to infinity so that each country becomes an autarky, a country's real market access is tied only to its own population size. Therefore, the determination of institutional quality is simply a tug-of-war between the rates at which the marginal benefit and the marginal cost change with population size. At $\eta = 1.3$, $\eta < \frac{\sigma}{\sigma-1}$ holds, and thus the result verifies Corollary 1 and is similar to that seen in Figure 1. Second, when there is no trade cost ($\tau = 1$), a country's population size contributes only a portion to the real market access, as indicated by (24). Therefore, the contribution of a country's population size to real market access is diluted compared with the autarkic case just discussed, thus diluting the rate at which the marginal benefit of improving institutional quality changes with population size and

Figure 4: Trade Liberalization between Country 1 and Country 3



Notes: The three countries have equal population sizes; countries 1 and 3 reduce their bilateral trade costs from $\tau = 3$, whereas country 2's trade cost with the other two countries remains at $\tau = 3$. The price indices of countries 1 and 3 are normalized to 1.

entailing the pattern seen in Figure 2.[12]

4.2.2 Effects of differential trade costs

Next, we investigate the effects of differential trade costs. In particular, we would like to see how trade liberalization between two countries may affect the institutional qualities of other countries. For our numerical analysis, we consider the case where three countries have the same population size with the same bilateral trade costs $\tau = 3$ initially.[13] The upper panel of Figure 4 plots the changes in equilibrium institutional qualities against the level of the bilateral trade cost between countries 1 and 3 while the trade cost of either

[12]Observe that in the integrated world case, the larger the population size, the smaller the institutional quality. This does not mean that the institutional externality effect does not exist. Instead, it indicates that this effect is dominated by the larger effect of population size on the marginal cost.

[13]The other parameters are $L = 10$, $f = 1$, $\eta = 1.3$, $\alpha = 0.25$, $\beta = 0.6$, which implies $\sigma = 2.5$.

country with country 2 remains unchanged at $\tau = 3$. The lower panel plots the corresponding real market access and institutional quality.

From Figure 4, countries 1 and 3 experience better institutional quality as they mutually decrease their trade costs, whereas country 2's institutional quality deteriorates even though its trade costs are unchanged. We choose two equilibrium points to further elaborate on the effects of asymmetric trade liberalization. In particular, the circles and the asterisks denote the two equilibria where the trade costs between countries 1 and 3 are $\tau = 2.5$ and $\tau = 1.2$, respectively. Because real market access is the only channel through which trade costs affect institutional quality, the results in the upper panel suggest that country 2's real market access deteriorates while that of countries 1 and 3 improves, which is indeed what we see in the lower panel.

Why does country 2's real market access and institutional quality deteriorate when its trade costs with the other two countries are unchanged? We dissect the reasoning into three parts. First, suppose that institutions are exogenous. The direct effect of the mutual trade liberalization between countries 1 and 3 lowers the price indices of these two countries, implying fiercer competition for country 2's firms in the other two countries' markets (larger outward multilateral resistance for country 2), thereby decreasing these firms' real market access. Because it becomes more difficult for country 2's firms to export and easier for countries 1 and 2 to trade, this is indeed the *trade diversion effect* commonly seen in the literature. Second, when institutional qualities are endogenous, increased real market access for countries 1 and 3 induces increases in their institutional qualities, which further reduces the price indices of these two countries. This, in turn, further reduces country 2's real market access due to the even fiercer competition. We call this an *endogenous-institution effect*. Third, the above-discussed institutional externality effect also works here because country 2 strategically free rides on increased institutional qualities of the other two countries and hence further reduces its own institutional quality.

We have verified that all of the above results shown in Figures 1 to 4 are robust to a wide range of parameter values.

