

Rice, State Capacity, and Economic Transformation in China

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Abstract

I propose an agricultural theory of economic transformation that rice cultivation is conducive to market reform. Using sub-national data from China, I show that market reform is more successful in rice than in wheat regions after controlling for income, policy, geography, and interest groups, and that the effect of rice is as important as geography. Exploiting a geographic regression discontinuity design based on China's Qin Mountains-Huai River line, I show that rice has a causal effect on reform outcome. Causal mediation analysis and historical evidence demonstrate that rice cultivation contributes to a market economy through strong state fiscal capacity, rather than through culture or public support, because it necessitates large water-control projects that require a strong state. The agricultural theory pushes back the causal chain to find a structurally deeper cause of reform outcomes in the developing world. Caution should be exercised when generalizing the theory outside Asia.

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One of the most dramatic political events in the last three decades is the collapse of communism and the transition to market economies in the post-communist world. This transformation has attracted the scholarly attention of social scientists, who have examined the causes, processes, and consequences of the transition.¹ They have debated what makes the economic transformation from a command economy to a market economy more successful. Prior studies have explored the impact of income level, regime type, interest groups, and the European Union (EU) on the creation of market economies.² However, as Frye pointed out, “these middle-range factors and economic reform may spring from the same source. Thus, many questions remain about causal relationships in the study of transition economies.”³ In other words, while these factors might cause market reform, market reform may also influence these factors, or some exogenous causes may affect everything. As Kitschelt argued, the literature should identify more temporally distant causal factors to reduce the likelihood of tautology or banality.⁴

In this article, I examine the effect of different crops on reform outcomes and report strong evidence that rice cultivation is conducive to successful market reform. I further argue that the relationship between rice and market reform is mediated by state fiscal capacity, which is required in rice cultivating regions to coordinate water-control projects and labor mobilization, and that strong state fiscal capacity in turn makes market reform more successful. I term this causal chain the agricultural theory of economic transformation.

I test the theory using sub-national data from China. Statistical results show that market reform is more successful in rice-cultivating than in wheat-cultivating regions, controlling for income level, interest group concentration, policies, and geography. Rice has the second-largest effect at the provincial level (right after income level), and at the prefectural level its effect is as important as distance to ports. Exploiting a geographic regression discontinuity design (GRD) based on China’s Qin Mountains-Huai River Line (Qin-Huai), which divides the rice and wheat regions, I show that rice cultivation has a *causal* impact on reform outcome. I also report evidence from causal mediation analysis and archival data that state fiscal capacity is

¹Przeworski 1991; Shirk 1993; Duch 1993; Yang 1996; Hellman 1998; Roland 2000; Stokes 2001; Jackson, Klich and Poznanska 2005; Tucker et al. 2006.

²Please see Frye 2007 for a review.

³Frye 2007, 941.

⁴Kitschelt 2003.

one causal mechanism that links rice and reform outcome. However, I do not find supporting evidence for other alternative mechanisms, such as social capital or public support.

I am not aware of others who have examined the link between rice and market transition, with the exception of Yang who showed a statistical correlation between rice cultivation and reform propensity in China.⁵ A long tradition dating back to Marx and Wittfogel links the mode of agricultural production to the form of government. While this article supports the Wittfogel argument that rice cultivation demands a strong state, my theory differs from Wittfogel's "Oriental Despotism" in that I show that rice has a normatively positive effect.⁶ My argument also differs from a popular geography hypothesis, which holds that economies situated in temperate zones are wealthier than those situated in the tropics because of the prevalence of tropical diseases, especially malaria, and low agricultural productivity in tropical climates.⁷ I instead show that the sub-tropical and tropical climates in south China are conducive to rice cultivation, which has created strong state fiscal capacity and a more marketized economy, whereas the temperate climate in the north suits wheat cultivation and hence has resulted in a less marketized economy. Another version of the geography hypothesis contends that different historical endowments of plant and animal species created variation in hunting versus farming, and in places where farming dominated, technological innovation took place much more rapidly than in other parts of the world.⁸ This article goes further, showing that there is a difference between wheat and rice farming, and that the latter is more favorable to transitioning to a modern economy. My endogenous account of market institutions is also different from the argument that European colonizers imposed property-protecting institutions on their colonies from the outside;⁹ I contend that states' market institutions have internal agricultural roots.

My findings also offer a new perspective to the state-making literature that has been dominated by the European experience in which external threats, such as wars, have been a major

⁵Please see Yang 1996, 141-142. Yang's argument is that wet-rice cultivation is not subject to economies of scale, so the northern wheat provinces in China were more hospitable to collective agriculture, and the southern rice provinces were more prone to agricultural reform.

⁶Wittfogel 1957.

⁷Sachs 2001.

⁸Diamond 1997.

⁹Acemoglu, Johnson and Robinson 2001.

catalyst for state building.¹⁰ I show that internal agricultural demand can create further pressure to strengthen the state. In addition, my study is consistent with a strand of the literature that emphasizes the central role of the state in promoting reform in post-communist economies¹¹ and with the developmental state literature, which underlines the state's critical role in driving economic development.¹² However, this article pushes back the causal chain to find a deeper cause of state capacity and reform outcomes. By doing so, it joins a number of recent efforts to identify more distant causal factors—such as the timing of state formation, the type of communist rule,¹³ geographic proximity to market-oriented democracies,¹⁴ the timing of mass literacy, the content of the national curriculum,¹⁵ and the partisan balance of political power¹⁶—of post-communist transitions.

I use data from China to test the theory because China has a large area that spans different climate zones and offers great variation in agricultural modes and market transformation. The complete nationalization of private assets and socialist transformation in the 1950s and Deng Xiaoping's market-oriented reforms in the late 1970s offer an ideal situation in which to control for sub-national differences in the historical endowment of market institutions. The Qin-Huai line that separates the sub-tropical and temperate zones (and, therefore, the rice and wheat regions) offers a natural experiment to assess the causal effect of rice agriculture on the market economy. A within-country comparison also helps hold some of the important variables, such as regime type and the EU effect, constant. However, although the findings have high interval validity, I offer caveats at the end of the article about the conditions under which the theory could be applied outside China.

¹⁰Tilly 1992.

¹¹Shue 1988; Offe and Adler 1991; Sachs 1995; Holmes 1996; Grzymala-Busse and Luong 2002.

¹²Johnson 1982; Haggard 1990; Evans 1995; Kohli 2004.

¹³Kitschelt 2003.

¹⁴Kopstein and Reilly 2000.

¹⁵Darden and Grzymala-Busse 2006.

¹⁶Fish 1997; Frye 2007.

Rice, State, and Market

Wheat and rice are the two main staple crops in the world, as well as in China. The earliest archeological finds of domesticated rice came from Hemudu in Zhejiang Province in China, which has been carbon dated to about 5,000 B.C.¹⁷ However, for a long period of time, during the Former and Later Han dynasties (206 B.C.-A.D. 220), China's population (and hence its agriculture) was concentrated on the North China Plain, and the principal grain crops were millet and wheat, which were produced by dry farming methods. During the fourth and fifth centuries A.D., Chinese settlers began to migrate in large numbers to the Yangtze River valley, an area suitable for the cultivation of rice. As more people moved south, farming became settled and wet rice cultivation became dominant.¹⁸ By about 1700 Chinese agriculture had assumed its final pre-modern pattern: a basic division into a northern wheat region and a southern rice region, with a variety of other crops being grown on the poorer lands.¹⁹

From Rice to State

Rice cultivation is a different process from wheat farming. First, rice is by nature a swamp plant, and by far the greatest number of varieties are grown in standing water, which inspired the development of *irrigation farming*, whereas wheat can be cultivated on dry land and requires only *rainfall farming*.²⁰ In addition, rice cultivation is labor intensive and requires cooperation on a large scale. While wheat only ripens once a year, rice can ripen up to three times a year, so labor is in peak demand at transplanting and harvesting times.²¹ A rice peasant also needs to spend 20-50 % of his or her work time irrigating.²² Rice growing, therefore, necessitates intensive cooperation: the mass mobilization of labor is required to construct irrigation and flood control works.²³ In imperial China, every commoner family was expected to provide labor on demand for hydraulic and other public services, including irrigation, flood control,

¹⁷Bray 1986, 9.

¹⁸Perkins 1969, 6.

¹⁹Elvin 1982, 16.

²⁰Bray 1986, 11.

²¹Bray 1986, 17.

²²Wittfogel 1957, 23.

