# Market Size and Institutions in a Global Economy*

Xuan Luo† Wen-Tai Hsu‡

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## Abstract

This paper studies the relationship between market size and institutional quality in a global economy. Using a comprehensive dataset from the International Country Risk Guide, we examine how real market access — constructed using a structural gravity equation framework — affects various dimensions of institutional quality from 1986 to 2010. While several institutional aspects show positive correlations with market access in the OLS results, only the dimension of Law and Order remains significant across different instrumental variable estimations, underscoring the relevance of contracting institutions. We then propose a theory of market size and institution by extending the incomplete-contract model in Acemoglu, Antràs, and Helpman (2007) to an open-economy 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 a higher institutional quality. It also discusses the direction of the scale effect of population, discovers a trade-diversion effect 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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†School of Economics and Management, Wuhan University. Email: luoxuan@whu.edu.cn

‡Institute of Economics, Academia Sinica. Email: wthsu@econ.sinica.edu.tw.

# 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 Korea.

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 by improving property rights protection and contractual environment, reducing the weights of state-owned enterprises, etc., making themselves more "inclusive" economically (Acemoglu and Robinson, 2012).So, our more specific question is does market access lead to improvement in institutional quality?

Another important piece of evidence is the Atlantic trade, as emphasized in Acemoglu, Johnson, and Robinson (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.

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 identify which dimensions of institutions may be affected by market access. Second, it develops a theory to explain the relationship between market access and institutional quality.

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. Institutions are multi-faceted. We examine how real market access may affect each of the 12 dimensions in the Political Risk Rating in the ICRG, as well as the composite index, Political Risk. Our empirical specification relies on long-difference regressions, as institutional qualities change relatively slowly. Namely, we examine how changes in real market access affect changes in institutional quality between 1986 and 2010, and time-invariant country characteristics are differenced out. To deal with endogeneity issues, we employ instrumental variable (IV) estimations to address endogeneity concerns. Borrowing from Head and Mayer (2014), we use geographic centrality, the sum of the inverses of geographic distances of a country to all countries in the world, as the instrument, and show that the geographic centrality not only affects market access but also the change in market access. We experiment with three versions of geographic centrality: population-weighted, area-weighted, and unweighted.

While half of the 12 dimensions and the composite index show strong and positive conditional correlations with real market access in the OLS results, only one dimension, Law and Order, remains significant across all three IV estimations. As the ICRG Law and Order can be taken as a proxy to contracting institutions (Nunn, 2007; Levchenko, 2007; Chang and Chen, 2021; Cui, Yu, and Zhang, 2022), the results indicate that one should focus on why a larger real market access leads to better contracting institutions.

Our theory consists of two steps. The first step is to incorporate the model of the contractual environment and technology adoption by Acemoglu et al. (2007) into an international trade environment *á la* Krugman (1980), which belongs to the structural gravity framework.[1] 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 (Williamson, 1985; 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 a lower overall productive efficiency. Improvement in institutional quality leads to improvement in overall productive efficiency. We show that a country's real income increases with its institutional quality and real market access, and the two are complementary.

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. In an open-economy environment, a larger effective market size (which may arise from locational advantages, trade liberalization, an increase in the home or nearby countries' population/human capital/purchasing power, or better political ties) makes the pie of a better production process larger, and hence governments will choose a better contracting institution if the associated costs are not prohibitive.

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. Absent a global plan-

[1] 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.

ner, the institutional externality is not internalized in either competitive or Nash equilibrium. Furthermore, the effect of improving institutional quality on the home market size is ignored in competitive equilibria. Thus, 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 as follows. The first concerns the *scale effect of population size*. As this paper argues that larger real market access leads to institutional improvement, our theory naturally features a scale effect. Whereas trade costs affect the determination of institutional quality only via real market access, population affects both real market access and institutional costs, as we assume that such costs increase with population. Presumably, larger countries usually involve a larger geographic space and more diverse ethnic/religious groups, both of which increase the communications costs for building and maintaining institutions. As a result, 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*. 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.[2]

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), Dutt and Traca (2010), Beverelli, Keck, Larch, and Yotov (2018), and Chor and Ma (2021), several studies have also examined the reverse relationship, such as North and Thomas (1973), Acemoglu et al. (2005), Levchenko (2012),

[2]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.

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 two papers as our empirical analysis uses modern and global data (ICRG) and examines the effects of real market access on various dimensions of institutional qualities. Our theory also differs from Puga and Trefler (2014) because we focus on the role of market size and increasing returns, whereas theirs focuses on the dynamics of the political economy. Our discussion on the scale effect of population is reminiscent of North and Thomas (1973), but the arguments differ.

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. As a robustness check, they also examine cross-country evidence using the Political Risk index in ICRG. Fitting their Vietnam results, their theory explains why trade openness leads to better institutions using a small-open-economy approach. Despite the similarity in the main message, 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. Our results differ as the effect of real market access on Political Risk is insignificant, and we identify that Law and Order is what matters. 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. We also explore the welfare properties of competitive and Nash equilibria.

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

## 2 Empirical Analysis

As mentioned in the introduction, we are interested in answering whether larger market access leads to improvement in institutional quality. Market access measures 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. As will be defined in mathematical terms shortly, market access encompasses information on each market's purchasing power and the trade barriers (tariff, transport cost, and non-tariff barriers, as mentioned in the introduction). Institutions are multifaceted. We would like to investigate how various aspects of a country's institution are affected by market access.

Market access has been used to explain wage inequality (Redding and Venables, 2004) and land value (Donaldson and Hornbeck, 2016). In this paper, we are interested in how market access affects a country's institutional quality. 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 if the 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, and it is likely that the real object that the planner is concerned with is directly linked with real market access rather than the nominal one. 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 Mayer, 2014).

### 2.1 Structural Gravity Model

In the class of structural gravity models as defined in Head and Mayer (2014) and Fally (2015), 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, $\tau_{ij}$ is the trade cost between country $i$ and country $j$, $\theta$ 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 $\Pi_i$ 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 $P_i^{\theta+1}$.

### 2.2 Data and Measurement

For the different aspects of institutional quality, our main data source is the International Country Risk Guide (ICRG) (Howell, 2011). The indices in ICRG are comparable over time and across countries. Following Alesina, Tabellini, and Trebbi (2017) and Faccio and Zingales (2022), we examine the 12 variables in the Political Risk Rating in the ICRG dataset. This category consists of 12 dimensions: (A) Government Stability, (B) Socio-economic Conditions, (C) Investment Profile, (D) Internal Conflict, (E) External Conflict, (F) Corruption (G) Military in Politics, (H) Religious Tensions, (I) Law and Order (J) Ethnic Tensions, (K) Democratic Accountability, and (L) Bureaucracy Quality. The higher a country scores in a dimension, the better the country fares in that dimension. For example, higher points for (F) Corruption or (H) Religious Tensions imply less corruption or less religious tensions. Some dimensions range from 0 to 12 points, and some range from 0 to 6 points. We also examine the composite index — Political Risk Index, which is an unweighted sum of the 12 dimensions.[3]

To calculate country-specific real market access, we first need to estimate the gravity equation (1). Taking the logarithms of equation (1) and estimating it by OLS drop zero trade flows and consequently generate selection bias. We apply the Pseudo Poison Maximum Likelihood (PPML) as in Santos Silva and Tenreyro (2006) to solve this issue. 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 (i.e., share the same border) 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 the "TRADEHIST" dataset in CEPII.