4.3 Flying Geese Paradigm of Institutions

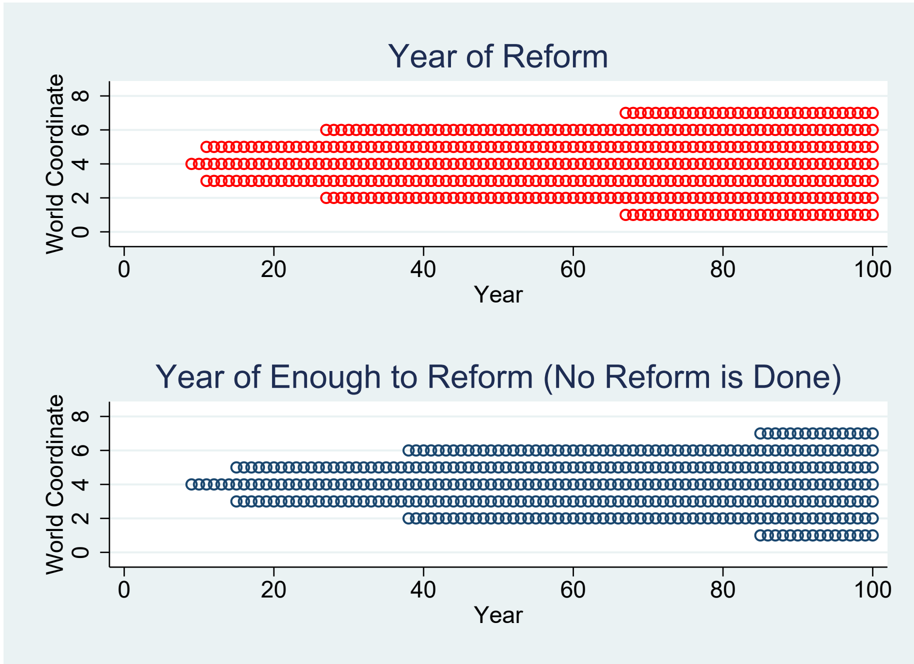
In this subsection, we take advantage of our model to demonstrate a flying geese pattern of institutions driven by improving transport technology and thus enlarging the effective market sizes. The same argument can be applied to other factors (such as the political factors mentioned in the introduction) that drive the increases in effective market size. Suppose that there are J same-sized countries, and the geography of the world is a line segment with the countries being spaced evenly. Under this geography, the one(s) in the middle naturally enjoy the largest real market access, and they are referred to as the "world center".[14] Label the countries from left to right by 1 to J in order. Starting from some point in time ($t = 0$), the trade cost between countries i and j at year t is given by $\tau_{ijt} = 1 + \exp(-\nu t)(\tau_0^{|i-j|} - 1)$, where ν is the tuning parameter governing the extent to which trade costs decline over time due to the advancement of transport technology, and τ_0 is the trade cost parameter at $t = 0$. The world center is $\frac{J+1}{2}$ if J is odd, and are $\frac{J}{2}$ and $\frac{J}{2} + 1$ if J is even. In our simulation, we choose $J = 7$.

To highlight the core idea and simplify the simulation, we assume that each country can choose either a high or low institutional quality, μ_H or μ_L.[15] Every country starts with μ_L, and to obtain and maintain μ_H, a fixed improving cost F is required for every period that this country wants the institutional quality μ_H. The model is solved using Nash equilibrium. Figure 5 shows how institutional qualities evolve over time. Focus on the upper panel of the figure first, and note that a colored circle indicates that the country has reformed and obtained the high institutional quality μ_H in that period. During the first few periods, even though real market access increases due to the decline in trade costs, no country makes any institutional improvement because the benefit of improving institutional quality is not enough to overcome the fixed improvement cost. As trade costs continue to decline, country 4 (the world center) takes the initiative to reform and obtain

[14] These countries can also be evenly spaced on a circumference or a sphere, as long as the structure of trade costs among countries exhibits the pattern that the average trade cost is the lowest at the "world center" and diminishes for countries that are further away from this center.

[15] The parameters are $\mu_H = 1$, $\mu_L = 0.2$, $f = 1$, $\alpha = 0.25$, $\beta = 0.4$, $\tau_0 = 2$, $\nu = 0.02$, $F = 68$, and $L = 10$.

Figure 5: Flying Geese Pattern of Institutional Quality



Notes: There are 7 countries in the world; each chooses between a high or low institutional quality, given other countries' choices. The trade cost between country i and country j at year t takes the form $\tau_{ijt} = 1 + \exp(-\nu t)(\tau_0^{|i-j|} - 1)$, where ν is the tuning parameter governing the extent to which trade costs decline over time, and τ_0 is the trade cost parameter at $t = 0$. A colored circle indicates that the country has reformed and obtained the high institutional quality μ_H in that period.

high institutional quality in period 9. This is followed by countries 3 and 5 in period 11, countries 2 and 6 in period 27, and finally, countries 1 and 7 from period 67 onward. Indeed, the timing and locations of reforms display a flying-geese pattern.