²³Perkins 1969, 8.

and drainage works.²⁴

Rice farming, which necessitates water control, hence requires a strong state to extract tax revenue and coordinate large public projects. The logic is similar to Tilly's argument, that as population density increased, European nations began to compete for territory, and the constant threat of war and the need to protect valued territory forced leaders to place particular emphasis on controlling remote areas that could be lost in battle.²⁵ In a similar vein, Slater argued that in Southeast Asia, states are strong when they have elite coalitions unified by shared support for heightened state power as bulwarks against especially threatening and challenging types of contentious politics.²⁶ The Chinese case presents a different path towards state building, in which the agrarian nature of the nation compelled leaders to tailor state institutions to agricultural needs. As Weber put it, "irrigation gave the entire economy of these areas a very specific character in historical times."²⁷

The idea of rice making the state is not at all new, and can be traced back to Marx's "Asiatic Mode of Production"²⁸ and Wittfogel's "Oriental Despotism."²⁹ Economic historians have long attributed the creation of China's central state to the need for water control. As Perkins argued, "Elaborate water-control schemes were carried out in China many centuries prior to the unification of the empire in 221 B.C. Such water-control activities have been used to explain not only agricultural productivity, but the rise and fall of dynasties and numerous other political and social phenomena as well."³⁰ Many historians, including Sima Qian and Ch'ao-t'ing Chi, believed that the construction of large water-control projects contributed to the rise of the Qin—the first imperial dynasty of China. Chi attributed the crowning of the first emperor as the king of Qin to the construction of the Zhengguo Canal, which "laid the material basis for prosperity and power of Ch'in and made central Shensi the first Key Economic Area in China. The control of this area gave Ch'in a powerful weapon for the subjugation of the rest of

²⁴Wittfogel 1957, 25.

²⁵Tilly 1992.

²⁶Slater 2010.

²⁷Weber 2013, 38.

²⁸Marx 1853.

²⁹Wittfogel 1957.

³⁰Perkins 1969, 60.

the feudal states.”³¹ In *Shiji*, one of the oldest and most influential historical works in human history, completed around 100 B.C., Sima remarked that after the Zhengguo Canal was completed, “Thereupon the area within the passes was turned into fertile but uncultivated land, and there were no calamitous years, and thus Qin became rich and strong, and in the end unified the feudal states.”³²

Rice cultivation and water control were not only a driving force of state building in ancient China, they served as a major motivation for China’s modern state-building effort as well. The logic of Mao’s many collectivization policies in the late 1950s was no different from that of ancient emperors’ efforts to build great canals. Shue contended that Mao’s collectivization was an effort to build a modern state and penetrate local interests.³³ Perkins (1969, 66) argued, “One of the principal economic reasons for setting up first the cooperatives in 1955-56 and then the communes in 1958 was to enable cadres to mobilize rural labor for local water control construction.”³⁴

From State to Market

A strong state, in turn, is conducive to the economic transformation of command economies. While some earlier studies emphasized scaling back the state, recent scholars have realized that an enfeebled state did little to promote economic reform.³⁵ Others have shown that the state has been central to economic transformation.³⁶ The developmental state literature also stresses the state’s critical role in leading a country’s industrialization.³⁷

Since Polanyi, scholars have noted the importance of a strong modern state in destroying “protectionist towns and principalities” and creating modern market economies.³⁸ For post-communist economies, as Kornai pointed out, the transition to a market economy often entails

³¹Chi 1936, 69.

³²Sima 2007, 102

³³Shue 1988.

³⁴Perkins 1969, 66.

³⁵Sachs 1995; Holmes 1996.

³⁶Shue 1988; Offe and Adler 1991; Grzymala-Busse and Luong 2002.

³⁷Johnson 1982.

³⁸Polanyi 2001, 68.

two separate processes: the retreat of the state and the entry of private actors.³⁹ Both processes require a strong state's involvement. After all, one of the first things that Deng Xiaoping did to push for China's reform was to empower local states.⁴⁰ It might sound counterintuitive that a strong state would facilitate the retreat of the state. However, state capacity, as defined by Skocpol, represents its ability "to implement official goals, especially over the actual and potential opposition of powerful social groups or in the face of recalcitrant socioeconomic circumstances."⁴¹ So if the retreat of the state is the official goal, then a strong state should be better able to achieve.

In China, the retreat of the state occurred in the early 1980s when people's communes were dismantled by innovative peasants and reform-minded leaders, and in the late 1990s when hundreds of thousands of small and medium-sized state-owned enterprises were privatized. In both processes, the state, especially local states, played an important role in facilitating the reform. For the former, the obstacles were local entrenched interests, such as families and local cadres—termed by Shue as "honeycombs"—who benefited from the old system. As Shue argued, "the wide-ranging rural reform program it pursued was in part motivated by the new leadership's determination to smash that very honeycomb pattern of economic organization, the entrenched power pockets, and the conspiracies of misinformation that conditioned performance in the lower state apparatus."⁴² The newly structured local states, which replaced the "honeycombs," became a powerful engine for China's rural industrialization.⁴³ For the latter, local states were expected to monitor the privatization process, compensate the laid-off employees, and maintain social order.

The second process, entry of private actors, such as private enterprises and foreign investors, also required local states to make initiatives, cut deals, and build property-rights protecting institutions. Local states should be able to push for policies that changed the status quo and to experiment with new initiatives.⁴⁴ A strong state with abundant financial resources has been

³⁹Kornai 2008.

⁴⁰Shirk 1993.

⁴¹Skocpol 1985, 9.

⁴²Shue 1988, 131.

⁴³Oi 1992.

⁴⁴Heilmann and Perry 2011.

shown to have a comparative advantage in building these infrastructures, such as courts, to attract and retain investors.⁴⁵

This article refrains from making the argument that state capacity has always been a positive force. I only discuss the role of state capacity in the context of China's recent reform and treat state capacity as a neutral concept. As Weingast famously said, "A government strong enough to protect property rights and enforce contracts is also strong enough to confiscate the wealth of its citizens."⁴⁶ Strong state capacity can be utilized by reform-minded leaders, such as Deng, to push for reform, but also can be used by radical leaders, such as Mao, to create disasters. For example, Bai and Kung showed that collective agriculture, which was created to coordinate water control and labor mobilization during the early Mao era, were fraught with problems such as work incentives and excessive grain procurement, which in one extreme historical instance had resulted in great tragedy—China's Great Leap Famine.⁴⁷

In sum, the agricultural theory suggests that the causal chain could be:

Rice cultivation \Rightarrow Strong state \Rightarrow Market transformation.

And the discussions can be summarized in the following two testable hypotheses:

Hypothesis 1: Market reform is more successful in rice than in wheat regions, ceteris paribus.

Hypothesis 1.1: Market reform is more successful in rice than in wheat regions because rice cultivation encourages the development of a strong state, which in turn makes market transformation more successful.

Finally, it is important to note that all of these are *unintended* consequences of rice growing. As Wittfogel argued, "The pioneers of hydraulic agriculture, like the pioneers of rainfall farming, were unaware of the ultimate consequences of their choice."⁴⁸ In addition, rice cannot act on its own; people, after all, support or obstruct reform. The last 60 years of Chinese history show that leaders and the masses are far more important in determining the outcome of the economy: Mao Zedong transformed the country into a Soviet-style command economy,

⁴⁵Wang 2013.

⁴⁶Weingast 1995, 1.

⁴⁷Bai and Kung 2014.

⁴⁸Wittfogel 1957, 19.

and Deng Xiaoping initiated the transition to a modern market economy. The agricultural theory merely implies that, once given the opportunity, people in rice regions are more capable of establishing a market economy.

ESTIMATING THE EFFECT OF RICE

I report the empirical evidence for the agricultural theory in two steps. This section focuses on estimating the causal effect of rice cultivation on reform outcome (Hypothesis 1), and the next section explores possible causal mechanisms (Hypothesis 1.1). I use Chinese data to separately estimate models at two levels of jurisdiction—provincial and prefectural—to examine whether the results hold at different levels.⁴⁹ I collect data from various sources, including government statistics, stock market, a mass survey, and the geographic information system (GIS). Most government statistics are averaged over five years to minimize temporal fluctuations or manipulation bias due to Chinese officials' electoral cycles.⁵⁰

I employ two empirical strategies—a conventional approach and a GRD design—to estimate the effect of rice growing on market reform outcome. The conventional approach that relies on multivariate regressions includes all observations in the estimation and, therefore, maximizes the external validity of the results. However, multivariate regressions fall short of identifying the causal effect. For example, unobservable factors that affect reform outcome, such as historical variables, cannot be properly controlled for in a multivariate framework, which could produce omitted variable bias. In addition, regions with more marketized economies might be more likely to grow rice, or some exogenous variables might cause both rice cultivation and reform outcome, and this endogeneity problem could also bias the estimates.

To complement the conventional approach, I exploit a geography-based natural experiment to compare prefectures along the Qin-Huai Line—which divides the northern wheat and southern rice regions—to estimate the causal effect of rice cultivation. The regression discontinuity design, when meeting certain “mild” assumptions, has high internal validity relative to observa-

⁴⁹China has a four-level government: center, province, prefecture, and county.

⁵⁰Guo 2009; Wallace 2014*b*.

tional study methods and typical natural experiment strategies.⁵¹ Both multivariate regressions and the GRD design produce the same finding: rice cultivation has a positive effect on reform outcome.

Conventional Approach

The conventional approach uses ordinary least squares (OLS) to fit the following equation to a provincial- or prefectural-level cross-section data file:

$$MARKET_j = \beta_0 + \beta_1 RICE_j + X_j\Gamma + \epsilon_j, \quad (1)$$

where coefficient β_1 measures the effect of rice cultivation on reform outcome, after controlling for the available covariates in X . I measure the key variables as follows.