Equation (4) is estimated in the panel setting from 1984 to 2014, the time periods when the ICRG and "TRADEHIST" datasets overlap; $\ln s_{it}$ and $\ln d_{jt}$ are treated as time-varying exporter and importer fixed effects.[4] As our data set does not contain intranational trade flows, the specification in (4) is estimated with "international" trade flows only. To compute the intranational trade cost $\tau_{ii}$ 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 $\text{area}_i$ 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. As will be shown shortly, 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, similar to Donaldson and Hornbeck (2016)

[3]When implementing our empirical exercises, each of the 12 dimensions of institutional quality, as well as the composite index, is normalized to $[0, 1]$.

[4]We use commands taken from Larch, Wanner, Yotov, and Zylkin (2019) for fast estimation.

and Redding and Venables (2004). 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 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 $\theta$, $\hat{P}_{jt}$ and $\widehat{RMA}_{it}$ can be calculated. We take $\theta = 3.78$ so that the trade elasticity $\theta$ 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 $\theta$.

### 2.3 Empirical Strategy

How are the different dimensions of institutional qualities affected by changes in real market access? To answer this question, we estimate a long-difference specification, as institutional quality evolves relatively slowly. We take five-year averages of the variables to mitigate the concerns of measurement errors, as in Campante and Do (2014). Our ICRG data cover the years between 1984 and 2010. We define the years from 1984 to 1990 as period 1 and every five years as a new period thereafter. The long difference is taken between period 5 (2006–2010) and period 1 (1984–1990), and the specification is as follows.

$$\Delta \text{IQ}_i = \beta_0 + \beta_1 \Delta \ln \text{RMA}_i + \text{Controls} + \epsilon_i, \quad (5)$$

where $\Delta \text{IQ}_i$ refers to the change in a specific dimension of institutional quality in country $i$, $\Delta \ln \text{RMA}_i$ is the change in the logarithm of country $i$'s real market access, Controls are an array of control variables, and $\epsilon_i$ is the error term. Our coefficient of interest is $\beta_1$, which captures how changes in real market access induce changes in institutional quality. The long-difference specification is essentially equivalent to the non-differenced specification with country fixed effects. The time-invariant country-level characteristics are differenced out.

We first estimate (5) using OLS. We control for country-level time-varying variables that are important determinants of institutional quality besides the potential role of real market access. This includes population size and human capital. The population size of a country contributes to the real market access of that country, but it may also affect institutional qualities 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). Controlling for human capital is also necessary. On the one hand, it accounts for the productive efficiency of the population. On the other hand, 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. As both population and human capital can be affected by market access, they may end up as bad controls (Angrist and Pischke, 2009). Thus, instead of directly controlling for the long differences of population size and human capital, we control for the initial values of population size and human capital in period 1. This is equivalent to controlling for the interaction term between the initial population size (or human capital) and the period dummies in the non-differenced specification with country fixed effects. The human capital data is obtained from Barro and Lee (2013). Moreover, we control for the initial institutional quality of each dimension, following Acemoglu et al. (2005).

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 institutional quality may contribute to larger market access. Note that the market access can be decomposed into the home market access and foreign market access. Institutional quality may affect the production structure (e.g., corruption or inferior contracting institutions may distort production) and hence aggregate productivity, which, in turn, is closely linked to the income level of the country and, thus, home market size. In addition, a country's institutional quality may affect foreign market access through general equilibrium effects on relative prices and wages. Second, some relevant time-varying country characteristics might still be omitted, which may confound the estimate.

To have a causal interpretation, we adopt an instrumental variable (IV) approach to estimate (5). Borrowing from Head and Mayer (2014), we exploit the exogenous variation of the change in real market access that stems from a trend effect of a country's geographic centrality.[5] 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 $\text{pop\_share}_j$ is the population share of country $j$ in the initial period, and the self distance $\text{dist}_{ii}$ is calculated in the same way as Section 2.2. The relevance condition

[5]This is equivalent to instrumenting real market access by the interaction term between geographic centrality and period dummies in a non-differenced specification.

is likely to hold as the geographic centrality not only affects market access but also the change in market access.[6] As we will see soon, it is also corroborated by the first stage results.

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 and early disease environment (Acemoglu, Johnson, and Robinson, 2001; La Porta, Lopez-de Silanes, and Shleifer, 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 is controlled. We also experiment with area-weighted geographic centrality and unweighted geographic centrality, but we consider the population-weighted geographic centrality as our benchmark instrument because the way in which it is constructed is closest to real market access.

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 $\text{FMA}^{\text{RV}}$, 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 $\text{pop}_j$ is the population of country $j$.[7] Correspondingly, the home country is also excluded when calculating geographic centrality for these two IV estimations.

## 2.4 Empirical Results

Table 1 presents the OLS regression results of the effect of Real Market Access on various dimensions of institutions from ICRG. The first twelve columns correspond to the 12 dimensions in the

[6]To see this, one can start with the definition of real market access and derive the following:

$$d \ln RMA_{it} = d \ln M_{it} - (\theta + 1)\, d \ln P_{it} = \sum_j \left( \frac{d_{jt}\, d \ln \tau_{ijt}^{-\theta} d_{jt}}{M_{it}} + \frac{\theta + 1}{\theta} \frac{s_{jt}\, d \ln \tau_{ijt}^{-\theta} s_{jt}}{P_{it}^{-\theta}} \right) \tau_{ijt}^{-\theta}.$$

Assume that the trade cost $\tau_{ijt}$ can be decomposed into a distance term, which is time-invariant, and a remaining component $\tau'_{ijt}$ by $\tau_{ijt}^{-\theta} = dist_{ij}^{-\delta_1} * \tau_{ijt}'^{-\theta}$. Then,

$$d \ln RMA_{it} = \sum_j \left( \frac{d_{jt} \tau_{ijt}'^{-\theta} d \ln d_{jt} \tau_{ijt}'^{-\theta}}{M_{it}} + \frac{\theta + 1}{\theta} \frac{s_{jt} \tau_{ijt}'^{-\theta} d \ln s_{jt} \tau_{ijt}'^{-\theta}}{P_{it}^{-\theta}} \right) dist_{ij}^{-\delta_1} \equiv \sum_j \chi_{ijt}\, dist_{ij}^{-\delta_1}$$

