The Deep Determinants of Economic Development in China – A Provincial Perspective

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Abstract. There is a significant body of literature arguing that institutional quality is the key for long run economic growth and development. While the majority of these studies are based on cross-country growth regression, in our paper, we focus on the institution-economic growth nexus within a particular country, namely China. China is often regarded as an exception by having achieved miraculous growth for more than three decades despite relatively low institutional quality. Nonetheless, our key findings suggest that at the provincial level, institutional quality played in fact an important role for the economic success of a province in China, even more important than geographical factors and integration. However, when simultaneously examining the relationship between institutions, human capital, and provincial economic development, we find that human capital "trumps" everything else; however institutional quality has a highly significant indirect effect on provincial per capita income by improving human capital. We employ instrumental variable estimation techniques to address the endogeneity problems regarding the institutions-development and human capital-development relationship.

Keywords: economic growth and development, deep determinants of economic growth, institutional quality, human capital, the Chinese economy

JEL Classification: O11, O43, O53

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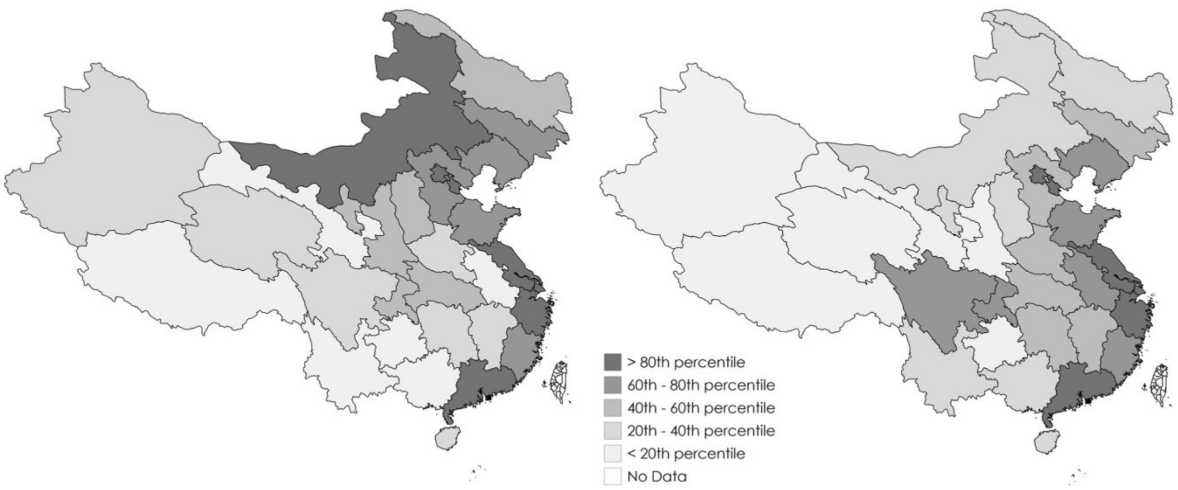
1 Introduction

Since the 1990s, a considerable body of literature has emerged, focusing on the so-called ‘deep determinants’ (namely, geography, institutions, and integration) for explaining current cross-country differences in per capita income (see Easterly and Levine, 2003, and Spolaore and Wacziarg, 2013, for survey articles). While early contributions treat the deep determinants separately and disagree on which determinant is the most important, more recent studies taking into account the three determinants simultaneously, postulate the primacy of institutions (Rodrik et al., 2004; Bhattacharyya, 2004). Against this background, China appears to be an exception: Despite lacking institutional quality, the country has experienced rapid growth over the last three decades (Huang, 2008; Wedeman, 2012; Ahlers, 2014; Zhou, 2014). This phenomenon has left researchers puzzled and is sometimes referred to as the “China paradox” (Rothstein, 2014). However, that does not mean that institutions did not matter for China; as we will see, our study reveals that institutions do have played an important role in China’s economic development process if we analyze the impact of the deep determinants *within* China. That is, in contrast to the majority of studies analyzing the deep determinants of economic development by using cross-country samples, we choose a *provincial perspective*.[1]

Figure 1. Provincial institutional quality and per capita income in 2010.

(a) Provincial per capita GDP (in US$) **(b)** Institutional quality index



Data Source: Provincial per capita income: NBS (2017), converted in US$ using the yuan-dollar exchange rates of the Federal Reserve Economic Data; Institutional quality index: Fan et al. (2011). Own representation.

China is a huge country consisting of 31 provinces, autonomous regions, and municipalities, some of which are themselves larger than some European countries – not only regarding the geographical size but also with respect to population, GDP, and even GDP per capita. Moreover, as depicted by Figure 1a, there is a very unequal economic development across

[1] There are some other studies that analyze institutional quality within China. Examples include Ji et al. (2013), Ang et al. (2014), and Zhou (2014). However, the latter two primarily focus on the impact of institutional quality on the firms’ R&D activity. Ji et al. (2013) analyze institutional quality within China in the context of the interplay between resource abundance, institutions, and economic growth in China with a focus on natural resources.

provinces. Almost two decades into the implementation of Deng Xiaoping's 'get rich first' policy, inland provinces fell far behind the prosperous coast. For example, Beijing's average per capita income (US$ 9,350) is more than 5.6 times that of Guizhou's (US$ 1,659). Moreover, although Chinese provinces possess homogeneous constitution, law and governance structures (Ji et al., 2014), Figure 1b reveals that there are significant differences regarding institutional quality. In fact, Figures 1a and 1b depict a relatively similar pattern (Anhui and Inner Mongolia appear to be exceptions) and there is a strong positive correlation between institutional quality and the log of provincial per capita income (with a coefficient of 0.79).

Institutional quality can differ across provinces because of geographical, political, and historical reasons (Ji et al., 2014) or a mix of them. For example, in the course of the 'get rich first' policy under Deng Xiaoping, the government created a favorable policy environment for coastal provinces. This decision, in turn, was probably influenced by the favorable geographical location (proximity to ports etc.) of these provinces.