Dependent Variable. The dependent variable, $MARKET_j$, measures the level of marketization in province or prefecture j in China. The most popular cross-national measure of reform outcome is the European Bank for Reconstruction and Development (EBRD) score, which is an index that consists of bank experts' evaluations of progress on economic transformation across eight dimensions.⁵² The EBRD score rates reform outcome on a continuous scale from a command economy to a market economy.⁵³ However, the EBRD does not provide sub-national measures of reform outcome. Fan and his colleagues at the National Economic Research Institute in China developed a provincial-level marketization index for China, which partly overlaps with the EBRD score.⁵⁴ The index comprises 19 indicators of institutional arrangements and policies in five major areas of the market-oriented reforms on a scale of 0 (little change from the command economy) to 10 (closer to a developed market economy).⁵⁵ The Fan, Wang and Zhu index covers the two dimensions of market reform—retreat of the state and entry of private actors—and can be used as a credible measure of reform outcome. At the provincial

⁵¹Lee and Lemieux 2010, 282.

⁵²The dimensions include price liberalization, agricultural liberalization, foreign exchange and trade liberalization, competition policy, large privatization, small privatization, enterprise reform, bank reform, and non-bank financial reform.

⁵³Please see <http://www.ebrd.com/> (Accessed June 17, 2014).

⁵⁴Fan, Wang and Zhu 2011.

⁵⁵For details about the index, please see Section 1.1 in the web appendix.

level, I use the five-year average (2006-2010) of Fan, Wang and Zhu's marketization index as the dependent variable.

At the prefectural level, because of poor data availability, I construct my own index that comprises the factor, which is scored using the regression method with the following three variables: the 2006-2010 average share of government expenditure of the gross domestic product (GDP) of a prefecture (which measures government size—smaller government implies a bigger market), the 2006-2010 average share of private sector employees in the population of a prefecture (which measures private sector development), and the share of the total stock of foreign direct investment (FDI) in the prefectural GDP in 2010 (which measures openness and the entry of foreign investors). The size of government measures the weight of the government in the economy, while private sector development and FDI measure the entry of private sectors. These three variables are highly correlated and constitute a single dimension in the factor analysis.⁵⁶ Later, I also use the three variables individually rather than as an index and find similar results.⁵⁷ This prefectural-level measure is highly correlated with the provincial-level measure (correlation coeff.=0.577, $p < 0.01$), which indicates its validity and consistency.

Independent Variable. I use two measures for the independent variable. One, **RICE**, is the percentage of cultivated land in a province or prefecture devoted to rice paddies. The earliest data at the provincial level are from 1952 with some missing values, and more systematic data are from provincial statistical yearbooks in 1996. RICE 1952 and RICE 1996 are highly correlated (correlation coeff.=0.954, $p < 0.01$), indicating that there have been few changes in the geographical distribution of crops in China. I include RICE 1952 and RICE 1996, respectively, in the models to check the robustness of the results to different measures. At the prefectural level, I collect the rice data from provincial statistical yearbooks as early as possible; many prefectures had data back to the early 1990s. I am confident that historical rice cultivation patterns are highly correlated with recent patterns. To check whether my results still hold while using more historical measures, I use **RICE ENVIRONMENT** as an alternative independent variable, which is a z score of the environmental suitability of each province or

⁵⁶For details of the index construction, please see Section 1.2 in the web appendix.

⁵⁷For analyses using these three variables separately, please see Table A3 in the web appendix.

prefecture for growing wetland rice based on the United Nations Food and Agriculture Organization's Global Agro-Ecological Zones database.⁵⁸ RICE ENVIRONMENT simply measures whether the climate was historically suitable for growing wetland rice, regardless of modern technologies. Both measures exclude data from Tibet, Xinjiang, and Inner Mongolia, because these are herding regions.

Controls. Prior studies have identified the following factors that affect reform outcome. The modernization theory predicts that industrialization, urbanization, marketization, and political changes develop in unison as the level of income increases.⁵⁹ To measure modernization, I use the 2006-2010 average per capita GDP (**PER CAPITA GDP**) and the share of service industry in GDP (**SERVICE INDUSTRY**) at the provincial or prefectural level.

China's market reform has been policy driven, especially many of Deng Xiaoping's early policies, such as special economic zones (SEZs) or coastal open cities (COCs), which gave a head start to the economic development of coastal regions.⁶⁰ I use a dummy variable (**POLICY**) to indicate whether a province has (or a prefecture is) a designated SEZ or COC.⁶¹

Access to the sea is believed to be vital to development.⁶² **GEOGRAPHY** uses GIS data to calculate the driving distance (in kilometers) from the provincial capital or prefectural central district to the nearest major ports.⁶³

Some studies have focused on interest groups in market reform, although their role is debated. Some scholars have argued that economic reforms need to create opportunities for politicians to build coalitions of early winners from reform to support further liberalization later in the transformation.⁶⁴ However, others have argued that economic actors that gain from early economic reforms have frequently attempted to block further advances in the reform process that threaten to eliminate the special advantages upon which their early gains were based. As

⁵⁸The data are from Talhelm et al. 2014.

⁵⁹Lipset 1959.

⁶⁰Shirk 1993; Naughton 1996.

⁶¹The SEZs include Shenzhen, Shantou, and Zhuhai in Guangdong Province, Xiamen in Fujian Province, and the whole Hainan Province. The COCs include Dalian (Liaoning), Qinhuangdao (Hebei), Tianjin, Yantai (Shandong), Qingdao (Shandong), Lianyungang (Jiangsu), Nantong (Jiangsu), Shanghai, Ningbo (Zhejiang), Wenzhou (Zhejiang), Fuzhou (Fujian), Guangzhou (Guangdong), Zhanjiang (Guangdong), and Beihai (Guangxi).

⁶²Collier 2007, 53.

⁶³China's major ports include Shanghai Port, Qinhuangdao Port, Dalian Port, Tianjin Port, Qingdao Port, Lianyungang Port, Guangzhou Port, Zhanjiang Port, and Fuzhou Port.

⁶⁴Haggard 1990; Roland 2000; Qian 2003.

Hellman showed, “the short-term winners have often sought to stall the economy in a *partial reform equilibrium* that generates concentrated rents for themselves, while imposing high costs on the rest of society.”⁶⁵ Recent studies, however, show that strong interest groups such as foreign investors or veto players can overcome the “partial reform equilibrium” and push for economic reforms.⁶⁶ Despite the debate, both camps have focused on enterprise insiders, primarily company managers, who either support or undermine economic reform.⁶⁷

I use stock market data to measure interest group concentration. **INTEREST GROUPS** is the percentage of publicly traded firms that had at least one former government official on their board of directors in a province or prefecture in 2010. The rationale is based on the political connections literature, which argues that firms hire politicians to gain political bargaining power vis-à-vis the government.⁶⁸ I focus on publicly traded firms because they are the biggest players (winners) in the market and have strong political leverage in policymaking.⁶⁹

Finally, I also control for the share of migrants in the total population. Although China’s family registration system has limited social mobility from rural to urban areas, hundreds of millions of people have migrated to cities since the reform started.⁷⁰ If the causal mechanism is through people, such as culture, migrants would bring “wheat culture” to rice regions, or vice versa, and bias the results. One fact may alleviate this concern: most migrants in China are moving from west to east rather than from north to south;⁷¹ while the latter mixes wheat and rice, the former just creates mobility within wheat or rice regions. Holding the share of migrants constant will further decrease the bias. Because only *inter*-province migration would create the bias, I use **MIGRANTS**—the percentage of registered inter-province migrants in the total population of a province or prefecture—based on the 2000 census. Tables A19 and A20 in the web appendix present all variables’ summary statistics.

[INSERT TABLE 1 HERE]

⁶⁵Hellman 1998, 204.

⁶⁶Malesky 2009; Gehlbach and Malesky 2010.

⁶⁷Shleifer 1998.

⁶⁸Truex 2014; Eggers and Hainmueller 2009.

⁶⁹Section 1.3 in the web appendix discusses how this variable is constructed.

⁷⁰Wallace 2014a.

⁷¹Chan, Henderson and Tsui 2008.

Table 1 presents the OLS estimates of Equation (1) with robust standard errors in parentheses using provincial-level data. Columns 1-6 use RICE 1996 as the explanatory variable with different sets of controls, Column 7 uses RICE 1952, and Column 8 uses RICE ENVIRONMENT. Column 1, which excludes all controls to avoid post-treatment bias, shows the bivariate relationship between RICE 1996 and MARKET, while other columns include various controls to avoid omitted variable bias. As shown, there is a consistently positive correlation between RICE 1996 and MARKET. Although adding more controls decreases the degree of freedom (and hence the significance level), RICE 1996 remains the only significant variable at the 0.1 level in the full model. RICE 1952 and RICE ENVIRONMENT, which reflect the shadow of the past, also have a significantly positive effect on MARKET, holding everything else constant. The coefficient of RICE 1952 is larger than that of RICE 1996, indicating that historical rice cultivation has a persistent effect on reform outcome today.

