FDI and Economic Growth: the Role of Gradual Financial Deregulation

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Abstract

We argue that financial liberalization and FDI as a measure of openness complement each other. The intuition is that domestic financial reform will lower the cost for international advanced technology transfer through direct investment. The resultant higher inflow of FDI decreases the imitation cost of local firms, raising their imitation speed and thus the growth rate of the host country. We use the province-level financial deregulation experience of China from 1981 to 1998 to examine the prediction. We address issues of endogeneity of FDI by instrumenting with a series of weather indicators. Dealing with weak instruments, our limited-information maximum likelihood (LIML) results suggest that there is a strong complementarity between FDI and the level of financial deregulation in promoting economic growth. Moreover, financial reform does not have an interaction effect with domestic investment, export or human capital in promoting economic growth. The results are robust after controlling for standard growth factors, and time and province effects.

Keywords: Foreign direction investment; Gradual financial deregulation; Complementarity; Limited-information maximum likelihood (LIML); Panel data

JEL classification: O11; O33; F43; C23
FDI and Economic Growth: the Role of Gradual Financial Deregulation

Abstract

We argue that financial liberalization and FDI as a measure of openness complement each other. The intuition is that domestic financial reform will lower the cost for international advanced technology transfer through direct investment. The resultant higher inflow of FDI decreases the imitation cost of local firms, raising their imitation speed and thus the growth rate of the host country. We use the province-level financial deregulation experience of China from 1981 to 1998 to examine the prediction. We address issues of endogeneity of FDI by instrumenting with a series of weather indicators. Dealing with weak instruments, our limited-information maximum likelihood (LIML) results suggest that there is a strong complementarity between FDI and the level of financial deregulation in promoting economic growth. Moreover, financial reform does not have an interaction effect with domestic investment, export or human capital in promoting economic growth. The results are robust after controlling for standard growth factors, and time and province effects.

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1. Introduction

Globalization has witnessed an increasing role of foreign direct investment (FDI) partly because countries at all levels of development seek to leverage FDI for development (UNCTAD, 2008).1 The subtle rationale is that technology diffusion plays an essential role in the process of economic development (e.g., Nelson and Phelps, 1966; Grossman and Helpman, 1991, chs 11 and 12; Borensztein et al., 1998; Branstetter, 20062). For developing countries in particular, their rate of economic growth, based on a leader-follower model of technology diffusion (Barro and Sala-i-Martin, 2004, ch.8), depends on the extent of adoption and implementation of new technologies transferred from leading countries. FDI is considered to be a major channel through which advanced technologies are transferred to developing countries (e.g., Findlay, 1978; Borensztein et al., 1998). There are reasons why technology diffusion via FDI is conducive to

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1For instance, in 2008, UNCTAD states that FDI is the largest source of external finance for developing countries whose inward stock of FDI amounted to about one third of their GDP (see http://www.unctad.org/ Templates/StartPage.asp?intItemID=2527&clang=1).

2Branstetter (2006), using firm-level data of Japan FDI in the USA, finds that FDI is channel of knowledge spillovers.
the economic growth of backward countries. FDI has higher efficiency from a combination of advanced management practices and more efficient technology as emphasized by Graham and Krugman (1991). Moreover, FDI has externality on the efficiency of local firms and thus increases the rate of technical progress in the host country through a ‘contagion’ effect from the use of more advanced technology and management skills as stated by Findlay (1978).

Developing countries, however, often have different types of economic distortions and protectionist policies, as Borensztein et al. (1998) argue, that may mitigate the role of FDI in transferring advanced technology. Widespread bureaucratic corruption and delay, inefficient financial system, lax contract enforcement, and instable macroeconomic environment may create serious barriers for the inflow of FDI. These existing distortions may increase the entry cost or decrease the profit margin of FDI, which may result in lower inflow of FDI. Gastanaga et al. (1998) show that such policy/institutional variables as tariff rates, the degree of openness to international capital flows and exchange rate distortions affect FDI inflows. Eliminating those distortions would facilitate the inflow of FDI and the speed of technological diffusion from leading economies. Hence, in this paper we highlight the roles of both the introduction of more advanced technology and the requirement of domestic institutional reform as determinants of economic growth, and suggest the empirical investigation of the complementarity between FDI and domestic financial reform in the process of economic development.