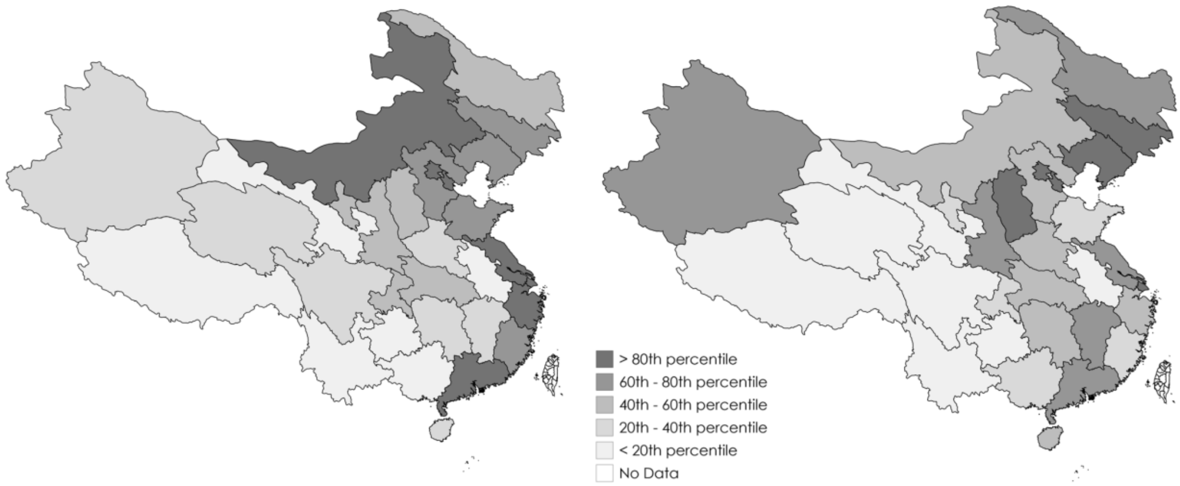
In the first part of our paper, we analyze in how far the deep determinants and particularly institutional quality can explain differences in economic performance across provinces in China by using ordinary least squares (OLS) and two-stage least squares (2SLS) regression analysis. We show that institutional quality "trumps" geography and integration.

Besides the question of which of the three deep determinants is most decisive for the economic development process, there is also ongoing debate in the economic growth literature on whether institutions cause economic growth or, alternatively, human capital accumulation leads to institutional improvement (see Glaeser et al., 2004). The proponents of the supremacy of institutions hypothesis, including North and Thomas (1973), Knack and Keefer (1995), Hall and Jones (1999), and Acemolgu et al. (2001, 2005, 2014), argue that physical and human capital as well as TFP are determined by, and act as channels of influence for, institutions (Acemoglu et al. 2014, p. 878). In contrast, in the view of Lipset (1960) and Glaeser et al. (2004), growth in income and human capital is the source of institutional improvements. However, regarding the role of human capital in China's development, the literature is equally pessimistic as with respect to the institutional quality and the vast majority of articles assesses human capital as relatively unimportant for explaining the Chinese growth miracle (Chow and Li, 2002; Wang and Yao, 2003; Bosworth and Colling, 2008). However, again, at the provincial level, the picture is more nuanced and in 2009 the average years of schooling range between 4.55 for Tibet and 11.17 for Beijing (see Figure 2b); the average of all provinces is around 8.67. Moreover, there is strong correlation between human capital and provincial per capita income with a coefficient of 0.76 and a slightly weaker correlation between human capital and institutional quality with a coefficient of 0.61.

In the second part of our paper, we test whether the primacy of institutions at the provincial level also holds when controlling for human capital, thus adding further arguments to the discussion of whether institutional quality or human capital is the major source for current cross-regional income differences. While both – human capital and institutional quality – appear to be important for the economic success of a province in China, we find that the effect of institutions is primarily indirect by positively influencing human capital.

Figure 2. Provincial human capital in 2009 and per capita income in 2010.

(a) Provincial per capita GDP (in US$) **(b)** Average years of schooling



Data Source: Provincial per capita income: see Figure 1; average years of schooling: NBS (2010) data on the population aged 6 and above with no, primary, junior/senior secondary, and tertiary education in 2009 as well as population data for 2009, own calculation. We report the average years of schooling in 2009 since the raw data to calculate this indicator is (partly) not available for 2010.

The reminder of the paper is organized as follows. In Section 2 we describe our data and provide some descriptive statistics. In Section 3, we analyze which of the three deep determinants (geography, integration, and institutions) is the dominating factor for explaining cross-provincial differences in economic development in China. Section 4 then investigates the relationship between institutions, human capital, and economic development at the provincial level. Section 5 concludes and provides some policy implications.

2 Data and Descriptive Statistics

Descriptive statistics of the key variables are provided in Table 1. Our base sample consists of 31 provinces, including 4 municipalities and 5 autonomous regions (see Appendix A). The log of per capita provincial income (in current RMB) for 2010 is our measure of economic performance.[2] The marketization index for the year 2007 is used as a measure of institutional quality (INS) and is due to Fan et al. (2011). It is used as a measure of institutional quality by various empirical studies (examples include, among others, Che and Wang, 2013, and Zhou, 2014). This relative index varies between 0 and 10, a higher score indicating stronger institutions, and consists of five sub-indices, namely "government and market relation", "development of the non-state enterprise sector", "development of the commodity market", "development of factor markets" and "market intermediaries and the legal environment for the market", as well as a total of 23 basic indicators (cf. Fan et al., 2011, pp. 7-8). It has to be noted that the set of institutions that matter for economic performance is far more complex and can-

[2] We also repeated our entire analysis using the log of per capita GDP in US dollar. However, our results remain unchanged.

not be fully captured by this index. However, since data on the quality of provincial institutions in China is limited and the marketization index comprises important aspects of institutional quality (for example regarding contracting institutions and property rights institutions), our choice of variable seems reasonable. As a robustness check, we also used two alternative measures of institutional quality, namely the government efficiency index developed by Tang et al. (2014)[3] as well as the indicator of a business-friendly environment (BFE) that we calculated using data of the World Bank report "Doing Business in China 2008".[4]

Table 1. Descriptive statistics.

	Mean (Std. Dev.)
Log of per capita gross provincial product (PCGDP)	10.30 (0.45)
Institutional quality (marketization index) (MI)	7.50 (1.99)
Log of the trade share (% of GDP) (TRADE)	-1.72 (1.01)
Geography (Latitude)	0.37 (0.08)
Average years of schooling (YEARS)	8.37 (1.15)
Distance to Beijing/Shanghai (DISTANCE)	975.25 (703.48)
Coastal dummy (COAST)	0.39 (0.50)
Student-teacher ratio, primary school (1994) (ST_T_RATIO)	19.20 (4.27)
Ethnic fractionalization 1990 (EFI90)	0.18 (0.22)
Ethnic fractionalization 2000 (EFI00)	0.19 (0.21)
Observations	31

Notes: Variable definitions and sources are provided in the text. Regarding ethnic fractionalization in 1990 we have no data for Tibet.

Integration, measured as the (log) share of trade in GDP (INT), is compiled using NBS (2017) provincial trade and GDP data. Human capital (HC) is measured by the average years of schooling and is also calculated using NBS provincial data. In particular, our calculations are based on the current educational system in China (16 years for graduates from universi-

[3] The government efficiency index consists of four indicators, namely "government public services", "public infrastructure", "government size", and "welfare of residents", as well as various sub-indicators and 47 indexes. However, since it also includes various educational measures that might be correlated with our human capital variable, we cannot use this index to investigate the institutions-human capital development relationship.