The alternative hypotheses do not offer strong support for the modernization theory. Both PER CAPITA GDP and SERVICE INDUSTRY lose any statistical significance after controlling for everything else while using the more recent measure of RICE, and SERVICE INDUSTRY even has a negative impact on MARKET. However, the modernization variables become significant when using RICE 1952 as the independent variable, implying that holding history constant, contemporary income level is still correlated with market reform. I do find a weak POLICY effect: places designated as SEZs or COCs are significantly more marketized than others, but this difference is statistically insignificant in the full model. There is also weak support for the geography hypothesis: regions further away from the ocean have less developed market economies. However, the GEOGRAPHY effect is indistinguishable from zero in the full model. INTEREST GROUPS has a positive effect on MARKET; the effect is statistically significant without other controls and becomes insignificant with the controls. This lends partial support to the view that groups that benefit from reform advocate for deeper reform.⁷² However, this effect becomes negative and insignificant when using RICE 1952.

With an index as the outcome variable, it is difficult to compare the magnitude of each effect. I use the η^2 method to measure the proportion of the total variance in the dependent

⁷²Haggard 1990; Malesky 2009.

variable that is attributed to an effect. The last column in Table 1 presents the η^2 of each variable. RICE 1996 has the second-largest effect, right after PER CAPITA GDP. The third-largest effect comes from GEOGRAPHY. Both substantively and statistically, the results support Hypothesis 1.

Table 2 presents the OLS estimates of Equation (1) with standard errors clustered at the provincial level in parentheses using prefectural-level data.⁷³ The results are similar to Table 1. RICE regions are significantly more marketized, holding everything else constant. The historical effect of RICE ENVIRONMENT is also significantly positive. The modernization hypothesis finds some support from the prefectural data: PER CAPITA GDP's effect is significantly positive, although SERVICE INDUSTRY has a null effect. POLICY's and GEOGRAPHY's effects are as expected, and more significant than in the provincial results. There is no evidence at the prefectural level that INTEREST GROUPS has any effect, and because not every prefecture had listed firms, adding this variable decreases N to 105.⁷⁴

[INSERT TABLE 2 HERE]

Based on results from Table A3 in the web appendix that uses individual indicators as the dependent variables, I can calculate that a 10% increase in RICE 1990 causes private employment in the total population in the 2000s to increase by 0.56%, which can be translated into 7.28 million more people (roughly the population of Hong Kong) working in the private sector nationwide. In addition, a 10% increase in RICE 1990 will lead to a 0.02% increase in FDI/GDP in the 2000s, which brings about \$904.4 million (roughly the GDP of Dominica). Similarly, using the η^2 method, I calculate the size of the effect of each explanatory variable. RICE's importance decreases at the prefectural level, but it is still more substantial than SERVICE INDUSTRY and INTEREST GROUPS, and is almost as important as GEOGRAPHY. At the prefectural level, PER CAPITA GDP and POLICY seem to be the most crucial driving forces of market reform. In general, the prefectural-level results also support Hypothesis 1.

⁷³I add DISTANCE TO BEIJING as an extra control at the prefectural level to control for the center's influence and find no impact. Please see Table A3.1 in the web appendix.

⁷⁴Only prefectures that had more than ten listed firms in 2010 were included in the analysis.

Although the conventional approach has high external validity because of the inclusion of all available observations, it is not an ideal approach to identify the causal effect due to two major challenges. First, unobservable determinants of market transition, such as historical variables, might cause omitted variable bias. Second, more marketized regions might be more likely to grow rice, or some exogenous third factor might cause both rice cultivation and market transition, and these endogeneity problems would also bias the estimates. I employ a geography-based natural experiment to tackle these two challenges in the next section.

A GRD Design

I exploit a GRD design that is based on China's Qin-Huai line that divides northern wheat regions and southern rice regions to estimate the causal effect of rice cultivation on reform outcome. This line, which connects the Qin Mountains in the west and the Huai River in the east, reaches eastward from Tibet to the Pacific. The line, located around 32° N latitude, also coincides with the 30th parallel north, which divides temperate climates in the north from subtropical climates in the south. Ideally for this study, the different climates on either side of the Qin-Huai line created natural environments that were favorable to wheat cultivation in the north and rice cultivation in the south. As Perry showed, "the Huai River has formed the demarcation line between rice-producing South China and the wheat-growing North."⁷⁵

[INSERT FIGURE 1 HERE]

Figure 1 differentiates prefectures that devoted more than half of their sown lands to rice paddies (dark red) from those that used more than half of their sown lands to grow non-rice products (primarily wheat) in the early 1990s (light red). The Qin-Huai line in the middle clearly divides these two regions. And it is critical to note that these regions rarely shift. As Perkins pointed out, "Most of the regions where rice is an important crop today were major rice producers a thousand years ago."⁷⁶ The immovability northward of rice cultivation, Perkins added, "was and is primarily the result of inadequate rainfall."⁷⁷ This provides one of

⁷⁵Perry 1980, 25.

⁷⁶Perkins 1969, 41.

⁷⁷Perkins 1969, 43.

the most important foundations for a successful RD design, that is, exposure to treatment (rice cultivation) was not due to self-selection, which would likely produce a large source bias.

Figure 2 shows prefectures by RICE 1990, the percentage of cultivated lands devoted to rice paddies, and the geo-coded distance from city centroid (in degree latitude) to the Qin-Huai line, set at 32° N latitude. For this natural experiment, the “treatment” is exposure to rice cultivation as the major agricultural activity in a prefecture, and the “control” condition is exposure to non-rice cultivation, such as wheat. The forcing variable is latitude. A linear regression estimated within a 2.92° window, the “optimal” bandwidth estimated by the data-driven method proposed by Imbens and Kalyanaraman,⁷⁸ on either side of the Qin-Huai line estimates a jump of 42.55% (s.e. clustered by latitude=5.18) in RICE.⁷⁹ This jump at the cutoff point provides the basis for identifying the causal effects of being in the rice versus the wheat region.

[INSERT FIGURE 2 HERE]

Figures 1 and 2 both show that the jump is not from 0 to 1, that is, from complete rice cultivation to complete wheat cultivation, indicating “fuzziness” around the cutoff point. Hence the appropriate methodology should be a “fuzzy” RD design.⁸⁰ As with the sharp design, the rationale is that the exogenous nature of the Qin-Huai line means that units just to its north are likely to be similar to those just to its south in all ways except for treatment exposure likelihood and post-treatment outcomes, creating a “local” quasi-experiment. Given the discontinuous jump in the probability of exposure to rice cultivation, I can identify the effect of rice cultivation for prefectures defined by their latitudes (the forcing variable) at the cutoff point as long as two assumptions hold. First, if the expected values of “potential outcomes” under treatment and control are smooth around the cutoff point. Second, in the immediate neighborhood of the cutoff point, if treatment status is unconfounded relative to the outcomes of interest, conditional on the forcing variable. When these conditions hold, there is a close analogy between how the treatment effect is defined in the fuzzy RD design and in the “Wald” formulation of the treatment effect in an instrumental variables setting.⁸¹ The instrument is an indicator variable

⁷⁸Imbens and Kalyanaraman 2011.

⁷⁹Table A4 in the web appendix provides the full results.

⁸⁰Hahn, Todd and Van der Klaauw 2001; Imbens and Lemieux 2008.

⁸¹Hahn, Todd and Van der Klaauw 2001.

for whether the prefecture is above or below the Qin-Huai line. The treatment, rice cultivation, is an endogenous regressor. Treatment effects can then be estimated using two-stage least-squares (2SLS), with standard errors clustered by latitude providing the appropriate basis for inference.⁸²

There are two remaining issues before estimating the model. First, I must choose the size of the bandwidth within which to fit the model. Second, I need to decide on a way to model the smooth relationship between the forcing variable and outcomes. The choices reflect the crucial bias-variance tradeoff in RD designs. The literature provides two alternative approaches to striking a balance. One, proposed by Imbens and Kalyanaraman, is a data-driven method for choosing an asymptotically “optimal” bandwidth and local regression estimator.⁸³ This approach minimizes the expected prediction error at the cutoff point and exhibits desirable asymptotic convergence properties. The second approach is to fit high-order polynomial regressions in a wide window.⁸⁴ As evaluated by Green et al., both approaches perform well.⁸⁵

Below, I estimate the effect of rice cultivation on reform outcome using the following two strategies: (1) the Imbens-Kalyanaraman asymptotically optimal bandwidth,⁸⁶ (2) one that is twice the “optimal” bandwidth with the high-order polynomial specification search strategy recommended by Green et al..

I use 2SLS to fit the following equation to the prefectural-level cross-section data file:

$$\begin{aligned}
 MARKET_j &= \beta_0 + \beta_1 RICE1990_j \\
 &+ \beta_2 DISTANCE_j \\
 &+ \beta_3 SOUTH_j \times DISTANCE_j \\
 &+ \phi higher\ order\ terms_j + \epsilon_j,
 \end{aligned} \tag{2}$$

⁸²Hahn, Todd and Van der Klaauw 2001.