To our knowledge, there is no empirical work examining the complementarity between FDI and financial liberalization in the host economy. China provides a suitable case for the empirical investigation. The economic success of China began with its reform and opening-up in 1978. The strategy of China is unique because it not only opens its borders to foreign investors, but also makes continuous efforts to reform its economic institutions. The Chinese government puts attracting more FDI as a priority on its agenda, meanwhile it gradually reforms existing economic distortions to promote the introduction of FDI. This results in large volumes of FDI inflows to China. Figure 1 shows that FDI inflows are positively associated with the pace of financial reform. Shortly after 1978, China’s FDI inflows comprise the dominant share of total FDI inflows to East Asia. The share is as high as 88% in 1985 and stays around 70% in the 1990s. The share of world FDI inflows to East Asia increases from 2% in 1979 to 17% in 1994, which is mainly due to the increasing volumes of FDI inflows to China (UNCTAD, 2008). The diffusion of technology explains China’s economic success as discussed in Barro and Sala-i-Martin (2004, p.350). We take a step further to see how financial deregulation facilitates the diffusion of technology. Our empirical investigation helps to explain why China’s strategy of reform and opening-up brings miraculous economic growth. Moreover, it contributes to explaining how financial system reform is important to exploit FDI more efficiently, which is close to Alfaro et al. (2004) who show that countries’ financial system interacts with FDI inflows.

The appealing feature of the Chinese financial reform strategy lies in its gradual approach to

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3China’s average annual growth rate of real GDP per worker stands at 8% from 1981 to 1998.
4Technological adoption and imitation from leading countries is emphasized by Deng, the designer of the reform and opening-up strategy and the leader of China after 1978 (see Deng (1975)).
5See Lardy 1998, ch. 3; Naughton 1995, ch. 1 for reference on removing distortions in the Chinese economy.
financial reform contrast to ‘shock therapy’ adopted elsewhere,\textsuperscript{6} which has two—cross-section and time-series—important aspects that ‘shock therapy’ lacks.\textsuperscript{7} Across province, it allows some provinces to implement some piece-meal financial deregulation policies first. This financial reform strategy creates a provincial variation in the pace and extent of financial deepening as well as in the inflow of FDI (figures 2 to 4). Figure 2 presents the time-series plots of domestic and foreign direct investment rates for Guangdong (GD) and Gansu (Gansu) provinces. In 1986, the nominal FDI to GDP ratio is as high as 3.3% and as low as 0.01% for Guangdong and Gansu respectively, a 323 to 1 ratio. By 1998, the nominal FDI to GDP ratio increases to 12.6% and 0.37% for Guangdong and Gansu respectively.\textsuperscript{8} For Guangdong, its FDI rate increases steadily over time until 1994 when it is higher than domestic investment rate, so FDI has become the principal source of external capital. In contrast, Gansu’s FDI rate increases steadily over time until 1994 when it is still lower than 1%, while its domestic investment rate steadily increases until 1998 when its domestic investment rate reaches 33%. Therefore, in Gansu, FDI has not played a significant role. Across time, the Chinese financial reform involves a gradual implementation of piece-meal financial deregulation policies over a long period of time. Figures 3 and 4 show the provincial variation in financial deregulation policies received over time (see subsection 3.4 for details). This generates time variations for us to control for unobserved province effects. Moreover, China has experienced a large variation in growth performances across provinces (e.g., Jones et al., 2003).\textsuperscript{9} It is meaningful to examine whether provincial variation in financial deregulation and inflows of FDI drive the provincial variation in growth rates.

The panel data analyses in this paper are advantageous over cross-country regressions. Most existing works on FDI and economic growth are based upon cross-country regressions (e.g., Borensztein et al., 1998; Alfaro et al., 2004). However, the heterogeneity among countries may create bias for cross-country regressions. Nair-Reichert and Weinhold (2001) find that the effect of FDI on growth could display quite heterogeneous behavior across countries, so they highlight the potential for serious errors in the analysis of the relationship between FDI and growth if unrealistic homogeneity assumptions imposed in the econometric modeling. Cross-country regressions seldom control for unobserved country effects, making their results subject to potential bias. Cross-province analyses are more suitable because the provinces within one country are relatively more homogenous to one another. The differences in culture, customs, and beliefs across Chinese provinces are relatively small. Most importantly, the time variations in the cross-province regressions within China allow us to control for potential omitted variable bias from cross-sectional characteristics, presenting a more convincing result.