[4] The BFE index captures how encouraging regulations are to business activities. Following Zhou (2014, p. 76), we calculated the BFE index as the simple average of a city's percentile rankings on each of the four areas of business regulation and their enforcement reported in the World Bank report, namely (i) starting a business, (ii) registering property, (iii) getting credit – creating and registering collateral, and (iv) enforcing contracts (World Bank 2008, p. 1). The underlying data we used to construct this index is only available at the city-level (in particular for the capital cities of the 30 Chinese provinces). We assume that the data for the capital city of a province is representative for the whole province. However, one should keep in mind that the business environment is probably more encouraging in the capital city of a province than in the peripheral regions.

ties; 12 years for senior secondary school graduates; 9 years for junior secondary school graduates; 6 years for primary school graduates; zero years for non-educated persons). Geography (GEO) is measured by latitude, that is the distance from the equator. This variable is often used to control for the effect of climate on economic development. Ethnic fractionalization indexes for the years 1990 and 2000 (ranging between 0 and 1, where zero corresponds to a completely homogenous province) are used as instruments for institutions and are obtained from Yeoh (2012). Moreover, we use the air distance to Beijing/Shanghai, whichever is less, ($DIST$) (calculated with the great-circle distance formula) as instrument for institutions.[5] Beijing and Shanghai are the oldest (currently) existing municipalities under the direct administration of the central government. There are various arguments that being far from these two cities has a negative effect on institutional quality. First, increasingly remote provinces are under less control of the central government to provide a good institutional environment (such as the provision of property rights that are captured in our index of institutional quality). Moreover, the local politicians might be more likely to be captured by local interest groups which may also have a negative effect on the quality of institutions in the respective provinces. The dummy variable $COAST$ indicates whether a province is located at the coast or not and is used as instrument for integration. We use the student-teacher ratio for the year 1994 (obtained from the NBS) as instrument for human capital.

In the economic growth and development literature it is common to use geographical (and historical) variables as instruments for contemporary endogenous regressors (such as institutional quality, cultural variables, inequality etc.).[6] However, it should be considered that despite the frequent use of such instruments, instrumental variable estimation is afflicted with several problems, particularly with respect to the exclusivity restriction (i.e., the excluded instruments affect the dependent variable only indirectly, through their correlations with the included variables). This concern relates particularly to our institutional instrument. Although we cannot fully overcome the limitations of the instrumental variable approach, we perform various robustness checks that support our findings.[7]

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[5] The great-circle distance (in km) (D) between two provinces can be obtained via the following formula: $D = \arccos\left(\sin(\phi_1) * \sin(\phi_2) + \cos(\phi_1) * \cos(\phi_2) * \cos(\lambda_1 - \lambda_2)\right) * \mathrm{R}_{\oplus}$, where $\phi_1 (\phi_2)$ is the latitude of province 1 (province 2) and λ_1 (λ_2) is the longitude of province 1 (province 2). $\mathrm{R}_{\oplus}$ denotes the earth radius (approximately 6.371 km). Using an alternative formula developed by Thaddeus Vincenty which is not based on a sphere but on an ellipsoid (Vincenty, 1975) does not affect our results; the significance levels stay the same and even the coefficients are almost identical compared to those obtained via the great-circle distance formula.

[6] Examples include the studies of Easterly (2007), Becker and Woessmann (2009), Becker et al. (2010), and Naritomi et al. (2012). Moreover, several of the studies listed above use the distance to a city or a country as instruments (For example, Becker and Woessmann, 2009, use the distance to Wittenberg as an instrument for Protestantism.).

[7] We empirically tested instrument validity by performing the Hansen J test using Lewbel's (2012) constructed instruments. Moreover, as suggested by Baum (2008), we tested the exclusive restriction by including the instruments as regressors; however, they are statistically insignificant. As another robustness check, we also included the distance to the coast as an additional regressor in our core specification; however, our main results remain unchanged. Regarding the first-stage relationships, the distance to the coast is not significantly correlated with trade or institutions.

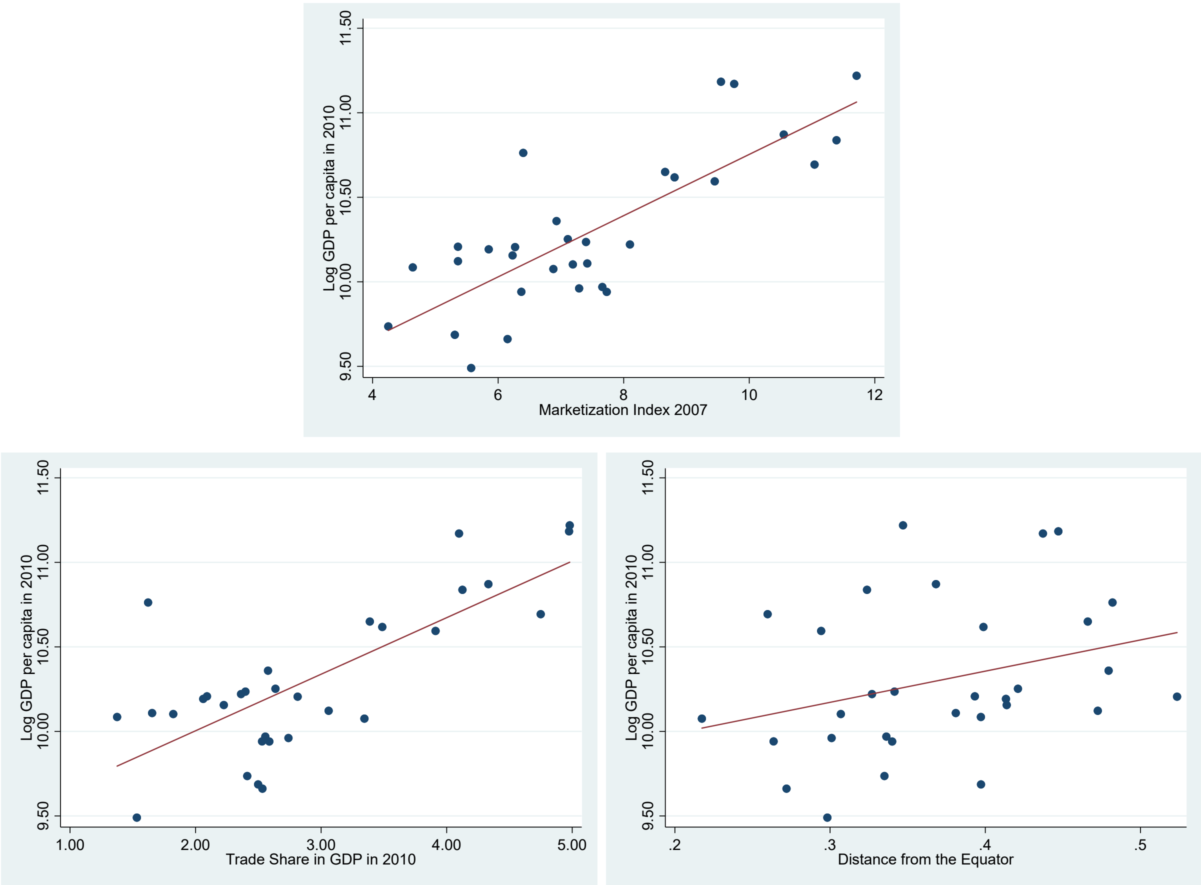
3 The deep determinants of economic development in China's provinces

Our regression model to estimate the effect of the deep determinants (and especially institutional quality) on the log provincial per capita income ($log\ y_i$) is given by the following equation:

$$(1) \qquad log\ y_i = \alpha + \beta INS_i + \gamma INT_i + \delta GEO_i + \varepsilon_i,$$

where INS_i is the institutional measure, in particular the marketization index (MI). INT_i and GEO_i denote the remaining two deep determinants, namely integration, i.e. the log of the trade share in provincial income and the geographical measure, i.e. the latitude of a province. ε_i denotes the random error term. We use standardized measures of our three regressors, which enables us to directly compare the estimated coefficients.[8]

Figure 3. Bivariate OLS relationships between the deep determinants and per capita income.