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

**Table 1**: Effects of Real Market Access on Different Dimensions of Institutional Quality – OLS Estimation

| | ΔDependant variables | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | (1) government Stability | (2) socioeconomic conditions | (3) investment profile | (4) internal conflict | (5) external conflict | (6) law order | (7) corruption control | (8) military in politics | (9) religious tensions | (10) ethnic tensions | (11) democratic accountability | (12) bureaucracy quality | (13) political risk |
| Δ ln(RMA) | 0.043 | 0.090*** | 0.052 | 0.038** | 0.046** | 0.116*** | 0.021 | 0.150*** | 0.042 | 0.040 | 0.011 | 0.084** | 0.005*** |
| | (0.030) | (0.027) | (0.035) | (0.019) | (0.020) | (0.034) | (0.028) | (0.054) | (0.036) | (0.039) | (0.076) | (0.039) | (0.001) |
| Initial ln(population) | -0.022*** | -0.005 | -0.016** | -0.027*** | -0.021*** | -0.010 | -0.003 | -0.016 | -0.028*** | -0.032*** | 0.002 | 0.005 | -0.002*** |
| | (0.006) | (0.007) | (0.007) | (0.005) | (0.005) | (0.008) | (0.008) | (0.012) | (0.009) | (0.009) | (0.016) | (0.010) | (0.000) |
| Initial human capital | -0.029** | 0.088*** | 0.040*** | 0.030*** | -0.002 | 0.086*** | 0.071*** | 0.071*** | 0.035* | -0.001 | 0.049** | 0.148*** | 0.003*** |
| | (0.012) | (0.014) | (0.013) | (0.011) | (0.011) | (0.015) | (0.016) | (0.021) | (0.018) | (0.016) | (0.021) | (0.019) | (0.001) |
| Initial institution | -0.863*** | -0.319*** | -0.243** | -0.827*** | -0.842*** | -0.680*** | -0.637*** | -0.562*** | -0.579*** | -0.536*** | -0.507*** | -0.721*** | -0.586*** |
| | (0.078) | (0.083) | (0.113) | (0.050) | (0.058) | (0.059) | (0.076) | (0.085) | (0.078) | (0.064) | (0.113) | (0.070) | (0.057) |
| Observations | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 |
| R-squared | 0.674 | 0.298 | 0.108 | 0.815 | 0.826 | 0.504 | 0.457 | 0.375 | 0.409 | 0.481 | 0.177 | 0.583 | 0.620 |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Robust standard errors 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. We focus on period 1 and period 5 (years 2006-2010). The results are reported based on the long difference regression between period 1 and period 5 after averaging the variables in each period. Here, ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

ICRG's Political Risk Rating, and the last column is the composite index, Political Risk. Half of the 12 dimensions positively correlate with real market access with statistical significance, conditioned on initial levels of population, human capital, and institutional quality. The result of political risk is also highly significant.

For the other covariates, the coefficients on population are mostly negative and statistically significant; this likely reflects the negative relationship between population size and the building/maintenance costs of institutions, as mentioned earlier. Higher initial human capital paves the way for a large scope of institutional reform, whereas higher initial institutional quality may indicate less room to improve institutional quality subsequently. These patterns hold generally across different dimensions of institutional quality.

Next, we show the results of IV estimations. Table 2 shows the first-stage results for the IV regressions for all three separate instruments discussed in the previous subsection. Column 1 reports the result with the population-weighted geographic centrality and the same set of controls in the OLS estimation (Table 1); Columns 2 and 3 report the results when area-weighted geographic centrality and unweighted geographic centrality are used, respectively. As expected, changes in real market access are strongly and positively correlated with various measures of geographic centrality. The Anderson-Rubin Wald test and the Stock-Wright LM test both indicate the instruments are not weak; the relevance restriction is satisfied.

Table 3 shows the second-stage results. Panels A to C in Table 3 correspond to Columns 1 to 3 in Table 2. As Table 3 has the same set of controls as in the OLS estimation, it shows a sharp contrast that many of the 12 institutional dimensions that were statistically significant in the OLS estimation become insignificant in the IV estimations. In particular, only Law and Order, Religious Tensions, and Bureaucracy Quality survive in terms of statistical significance. Moreover, only Law and Order is significant across the three IV estimations. As a result, the composite index, Political Risk, is insignificant for all three IV estimations.

The results from Table 3 suggest that one should focus on Law and Order for how real market access may influence institutional quality. 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. Several prior studies have used Law and Order or similar measures such as the rule of law to proxy the contracting institution (Nunn, 2007; Levchenko, 2007; Chang and Chen, 2021; Cui et al., 2022), and hence one natural candidate for explaining the found empirical relation is through how real market access may help improve the contracting institution. More specifically, a strong and

**Table 2**: The First-Stage Results for the IV Estimations

| | Dependant variables: $\Delta \ln(\text{RMA})$ | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | Population-weighted | Area-weighted | Unweighted |
| Geographic centrality | 0.371*** | 0.485** | 0.227** |
| | (0.098) | (0.187) | (0.101) |
| Controls | Yes | Yes | Yes |
| Anderson-Rubin Wald test | 32.44*** | 11.25*** | 10.55*** |
| Stock-Wright LM S statistic | 24.60*** | 11.23*** | 8.91*** |
| Observations | 109 | 109 | 109 |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Robust standard errors 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. We focus on period 1 and period 5 (years 2006-2010). The results are reported based on the long difference regression between period 1 and period 5 after averaging the variables in each period. All regressions control for the average population, human capital, and institutional quality in period 1. In Column (1), we instrument the $\Delta \ln(\text{RMA})$ with geographic centrality weighted by the average population in period 1, measured as the sum of the inverse distance to each country in the world (including itself), i.e.$\sum_{j=1}^{J} \text{pop\_share}_j/\text{dist}_{ij}$. Column (2) and Column (3) use area-weighted and unweighted geographic centrality, respectively. Here, ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

impartial legal system implies a contractual environment that is conducive to doing business. If a country has a larger effective market size accessible to its firms, the government may deem it more beneficial to reform contractual institutions. 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 maximizing the benefits of the larger effective market size. To formalize these ideas, we will propose a theory of how the contracting institutions are determined and affected by trade costs and effective market sizes.

As population-weighted geographic centrality is our preferred instrument, we interpret the quantitative significance of Law and Order using Panel A of Table 3. When the log change of real market access moves from the first quartile (Ghana) to the third quartile (South Korea), the institutional quality improves by 0.23 units, equivalent to 1.05 standard deviation of the ICRG Law and Order.

**Table 3**: Effects of Real Market Access on Different Dimensions of Institutional Quality (IV Estimations)

| | $\Delta$Dependant variables | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | (1) government Stability | (2) socioeconomic conditions | (3) investment profile | (4) internal conflict | (5) external conflict | (6) law order | (7) corruption control | (8) military in politics | (9) religious tensions | (10) ethnic tensions | (11) democratic accountability | (12) bureaucracy quality | (13) political risk |
| | Panel A—Population-weighted IV | | | | | | | | | | | | |
| $\Delta$ ln(RMA) | 0.091 | 0.104 | 0.096 | 0.001 | 0.005 | 0.491*** | 0.058 | 0.041 | -0.450** | 0.056 | -0.176 | 0.193* | 0.004 |
| | (0.084) | (0.093) | (0.097) | (0.065) | (0.055) | (0.120) | (0.086) | (0.138) | (0.213) | (0.122) | (0.172) | (0.100) | (0.004) |
| | Panel B—Area-weighted IV | | | | | | | | | | | | |
| $\Delta$ ln(RMA) | 0.104 | -0.051 | 0.101 | -0.069 | -0.059 | 0.406** | 0.031 | 0.056 | -0.195 | -0.072 | 0.141 | -0.123 | 0.001 |
| | (0.112) | (0.111) | (0.106) | (0.086) | (0.079) | (0.183) | (0.127) | (0.171) | (0.225) | (0.166) | (0.190) | (0.153) | (0.005) |
| | Panel C—Unweighted IV | | | | | | | | | | | | |
| $\Delta$ ln(RMA) | 0.116 | 0.222 | 0.329 | 0.037 | -0.013 | 0.484** | 0.077 | 0.069 | -0.480 | 0.090 | 0.038 | 0.200 | 0.009 |
| | (0.144) | (0.201) | (0.204) | (0.089) | (0.095) | (0.232) | (0.169) | (0.208) | (0.373) | (0.192) | (0.209) | (0.177) | (0.007) |