Previous cross-country works on FDI have not well overcome the endogeneity problem of FDI. As Borensztein et al. (1998) argue, cross-country regressions with FDI may be subject

\textsuperscript{6}Dewatripont and Roland (1992) first study the gradual approach to reform.

\textsuperscript{7}This is the only comparison between gradual financial reform and shock therapy in this paper which does not attempt to answer which reform strategy is better.

\textsuperscript{8}The nominal export to GDP ratio, as another measure of openness, is 23.0% and 2.5% for Guangdong and Qinghai respectively, a 9 to 1 ratio in 1986, while the ratio increases to 22 to 1 in 1998.

\textsuperscript{9}Demurger et al (2002) show that the difference in annual growth rates between the fastest and slowest growing provinces in China over the period of 1979-1998 is 6.2 percentage points.
to endogeneity problems. For example, they may be omitted variables that will simultaneously increase both the growth rate and the inflow of FDI. These situations would generate a correlation between FDI and the error term, which would cause the estimated coefficients to be biased. The endogeneity problem can be avoided by applying instrumental variable (IV) techniques. However, the fundamental problem in cross-country regressions is that there are no ideal instruments available. Nair-Reichert and Weinhold (2001) have studied the endogeneity problem of FDI in the direction of adding time variations rather than providing a suitable instrument. For our empirical work with China, suitable instruments are found to be a series of weather indicators such as yearly average rainfall, temperature, hours of sunshine and their variations. These weather indicators are good instruments because they are exogenous to the growth process and they jointly have significant effects on FDI (at the 5% level). The IV method makes it credible to examine whether there is a causal relationship between FDI and economic growth. To take account of the possibility of weak instruments, we use the limited-information maximum likelihood (LIML) estimation in stata command ivreg2 which implements the recent theoretical development on weak instruments (e.g. Stock and Yogo 2002; Hahn and Hausman 2005).¹⁰ Stock and Yogo (2002) confirm that LIML is far superior to 2SLS estimation in the presence of weak instruments.

This identification strategy assumes the exogeneity of financial reform policies. In China, exogenous political, institutional, and geographical factors determine the time and provincial variations in financial reform policies. Shirk (2003, p. 6) argues that the pattern of economic reform in China reflects a political logic: “Every policy bore the marks of being hammered out in Chinese communist institutions: the CCP delegated specific economic policy decisions to government bureaucracies; party leaders used reform policies to compete for power by appealing to officials in the selectorate; bureaucrats articulated the interests of their economic sectors and geographical regions; regions as well as sectors sat around the table; industry had a stronger voice than agriculture, and heavy industry had a stronger voice than light industry; and decisions were made by consensus...the actual pattern of economic reform did not reflect economic theories so much as it did ‘the conflict of various kinds of interests, that is the conflict, coordination, and balancing of interests between various trades and industries, between urban and rural areas, between localities, and between localities and the central authorities’....” These exogenous factors, rather than the consideration of growth potentials, drive the logic and path of financial reform. Moreover, the province variations in the pace of financial deregulation enable us to quantify the financial reform policies. Then we are able to formally test the direction of causality between quantified financial reform policies and growth in the Granger-Sims framework (Granger 1969; Sims 1972). The results show that financial reform Granger-causes economic growth in China. Therefore, we argue, for the case of China, financial reform precedes growth.

Our object is to examine empirically the complementarity between FDI as a means of technology diffusion and financial reform as a way of lowering cost for technology diffusion. We motivate our empirical investigation with a leader-follower model of endogenous growth, in which the main determinant of long-run growth is technological progress in the form of the introduction of new

¹⁰See Murray (2006) for a survey of the literature on weak instruments.
varieties of capital goods. We employ a framework of cross-province regressions utilizing data on FDI inflows to Chinese provinces from 1981 to 1998. Using weather indicators as instruments for FDI, our LIML results suggest that there is a strong complementary effect between FDI and domestic financial deregulation, that is, the contribution of FDI to economic growth is enhanced by its interaction with the level of financial deepening in the host province. The results are robust to the controlling for the variables usually identified as the main determinants of economic growth in cross-country regressions (e.g., Mankiw et al. 1992). Particularly, the results are robust to the controlling of time and province effects. We also find that export (another measure of openness as in Frankel and Romer, 1999) and domestic investment do not have a growth promoting interaction effect with financial liberalization.