Before we discuss our estimation results, we take a look on the scatter plots depicting the bivariate relationship between each of the deep determinants and the log of provincial per capita income. As depicted by Figure 3, there is a strong positive relationship between institu-

[8] The standardized variable x^* is obtained by using the following formula: $x^* = \frac{x-\mu}{sd}$, where x denotes the original variable and μ (sd) is the mean (standard deviation) of x.

tions and income as well as between openness and income.[9] Moreover, there is a moderate positive relationship between latitude and income.

The corresponding OLS estimates are reported in Table 2. Columns (1) and (2) show that institutional quality and integration have the expected positive sign and are highly significant with coefficients of 0.36 and 0.34, respectively. Adding latitude (in Columns 3 and 4) does not change our results significantly. However, as soon as we control for institutional quality, integration turns insignificant and its coefficient is much reduced (for example to 0.12 in Column 5). When including all three deep determinants simultaneously in Column (6) institutional quality and geography are highly significant (with coefficients of 0.31 and 0.19), whereas the coefficient of integration is insignificant at the 10-percent level and is further reduced to 0.09.

Table 2. OLS estimates (standardized variables).

	(1)	(2)	(3)	(4)	(5)	(6)
Institutions (MI)	0.3606***		0.3911***		0.2539***	0.3129***
	(7.03)		(10.58)		(2.80)	(4.79)
Integration (TRADE)		0.3393***		0.3510***	0.1284	0.0932
		(6.05)		(7.31)	(1.42)	(1.44)
Geography (Latitude)			0.1996***	0.1647***		0.1942***
			(5.40)	(3.43)		(5.33)
R-squared	0.6303	0.5582	0.8190	0.6890	0.6551	0.8319
Observations	31	31	31	31	31	31

Note: Dependent variable: Log per capita GDP. The independent variables are all scaled in the sense that they present deviations from the mean divided by the standard deviation. T-statistics are in parentheses. Significance at the 10, 5, and 1 percent levels are denoted by *, **, and ***, respectively.

We have to be careful when making statements about the causality of these relationships, inter alia due to the problems of reverse causality (richer economies can afford better institutions) as well as of omitted independent variables correlated with institutions. Therefore, in a next step, we treat institutional quality as well as integration as endogenous. We employ a two-stage-least-squares (2SLS) model. In particular, we use the distance to Beijing/Shanghai as an instrument for institutional quality and the coastal dummy as an instrument for integration. We also tested other instruments for institutional quality, namely indexes of ethnic fractionalization for 1990 and 2000. Our regression results using these alternative instruments (and the corresponding scatter plots between the respective instruments and institutional quality) are provided in the Appendix C. However, although all instruments are negatively correlated with institutional quality (at the 1-percent level), the F-statistics for the ethnicity variables are only slightly above the threshold of 10 suggested by Staiger and Stock (1997). Indeed, the distance to Beijing/Shanghai best fulfills the no-weak-instrument criteria.

[9] Scatter plots of the bivariate correlation between our alternative institutional measures and provincial per capita income is provided in the Appendix B, Figure B1.

Figure 4. Institutional quality and the distance to Shanghai/Beijing.

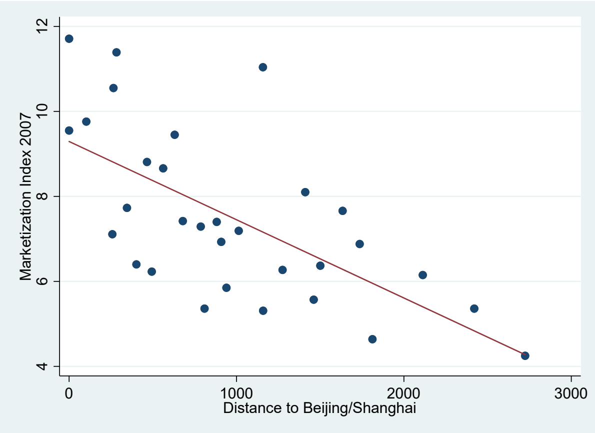


Figure 4 depicts the negative correlation between the distance to Beijing/Shanghai and the marketization index.[10] The first stage regressions are given by equations (2) and (3).

(2) $INS_i = \vartheta + \rho DIST_i + \theta COAST_i + \sigma GEO_i + \varepsilon_{INS_i}$,

(3) $INT_i = \varphi + \mu COAST_i + \pi DIST_i + \rho GEO_i + \varepsilon_{INT_i}$,

where $DIST_i$ is the distance to Beijing/Shanghai (whichever province is nearer), $COAST_i$ is the coastal dummy variable. Our full 2SLS model is given by equations (1)–(3). The exclusive restriction is that $DIST_i$ and $COAST_i$ do not appear in equation (1).

Our regression results are presented in Table 3. Panel A gives the 2SLS estimates and Panel B provides the corresponding first-stage relationships. Notably, for all columns, the coefficients of institutional quality are larger than the corresponding OLS estimates reported in Table 2, suggesting that the attenuation bias due to measurement error is more important than reverse causality or omitted variables biases (As argued by Acemoglu et al. (2001), in reality, we have a set of institutions that apply and not only one single measure which, therefore, can only capture a part of the "true institutions".). As in Table 2, in all columns, institutional quality is highly significant. Moreover, integration turns insignificant at the 10-percent level once we control for institutions (see Columns 5 and 6) and the coefficient is reduced (it even turns negative in Column 5). As before, the coefficient of latitude is positive and highly significant. Overall, institutional quality trumps integration and, when also considering the magnitude of the coefficients, it is also more important than geography.[11, 12]

[10] The corresponding scatter plots for our two alternative institutional measures are provided in Appendix B, Figure B2.

[11] Using the *average* of the (log) trade share in GDP and *average* of the marketization index for the years 2001 to 2007 does not change our results regarding the primacy of institutions.

[12] We derive very similar results when using our alternative measures of institutional quality. The only difference is that when using the government efficiency index, latitude has no direct effect on per capita income but only an indirect effect via institutional quality. When using the BFE index, latitude has no significant effect on the provincial per capita income government (neither direct nor indirect).The results are not presented here to save space but are available upon request.

Table 3. 2SLS estimates (standardized variables).