⁸³Imbens and Kalyanaraman 2011.

⁸⁴Green et al. 2009.

⁸⁵For an application of both approaches, please see Samii 2013.

⁸⁶The method is implemented in Stata 13 with the `rdob` package provided by Imbens. Please see <http://faculty-gsb.stanford.edu/imbens/RegressionDiscontinuity.html> (Accessed June 17, 2014).

where $MARKET_j$ is the index measuring market economy performance in prefecture j , and $RICE1990_j$ is an endogenous variable measuring the extent to which prefecture j devoted its cultivated land to rice paddies in the early 1990s. I use SOUTH, an indicator of whether a prefecture is below the Qin-Huai line, as an excluded instrument for RICE. $DISTANCE_j$ is the geo-coded perpendicular distance (in degrees latitude) from the prefecture centroid to the Qin-Huai line. β_1 is the estimated effect of RICE 1990 on MARKET, and according to Hypothesis 1, $\beta_1 > 0$.

[INSERT FIGURE 3 HERE]

Figure 3 presents the graphic analysis of Equation (2) with the optimal bandwidth, and Table 3 quantifies the results with the optimal and wider bandwidths.⁸⁷ As both the graph and table show, RICE 1990 has a significantly positive effect on MARKET, and the effect does not vary much over the different bandwidths. In sum, both the conventional approach and the GRD design results support Hypothesis 1.

[INSERT TABLE 3 HERE]

Robustness Checks

Despite the strong internal validity of RD designs, several methodological issues arise in geographical contexts. Following the recommendations of Keele and Titiunik, I conduct the following auxiliary analyses to check the robustness of the GRD findings.⁸⁸

First, a valid GRD design, similar to a non-spatial RD design, requires that pretreatment covariates of treated and control units are comparable. Keele and Titiunik suggested providing evidence that pretreatment covariates become more and more similar as the distance to the border decreases.⁸⁹ I conduct simple t-tests of PER CAPITA GDP, SERVICE INDUSTRY, POLICY, and GEOGRAPHY between rice and wheat regions within different latitude windows, and find that as the window narrows there is no significant difference between these two regions on these

⁸⁷The first-stage results are presented in Table A5 in the web appendix.

⁸⁸Keele and Titiunik 2015.

⁸⁹Keele and Titiunik 2015, 149.

covariates.⁹⁰ The null results are partly because of China's east/west divide, which prioritizes the allocation of policies and resources (both human and capital) to the coastal regions over the inland and western regions. These political-economic covariates might not be balanced on the east/west dimension, but are almost perfectly balanced on the north/south dimension.

Second, as Keele and Titiunik argued, compound treatments are common in GRD designs. This problem arises when a geographic border overlaps with an administrative border: it poses challenges for identifying the independent effect of the geographic border.⁹¹ Keele and Titiunik hence suggested restricting the analysis, if at all possible, to areas around the border where other important geographically defined institutional units are kept constant on either side of the border. So one strategy for isolating the treatment is to compare prefectures within the same province. Because provinces have considerable autonomy in making local policies,⁹² it is reasonable to assume that some important political, policy, and economic variables are held constant within a province. Jiangsu Province is an ideal case for such a test because it offers enough prefectures on either side of the Qin-Huai line. A t-test of MARKET on either side of the Qin-Huai line in Jiangsu Province shows that the difference is statistically significant (diff.=-1.37, s.e.=0.38).⁹³

Last, I measure DISTANCE using the perpendicular distance from the prefecture centroid to the Qin-Huai line. As Keele and Titiunik argued, this is a "naive" way to measure distance, because it does not account for distance *along* the border. However, Keele and Titiunik also showed that under some circumstances, naive distance will yield valid results, specifically when the boundary is short.⁹⁴ I hence divide my data into two sub-samples: one between 100° and 114° E longitudes and the other beyond 114° E longitude, so that each sub-sample has a shorter border. I estimate Equation (2) using the 2SLS approach within these two sub-samples and find similar results.⁹⁵

⁹⁰Table A6 in the web appendix shows the full results.

⁹¹Keele and Titiunik 2015, 149.

⁹²Shirk 1993; Montinola, Qian and Weingast 1995.

⁹³Table A7 in the web appendix presents the full results.

⁹⁴Keele and Titiunik 2015, 136-137.

⁹⁵Table A8 in the web appendix presents the results.

CAUSAL MECHANISMS

Now I have shown empirical evidence regarding *whether* rice cultivation has a causal effect on reform outcome. Below, I will explore *why* rice cultivation affects reform outcome, and show statistically and historically that rice cultivation causes market transition through strong state fiscal capacity.

Causal Mediation Analysis

Imai and his colleagues provided a general algorithm and statistical software for estimating causal mediation effects and a method for assessing the sensitivity of conclusions to potential violations of a key assumption.⁹⁶ Specifically, I am interested in estimating the average causal mediation effects (ACME) $\bar{\delta}(t)$ of a hypothesized mechanism (M) that links rice cultivation (T) and market economy (Y). ACME equals the change in the outcome corresponding to a change in the mediator from the value that would be realized under the control condition to the value that would be observed under the treatment condition, holding the treatment status at t . By fixing the treatment and changing only the mediator, causal mediation analysis eliminates all other causal mechanisms and isolates the hypothesized mechanism.

Hypothesis 1.1 states that rice cultivation required intensive water control and large public projects, which in turn contributed to strong state fiscal capacity that made market transition successful. The literature especially emphasized a state's fiscal capacity to collect revenue for large construction projects.⁹⁷ Following Besley and Persson,⁹⁸ I measure local state fiscal capacity (**STATE FISCAL CAPACITY**) using the (5-year-average) share of tax revenue in the total GDP of a prefecture.⁹⁹ A higher percentage indicates a stronger capacity to extract tax revenue from the society.¹⁰⁰

⁹⁶Imai et al. 2011.

⁹⁷Wittfogel 1957.

⁹⁸Besley and Persson 2009.

⁹⁹The data are from the Ministry of Finance's Statistical Reports of All Prefectures, Cities, and Counties (*Quanguo dishixian caizheng tongji ziliao*).

¹⁰⁰State capacity is a sophisticated concept that includes multiple dimensions, including (1) military capacity, (2) bureaucratic administrative capacity, and (3) the quality and coherence of political institutions, according to Hendrix 2010. However, as Hendrix 2010 showed, tax capacity is one of the most theoretically and empirically justified approaches to modeling state capacity.

Causal mediation analysis shows that STATE FISCAL CAPACITY has a positive, significant ACME at the 0.05 level.¹⁰¹ The average effect of the treatment variable (an indicator of prefectures with RICE>50%) on the outcome (MARKET) that operates through the mediator (STATE FISCAL CAPACITY) is 0.137 (95% confidence interval: [0.002,0.287]). The estimate of the direct effect is equal to 0.525, and the total effect is 0.663.¹⁰² This implies that STATE FISCAL CAPACITY has explained over 20% of the total effect mediated, but there are still some unexplored mechanisms that link rice and market transition.

Sensitivity analysis (Section 3.6 in the web appendix) shows that the results should be considered strong, because a confounder needs to explain more than 50% of the remaining variance in both STATE FISCAL CAPACITY and MARKET for the ACME to lose statistical significance.

I also test two alternative causal mechanisms. First, there might be a cultural mechanism that links rice and market. A recent social psychology study showed that people from the rice provinces in China think more collectively and are more loyal to their friends because rice cultivation requires large-scale cooperation among fellow villagers, and that this inter-personal trust was handed down through generations.¹⁰³ In the political science literature, Putnam showed that democratic institutions function more effectively in regions where there is a higher level of social capital, measured by inter-personal trust, tolerance, and civic engagement.¹⁰⁴ In the same vein, Levi argued that trust in the government determines citizens' compliance with government policies, which contributes to the effectiveness of governance.¹⁰⁵ It is thus expected that the social capital accumulated through collaboration in rice farming could contribute to government efforts to establish a market economy:

Rice cultivation \Rightarrow Social capital \Rightarrow Market transformation.

Second, because of the higher yield of rice compared to wheat in a given year, and the better water transport available in south China, there was a well-established market for grain in the

¹⁰¹The analyses were implemented in Stata 13 using Hicks and Tingley's (2011) *mediation* package.

¹⁰²Table A13 in the web appendix presents the full results.

¹⁰³Talhelm et al. 2014.

¹⁰⁴Putnam 1993.

¹⁰⁵Levi 1998.

southern rice region. Farmers in north China could produce cash crops that they could sell in distant markets, but even this was difficult where transport costs were high.¹⁰⁶ If people in rice regions have long been exposed to market activities, then their market skills and knowledge might be handed down through generations to recent periods. There is a vast literature showing that public support for market reform is crucial for a successful transformation,¹⁰⁷ and that people equipped with more market skills are more supportive of market transition.¹⁰⁸ So rice cultivation might support market transformation through public support:

Rice cultivation \Rightarrow Public support for market \Rightarrow Market transformation.