By flying geese, one implicitly means that what a country does triggers the same for another. In the model setup here, every country would eventually have enough to reform, i.e., the benefit of switching from μ_L to μ_H outweighs the fixed improvement cost, simply because of the ever-declining trade cost. To show how one country's reform may affect others, the colored circles in the lower panel of Figure 5 indicate the periods when the country has enough to reform but no reform is done. In contrast to the upper panel, the first periods when the countries have enough to reform are 9, 15, 38, and 85 from the world center to the peripheral countries; the timing for a country to have enough to reform is all delayed except for the world center. The lower panel captures the pure effect of increasing real market access due to declining trade costs, while the contrast between the two panels indicates that one country's reform, which leads to greater production efficiency in that country, also increases real market access for all countries and thereby speed up the reform process. So, this is a *bona fide* flying geese pattern.

5 Conclusion

Using the ICRG data from 1986 to 2010, our empirical analysis finds significant and positive effects of real market access on the quality of contracting institutions. We develop a theory that embeds the incomplete-contract model of Acemoglu et al. (2007) into a general equilibrium trade model and illustrates national planners' choices of institutional quality. Our theory matches the main empirical finding — that larger real market access leads to higher institutional quality — under different solution concepts.

Moreover, we find that the scale effect of population size depends on the relative strength between how population affects real market access and how it affects the costs of institutional building and maintenance. When only a subset of countries liberalize trade among themselves, the status-quo countries choose lower institutional qualities due to trade diversion. Finally, our model can generate a flying-geese pattern of institutional improvement. The institutional externality effect underlies the trade diversion effect and flying geese pattern.

A Appendix

A.1 Proof of Lemma 1

We would like to show that $I(\mu)$ and $D(\mu)$ are both strictly increasing and concave in μ.

A.1.1 The properties of $I(\mu)$

Recall $I(\mu) = [\alpha(1-\gamma)]^{\frac{1-\mu}{1-\beta}}\left[\left(\frac{1-\gamma}{1-\beta(1-\mu)}+\gamma\right)\beta\right]^{\frac{\mu}{1-\beta}}$. Define $\bar{I}(\mu) \equiv (1-\beta)\ln I(\mu)$, and it suffices to show that $\frac{d\bar{I}}{d\mu} > 0$. Note that

$$\frac{d}{\mu}\left(\frac{d\bar{I}}{d\mu}\right) = \beta^2 \frac{\left[2\alpha(\beta-1)\beta-\beta^2\right]\mu - 2\left[\alpha(1-\beta)^2+\beta(1-\beta)\right]}{(\beta(\mu-1)+1)^2\left\{\beta+\alpha\left[\beta(\mu-1)+1\right]\right\}^2}.$$

Since $2\alpha(\beta-1)\beta-\beta^2 < 0$ and $\alpha(1-\beta)^2+\beta(1-\beta) > 0$, we have $\frac{d}{\mu}\left(\frac{d\bar{I}}{d\mu}\right) < 0$ on the interval $(0,1)$. Hence, $\ln I(\mu)$ is strictly concave in μ. As $\frac{d\bar{I}}{d\mu}$ is decreasing in $(0,1)$, $\frac{d\bar{I}}{d\mu}$ achieves its minimum at $\mu = 1$. Hence, $\frac{d\bar{I}}{d\mu}|_{\mu=1} = -\ln\left(\frac{\alpha}{\alpha+\beta}\right) - \frac{\beta^2}{\alpha+\beta}$, which is decreasing in α. When $\alpha = 1$, $\frac{d\bar{I}}{d\mu}|_{\mu=1} = \ln(1+\beta) - \frac{\beta^2}{1+\beta} > 0$ for any β in $(0,1)$. Hence $\frac{d\bar{I}}{d\mu}|_{\mu=1} > 0$ for any α and β in $(0,1)$. Therefore, $\frac{d\bar{I}}{d\mu}$ is always positive in $(0,1)$ and $I(\mu)$ is thus increasing in μ.

A.1.2 The properties of $D(\mu)$

Recall $D(\mu) = \left[1-\left(\beta\mu\frac{1-\gamma}{1-\beta+\beta\mu}+\alpha-\alpha\gamma\right)\right]I(\mu)^{\beta}$. Note that $\frac{d}{d\mu}\left(\frac{1-\beta}{\beta}\frac{d\ln D}{d\mu}\right) = \frac{-\beta^3}{(\beta(\mu-1)+1)(\beta+\alpha(\beta(\mu-1)+1))^2} < 0$. Thus, $\ln D(\mu)$ is strictly concave in μ. To show D is strictly increasing in μ, it suffices to show $\frac{d\ln D}{d\mu}|_{\mu=1} > 0$, as $\frac{d\ln D}{d\mu}$ is strictly decreasing in μ. Note that $\frac{1-\beta}{\beta}\frac{d\ln D}{d\mu}|_{\mu=1} = -\ln\left(\frac{\alpha}{\alpha+\beta}\right) - \frac{\beta}{\alpha+\beta}$, which is always positive for any positive α and β in $(0,1)$. Hence, $\frac{1-\beta}{\beta}\frac{d\ln D}{d\mu}|_{\mu=1} > 0$, and hence $D(\mu)$ is increasing in μ.