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: 2SLS						
Institutions (MI)	0.4901***		0.4064***		0.5856***	0.3264***
	(5.82)		(8.36)		(3.08)	(3.54)
Integration (TRADE)		0.3831***		0.4193***	-0.1505	0.1281
		(5.53)		(7.04)	(-0.78)	(1.35)
Geography (Latitude)			0.2020***	0.1695***		0.1988***
			(5.68)	(3.58)		(5.59)
R-squared	0.5490	0.5489	0.8179	0.6665	0.4896	0.8214
Underidentification test (p-value)	0.0000	0.0000	0.0001	0.0000	0.0030	0.0003
Test for endogeneity (p-value)	0.0253	0.2964	0.6437	0.2964	0.0146	0.1406
Observations	31	31	31	31	31	31
Panel B1: First-Stage for Institutions						
DISTANCE	-0.6506***		-0.7459***		-0.4073***	-0.4985***
	(-4.61)		(-5.60)		(-3.25)	(-3.80)
COAST					0.5262***	0.4594***
					(4.28)	(3.58)
Latitude			-0.3537**			-0.2095*
			(-2.66)			(-1.76)
F-statistic	21.281		31.36		26.19	28.71
Panel B2: First-Stage for Integration						
DISTANCE					-0.0680	-0.0470
					(-0.53)	(-0.33)
COAST		0.7914***		0.8023***	0.7605***	0.7782***
		(6.97)		(6.88)	(5.90)	(5.59)
Latitude				0.0648		0.0481
				(0.56)		(0.37)
F-statistic		48.59		47.37	23.83	22.98

Note: Dependent variable: Log per capita GDP. The independent variables are all scaled in the sense that they present deviations from the mean divided by the standard deviation. T-statistics are in parentheses. Significance at the 10, 5, and 1 percent levels are denoted by *, **, and ***, respectively.

Regarding the first-stage relationships, there is a significant positive relationship between our instruments and the endogenous variables (that is between institutions and the distance to Beijing/Shanghai and between integration and the coastal dummy variable) for all columns. Moreover, the coastal dummy is also significantly correlated with institutional quality while there is no significant relationship between the distance to Beijing/Shanghai and trade (see Columns 5 and 6). Latitude is negatively correlated with institutional quality at the 5-percent level (Column 3) and at the 10-percent level when including all regressors (in Column 6). There is no significant relationship regarding latitude and trade.

We briefly turn to some diagnostic statistics: In all Columns, the F-statistics for our excluded instruments vary between 21 and 31 regarding our institutional variable and between

23 and 49 for our trade variable, and thus far exceed the critical threshold of 10 suggested by Staiger and Stock (1997).[13] Moreover, the R-squared is reasonably high.

In a next step, we investigate the inter-relationships between institutions and integration, that is we (a) regress trade and geography on institutions and (b) regress institutions and geography on trade.[14] Our results are presented in Table 4. Panel A presents the OLS regressions and Panel B the 2SLS regressions (the first-stages are provided in Panel C).

Table 4. Inter-relationships between institutional quality and integration.

	(1)	(2)
Panel A: OLS Regression		
Dependent variable	Institutions	Integration
Geography (Latitude)	-0.0946 (-0.91)	0.0576 (0.54)
Institutions (MI)		0.8394*** (7.92)
Integration (TRADE)	0.8239*** (7.92)	
R-square	0.6988	0.6931
Panel B: 2SLS Regression		
Dependent variable	Institutions	Integration
Geography (Latitude)	-0.0898 (-0.90)	0.0248 (0.23)
Institutions (MI)		0.6246*** (4.21)
Integration (TRADE)	0.8920*** (7.10)	
R-square	0.6942	0.6481
Test for endogeneity (p-value)	0.3703	0.0240
Number of observations	31	31
Panel C: First-Stage for Institutions and Trade		
Dependent variable	Integration	Institutions
Latitude	0.0648 (0.56)	-0.3537** (-2.66)
DISTANCE		-0.7459*** (-5.60)
COAST	0.8023*** (6.88)	
F-statistic	47.37	31.357

Note: Dependent variable: Log per capita GDP. The independent variables are all scaled in the sense that they present deviations from the mean divided by the standard deviation. T-statistics are in parentheses. Significance at the 10, 5, and 1 percent levels are denoted by *, **, and ***, respectively.

We find that institutions and integration have a positive effect on each other. In particular, (when controlling for endogeneity) a unit increase in institutions increases the trade

[13] It has to be noted that in the strict sense, this "rule of thumb" only applies to the single endogenous regressor case (as in Columns 1-4 of Table 3). However, as argued by Rodrik et al. (2004), F-statistics far exceeding the threshold (as in our case) are nonetheless a good sign that our results do not suffer from weak instruments.

[14] Note that we follow Rodrik et al. (2004) by omitting the feedback effect from per capita income to institutions and integration.

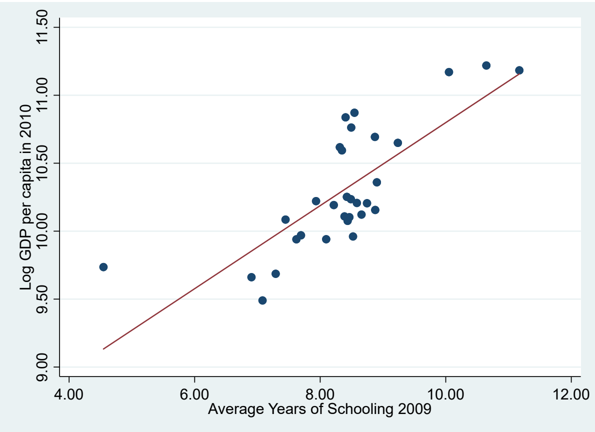
share by 0.62 units and a one unit increase in integration increases institutional quality by 0.89 units; both effects are highly significant.

In combination with Column (6) of Table 3, we can calculate the total impacts on the log per capita income for institutional quality and integration: A unit (positive) shock to the institution quality equation and a unit shock to the integration equation both ultimately produce an increase in the log per capita income of approximately 0.42.[15] However, if we only consider the statistically significant effects (at the 5-percent level), trade has no direct impact on income. Thus, the total impact of integration on income consists only of the indirect effect (via institutional quality) and is therefore reduced from 0.42 to 0.29. In contrast, the (statistically significant) total effect of institutions stems solely from the direct effect that it has on income and therefore corresponds to the estimate in Table 3, Column (6), namely 0.33. Although the estimated effect of institutions on trade is statistically significant, this has no impact on income because the direct effect of trade on income is insignificant.[16] Overall, institutions trump integration, albeit not to the same extent as in general cross-country studies. For example, Rodrik et al. (2004) show that integration has no effect on income at all once only the statistically significant effects are considered. The main reason for this difference is that in our case, trade has a large and highly significant impact on institutional quality.

4 The institutions-human capital-development relationship across Chinese provinces

As noted in Section 1, there is an ongoing debate in the economic growth literature on whether institutions cause economic growth or, alternatively, human capital accumulation leads to institutional improvement (see Glaeser et al., 2004). In this Section, we empirically evaluate the impact of institutional quality and human capital on the provincial per capita income in China. More precisely, we test whether the primacy of institutions identified in the previous Section also remains valid when adding human capital.