Robust standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Note: Robust standard errors 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. We focus on period 1 and period 5 (years 2006-2010). The results are reported based on the long difference regression between period 1 and period 5 after averaging the variables in each period. All regressions control for the average population, human capital, and institutional quality in period 1. In panel A, we instrument $\Delta$ ln(RMA) with countries' geographic centrality weighted by average population in period 1, measured as the sum of the inverse distance to each country in the world (including itself), i.e. $\sum_{j=1}^{J} \text{pop\_share}_j/\text{dist}_{ij}$. Panel B and Panel C use area-weighted IV and unweighted IV, respectively. Here, ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

**Table 4**: Robustness Checks

| | Dependant variable: Δ ICRG Law and Order | | | | |
|---|---|---|---|---|---|
| VARIABLES | (1) | (2) | (3) | (4) | (5) |
| | baseline | $\theta = 2$ | $\theta = 9$ | RV | DH |
| Δ ln(RMA) | 0.491*** | 0.433*** | 0.538*** | 0.479*** | 3.552** |
| | (0.120) | (0.104) | (0.133) | (0.109) | (1.458) |
| Controls | Yes | Yes | Yes | Yes | Yes |
| Estimation | IV | IV | IV | IV | IV |
| Observations | 109 | 109 | 109 | 109 | 109 |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Robust standard errors 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. We focus on period 1 and period 5 (years 2006-2010). The results are reported based on the long difference regression between period 1 and period 5 after averaging the variables in each period. Controls include the average population, human capital, and institutional quality in period 1. We instrument Δ ln(RMA) with countries' geographic centrality weighted by the average population in period 1, measured as the sum of the inverse distance to each country in the world (including itself), i.e. $\sum_{j=1}^{J} \text{pop\_share}_j / \text{dist}_{ij}$. Here, ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

## 2.5 Robustness Checks

Next, we conduct some robustness checks, and the results are shown in Table 4. All of these robustness checks focus on ICRG Law and Order and use the IV estimation with population-weighted geographic centrality and the same set of controls as in the previous tables. Column 1 replicates the baseline result for the ease of comparison. As the trade-elasticity parameter $\theta$ is required for constructing real market access, we gauge whether the main result is robust to using alternative values of $\theta$, as shown in Columns 2 and 3. Columns 4 and 5 show the results when real market access is replaced with (real) foreign market access using the approaches by Redding and Venables (2004) and Donaldson and Hornbeck (2016), respectively, as explained in Section 2.3. The main result, that larger real market access leads to higher institutional quality, is robust to all of these checks. The quantitative magnitudes of the estimates also remain in the same ballpark.

# 3 Theory: Contracting Institution and Global Economy

In this and the next sections, we propose a theory to explain the link between real market access and contracting institutions. To this end, we first extend the model of Acemoglu et al. (2007) to 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.

## 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, each of which is indexed by $\omega$:

$$U_j = \left( \int_{\omega} q_j (\omega)^{\beta} \, d\omega \right)^{\frac{1}{\beta}},$$

where $\beta \in (0, 1)$ and $q_j(\omega)$ is the quantity consumed. 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 $\omega$ 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 $\omega$ 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 $\omega$. The production function for every good $\omega$ 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 $\mu_i$ 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.[8] The four stages of

[8] In Acemoglu et al. (2007), the firm also chooses the number of suppliers, but this choice is shut down here. We

the game between each firm and its suppliers are given as follows:

1. The firm $\omega$ 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 $\kappa_s$ 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;

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). We start with the simpler case of complete contract ($\mu_i = 1$) to set up the environment of trade and economy. We then proceed to study the case of incomplete contract ($\mu_i < 1$). 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 Complete Contracts

Let the factory-gate price be denoted by $p_i$ (for cleaner exposition, index $\omega$ 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

normalize the number of suppliers for each firm to create unity and abstract away technology adoption, which is not our focus.

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 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

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

With a complete contract, the symmetry across all $s$ in (6) and across all $m$ in (7) imply that $x_i(m, s) = y_i$ for any $m$ and $s$. The total cost to produce $y_i$ units of a differentiated good is simply $w_i y_i$. Note here that by construction, productivity and the unit labor requirement are both normalized to 1 under a complete contract. The profit maximization problem for the firm is

$$\begin{aligned} \pi_i^* &= \max_{y_i} r_i - w_i y_i \\ &= \max_{y_i} y_i^{\beta} M_i^{1-\beta} - w_i y_i \end{aligned}$$

The standard solution yields profit-maximizing price, output, and profit:

$$p_i^* = \frac{\sigma}{\sigma - 1} w_i, \qquad y_i^* = \beta^{\frac{1}{1-\beta}} w_i^{-\frac{1}{1-\beta}} M_i, \qquad \pi_i^* = (1-\beta)\beta^{\frac{\beta}{1-\beta}} w_i^{-\frac{\beta}{1-\beta}} M_i.$$

Free entry implies that $\pi_i^* = w_i f$. 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 that 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 Hart and Moore (1990) and 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 $\gamma$ fraction of its revenue. Thus, $\gamma r_i$ is the Shapley value of the firm; $\gamma$ increases in $\alpha$ but decreases in $\beta$. This is intuitive since a larger $\alpha$ means a greater elasticity of substitution among specialized inputs and, hence, smaller bargaining power for the suppliers. A higher $\beta$ 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 $\kappa_s$, 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:

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

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 $\mu_i$. 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 $x^*$. Combining the solution of $y_i^*$ and the fact that $x^* = y_i^*$ in Section 3.2.1, $x^* = \beta^{\frac{1}{1-\beta}} w_i^{-\frac{1}{1-\beta}} M_i$. 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 $\mu_i$, 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 $I(\mu) = [\alpha(1-\gamma)]^{\frac{1-\mu}{1-\beta}} B(\mu)^{\mu}$. 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 $\mu$.

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

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

Therefore, 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 given by

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

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.

The number of firms in country $i$ is

$$n_i = \frac{L_i}{f + \mu_i x_c + (1-\mu_i)x_n} \tag{21}$$

$$= \frac{L_i}{f}\left[1 - \beta\left(\frac{(1-\gamma)\,\mu_i}{1-\beta+\beta\mu_i} + \gamma\right)\right], \tag{22}$$

The denominator in (21) is the firm size as measured by the total labor hired by each firm, comprising 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. Equation (22) is then derived by invoking the expression of $x_c$ and $x_n$ from (15-16), together with the free entry condition (19). 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.

We are now ready to define an equilibrium given institutional qualities $\{\mu_i\}$.

**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 $i$.

The results of this section are summarized by the following proposition.

**Proposition 1.** In an equilibrium given a vector of institutional quality $\{\mu_i\}_{i=1}^J$,

1. The real income is given by (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.

2. For each country:

(a) The number of firms decreases (and hence the firm size increases) in its institutional quality.

(b) Conditional on wages and market access, overall production efficiency and firm profits increase in its institutional quality.

## 4 Theory: National Planners and Institutional Qualities

This section studies how institutional qualities are determined and how the determination is affected by real market access. 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 $\mu_i$ 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 the previous subsection.