To get an estimate of how important FDI has been in promoting growth, it turns out that having a one standard deviation increase in log(FDI/GDP) would have allowed provinces receiving the mean level of financial reform to experience an annual growth rate increase of 3.0% points during the 18-year-period. All observations would have experienced an annual growth rate increase following a one standard deviation increase in log(FDI/GDP). If provinces receiving the mean level of log(FDI/GDP) had a one standard deviation increase in financial reform, they would have an annual growth rate decrease of 2.2% points. However, 13 out of the 81 observations would have an annual growth rate increase given a one standard deviation increase in financial reform, and Guangdong (Canton) province from 1993 to 1998 having the highest value of log(FDI/GDP) would have experienced an annual growth rate increase of 1.4% points.

1.1 Foreign Direction Investment, Financial Reform, and Technology Diffusion in China

There are many works studying FDI in China (e.g., Head and Ries, 1996; Lardy, 1998; Naughton, 1995; Branstetter and Feenstra, 2002), and some of them show that deregulation policies in China have promoted the inflow of FDI. For instance, Head and Ries (1996) have explored how policies favoring particular cities affect the city-level distribution of foreign investment in China. Branstetter and Feenstra (2002) have given an excellent summary of how liberalization policies related to FDI such as giving preferential tax and administrative treatment to foreign firms have increased the inflows of FDI. Branstetter and Feenstra show that in 1995, Guangdong and Fujian provinces together maintain a dominant position as the most important site of FDI activity. The reason is because they are the sites of the ‘special economic zones’ (SEZ) established in 1979 and charging a reduced tax of 15% on business income of foreign affiliated firms as compared to 33% for domestic firms.

A comprehensive description of how Chinese gradual financial reform has promoted the inflow of FDI is beyond the scope of this paper. Here, we give a brief summary of the most important financial deregulation policies related to FDI.

In subsection 3.4 that quantifies the financial deregulation policies, we locate the financial reform policies from the chapter “Fiscal, Finance, and Insurance” in the book “The Big Economic Events since China’s Reform and Opening-up (1978-1998)” edited by the Institute of Economic Research, the China Academy of Social Sciences. The chapter documents the important financial

reform policies implemented in China from 1978 to 1998. Most policies are conducted at the city level; few are at the province level. Below is a brief list of the financial deregulation policies related to FDI documented in the chapter.

In 1983, the People’s Bank of China announces that foreign financial institutions can apply to set up permanent institutions in Beijing and SEZ. In 1984, the State Council of China (SCC) reduces the tax rates in SEZ and 14 coastal ‘Open Door’ cities. In 1985, the regulations on foreign banks and sino-foreign joint venture banks in SEZ in the People’s Republic of China are announced and implemented to expand international economic and financial cooperation. The aim is to attract foreign investment and technology and promote the economic development of SEZ. In the same year, Xiamen International Bank opens for business, and the first foreign bank, HSBC Bank (Hongkong and Shanghai Banking Corporation), establishes a branch in Shenzhen city, one of the four SEZ. In 1986, Bank of China sets up four measures to support foreign invested enterprises so as to solve their existing problem of shortage of funds. In particular, Bank of China gives loans to foreign firms to support their development. In 1988, Shanghai sets up foreign exchange market, allowing state-owned enterprises, collective enterprises and foreign invested enterprises to mutually swap foreign exchange. In 1990, the SCC ratifies the Shanghai’s administrative solutions on foreign financial institutions, allowing foreign financial institutions to conduct financial business in China, which is unseen since the reform and opening-up in 1979. In 1997, two foreign banks in Shanghai conduct RMB (the Chinese currency) business. By 1998, another eight foreign banks are allowed to conduct RMB business.

From the brief list of the financial deregulation policies related to FDI, we can see the gradual approach to reform. Moreover, we can see that those policies directly reduce tax rates or the financing constraints and costs of FDI. The are many other financial deregulation policies unrelated to FDI, but they can still affect FDI by indirectly reducing the administrative and other management costs for foreign firms locating in China. These financial deregulation policies have successfully promoted the inflow of FDI. Given the quantified financial deregulation policies and FDI to GDP ratios in section 3, we plot FDI inflows against financial deregulation in figure 1 for our cross-province panel data. Obviously, higher level of financial deregulation is positively associated with higher level of FDI/GDP ratios, meaning financial liberalization has promoted the inflows of FDI.