Figure 5. Bivariate OLS relationships between human capital and per capita income.



[15] In particular, we obtain these values by solving the system of equations implied by Column (6) of Table 3, Panel A, and by Columns (1) and (2) of Table 4, Panel B.

[16] Again, using the average of the marketization index for the years 2001 to 2007 does not change our results.

Our analysis is primarily inspired by the studies of Acemoglu et al. (2014) and Glaeser et al. (2004), which both include institutions and human capital as endogenous independent variables as well as geography as exogenous independent variable. We follow these studies by using the average years of schooling as a proxy for human capital. Our modified core OLS regression model is given by the following equation:

(4) $$log\, y_i = \omega + \nu INS_i + \zeta HC_i + \tau GEO_i + \epsilon_i,$$

where HC_i denotes human capital in province i (in particular the average years of schooling in 2009). Moreover, as a robustness check, in one of our specifications we also include integration/trade.

Figure 5 reveals a strong positive relationship between the average years of schooling and the provincial per capita income. Table 5 presents our corresponding OLS regression results. Column (1) shows that there is a highly significant relationship between per capita income and human capital with a coefficient of 0.35 (which is almost the same as the coefficient of institutions reported in Table 2, Column 1). If we simultaneously include human capital and institutional quality, coefficients of both variables are slightly above 0.20 and highly significant. Adding trade in Column (3) does not change the positive relationship between human capital and per capita income, however, the coefficient of institutions is slightly reduced. When including human capital, institutions and geography at the same time, the coefficient of human capital drops considerably to 0.11 and is much lower than the coefficients of institutions (0.32) and geography (0.15).

Table 5. OLS estimates (standardized variables) – including human capital.

	(1)	(2)	(3)	(4)
Human capital (YEARS)	0.3507***	0.2087***	0.1995***	0.1054**
	(6.54)	(3.98)	(3.76)	(2.04)
Institutions (MI)		0.2339***	0.1704**	0.3201***
		(4.45)	(2.19)	(6.48)
Integration (TRADE)			0.0832	
			(1.10)	
Geography (Latitude)				0.1539***
				(3.70)
R-squared	0.5962	0.7636	0.7738	0.8431
Observations	31	31	31	31

Note: Dependent variable: Log per capita GDP. The independent variables are all scaled in the sense that they present deviations from the mean divided by the standard deviation. T-statistics are in parentheses. Significance at the 10, 5, and 1 percent levels are denoted by *, **, and ***, respectively.

Again, the estimates of Table 5 only provide us with information about the correlation between the independent variables and provincial per capita income; however, due to serious endogeneity concerns we are not able to make statements about the causality of this relationship. Therefore, in a next step, institutional quality and human capital are treated as endogenous. As before, we use the air distance to Beijing/Shanghai as instrument for institutions. Following Niquito et al. (2018), human capital is instrumented by the student-teacher ratio for primary school for the year 1994.

Figure 6. Human capital and student-teacher ratio.

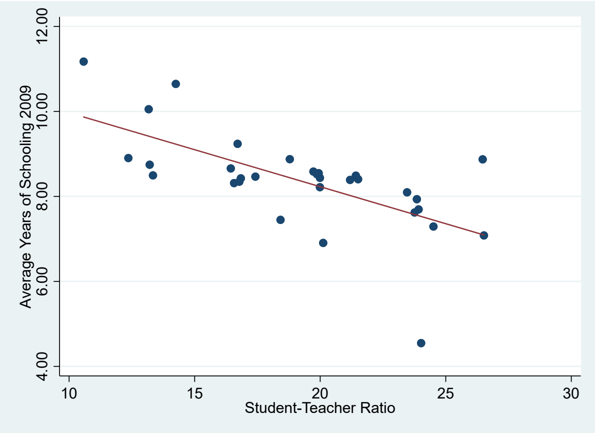


Figure 6 depicts the negative correlation between the average years of schooling in 2009 and the student-teacher ratio. The first stage regressions of our core specification are given by equations (5) and (6).

(5) $INS_i = \phi + \lambda DIST_i + \upsilon ST\_T\_RATIO_i + \varrho GEO_i + \epsilon_{INS_i}$

(6) $HC_i = \psi + \eta ST\_T\_RATIO_i + \kappa DIST_i + \xi GEO_i + \epsilon_{HC_i}$,

where $ST\_T\_RATIO_i$ is the student-teacher ratio for primary school in 1994. Our full 2SLS model is given by equations (4)–(6). The exclusive restriction is that $DIST_i$ and $ST\_T\_RATIO_i$ do not appear in equation (4). As a robustness check, in one of our specifications, we also include integration/trade (see Table 6, Column 3).

Table 6 presents our regression results. Panel A gives the 2SLS estimates and Panels B1-B3 report the corresponding first-stage relationships for human capital, institutions, and trade, respectively. In all columns, human capital is significant at the 1- or 5-percent level and its coefficient ranges from 0.39 to 0.43, i.e. it is much larger than the corresponding OLS estimates presented in Table 5 (particularly regarding our core specification in Column 4). Strikingly, institutional capital turns insignificant at the 10-percent level ones we control for human capital and its coefficient is reduced dramatically (to 0.07 in our core specification in Column 4). Adding latitude or trade does not change our results significantly; both variables are insignificant at the 10-percent level and rather small in their magnitude (especially our geographical variable). Overall, our results indicate that neglecting the human capital dimension overestimates the direct effect of institutional quality on provincial per capita income. Notably, even the coefficient of trade is larger in its magnitude compared to the institutional estimate (0.16 versus 0.04 in Column 3).[17]

[17] The results obtained using the BFE index are mostly consistent with the corresponding estimation results for the marketization index (however, the F-statistics of the institutional instrumental variable drops below the critical threshold of ten). As already mentioned above, we cannot perform robustness checks using the government efficiency index as alternative measure of institutional quality since it contains various indicators that might be correlated with our human capital variable.

Table 6. 2SLS estimates (standardized variables) – including human capital.