### 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 $T_i = P_i C_i(\mu_i, L_i)$. The lump-sum tax each individual pays is $t_i = T_i / L_i$. The benevolent government aims to maximize its people's welfare, which is defined as the real income net of the taxes, by choosing the institutional quality.

$$\max_{\mu_i} W_i \equiv \frac{w_i L_i - T_i}{P_i},$$
$$s.t. \quad T_i = P_i C_i(\mu_i, L_i),$$

which is equivalent to

$$\max_{\mu_i} W_i = \frac{w_i L_i}{P_i} - C_i(\mu_i, L_i). \tag{23}$$

Combining (20) and (23), a country's choice of institutional quality is determined by the following problem, given other countries' choices:

$$\mu_i^* = \arg\max_{\mu_i} W_i = \left(\frac{M_i}{P_i^\sigma}\frac{D(\mu_i)}{f}\right)^{\frac{1}{\sigma}} L_i - A_i \mu_i^\rho L_i^\eta. \tag{24}$$

#### 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 institutional quality $\mu_i$ is the solution to (24), given the equilibrium $\{M_i\}$ and $\{P_i\}$.

Under a competitive equilibrium, real market access $M_i/P_i^\sigma$ is taken as given by national planners. To ensure that (24) entails a unique solution, a sufficient condition is that the derived efficiency, $D(\mu_i)^{1/\sigma}$, is strictly concave in $\mu_i$ such that $W_i$ is also strictly concave in $\mu_i$. 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 $\beta$, the substitutability among different specialized inputs, $\alpha$, 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 ($\alpha$ 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, the change in 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. We define it formally as follows.

**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 $\mu_i^*$ is the solution to (24) given other national planners' choices $\{\mu_j^*\}_{j \neq i}$.

Analyzing problem (24) 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 $\tau$ 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 $\mu_i$, 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 improving institutional quality is proportional to $L^{\frac{\sigma}{\sigma-1}}$ while the marginal cost is proportional to $L^{\eta}$. Thus, when $\eta < \frac{\sigma}{\sigma-1}$, the increase in marginal benefit outweighs the increase in marginal cost, leading to higher institutional quality. Naturally, 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

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

Meanwhile, from the free entry condition, we have

$$w_j = \left( \frac{MK\left(\mu_j\right)}{f} \right)^{\frac{1}{\sigma}}$$

Combining the above two equations entails

$$M^{\frac{\sigma-1}{\sigma}} = \sum_j \left( \frac{D\left(\mu_j\right)}{f} \right)^{\frac{1}{\sigma}} L_j. \tag{25}$$

Equation (25) reveals an *institutional externality effect*, which we explain as follows. From (25), 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 $\eta$ 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 can be obtained by solving the following problem:

$$\max_{\{\mu_i\}} \sum_i W_i.$$

We have the following proposition, and the proof is relegated to Appendix A.7.

**Proposition 5.** In the symmetric world with $J$ countries, there exists a unique global planner's solution. Denote country $j$'s institutional quality as $\mu_j^g$, $\mu_j^n$, $\mu_j^c$ 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 $\mu_i^g$ and $\mu_i^n$ 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 (24) 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 ($M_i/P_i^\sigma$) 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.

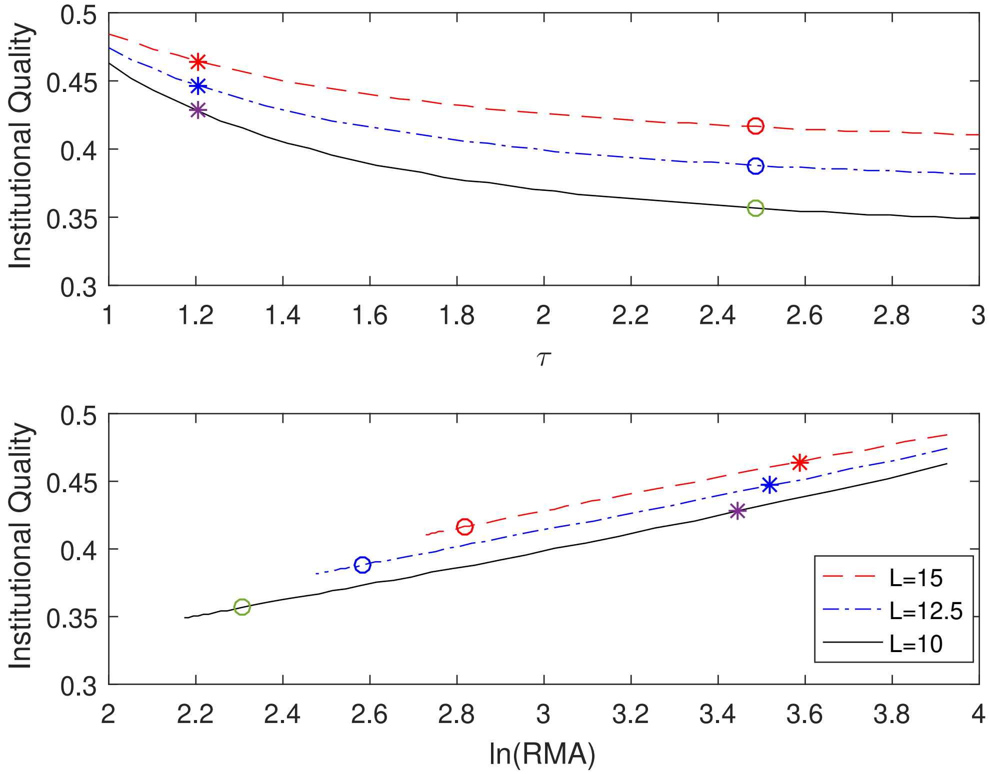
### 4.2.1 Effects of asymmetric population sizes

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 $\tau$. We choose $\beta = 0.7$ and $\eta = 1.01$ so that $\eta < \frac{\sigma}{\sigma-1}$.[9] 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 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 $\tau$, 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 incentives to provide higher qualities because it improves their home market access.