A.2 Proof of Lemma 2

Let $G = D^{\frac{1}{\sigma-1}}$, and denote $G_1 = \frac{d\ln G}{d\mu}$ and $G_2 = \frac{d}{d\mu}\left(\frac{d\ln G}{d\mu}\right)$. Then, we have $G'' = \left(G_1^2+G_2\right)G$. Note both $G(\mu)$ and $G'(\mu) > 0$ from Section A.1.2. To show that the function $G(\mu)$ is strictly concave is equivalent to show that $G_1^2 < -G_2$, or

$$\ln\left(1+\frac{\beta}{\alpha\beta(\mu-1)+\alpha}\right) < \left[\left(\frac{\beta}{(\beta(\mu-1)+1)}\right)^{\frac{1}{2}}+1\right]\frac{\beta}{-\alpha\beta+\alpha+\beta+\alpha\beta\mu}.$$

Let $x = \frac{\beta}{\beta(\mu-1)+1}$. Then, we have $\beta \leq x \leq \frac{\beta}{1-\beta}$ as $0 \leq \mu \leq 1$. Let $H(\alpha, x) \equiv \left(\sqrt{x}+1\right)\frac{x}{\alpha+x} - \ln\left(1+\frac{x}{\alpha}\right)$. To prove that $G(\mu)$ is concave, it suffices to show $H(\alpha, x) \geq 0$ for any α and x. Note $H(\alpha, x)$ is increasing in α when $\alpha < \sqrt{x}$, and decreasing in α when $\alpha > \sqrt{x}$. Both $H\left(\sqrt{x}, x\right)$ and $H(1, x)$ are positive for $\beta \leq x \leq \frac{\beta}{1-\beta}$. Therefore, for any value $x \in [\beta, \frac{\beta}{1-\beta}]$, we can always locate a unique $\alpha_0(x)$ such that $H(\alpha_0, x) = 0$ and $0 < \alpha_0 < \sqrt{x}$. A sufficient condition for the function $G(\mu)$ to be concave is that $\alpha > \max \alpha_0(x)$, where $\beta \leq x \leq \frac{\beta}{1-\beta}$.

A.3 Proof of Proposition 2

Recall (23) from Section 4.1 that

$$\mu_i^c = \arg\max_{\mu_i} W_i = \left(\mathrm{RMA}_i \frac{D(\mu_i)}{f}\right)^{\frac{1}{\sigma}} L_i - A_i \mu_i^{\rho} L_i^{\eta}, \tag{A.1}$$

where $\mathrm{RMA}_i \equiv \frac{M_i}{P_i^{\sigma}}$, which each national planner takes as given under a competitive equilibrium. The facts that $D(\mu)^{\frac{1}{\sigma}}$ is strictly concave (Lemma 2) and $\rho > 1$ imply that the problem (A.1) entails a unique solution for each country i. Hence, there exists a unique competitive equilibrium. If the solution to (A.1) is interior, then it satisfies the first-order condition, which can be written as

$$\frac{1}{\sigma} D'(\mu_i) D(\mu_i)^{\frac{1-\sigma}{\sigma}} \left(\mathrm{RMA}_i \frac{1}{f}\right)^{\frac{1}{\sigma}} L_i = \rho A_i \mu_i^{\rho-1} L_i^{\eta}, \tag{A.2}$$

where the left-hand side is the marginal benefit of increasing μ_i, while the right-hand side is the marginal cost. Obviously, the marginal cost strictly increases in μ_i, and the marginal benefit strictly decreases in μ_i as $D(\mu)$ is strictly increasing and concave in μ and $\sigma > 1$. Because the marginal benefit strictly increases in RMA_i, a larger real market access leads to better institutional quality, holding population size fixed.