For the cultural mechanism, I measure social capital using Putnam's three indicators: **TRUST (PERSONAL and POLITICAL), TOLERANCE, and CIVIC ENGAGEMENT.**¹⁰⁹ I draw data from the China Survey, which is a national probability sample survey that was designed by a group of leading survey researchers, coordinated by Texas A&M University and implemented by the Research Center for Contemporary China at Peking University in 2008. The China Survey used a GIS/GPS sampling technique to randomly draw a sample of 3,750 adult citizens.¹¹⁰ Section III in the web appendix discusses the details of the measures.

For the public support mechanism, I use **PUBLIC SUPPORT**, which is the prefectural average level of support for private sector development, measured by a question in the "China Survey" that asks whether the respondent supported a higher share of state-owned enterprises, or privately owned enterprises, or maintaining the current level. Section III in the web appendix discusses the details of the measures.

Causal mediation analyses do not substantiate any of the alternative mechanisms; none of the mechanisms' ACMEs is distinguishable from 0.¹¹¹

In sum, the causal mediation analysis supports Hypothesis 1.1. There is, however, no strong evidence for the cultural and public support arguments.

¹⁰⁶Perry 1980, 33.

¹⁰⁷Duch 1993; Przeworski 1991; Roland 2000; Stokes 2001; Tucker et al. 2006.

¹⁰⁸Denisova et al. 2009.

¹⁰⁹Putnam 1993.

¹¹⁰For more information about the "China Survey," please see <http://thechinasurvey.tamu.edu> (Accessed June 17, 2014).

¹¹¹Tables A14-A18 in the web appendix present the full results.

Historical Evidence

There are three remaining issues in the causal chain. First, the causal mediation analysis shows that rice cultivation contributed to strong state fiscal capacity, but *how*? Marx and Wittfogel suggested that rice cultivation, a form of irrigation farming, requires water control, such as irrigation, flood control, and drainage works.¹¹² If this is the mechanism that explains how rice cultivation contributed to strong state fiscal capacity, we should expect more historical water-control projects in rice than in wheat regions. Second, *when* did the “rice cultivation \Rightarrow state capacity \Rightarrow market economy” causal story occur? There are two possible scenarios: (1) Historical rice cultivation \Rightarrow Historical state capacity \Rightarrow Modern state capacity \Rightarrow Modern market economy; or (2) Historical rice cultivation \Rightarrow Historical state capacity \Rightarrow Historical market economy \Rightarrow Modern market economy. Third, how did historical factors persist in determining contemporary reform outcomes?

I have a lengthy discussion in Section V in the web appendix that tackles these three issues. To summarize, I report historical gazetteer data that four times as many water-control projects had been built in south China as in north China by the end of the Qing era. I further show qualitative evidence that water-control activities contributed to the rise and fall of dynasties in China. In addition, almost 30 years of anti-market political climate during the Mao era broke any connection between pre-1949 and post-reform developments toward a market economy. Last, I collect historical tax revenue data at the provincial level from 1952-89 to show that provincial state fiscal capacity remained very stable in every province during this period.

In sum, historical evidence supports the following, complete, causal chain:

Historical rice \Rightarrow Historical state \Rightarrow Modern state \Rightarrow Modern market.

CONCLUSION

Since Adam Smith, scholars have believed that a free market is critical to the growth of the wealth of nations. For many post-communist states, the challenge is to transition from a com-

¹¹²Marx 1853; Wittfogel 1957.

mand economy to a market economy. Many have succeeded in this process, such as Poland, some have stagnated, including Belarus, while many others have been punctuated by ups and downs, such as Russia. How can the various experiences of creating a greater role for markets be explained? Previous studies have focused on income level, regime type, interest groups, and the EU. However, these middle-range theories fall short of offering deeper historical causes and a causal path, and suffer from endogeneity problems.

I offer a new theory of economic transformation by examining the agricultural roots of market transition. Using sub-national data from China, I show that rice cultivation has a sizable effect on reform outcome, controlling for income level, policies, geography, and interest groups. Exploiting a GRD design that is based on China's Qin-Huai line, which divides the rice and wheat regions, I show that this effect is causal. At the provincial level, rice cultivation has the second-largest substantial effect on market economy right after income, while at the prefectural level rice cultivation's effect is almost as important as geography.

I further show statistically and historically that rice cultivation produces a market economy by building a strong state. Rice cultivation necessitates massive water-control projects, which require strong state fiscal capacity. A strong state, in turn, makes a market transition more successful. Historical evidence shows that the southern rice regions in China have built far more water-control projects since the 11th century; many believe that their construction explains the rise and fall of dynasties.

Although my theory can explain an economy that affects more than one-fifth of the world's population, one must be very careful when applying it beyond China. Using rice as the root cause of the theory requires that a country has rice as a major crop, which is not the case outside Asia. According to the United Nation's Food and Agriculture Organization, nine of the top ten rice producers in the world are in Asia.¹¹³ So the theory might have some explanatory power there. For example, when explaining the origins of the developmental state in East Asia, scholars have examined the impact of Japanese colonial rule on the development of a strong

¹¹³The top ten rice producers are China, India, Indonesia, Vietnam, Thailand, Bangladesh, Burma, the Philippines, Brazil, and Japan. Please see <http://faostat.fao.org/site/339/default.aspx> (Accessed June 24, 2014).

bureaucracy in South Korea and Taiwan.¹¹⁴ However, we still know little about how Japan developed a strong bureaucracy in the first place.¹¹⁵ The agricultural theory might provide some leverage in explaining the rise of the developmental state in East Asia, which also happens to be comprised of rice countries.¹¹⁶

The second part of the theory, which examines the relationship between state capacity and reform outcome, is more generalizable, as shown in the post-communist literature.¹¹⁷ However, I need to add a caveat that a strong state can make a transition toward a market economy more successful, but it can also make market reversal easier. Many recent cases of reform reversals, such as in Bolivia, Kazakhstan, Russia, Ukraine, Venezuela, and Zimbabwe, point to the importance of these other factors—including income level, regime type, interest groups, and the EU—in sustaining a market economy.

¹¹⁴Cumings 1984.

¹¹⁵Marx and Wittfogel, of course, argued that irrigation has contributed to the absolute rule in Asia.

¹¹⁶The idea to use rice culture to explain the uniqueness of the Japanese culture has been very popular. However, my theory departs from such a cultural argument.

¹¹⁷Shue 1988; Offe and Adler 1991; Sachs 1995; Holmes 1996; Grzymala-Busse and Luong 2002.

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Table 1: The Effect of Rice Paddies on Marketization (Provincial-Level OLS Estimates)

Variable	Coeff. (R.S.E.)	Coeff. (R.S.E.)	Coeff. (R.S.E.)	Coeff. (R.S.E.)	Coeff. (R.S.E.)	Coeff. (R.S.E.)	Coeff. (R.S.E.)	Coeff. (R.S.E.)	η^2
RICE 1996	0.029*** (0.011)	0.018** (0.007)	0.015** (0.007)	0.014** (0.007)	0.017** (0.008)	0.013* (0.007)	-	-	0.038
RICE 1952	-	-	-	-	-	-	0.018*** (0.005)	-	-
RICE ENVIRONMENT	-	-	-	-	-	-	-	0.016* (0.009)	-
PER CAPITA GDP	-	0.000* (0.000)	-	-	-	0.000 (0.000)	0.000*** (0.000)	0.000 (0.000)	0.052
SERVICE INDUSTRY	-	-0.086* (0.043)	-	-	-	-0.052 (0.050)	-0.117** (0.044)	-0.054 (0.050)	0.012
POLICY	-	-	1.392** (0.556)	-	-	0.318 (0.687)	-0.042 (0.522)	0.564 (0.723)	0.002
GEOGRAPHY	-	-	-	-0.002*** (0.001)	-	-0.001 (0.001)	0.000 (0.000)	-0.001 (0.001)	0.013
INTEREST GROUPS	-	-	-	-	0.039** (0.016)	0.020 (0.017)	-0.012 (0.018)	0.024 (0.018)	0.008
MIGRANTS	-	0.075 (0.086)	0.144*** (0.042)	0.105*** (0.030)	0.196*** (0.024)	0.053 (0.081)	0.030 (0.062)	0.074 (0.081)	-
INTERCEPT	6.256*** (0.511)	8.374*** (1.751)	5.640*** (0.366)	7.589*** (0.581)	2.901 (1.279)	6.550* (2.696)	9.910*** (2.150)	5.966** (2.794)	-
N	28	28	28	28	28	28	24	28	
R ²	0.241	0.675	0.621	0.680	0.566	0.756	0.836	0.751	