[9] 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

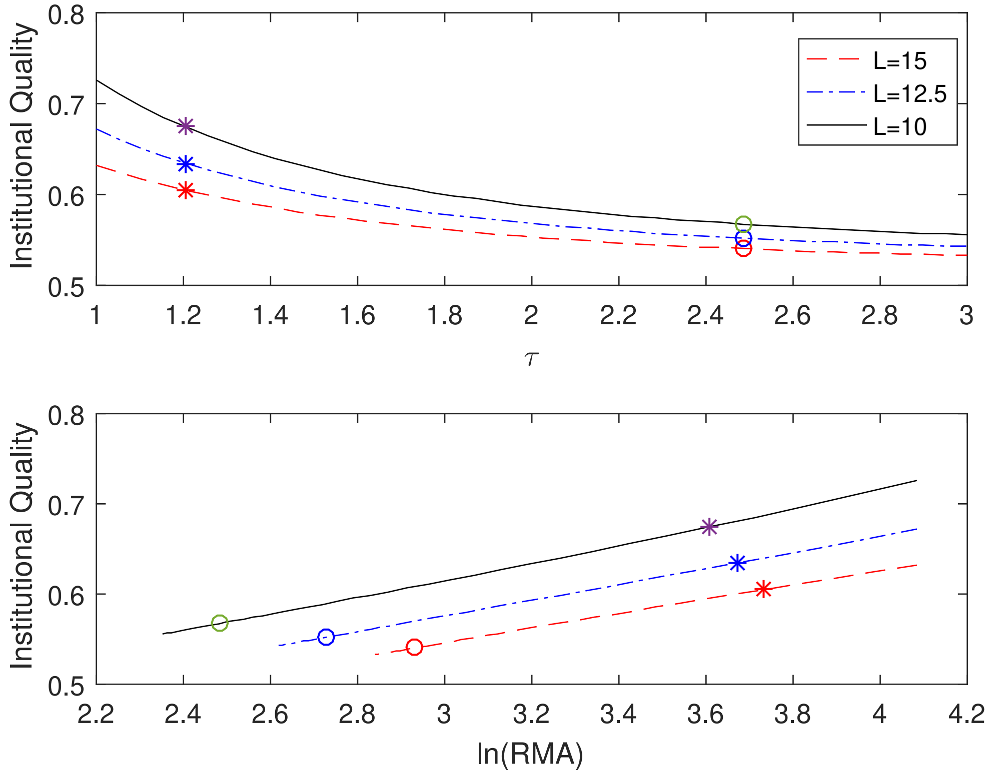



Notes: Three countries differ in their population sizes. The price index in country 1 is normalized to be 1. $\eta$ is set to be 1.01.

Figure 2 plots the case where all parameters are the same as Figure 1 except that $\eta$ 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 $\eta$. In contrast with Figure 1, Figure 2 shows that the higher 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 improving 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 $\eta$ 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 $\eta$. 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 the institutional quality, which is the pattern seen in Figure 2. To understand this flip, it is easier to consider the two extreme

**Figure 2**: Effects of Population Size on Institutional Quality

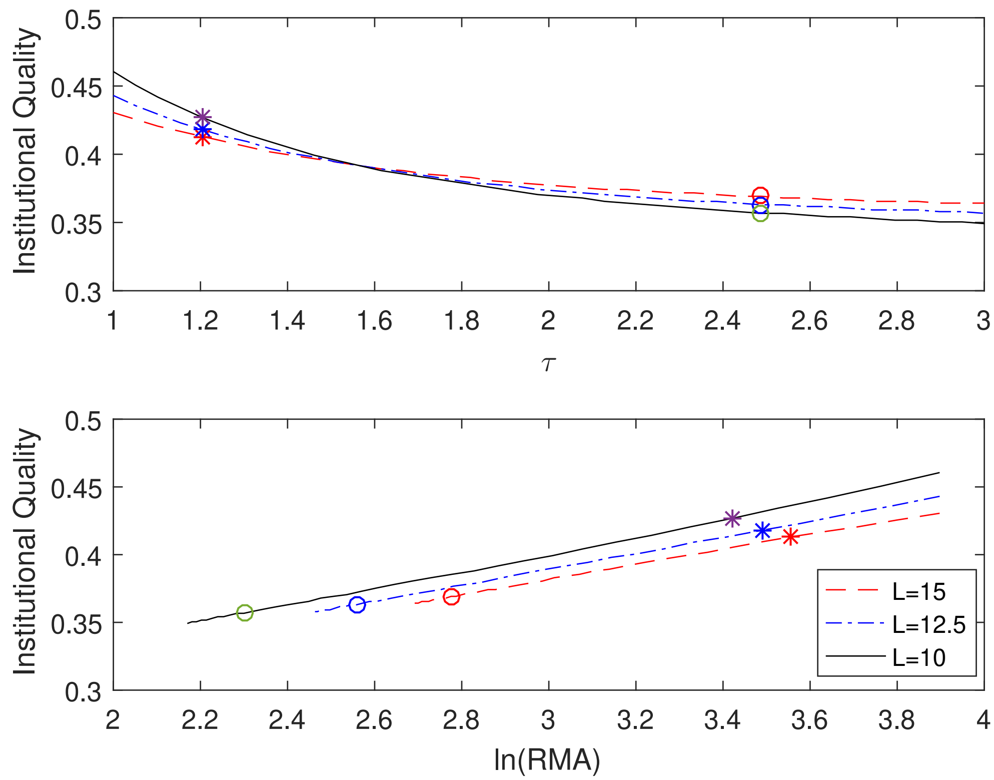



Notes: Three countries differ in their population sizes. The price index in country 1 is normalized to be 1. $\eta$ is set to be 1.5.

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 is similar to that seen in Figure 1, as suggested by Proposition 4. 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 (25). 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 entailing the pattern seen in Figure 2.[10]

[10] 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.

**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. $\eta$ is set to be 1.3.

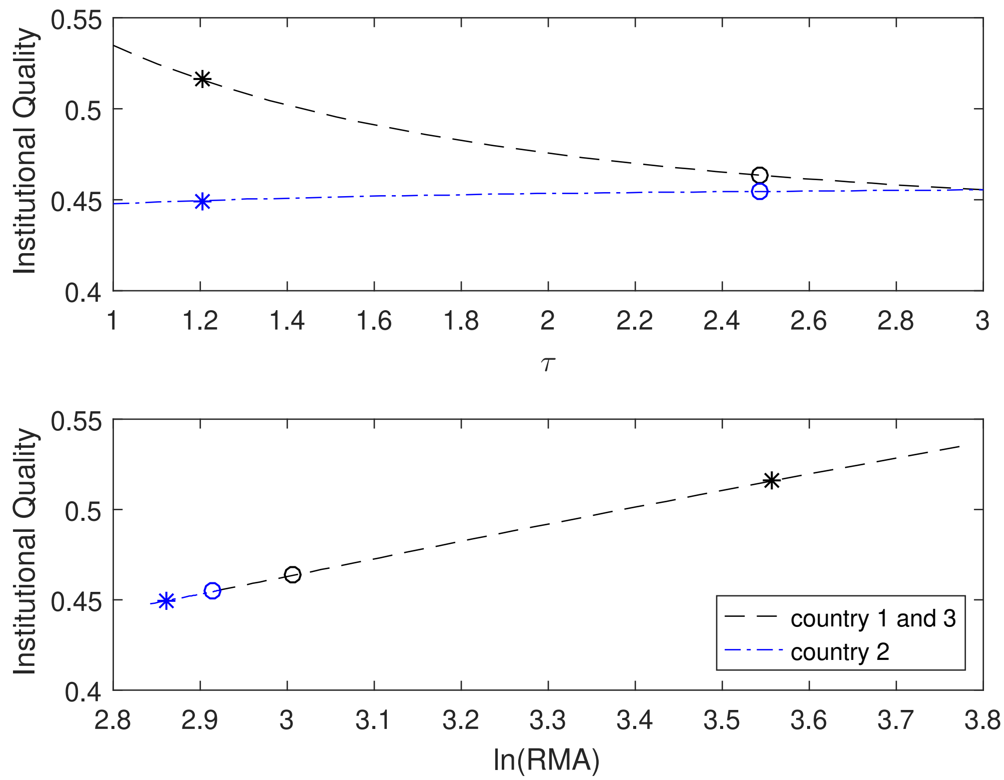
### 4.2.2 Effects of differential trade costs

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.[11] 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 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