A.4 Proof of Proposition 3

We would like to prove the following three statements. First, a decrease in trade cost τ or an increase in the number of trading partners $J-1$ leads to a larger real market access. Second, there exists a unique Nash equilibrium. Third, a decrease in trade cost or an increase in the number of trading partners leads to better institutional quality. Then, the statement of this proposition follows from the fact that real market access is the only channel through which institutional qualities are affected by trade costs or the number of trading partners.

Using (9) and the symmetry ($P_i = 1$), together with the free-entry condition (19), we have

$$M_i = f\left(\frac{\left[1+(J-1)\,\tau^{1-\sigma}\right]L_i}{f}\right)^{\frac{\sigma}{\sigma-1}} D\left(\mu_i\right)^{\frac{1}{\sigma-1}}. \tag{A.3}$$

Hence, a decrease in trade cost τ or an increase in the number of trading partners $J-1$ will lead to larger real market access and higher wage rates, conditioned on μ_i. This proves the first statement. For the second and third statements, first note that $\text{RMA}_i = \frac{M_i}{P_i^{\sigma}}$ is no longer taken as given in a Nash equilibrium. In the symmetric Nash equilibrium, we normalize the price index $P_i = 1$ for each country i, and $d\ln P_i = 0$. Hence, $\text{RMA}_i = M_i$. Total differentiating both sides of (9), the definition of market access, with respect to each country's institutional quality μ_i entails

$$d\ln M_i = \sum_j \frac{\tau_{ij}^{1-\sigma}E_jP_j^{\sigma-1}}{\sum_k \tau_{ik}^{1-\sigma}E_kP_k^{\sigma-1}}\, d\ln \tau_{ij}^{1-\sigma}E_jP_j^{\sigma-1}. \tag{A.4}$$

Using the free entry condition (19), we have

$$d\ln E_i = d\ln w_i = \frac{1}{\sigma}\, d\ln M_i D\left(\mu_i\right). \tag{A.5}$$

Note in the symmetric world, $E_i = E_j$, and $\tau_{ij} = \tau$. Plugging (A.5) into (A.4), yields

$$\left(1 - \frac{1}{1 + (J-1)\,\tau^{1-\sigma}}\frac{1}{\sigma}\right) d\ln M_i = \frac{1}{1 + (J-1)\,\tau^{1-\sigma}}\frac{1}{\sigma} d\ln D(\mu_i) + \frac{\tau^{1-\sigma}}{1 + (J-1)\,\tau^{1-\sigma}} \sum_{j\neq i} \frac{1}{\sigma} d\ln M_j D\left(\mu_j\right). \tag{A.6}$$

Summing both sides of (A.6) over i entails

$$\sum_i d\ln M_i = \frac{1}{\sigma - 1}\sum_i d\ln D(\mu_i). \tag{A.7}$$

Combining (A.6) and (A.7), we have

$$d\ln M_i = \frac{1}{\sigma-1}\frac{\left(\sigma - 1 + \tau^{1-\sigma}\right) d\ln D(\mu_i) + \sigma\tau^{1-\sigma}\sum_{j\neq i} d\ln D\left(\mu_j\right)}{\sigma - 1 + \tau^{1-\sigma} + (J-1)\,\sigma\tau^{1-\sigma}}. \tag{A.8}$$

Each national planner solves the problem (A.1) by choosing institutional quality μ_i, given other countries' institutional qualities. The first-order condition is

$$\left(\frac{M_i D(\mu_i)}{f}\right)^{\frac{1}{\sigma}} d\ln\left(\frac{M_i D(\mu_i)}{f}\right)^{\frac{1}{\sigma}} L_i = \rho A_i \mu_i^{\rho-1} L_i^{\eta} d\mu_i. \tag{A.9}$$

Plugging (A.8) into (A.9) and using $d\ln D\left(\mu_j\right) = 0$ for $j \neq i$, we have

$$\frac{1}{\sigma}\left(\frac{M_i D(\mu_i)}{f}\right)^{\frac{1}{\sigma}}\left(\frac{1}{\sigma-1}\frac{\sigma - 1 + \tau^{1-\sigma}}{\sigma - 1 + \tau^{1-\sigma} + (J-1)\,\sigma\tau^{1-\sigma}} + 1\right) L_i d\ln D(\mu_i) = \rho A_i \mu_i^{\rho-1} L_i^{\eta} d\mu_i, \tag{A.10}$$

where the left-hand side is the margin benefit of increasing μ_i, while the right-hand side is the marginal cost. Define trade openness by $\phi = \tau^{1-\sigma}$, and thus, $\phi \in [0,1]$. Plugging (A.3) into (A.10) entails