	(1)	(2)	(3)	(4)
Panel A: 2SLS				
Human Capital	0.4262***	0.4139***	0.3542***	0.3851**
	(5.15)	(4.08)	(4.24)	(2.07)
Institutions (MI)		0.0452	0.0400	0.0668
		(0.37)	(0.03)	(0.36)
Integration (TRADE)			0.1660	
			(1.30)	
Geography (Latitude)				0.0225
				(0.22)
R-squared	0.5686	0.6148	0.6813	0.6534
Underidentification test (p-value)	0.0003	0.0039	0.0005	0.0509
Test for endogeneity (p-value)	0.2160	0.0017	0.0049	0.0341
Observations	31	31	31	31
Panel B1: First-Stage for Schooling				
Student-Teacher Ratio	-0.6474***	-0.4280***	-0.4212***	-0.5348***
	(-4.57)	(-3.42)	(-3.43)	(-3.34)
DISTANCE		-0.5178***	-0.4368***	-0.5158***
		(-4.13)	(-3.25)	(-4.12)
COAST			0.1849	
			(1.48)	
Latitude				-0.1606
				(-1.07)
F-statistic	20.93	24.80	17.97	21.21
Panel B2: First-Stage for Institutions				
Student-Teacher Ratio		0 .1223	0.1423	-0.1856
		(0.78)	(1.16)	(-1.02)
DISTANCE		-0.7024***	-0.4651***	-0.6966***
		(-4.48)	(-3.47)	(-4.92)
COAST			0.5417***	
			(4.35)	
Latitude				-0.4630**
				(-2.71)
F-statistic		10.80	18.13	16.23
Panel B3: First-Stage for Integration				
Student-Teacher Ratio			-0.0957	
			(-0.75)	
DISTANCE			-0.0291	
			(-0.21)	
COAST			0.7569***	
			(5.82)	
Latitude				
F-statistic			15.82	

Note: Dependent variable: Log per capita GDP. The independent variables are all scaled in the sense that they present deviations from the mean divided by the standard deviation. T-statistics are in parentheses. Significance at the 10, 5, and 1 percent levels are denoted by *, **, and ***, respectively.

Regarding the first-stage relationships, Panel B1 reveals a strong negative relationship between the student-teacher ratio and our human capital measure. Moreover, human capital is also significantly correlated with the distance to Beijing/Shanghai. There is no significant relationship between human capital and the coastal dummy or latitude. As depicted by Panels B2 and B3, both, institutional quality and trade, are significantly correlated with their respective instruments. Moreover, institutional quality is also positively correlated with the coastal dummy and negatively correlated with latitude. The diagnostic statistics reveal that in all Columns and for all endogenous variables, the F-statistics are above the Staiger and Stock threshold of ten. The F-statistic for our human capital instrumental variable varies between 18 and 25. The R-squared ranges between 0.59 and 0.65.

Table 7. Inter-relationships between institutional quality and human capital.

	(1)	(2)
Panel A: OLS Regression		
Dependent variable	Institutions	Human capital
Geography (Latitude)	-0.3975***	0.4341***
	(-2.83)	(5.26)
Institutions (MI)		0.6733***
		(5.26)
Human capital (YEARS)	0.7387***	
	(5.26)	
R-square	0.5091	0.55525
Observations	31	31
Panel B: 2SLS Regression		
Dependent variable	Institutions	Human capital
Geography (Latitude)	-0.3661**	0.4660***
	(-2.50)	(3.63)
Institutions (MI)		0.8818***
		(5.04)
Human capital (YEARS)	0.6440***	
	(2.90)	
R-square	0.5012	0.5101
Overidentification test	0.0008	0.0001
Test for endogeneity (p-value)	0.5896	0.0696
Panel C: First-Stage for Institutions and Trade		
Dependent variable	Human capital	Institutions
Latitude	-0.1700	-0.3537**
	(-0.90)	(-2.66)
DISTANCE		-0.7459***
		(-5.60)
ST_T_RATIO	-0.7596***	
	(-4.02)	
F-statistic	16.16	31.36

Note: Dependent variable: Log per capita GDP. The independent variables are all scaled in the sense that they present deviations from the mean divided by the standard deviation. T-statistics are in parentheses. Significance at the 10, 5, and 1 percent levels are denoted by *, **, and ***, respectively.

Table 7 illustrates the inter-relationships between institutions and human capital. In particular, we regress human capital and institutional quality separately on geography and on each other. Panel A presents our OLS estimates and Panel B gives the 2SLS estimates (the first-stage relationships are provided in Panel C). We can state that when controlling for endogeneity a unit increase in human capital increases institutional quality by 0.64 units and a unit increase in institutional quality increases human capital by 0.88 units (see Table 7, Panel B).

The total effects of institution and integration on the provincial per capita income are roughly equal (slightly above 0.40); however, if we only consider the statistically significant effect, these coefficients are reduced to 0.39 for human capital (consisting only of the direct effect) and 0.34 for institutions (consisting solely of the indirect effect via human capital).[18] Notably, geography has a negative effect on institutional quality and a positive effect on human capital. Overall, human capital "trumps" everything else; however, institutional quality has a highly significant and non-negligible positive effect on human capital and thus, a strong indirect effect on provincial per capita income.

5 Conclusion

In our article, we have analyzed the importance of the deep determinants for the economic success of a province in China. In the first part of our paper, we examined which of the three deep determinants – geography, institutions, and integration – is most decisive for explaining cross-provincial income differences. Our analysis reveals that institutional quality plays an important role for the development level of a province in China, even more important than geography and integration (what is probably surprising regarding China's strong export performance). In the second part of our paper we then investigated whether this primacy of institutions at the provincial level also holds when controlling for human capital. Interestingly, our results indicate that neglecting the human capital dimension overestimates the direct effect of institutional quality on provincial per capita income. Although both, human capital and institutional quality, have a statistically significant total effect on the provincial per capita income (the effect of human capital is slightly higher), the positive effect of institutions stems solely from the indirect effect via human capital, whereas human capital directly (positively) affects the per capita income.

International comparison show that China's average years of schooling still lacks behind various Latin American and East Asian middle-income countries (see, for example, Glawe and Wagner, 2017).[19] In addition, cross-country rankings reveal that China's overall institutional quality is still relatively weak (see, for example, Wagner, 2015). The fact that China nonetheless achieved miraculous GDP growth on the national level for such a long period of time might (at least to some extent) stem from the fact that some provinces (primarily

[18] We obtain these values by solving the system of equations implied by Column (4) of Table 6, Panel A, and by Columns (1) and (2) of Table 7, Panel B.

[19] Regarding the educational quality, the PISA rankings indicate that China performs very well, emerging as the top performer in all categories (math, science, and writing) in 2012 (OECD, 2014, p. 5). However, these results should be treated with caution as only Shanghai-China is covered in the PISA 2012 study. Shanghai's share in the country's total population is rather small (ca. 1.78%) and it is one of the most developed provinces in China (NBS, 2016, own calculations). Thus, the performance of Shanghai's student needs not to be representative for the whole country. This concern is further confirmed by the newest PISA results: In 2015, when the PISA test participation was extended to additionally include Beijing, Jiangsu, and Guandong ("B-S-J-G China"), accounting for roughly 17.07% of the country's total population, China was barely able to retain its top 10 ranking in the average PISA score of reading, science, and math (OECD, 2018). It would be very interesting to see how including more (less developed) provinces would affect the PISA test outcome.

those located in the East of China) have much higher levels of education and much better institutions than the rest of China: our data indicates that the Eastern provinces record an average marketization index of 9.27. Moreover, a person has on average 9.05 years of schooling. In contrast, the inland provinces have much lower average values of only 6.37 and 7.94, respectively (the means of all provinces was around 7.50 and 8.37, respectively). In line with this finding, the Eastern provinces recorded on average a much higher average GDP per capita (US$6,905 versus US$3,606 in 2010).