The positive spillover effect of FDI in China on the performance and productivity of local firms has been found by many (e.g., Liu, 2002; Cheung and Lin, 2004; Buckley et al., 2002). For instance, Liu (2002), using data on 29 manufacturing industries over the period from 1993 to 1998 in the Shenzhen, one of the four SEZ in China, finds that foreign direct investment has large and significant spillover effects in that it raises both the level and growth rate of productivity of manufacturing industries, and domestic sectors are the main beneficiaries. Using provincial data from 1995 to 2000, Cheung and Lin (2004) find positive effects of FDI on the number of domestic patent applications in China. Buckley et al. (2002) use detailed cross-section data for 1995 and find that non-Chinese multinational enterprises (MNEs) generate technological spillover benefits for Chinese firms.

The paper is divided as follows. Section 2 uses a simple illustrative model to motivate our
empirical investigation; Section 3 provides an account of the data used in the empirical analysis; Section 4 presents the regression results, and Section 5 provides some concluding remarks.

2. An illustrative leader-follower model

We use a leader-follower model of endogenous growth based on Barro and Sala-i-Martin (2004, ch.8) and Borensztein et al. (1998). The diffusion of technology model can be used for China as discussed in Barro and Sala-i-Martin (2004, p.350): “Some success stories of economic development involve the absorption of technological expertise from abroad in ways that corresponds roughly to our theoretical setup...Foreign investments in China from Hong Kong and in Mexico from the United States have been important in facilitating the flow of knowledge about advanced manufacturing techniques (Romer, 1993).” We take a step further to see how financial deregulation facilitates the diffusion of technology from leading countries to Chinese provinces which are deemed as backward follower economies.

It is further assumed that there is no learning of the leading countries from follower ones. Therefore, the behavior of the leading country is independent of the follower economy, so it is omitted in this paper. This paper examines the follower country.

2.1 Final firms

The follower economy produces a single consumption good according to the following technology:

\[ Y_t = A \left( \frac{H}{L} \right)_t^{1-\alpha} \cdot \sum_{j=1}^{N} (X_j)^{\alpha} \]  

(1)

where the parameter \( A \) represents the exogenous state of ‘environment’, \( \frac{H}{L} \) is stock of human capital divided by the quantity of labor (i.e., per labor human capital), \( X \) stands for intermediate capital goods, and \( N \) is the number of intermediate capital goods available for use. Therefore, in this economy, technical progress is the result of ‘capital deepening’ in the form of an increase in the number of varieties of capital goods available, as in Romer (1990), Grossman and Helpman (1991), and Borensztein et al. (1998). The state of environment comprises various control variables (denoted by Controls) and government policies influencing the level of productivity in the economy. Therefore, it is potentially affected by governmental reform policies, particularly financial deregulation policies in our framework. This is implemented by assuming that higher degree of financial deregulation (which we denote by F-Reform) increases \( A \) :

\[ A = A (\text{Controls}, \text{F-Reform}) , \ \frac{\partial A}{\partial \text{F-Reform}} > 0. \]

The producers of final output in the follower economy maximize profits, taking as given the wage rate and the prices of intermediate goods. The demand for the \( j \)-th variety is obtained from the first-order condition associated with \( X_j \):

\[ X_j = \frac{H}{L} \left( A \alpha \right)^\frac{1}{1-\alpha} (P_j)^{-\frac{\alpha}{1-\alpha}} \]  

(2)
2.2 Imitating firms

We assume that the process of technology imitation is costly (Mansfield et al., 1981). We assume that the follower country is far away from the technology frontier so that the cost of imitation is smaller than the cost of innovation, as in Barro and Sala-i-Martin (2004, ch.8). The copying and adaptation of the leading country’s varieties for use in the follower country is assumed to incur a lump-sum cost, denoted by \( \eta \). As \( N \) increases relative to \( N^* \) (the number of varieties in the leading country), imitation possibilities are smaller and thus the cost of imitation is higher. We follow Borensztein et al. (1998) to use \( N/N^* \) to capture the ‘catch-up’ effect in technological progress. As in Borensztein et al. (1998), the economy has two types of firms that produce the varieties of intermediate capital goods: domestic and foreign firms that have undertaken a direct investment in the economy. Out of the total number of varieties of the follower country, \( N \), the domestic firms produce \( n \), and the foreign firms produce \( n^* \) with \( N = n + n^* \).