$$\varsigma(\phi, J)\, D(\mu_i)^{\frac{2-\sigma}{\sigma-1}} D'(\mu_i)\, L_i^{\frac{\sigma}{\sigma-1}} = \rho A_i \mu_i^{\rho-1} L_i^{\eta}, \tag{A.11}$$

where

$$\varsigma(\phi, J) \equiv \frac{1}{\sigma}\left(\frac{1+(J-1)\,\phi}{f}\right)^{\frac{1}{\sigma-1}}\left(\frac{1}{\sigma-1}\frac{\sigma-1+\phi}{\sigma-1+\phi+(J-1)\,\sigma\phi}+1\right).$$

The term $D(\mu_i)^{\frac{2-\sigma}{\sigma-1}} D'(\mu_i)$ on the left-hand side of (A.11) is the derivative of $D(\mu_i)^{\frac{1}{\sigma-1}}$. By Lemma 2, $D(\mu_i)^{\frac{1}{\sigma-1}}$ is strictly concave, and hence $D(\mu_i)^{\frac{2-\sigma}{\sigma-1}} D'(\mu_i)$ strictly decreases in μ_i. Thus, the marginal benefit of μ_i (the left-hand side) strictly decreases in μ_i, while the marginal cost strictly increases in μ_i. As the marginal benefit and cost are defined on the closed interval $\mu_i \in [0, 1]$, there must exist a unique solution. Hence, the symmetric Nash equilibrium is unique (the second statement). The solution is a corner one if the marginal cost is at least as large as the marginal benefit at $\mu_i = 0$ or if the marginal benefit is at least as large as the marginal cost at $\mu_i = 1$. Whenever there is an interior solution, it satisfies (A.11). To prove the third statement (equilibrium μ_i decreases in trade costs τ and increases in the number of trading partners $J-1$), it suffices to show that $\varsigma(\phi, J)$ increases in J and ϕ.

$$\begin{aligned}
\frac{\partial \ln \varsigma(\phi, J)}{\partial J} &= \frac{1}{\sigma-1}\frac{\phi}{1+(J-1)\,\phi} - \frac{\frac{1}{\sigma-1}\frac{\sigma-1+\phi}{(\sigma-1+\phi+(J-1)\sigma\phi)^2}\sigma\phi}{\frac{1}{\sigma-1}\frac{\sigma-1+x}{\sigma-1+\phi+(J-1)\sigma\phi}+1} \\
&> \frac{1}{\sigma-1}\frac{\phi}{1+(J-1)\,\phi} - \frac{\frac{1}{\sigma-1}\frac{\sigma-1+\phi}{(\sigma-1+\phi+(J-1)\sigma\phi)^2}\sigma\phi}{\frac{1}{\sigma-1}\frac{\sigma-1+\phi}{\sigma-1+\phi+(J-1)\sigma\phi}+\frac{\sigma-1+\phi}{\sigma-1+\phi+(J-1)\sigma\phi}} \\
&= \frac{\phi}{(\sigma-1)(1+(J-1)\,\phi)} - \frac{\phi}{(\sigma-1+\phi)\left(1+\frac{\sigma}{\sigma-1+\phi}(J-1)\,\phi\right)} > 0.
\end{aligned}$$

Similarly, it is readily shown that $\frac{\partial \ln \varsigma(\phi, J)}{\partial \phi} > 0$.

A.5 Proof of Proposition 4

According to (A.11), the left-hand side (marginal benefit of improving institutional quality) is proportional to $L^{\frac{\sigma}{\sigma-1}}$, whereas the right-hand side (marginal cost of improving institutional quality) is proportional to L^{η}. It follows that a country will experience worse institutional quality if its population size increases when $\eta > \frac{\sigma}{\sigma-1}$; a country will experience better institutional quality if its population size increases when $\eta < \frac{\sigma}{\sigma-1}$. Institutional quality is independent of population size when $\eta = \frac{\sigma}{\sigma-1}$.