Notes: This table presents the OLS estimates of Equation (1) using a provincial cross section. The dependent variable is the 2006-2010 average marketization index from Fan, Wang and Zhu 2011. RICE 1996 is the percentage of sown land devoted to rice paddies in 1996, RICE 1952 is the percentage of sown land devoted to rice paddies in 1952, and RICE ENVIRONMENT measures whether the climate was historically suitable for growing wetland rice, regardless of modern technologies. PER CAPITA GDP is the 2006-2010 average GDP per capita, and SERVICE INDUSTRY is the 2006-2010 average share of the service industry in GDP. POLICY is an indicator for provinces that have designated SEZs or COCs. GEOGRAPHY is the geocoded distance (in km) from the provincial capital to the nearest ports. INTEREST GROUPS is the percentage of publicly traded firms that had at least one former government official on their board of directors in 2010. MIGRANTS is the percentage of inter-province migrants in the whole population from the 2000 census. η^2 measures the proportion of the total variance in the dependent variable that is attributed to an effect. All variables are measured at the provincial level. Robust standard errors are reported in parentheses. All of China's provinces are included except Tibet, Xinjiang, and Inner Mongolia. p -values are based on a two-tailed test: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: The Effect of Rice Paddies on Marketization (Prefectural-Level OLS Estimates)

Variable	Coeff. (C.S.E.)	Coeff. (C.S.E.)	Coeff. (C.S.E.)	Coeff. (C.S.E.)	Coeff. (C.S.E.)	Coeff. (C.S.E.)	Coeff. (C.S.E.)	η^2
RICE 1990	0.010*** (0.002)	0.006*** (0.002)	0.006*** (0.002)	0.004*** (0.001)	0.005* (0.003)	0.005* (0.002)	-	0.016
RICE ENVIRONMENT	-	-	-	-	-	-	0.007*** (0.002)	-
PER CAPITA GDP	-	0.000*** (0.000)	-	-	-	0.000*** (0.000)	0.000* (0.000)	0.028
SERVICE INDUSTRY	-	0.011 (0.008)	-	-	-	0.011 (0.009)	0.012 (0.009)	0.005
POLICY	-	-	1.015*** (0.205)	-	-	0.595*** (0.182)	0.564*** (0.179)	0.028
GEOGRAPHY	-	-	-	-0.001*** (0.000)	-	-0.000*** (0.000)	-0.000*** (0.000)	0.018
INTEREST GROUPS	-	-	-	-	0.000 (0.002)	-0.005 (0.003)	-0.006 (0.004)	0.003
MIGRANTS	-	0.062*** (0.005)	0.085*** (0.007)	0.092*** (0.013)	0.083*** (0.008)	0.056*** (0.003)	0.055*** (0.003)	-
INTERCEPT	-0.369*** (0.062)	-1.342*** (0.264)	-0.561*** (0.117)	0.028 (0.105)	-0.101 (0.198)	-0.293 (0.531)	-0.274 (0.589)	-
N	277	277	277	277	105	105	104	
R ²	0.113	0.678	0.626	0.675	0.606	0.745	0.747	

Notes: This table presents the OLS estimates of Equation (1) using a prefectural cross section. The dependent variable is the 2006-2010 average marketization index. RICE 1990 is the percentage of sown land devoted to rice paddies in the early 1990s, and RICE ENVIRONMENT measures whether the climate was historically suitable for growing wetland rice, regardless of modern technologies. PER CAPITA GDP is the 2006-2010 average GDP per capita, and SERVICE INDUSTRY is the 2006-2010 average share of the service industry in GDP. POLICY is an indicator for prefectures that are designated SEZs or COCs. GEOGRAPHY is the geo-coded distance (in km) from the city central district to the nearest ports. INTEREST GROUPS is the percentage of publicly traded firms that had at least one former government official on their board of directors in 2010. MIGRANTS is the percentage of inter-province migrants in the whole population from the 2000 census. η^2 measures the proportion of the total variance in the dependent variable that is attributed to an effect. Standard errors clustered at the provincial level are reported in parentheses. All of China's prefectures are included except prefectures in Tibet, Xinjiang, and Inner Mongolia. p -values are based on a two-tailed test: * $p < 0.1$, ** $p < 0.5$, *** $p < 0.01$.

Table 3: The Effect of Rice Paddies on Marketization (Prefectural-Level 2SLS Estimates)

Variable	Coeff. (Clustered S.E.)	Coeff. (Clustered S.E.)
RICE 1990	0.037** (0.018)	0.048** (0.019)
DISTANCE	-0.442 (0.306)	-0.939* (0.480)
SOUTH×DISTANCE	0.176 (0.223)	0.533 (0.451)
DISTANCE ²	-	-0.082* (0.046)
SOUTH×DISTANCE ²	-	0.138*** (0.052)
INTERCEPT	-1.974* (1.026)	-2.776** (1.176)
N	135	226
Bandwidth	4.449	9.000

Notes: This table presents the 2SLS estimates of Equation (2) using a prefectural cross section. The dependent variable is the 2006-2010 average marketization index. RICE is the percentage of sown land devoted to rice paddies in the early 1990s. DISTANCE is the geo-coded perpendicular distance from the city centroid to the Qin-Huai line. SOUTH is an indicator for prefectures south of the Qin-Huai line. Standard errors clustered by latitude are reported in parentheses, and 4.449 is the Imbens-Kalyanaraman “optimal” bandwidth. p -values are based on a two-tailed test: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

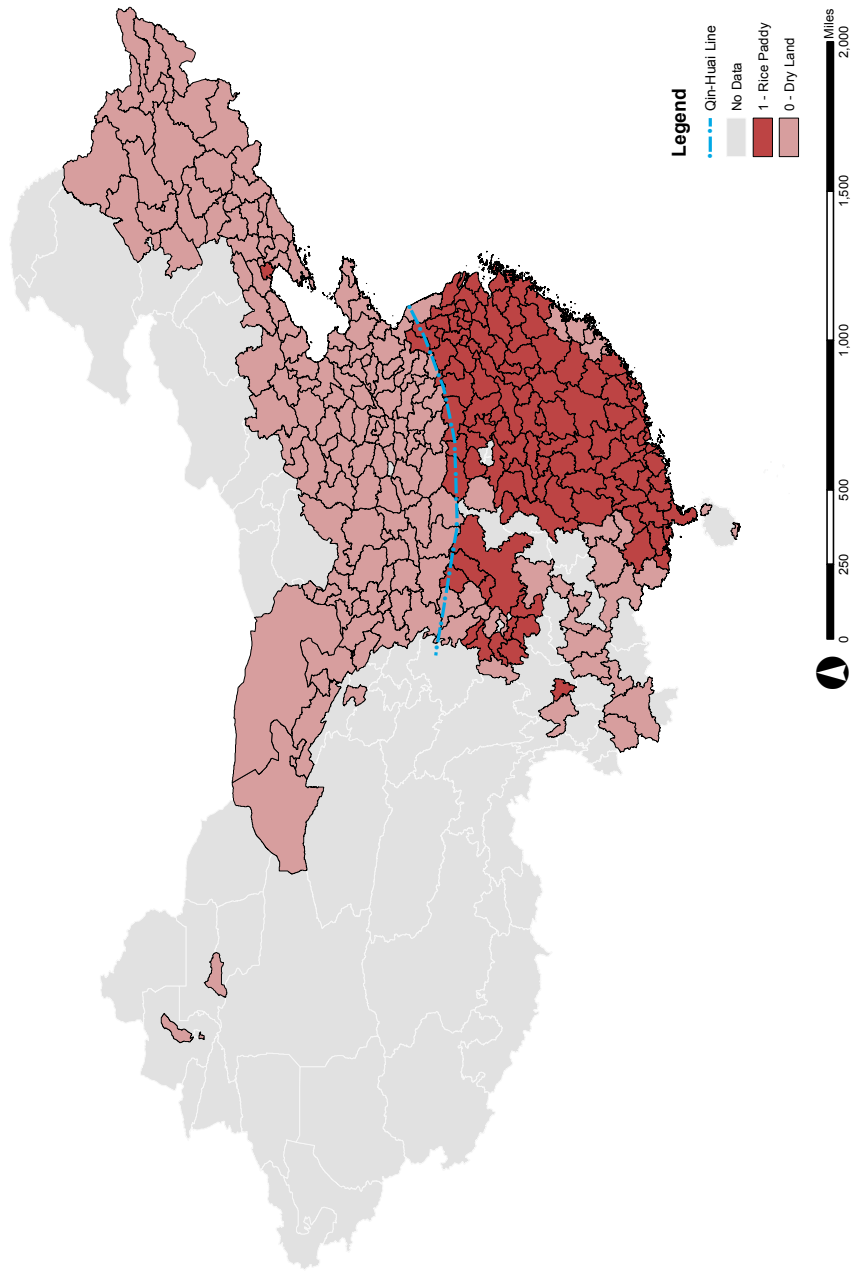


Figure 1: Mapping Rice Paddies

Notes: The darker color indicates prefectures that devoted more than half of their cultivated land to rice paddies in the early 1990s, and the lighter color denotes those that cultivated less than half. Most prefectures in the three major herding provinces, Tibet, Xinjiang, and Inner Mongolia, are not shaded. The rice paddy data are from provincial statistical yearbooks.