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

**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.

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 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".[12] 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

$$\tau_{ijt} = 1 + \exp(-\nu t)(\tau_0^{|i-j|} - 1),$$

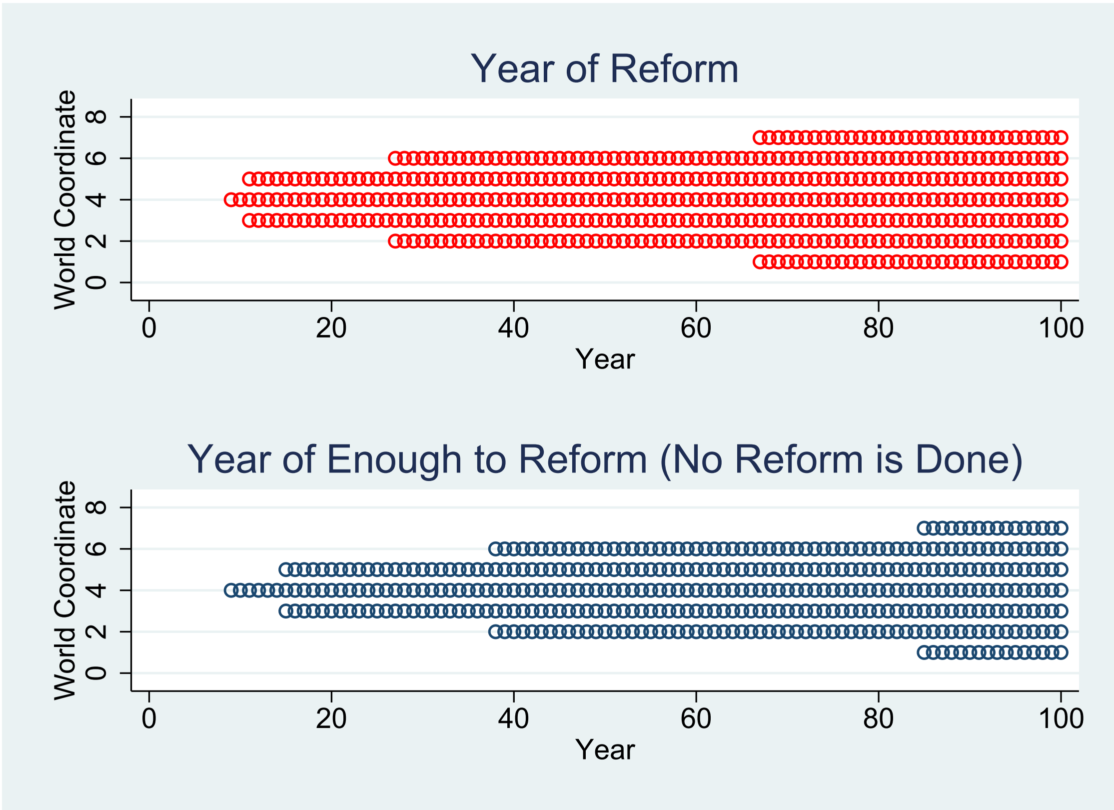
where $\nu$ is the tuning parameter governing the extent to which trade costs decline over time due to the advancement of transport technology, and $\tau_0$ is the trade cost parameter at $t = 0$. The world center is $\frac{J+1}{2}$ if $J$ is odd, and are $\frac{J}{2}$ and $\frac{J}{2} + 1$ if $J$ is 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, $\mu_H$ or $\mu_L$.[13] Every country starts with $\mu_L$, and to obtain and maintain $\mu_H$, a fixed improving cost $F$ is required for every period that this country wants the institutional quality $\mu_H$. The model is solved using Nash equilibrium. Figure 5 shows

[12] 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.

[13] 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




Note: There are 7 countries in the world, each of which 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 $\nu$ is the tuning parameter governing the extent to which trade costs decline over time, and $\tau_0$ is the trade cost parameter at $t = 0$. A colored circle indicates that the country has reformed and obtained the high institutional quality $\mu_H$ in that period.

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 $\mu_H$ 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 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 $\mu_L$ to $\mu_H$ 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, our empirical analysis examines the effects of real market access on various dimensions of institutional quality from 1986 to 2010. We find that only the dimension of Law and Order remains significant across different instrumental variable estimations, underscoring the relevance 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.

We do not intend to challenge any existing theories on economic and institutional development, as different theories do not necessarily conflict with each other Rather, this study complements the literature on the determination of institutional quality by showing squarely how market size matters. Numerous factors could be behind market sizes, including geography, political relations (for which history is critical), technology, and the current state of the economy. But after all, there is a clear relationship between market size and contracting institutions. Our messages echo the role of trade in medieval Venice's achievement of institutional innovations (Puga and Trefler, 2014).

Note that we choose Krugman (1980) for our general equilibrium trade model for its simplicity. The theory should also work in other (more complex) general equilibrium trade models. This paper demonstrates the flexibility of the model of Acemoglu et al. (2007) to be combined with trade models. Future similar applications may be desirable.

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# 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 $\mu$.

### 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 then we have

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

It suffices to show that $\frac{d\bar{I}}{d\mu} > 0$. Note that

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

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 $\mu$. Because $\frac{d\bar{I}}{d\mu}$ is decreasing in $(0,1)$, $\frac{d\bar{I}}{d\mu}$ achieves its minimum at $\mu=1$. Hence, $\frac{d\bar{I}}{d\mu}|_{\mu=1} = -\ln\left(\frac{\alpha\beta}{\alpha+\beta}\right) - \frac{\beta^2}{\alpha+\beta} + \ln\beta = -\ln\left(\frac{\alpha}{\alpha+\beta}\right) - \frac{\beta^2}{\alpha+\beta}$, which is decreasing in $\alpha$. When $\alpha=1$, $\frac{d\bar{I}}{d\mu}|_{\mu=1} = \ln(1+\beta) - \frac{\beta^2}{1+\beta} > 0$ for any $\beta$ in $(0,1)$. Hence $\frac{d\bar{I}}{d\mu}|_{\mu=1} > 0$ for any $\alpha$ and $\beta$ in $(0,1)$. Therefore, $\frac{d\bar{I}}{d\mu}$ is always positive in $(0,1)$ and $I(\mu)$ is thus increasing in $\mu$.

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

Recall $D(\mu) = \left[1-\left(\beta\mu\frac{1-\gamma}{1-\beta+\beta\mu}+\alpha-\alpha\gamma\right)\right]I(\mu)^\beta$. Taking log on both sides, we have

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

Therefore,

$$\begin{aligned}\frac{1-\beta}{\beta}\frac{d\ln D}{d\mu} &= -\frac{\beta\left(1-\beta\right)}{\left[\beta\left(\mu-1\right)+1\right]\left(-\alpha\beta+\alpha+\beta+\alpha\beta\mu\right)}-\ln\left(\frac{\alpha\beta}{\alpha+\beta}\right)\\ &\quad -\frac{\beta^{2}\mu}{\left[\beta\left(\mu-1\right)+1\right]\left(-\alpha\beta+\alpha+\beta+\alpha\beta\mu\right)}+\ln\left(\frac{\beta\left(-\alpha\beta+\alpha+\beta+\alpha\beta\mu\right)}{\left(\alpha+\beta\right)\left[\beta\left(\mu-1\right)+1\right]}\right)\\ &= -\ln\left(\frac{\alpha\beta}{\alpha+\beta}\right)-\frac{\beta}{-\alpha\beta+\alpha+\beta+\alpha\beta\mu}+\ln\frac{\beta\left(-\alpha\beta+\alpha+\beta+\alpha\beta\mu\right)}{\left(\alpha+\beta\right)\left[\beta\left(\mu-1\right)+1\right]}.\end{aligned}$$

Note that

$$\frac{d}{d\mu}\left(\frac{1-\beta}{\beta}\frac{d\ln D}{d\mu}\right)=\frac{-\beta^{3}}{\left(\beta\left(\mu-1\right)+1\right)\left(\beta+\alpha\left(\beta\left(\mu-1\right)+1\right)\right)^{2}}<0,$$

Thus, $\ln D\left(\mu\right)$ is strictly concave in $\mu$.