A.6 Proof of Corollary 1

Using (3), the definition of demand capacity $d_i \equiv E_i/P_i = (w_i L_i)/P_i$, and $\tau_{ij} \longrightarrow \infty$ for all $j \neq i$ for a closed economy, one immediately obtains that the real market access $\frac{M_i}{P_i^{\theta+1}}$ equals the real income $\frac{w_i L_i}{P_i}$. Combining this fact with (20) entails

$$\frac{w_i L_i}{P_i} = \left(\frac{D(\mu_i)}{f}\right)^{\frac{1}{\sigma-1}} L_i^{\frac{\sigma}{\sigma-1}}. \tag{A.12}$$

Plugging (A.12) into (22) and taking the first-order condition yield

$$\frac{1}{\sigma-1}\left(\frac{1}{f}\right)^{\frac{1}{\sigma-1}} L_i^{\frac{\sigma}{\sigma-1}} D\left(\mu_i\right)^{\frac{2-\sigma}{\sigma-1}} D'\left(\mu_i\right) = \rho A_i \mu_i^{\rho-1} L_i^{\eta},$$

which is, indeed, (A.11) with $J = 1$ and $\phi = 0$. Similar to the proof in Appendix A.5, a country experiences worse (better) institutional quality when its population size increases if $\eta > \frac{\sigma}{\sigma-1}$ ($\eta < \frac{\sigma}{\sigma-1}$). Institutional quality is independent of population size when $\eta = \frac{\sigma}{\sigma-1}$.

A.7 Proof of Proposition 5

We first solve the global planner's problem, where the planner takes into account all aggregate variables and attaches equal weight to each country's welfare:

$$\max_{\{\mu_i\}} \sum_i \left(\frac{M_i}{P_i^{\sigma}}\frac{D\left(\mu_i\right)}{f}\right)^{\frac{1}{\sigma}} L_i - \sum_i A_i \mu_i^{\rho} L_i^{\eta}.$$

Using (A.3), (A.7) and the symmetry that $M_i D\left(\mu_i\right) = M_j D\left(\mu_j\right)$, we have the first-order condition reduced to the following:

$$\frac{1}{\sigma-1}\left(\frac{1+(J-1)\,\tau^{1-\sigma}}{f}\right)^{\frac{1}{\sigma-1}} D\left(\mu_i\right)^{\frac{2-\sigma}{\sigma-1}} D'\left(\mu_i\right) L_i^{\frac{\sigma}{\sigma-1}} = \rho A_i \mu_i^{\rho-1} L_i^{\eta}. \tag{A.13}$$

Similar to the proof for Proposition 3, the left-hand side is the marginal benefit of improving μ_i, which strictly decreases in μ_i, while the right-hand side is the marginal cost, which strictly increases in μ_i. As the marginal benefit and cost are defined over a closed interval $\mu_i \in [0, 1]$, there exists a unique solution. When the solution is interior, it satisfies (A.13).

Next, we consider the symmetric competitive equilibrium where each national planner i takes the market access M_i and price index P_i as given. Under symmetry, P_i is normalized to 1 for all countries. Using $\text{RMA}_i \equiv \frac{M_i}{P_i^{\sigma}}$ and plugging (A.3) into (A.2), the first-order condition that determines μ_i^c is given as follows:

$$\frac{1}{\sigma}\left(\frac{1+(J-1)\,\tau^{1-\sigma}}{f}\right)^{\frac{1}{\sigma-1}} D\left(\mu_i\right)^{\frac{2-\sigma}{\sigma-1}} D'\left(\mu_i\right) L_i^{\frac{\sigma}{\sigma-1}} = \rho A_i \mu_i^{\rho-1} L_i^{\eta}. \tag{A.14}$$

The first-order conditions for determining μ_i^g, μ_i^n, and μ_i^c are given by (A.13), (A.11), and (A.14), respectively; they are different only in terms of the multiplicative constant before the term $D\left(\mu_i\right)^{\frac{2-\sigma}{\sigma-1}}$. As mentioned, the left-hand sides of all three equations decrease in μ_i, and the right-hand sides increase in μ_i. It is readily verified that

$$\frac{1}{\sigma-1} > \frac{1}{\sigma}\left(\frac{1}{\sigma-1}\frac{\sigma-1+\tau^{1-\sigma}}{\sigma-1+\tau^{1-\sigma}+(J-1)\,\sigma\tau^{1-\sigma}}+1\right) > \frac{1}{\sigma}, \tag{A.15}$$

and thus $\mu_i^g > \mu_i^n > \mu_i^c$. Because the marginal benefit of improving institutional quality is larger in the global planner's problem, followed by the Nash equilibrium and the competitive equilibrium, and the marginal costs are the same under the three solutions, we have $W_i^g > W_i^n > W_i^c$.