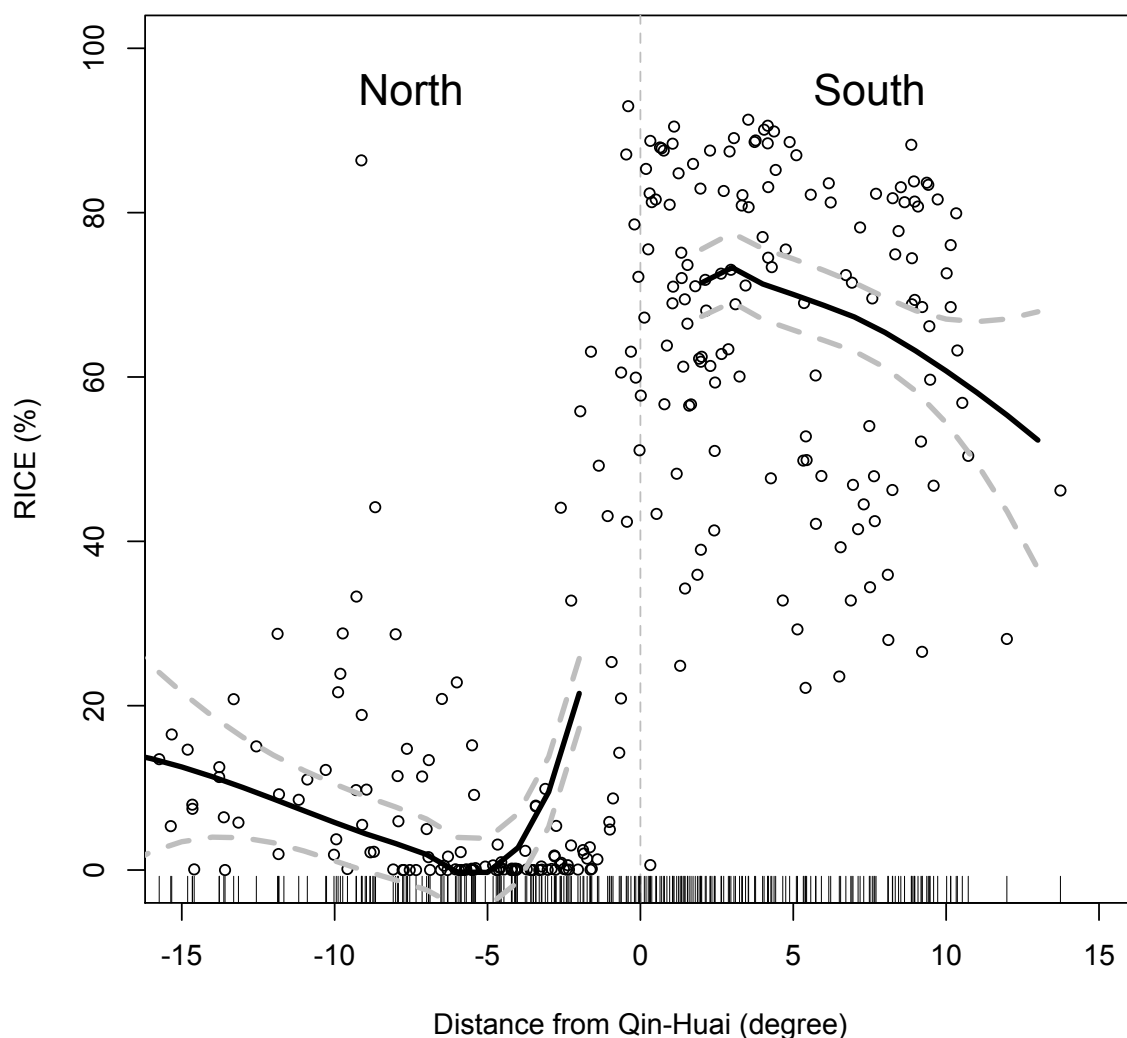


Figure 2: Rice Paddies by Latitude (Centered at the Qin-Huai Line)

Notes: The figure plots RICE 1990, the percentage of a prefecture’s cultivated land devoted to rice paddies in the early 1990s, over distance to the Qin-Huai line. The lines are from local linear regression smoother fits to the prefectures (smoothing parameter=0.7). The local linear regression smoothers are fit on either side of the cutoff point, demarcated by the vertical line. Positive distances represent south, negative distances present north. The rug indicates the actual distribution of prefectures in the sample. The grey dotted line represents the 95% confidence interval. The jump of RICE at the cutoff point is estimated to be 42.55% (s.e. clustered by latitude=5.18) with the “Imbens-Kalyanaraman optimal” bandwidth of 2.92° and a rectangle kernel. Table A4 in the web appendix provides the full results.

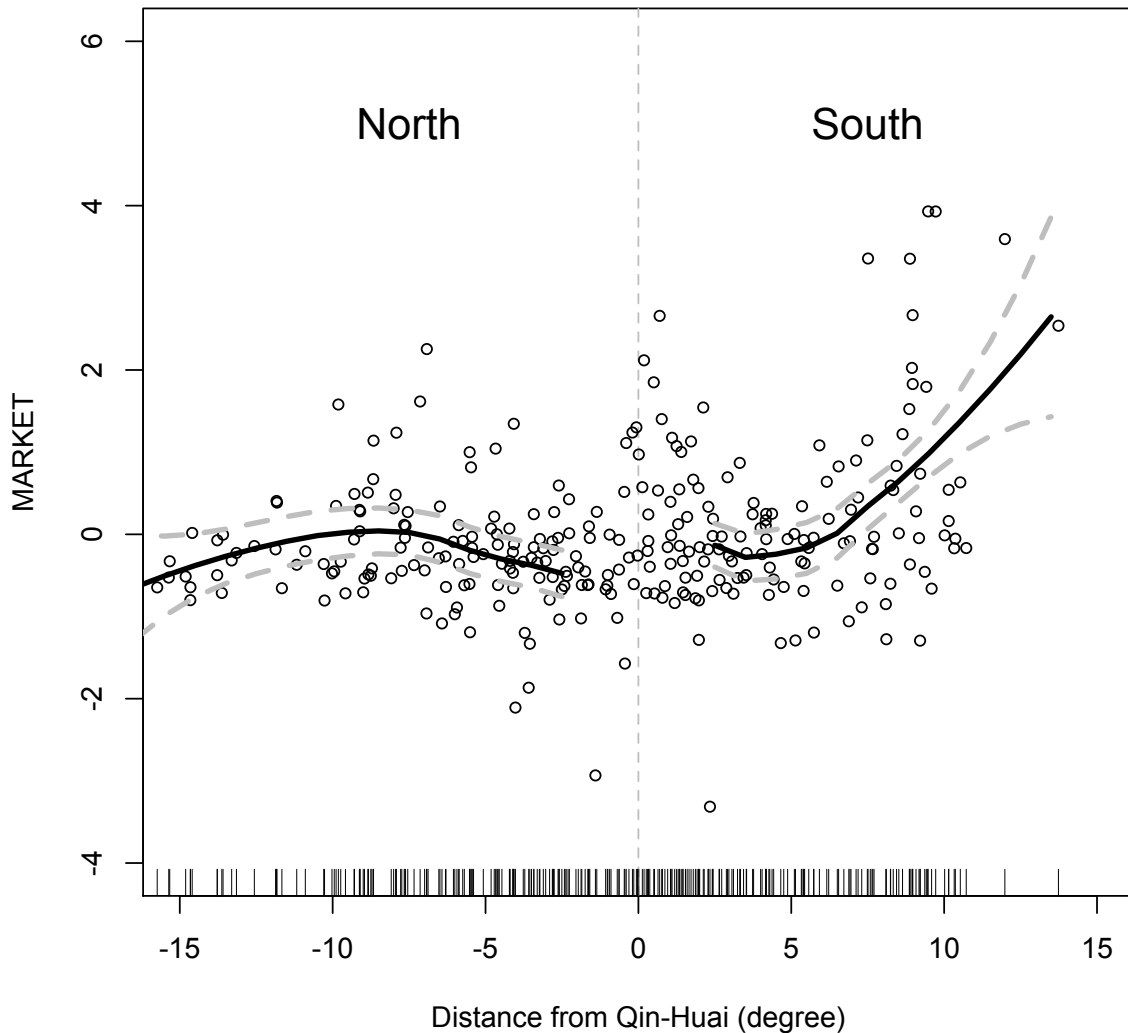


Figure 3: Marketization by Latitude (Geographic Regression Discontinuity Design)

Notes: The figure plots MARKET, an index measuring the performance of a prefecture’s market economy, over distance to the Qin-Huai line. The lines are from local linear regression smoother fits to the prefectures (smoothing parameter=0.7). The local linear regression smoothers are fit on either side of the cutoff point, demarcated by the vertical line. Positive distances represent south, negative distances present north. The rug indicates the actual distribution of prefectures in the sample. The grey dotted line represents the 95% confidence interval. The jump of MARKET at the cutoff point is estimated to be 0.017 (s.e. clustered by latitude=0.007) with the “Imbens-Kalyanaraman optimal” bandwidth of 4.45° and a rectangle kernel.