To show $D$ is strictly increasing in $\mu$, it suffices to show that $\frac{d\ln D}{d\mu}|_{\mu=1}>0$, as $\frac{d\ln D}{d\mu}$ is strictly decreasing in $\mu$. Note that $\frac{1-\beta}{\beta}\frac{d\ln D}{d\mu}|_{\mu=1}=-\ln\left(\frac{\alpha\beta}{\alpha+\beta}\right)-\frac{\beta}{\alpha+\beta}+\ln\beta=-\ln\left(\frac{\alpha}{\alpha+\beta}\right)-\frac{\beta}{\alpha+\beta}$, which is always positive for any positive $\alpha$ and $\beta$ in $(0,1)$. Hence, $\frac{1-\beta}{\beta}\frac{d\ln D}{d\mu}|_{\mu=1}>0$, and hence $D(\mu)$ is increasing in $\mu$.

## 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

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

Let $x=\frac{\beta}{\beta(\mu-1)+1}$. Then, we have $\beta\leq x\leq\frac{\beta}{1-\beta}$ as $0\leq\mu\leq1$. Let

$$H\left(\alpha,x\right)\equiv\left(\sqrt{x}+1\right)\frac{x}{\alpha+x}-\ln\left(1+\frac{x}{\alpha}\right).$$

To prove that $G(\mu)$ is concave, it suffices to show $H\left(\alpha,x\right)\geq0$ for any $\alpha$ and $x$. Note $H\left(\alpha,x\right)$ is increasing in $\alpha$ when $\alpha<\sqrt{x}$, and decreasing in $\alpha$ when $\alpha>\sqrt{x}$. Both $H\left(\sqrt{x},x\right)$ and $H\left(1,x\right)$ 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 $\alpha_0\left(x\right)$ such that $H\left(\alpha_0,x\right)=0$ and $0<\alpha_0<\sqrt{x}$. A sufficient condition for the function $G(\mu)$ to be concave is that $\alpha>\max\alpha_0\left(x\right)$, where $\beta\leq x\leq\frac{\beta}{1-\beta}$.

### A.3 Proof of Proposition 2

Recall (24) 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 $\mu_i$, while the right-hand side is the marginal cost. Obviously, the marginal cost strictly increases in $\mu_i$, and the marginal benefit strictly decreases in $\mu_i$ as $D(\mu)$ is strictly increasing and concave in $\mu$ and $\sigma > 1$. Because the marginal benefit strictly increases in $\mathrm{RMA}_i$, 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 $\tau$ 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 ($P_i = 1$), we have

$$M_i = \left(1 + (J-1)\tau^{1-\sigma}\right) w_i L_i,$$

which, together with the free-entry condition (19), implies that

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

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

Hence, a decrease in trade cost $\tau$ or an increase in the number of trading partners $J-1$ will lead to larger real market access and higher wage rates, conditioned on $\mu_i$. This proves the first statement.

For the second and third statements, first note that $\mathrm{RMA}_i = \frac{M_i}{P_i^{\sigma}}$ 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, $\mathrm{RMA}_i = M_i$. Total differentiating both sides of (9), the definition of market access, with respect to each country's institutional quality $\mu_i$ entails

$$d \ln M_i = \sum_j \frac{\tau_{ij}^{1-\sigma} E_j P_j^{\sigma-1}}{\sum_k \tau_{ik}^{1-\sigma} E_k P_k^{\sigma-1}} d \ln \tau_{ij}^{1-\sigma} E_j P_j^{\sigma-1}. \tag{A.4}$$

In the symmetric world, $E_i = E_j$, and $\tau_{ij} = \tau$. Hence, we have

$$d \ln M_i = \frac{1}{1 + (n-1)\,\tau^{1-\sigma}} d \ln E_i + \sum_{j \neq i} \frac{\tau^{1-\sigma}}{1 + (n-1)\,\tau^{1-\sigma}} d \ln E_j.$$

Using the free entry condition (19), we have

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

Plugging (A.5) into (A.4) yields

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

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

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

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

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

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

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

where the left-hand side is the margin benefit of increasing $\mu_i$, 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

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

where

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

The term $D\left(\mu_i\right)^{\frac{2-\sigma}{\sigma-1}}D'\left(\mu_i\right)$ on the left-hand side of (A.11) is the derivative of $D\left(\mu_i\right)^{\frac{1}{\sigma-1}}$. By Lemma 2, $D\left(\mu_i\right)^{\frac{1}{\sigma-1}}$ is strictly concave, and hence $D\left(\mu_i\right)^{\frac{2-\sigma}{\sigma-1}}D'\left(\mu_i\right)$ strictly decreases in $\mu_i$. Thus, the marginal benefit of $\mu_i$ (the left-hand side) strictly decreases in $\mu_i$, while the marginal cost strictly increases in $\mu_i$. 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 $\mu_i$ decreases in trade costs $\tau$ and increases in the number of trading partners $J-1$), it suffices to show that $\varsigma(\phi,J)$ increases in $J$ and $\phi$.

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

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 $L^{\eta}$. 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 (23) and taking the first-order condition yield

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

which is, indeed, (A.11) with $J = 1$ and $\phi = 0$. Thus, similar to the proof in Appendix A.5, 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.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:

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

The first-order condition for each $\mu_i$ is

$$\left( \frac{M_i D(\mu_i)}{f} \right)^{\frac{1}{\sigma}} L_i d \ln \left( \frac{M_i D(\mu_i)}{f} \right)^{\frac{1}{\sigma}} + \sum_{j \neq i} \left( \frac{M_j D(\mu_j)}{f} \right)^{\frac{1}{\sigma}} L_i d \ln \left( \frac{M_j D(\mu_j)}{f} \right)^{\frac{1}{\sigma}} = \rho A_i \mu_i^{\rho-1} L_i^\eta d\mu_i.$$

Focus on $\mu_i$, and thus $d \ln D(\mu_j) = 0$ for other countries $j \neq i$. Using (A.7) and the symmetry that $M_i D(\mu_i) = M_j D(\mu_j)$, we have

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

Plugging (A.3) into the above equation yields the following:

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

Similar to the proof for Proposition 3, the left-hand side is the marginal benefit of improving $\mu_i$, which strictly decreases in $\mu_i$, while the right-hand side is the marginal cost, which strictly increases in $\mu_i$. 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 $\mu_i^c$ 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 $\mu_i^g$, $\mu_i^n$, and $\mu_i^c$ 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 $\mu_i$, and the right-hand sides increase in $\mu_i$. 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 $\mu_i^g$ and $\mu_i^n$ and hence that between $W_i^g$ and $W_i^n$ remain.