However, in the future, it might probably not be enough to rely on the relatively high educational level, the good institutional quality and the exceptional economic performance of only some provinces. Indeed, the Chinese government has already shifted its focus to the inland parts of China by pursuing various initiatives such as "China's Western Development Strategy" since 1999 as well as the new "One Belt One Road" initiative. Our findings suggest that improving human capital and institutional quality is a key factor to successfully exploit the growth potential of the inland provinces.

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Appendix A. List of provinces

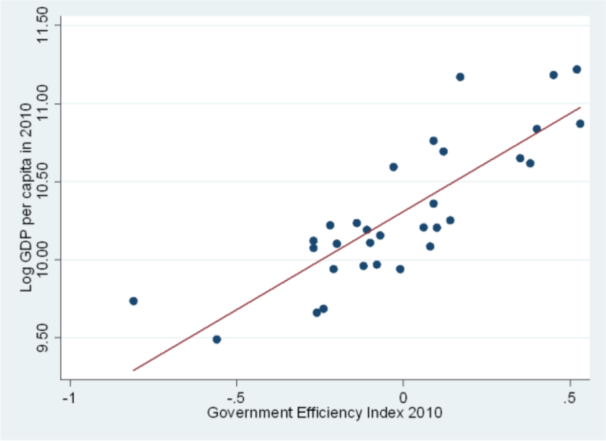
<u>List of provinces for which we have data on the marketization index (Fan et al., 2010)</u>

Anhui, Beijing, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Inner Mongolia, Jiangsu, Jiangxi, Jilin, Liaoning, Ningxia, Qinghai, Shaanxi, Shandong, Shanghai, Shanxi, Sichuan, Tianjin, Tibet, Xinjiang, Yunnan, Zhejiang

Appendix B. Alternative measures of institutional quality

Figure B1. Provincial per capita income and alternative measures of institutional quality.

a) Government efficiency index



b) Business-friendly environment index

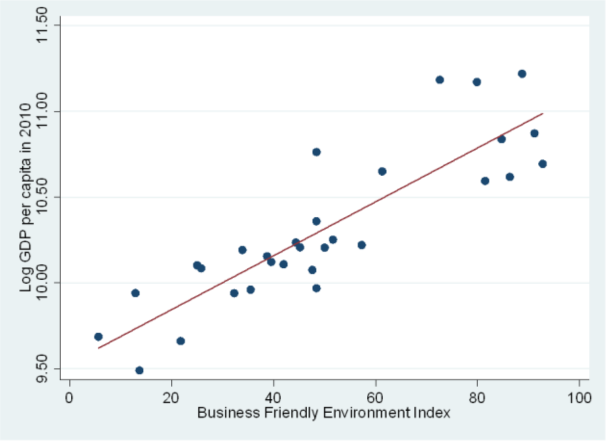
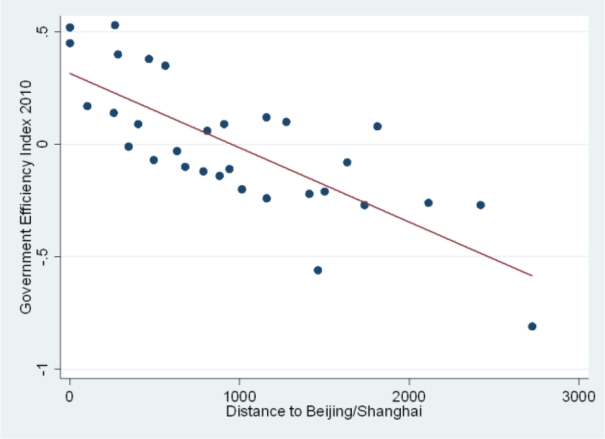
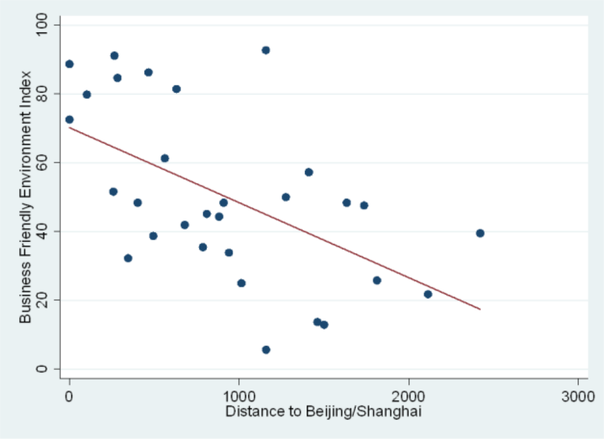


Figure B2. Alternative measures of institutional quality and the distance to Beijing/Shanghai.

a) Government efficiency index



b) Business-friendly environment index



Appendix C. Alternative instruments (ethnic fractionalization)

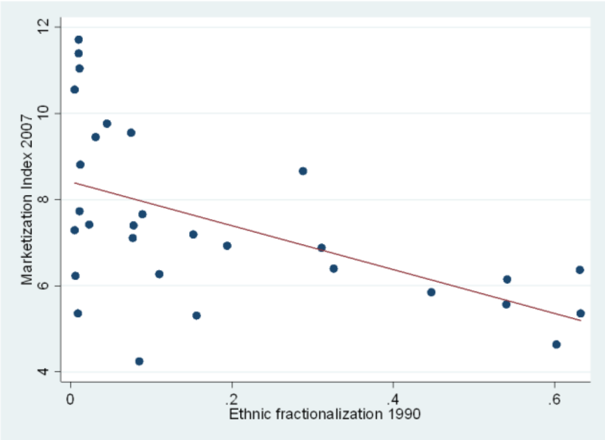
Table C1. 2SLS regression (alternative instruments).

	(1)	(2)	(3)	(4)
Panel B: 2SLS Regression				
Institutions (MI)	0.3519***	0.3421***	0.3513***	0.3372***
	(3.82)	(5.16)	(3.92)	(5.25)
Geography (Latitude)		0.1907***		0.1914***
		(5.05)		(5.13)
R-squared	0.6353	0.8084	0.6299	0.8052
Underidentification test (p-value)	0.0029	0.0024	0.0021	0.0016
Endogeneity test (p-value)	0.8910	0.3536	0.9010	0.2912
Panel B: First-stage for institutions				
EFI90	-0.5519***	-0.5566***		
	(-3.43)	(-3.46)		
EFI00			-0.5535***	-0.5606***
			(-3.58)	(-3.64)
Latitude		-0.1641		-0.1757
		(-1.03)		(-1.14)
F-statistic	11.74	11.96	12.81	13.25
Observations	30	30	31	31

Note: Dependent variable: Log per capita GDP. EFI90 (EFI00) is the ethnic fractionalization index (ranging from 0 to 1, a higher value indicating greater heterogeneity) for the year 1990 (2000). The independent variables are all scaled in the sense that they present deviations from the mean divided by the standard deviation. T-statistics are in parentheses. Significance at the 10, 5, and 1 percent levels are denoted by *, **, and ***, respectively

Figure C1. Alterative instruments for institutions.

a) Ethnic fractionalization (1990)



b) Ethnic fractionalization (2000)