Observe that when $J \longrightarrow \infty$, the second inequality in (A.15) becomes equality, while the first inequality remains. This means that $\mu_i^n \longrightarrow \mu_i^c$ and $W_i^n \longrightarrow W_i^c$ as $J \longrightarrow \infty$, whereas the gap between μ_i^g and μ_i^n and hence that between W_i^g and W_i^n remain.

References

Acemoglu, D., Antràs, P., and Helpman, E. (2007). Contracts and technology adoption. *American Economic Review*, 97(3):916–943.

Acemoglu, D., Johnson, S., and Robinson, J. (2005). The rise of europe: Atlantic trade, institutional change, and economic growth. *American Economic Review*, 95(3):546–579.

Acemoglu, D., Johnson, S., and Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American Economic Review*, 91(5):1369–1401.

Acemoglu, D. and Robinson, J. A. (2012). *Why nations fail: The origins of power, prosperity, and poverty*. Crown Currency.

Akamatsu, K. (1962). A historical pattern of economic growth in developing countries. *Developing Economies*, 1:3–25.

Alesina, A. and Spolaore, E. (1997). On the number and size of nations. *Quarterly Journal of Economics*, 112(4):1027–1056.

Alesina, A., Tabellini, G., and Trebbi, F. (2017). Is europe an optimal political area? *National Bureau of Economic Research*.

Anderson, J. E. and Van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Rview*, 93(1):170–192.

Antràs, P. (2005). Incomplete contracts and the product cycle. *American Economic Review*, 95(4):1054–1073.

Auer, R. A. (2013). Geography, institutions, and the making of comparative development. *Journal of Economic Growth*, 18(2):179–215.

Barro, R. J. and Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, 104:184–198.

Beverelli, C., Keck, A., Larch, M., and Yotov, Y. (2018). Institutions, trade and development: a quantitative analysis. *CESifo Working Paper Series*.

Campante, F. R. and Do, Q.-A. (2014). Isolated capital cities, accountability, and corruption: Evidence from us states. *American Economic Review*, 104(8):2456–2481.

Chor, D. and Ma, L. (2021). Contracting frictions in global sourcing: Implications for welfare. *Dartmouth College Working Paper*.

Diamond, J. M. (1997). *Guns, Germs, and Steel: The Fates of Human Societies*. W. W. Norton Company.

Donaldson, D. and Hornbeck, R. (2016). Railroads and american economic growth: A "market access" approach. *Quarterly Journal of Economics*, 131(2):799–858.

Faccio, M. and Zingales, L. (2022). Political determinants of competition in the mobile telecommunication industry. *Review of Financial Studies*, 35(4):1983–2018.

Fally, T. (2015). Structural gravity and fixed effects. *Journal of International Economics*, 97(1):76–85.

Grossman, S. J. and Hart, O. D. (1986). The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy*, 94(4):691–719.

Head, K. and Mayer, T. (2014). Gravity equations: Workhorse, toolkit, and cookbook. *Handbook of International Economics*, 4:131–195.

Howell, L. D. (2011). International country risk guide methodology. *East Syracuse, NY: PRS Group*.

Hsieh, C.-T. and Olken, B. A. (2014). The missing "missing middle". *Journal of Economic Perspectives*, 28(3):89–108.

Jiao, Y. and Wei, S.-J. (2022). Globalization shocks and governance reforms: Evidence from vietnam. *Singapore Management University Working Paper*.

Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *American Economic Review*, 70(5):950–959.

La Porta, R., Lopez-de Silanes, F., and Shleifer, A. (2008). The economic consequences of legal origins. *Journal of Economic Literature*, 46(2):285–332.

Larch, M., Wanner, J., Yotov, Y. V., and Zylkin, T. (2019). Currency unions and trade: A ppml re-assessment with high-dimensional fixed effects. *Oxford Bulletin of Economics and Statistics*, 81(3):487–510.

Levchenko, A. A. (2007). Institutional quality and international trade. *Review of Economic Studies*, 74(3):791–819.

Levchenko, A. A. (2012). International trade and institutional change. *Journal of Law, Economics, & Organization*, 29(5):1145–1181.

Mukoyama, T. and Popov, L. (2015). Industrialization and the evolution of enforcement institutions. *Economic Theory*, pages 1–44.

Puga, D. and Trefler, D. (2014). International trade and institutional change: Medieval venice's response to globalization. *Quarterly Journal of Economics*, 129(2):753–821.

Redding, S. and Venables, A. J. (2004). Economic geography and international inequality. *Journal of international Economics*, 62(1):53–82.

Santos Silva, J. and Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics*, 88(4):641–658.