Findlay (1978) argues that foreign firms have positive externality on the efficiency of local firms through a ‘contagion’ effect from the use of more advanced technology and management skills. Empirical works (e.g., Liu, 2002; Cheung and Lin, 2004; Buckley et al., 2002) show that FDI in China has significant spillover effects on the performance and productivity of local firms. We capture this property by assuming that the cost of imitation depends negatively on the ratio of the number of foreign firms operating in the host economy to the total number of firms \( (n^*/N) \). As described in subsection 1.1., financial reform lowers the costs for FDI. This is captured by assuming higher degree of financial deregulation in the follower economy increases the inflow of FDI \( (n^*/N) \). Therefore, we assume the following functional form for the imitation cost:

\[
\eta = \eta_0 \left( \frac{n^*}{N} (F\text{-Reform}) \right) \left( \frac{N}{N^*} \right), \quad \text{where} \quad \frac{\partial \eta_0}{\partial \left( \frac{n^*}{N} \right)} < 0 \quad \text{and} \quad \frac{\partial \left( \frac{n^*}{N} \right)}{\partial (F\text{-Reform})} > 0 \quad (3)
\]

If an agent in the follower economy pays the imitation cost at time \( t \) to imitate the \( j \)-th variety of intermediate good from the world technological frontiers, it is assumed that this agent obtains a perpetual monopoly over the use of intermediate \( j \) in the follower economy. Normalizing final goods’ price as 1, the marginal cost of producing an intermediate input is also 1. After imitation is done, intermediate good firm \( j \) maximizes profit, taking demand in equation (2) as given. This leads to the price mark-up: \( P_j = \frac{1}{\alpha} \), and the quantity of intermediates sold:

\[
X_j = \frac{H}{L} \left( A \right)^{\frac{1}{1-\alpha}} \left( \alpha \right)^{\frac{2}{1-\alpha}} \quad (4)
\]

The flow of profit, \( \pi_j \) is

\[
\pi_j = \pi = \left( \frac{1 - \alpha}{\alpha} \right) \left( A \right)^{\frac{1}{1-\alpha}} \left( \alpha \right)^{\frac{2}{1-\alpha}} \frac{H}{L} \quad (5)
\]

The present value of profits from imitation of intermediate \( j \) in the follower economy is

\[
V_j = \pi_j \int_t^\infty e^{-\int_t^s r(v) dv} ds \quad (6)
\]

8
where $r$ is the interest rate. It is assumed that there is free entry into the imitation business in the follower economy. Therefore, the equilibrium amount of resources devoted to imitation must equal the cost of imitation at each point in time:

$$V_j = \eta$$  \hspace{1cm} (7)

Using equation (7), differentiating both sides of equation (6) with respect to $t$ yields the non-arbitrage condition:

$$r = \frac{\pi}{\eta}$$  \hspace{1cm} (8)

2.3 Consumers

A infinitely-lived representative household maximizes her utility by

$$U = \int_0^\infty e^{-\rho t} \cdot \frac{C^{1-\theta} - 1}{1 - \theta} dt$$  \hspace{1cm} (9)

$$s.t. \eta \dot{N} = w + r\eta N - C$$

where $C$ is the consumption level in units of final good $Y$, $r$ is the interest rate, and $w$ is the wage rate. The transversality condition implies that $r$ must exceed the long-run growth rate of the economy. The Euler equation for households is

$$\frac{\dot{C}}{C} = \frac{1}{\theta} (r - \rho)$$  \hspace{1cm} (10)

2.4 General equilibrium and empirical formulation

Substituting for $r$ from equation (8) into equation (10) and using equation (5) deliver the growth rate of the economy:

$$g = \frac{1}{\theta} \left[ \left( \frac{1 - \alpha}{\alpha} \right) A (F-Reform)^{1-\alpha} (\alpha)^{1-\alpha} \frac{H}{L \eta_0 (n^*/N(F-Reform),N/N^*)} - \rho \right]$$  \hspace{1cm} (11)

According to equation (11), FDI measured by the fraction of varieties produced by foreign firms in the total number of varieties ($n^*/N$) lowers the imitation cost of domestic firms, which increases the copying and implementation of new varieties from abroad. Higher degree of financial reform has two effects on growth. One is through increasing $A$, the state of environment. We interpret this effect as financial deregulation is good for all firms (both domestic and foreign firms) by increasing their profit margin. The other is through increasing inflow of FDI, and thus reducing the cost of imitation for domestic firms. The cost of imitation is smaller for more backward countries, thus, backward countries with lower $N/N^*$ will tend to grow faster. Therefore, as in Borensztein et al. (1998) and Alfaro et al. (2004), we utilize the following basic formulation to empirically assess the interaction effect between FDI and financial deepening in
promoting economic growth:

\[ g = \beta_0 + \beta_1 FDI + \beta_2 FDI \times F-Reform + \beta_3 F-Reform + \beta_4 Y_0 + \beta_5 \frac{H}{L} + \beta_6 \text{(Controls)} \]  

(12)

where \( FDI \) is foreign direct investment, \( F-Reform \) is degree of financial reform, \( Y_0 \) is initial real GDP per worker which captures the ‘catch-up’ effect \( (N/N^*) \), \( \frac{H}{L} \) is the stock of human capital divided by labor input, and \( \text{(Controls)} \) is a set of other variables that affect economic growth. As in Borensztein et al. (1998), the variable FDI is measured as a ratio to GDP. We will take six-year averages of the panel data, so we assume the average ratio of foreign direct investment to GDP is a proxy for the fraction of goods produced by foreign firms \( (n^*/N) \). Measures of the degree of financial reform will be described in section 3.4.

The group of control variables comprises those which are frequently included as determinants of growth in cross-country studies (See Mankiw et al. 1992; Barro and Sala-i-Martin 2004, ch.12). These variables include government consumption, labor force growth, physical capital investment rate, export to GDP ratios. The panel data regression will also control for time and province effects.

3. Data

To provide an account of the data needed in the empirical analysis, we first discuss the endogeneity problem of FDI and its identification strategy. In addition, we will analyze the direction of causality between growth and financial reform to conclude that financial reform in China leads economic growth.

3.1 Endogeneity of FDI and its identification strategy

We are aware that our regressions presented below may be subject to the endogeneity problem of FDI. FDI may be endogenous to the growth process, that is, innovations in the stochastic process governing growth rates may also affect the inflow of FDI. For example, there may exist omitted variables that increase both the growth rate and the inflow of foreign direct investment simultaneously. A correlation between FDI and the province-specific error term would arise in these circumstances, which would cause the estimated coefficients to be biased and inconsistent.

The endogeneity problem can be avoided by applying instrumental variable techniques, and the task is to find an ideal instrument. An ideal instrument would be a variable which is highly correlated with FDI but not with the error term in the regressions. We employ a series of weather indicators to overcome the endogeneity problem of FDI. Weather indicators are valid instruments because they are exogenous to the growth process, meaning they are not correlated with the error term, and they are highly correlated with FDI.

The validity of weather being instruments needs justification and intuition. Intuition is important in choosing valid instruments (Levitt, 2002; Murray 2006). There are many factors causing the provincial variation in FDI inflows, and weather is one of them. The relationship between FDI and weather is indeed touched upon in Goldsmith and Sporleder (1998). In analyzing the food and beverage firms’ foreign direct investment decisions, Goldsmith and Sporleder
argue that weather as part of large uncertainty or randomness in transactions will affect firms’ FDI decisions. There are many large international food and beverage firms such as Macdonald’s and KFC and retail superstores doing direct investment in China. Given Goldsmith and Sporleder’s argument, it is intuitive that those firms’ direct investment in China is affected by weather conditions. During the period of 1978 to 1998, China is still a backward developing country in which agricultural products consist of a large share of total GDP. Many Chinese scholars have studied the sectoral composition of FDI. The common finding is that some FDI inflows are directed towards agriculture and agriculture-related labor-intensive industries like textile and food-processing. Those FDI inflows tend to locate in Chinese provinces majoring in agricultural production that is heavily affected by weather conditions. This is consistent with the sectoral composition of world FDI, as World Bank states that the sectoral focus of world FDI has shifted from agriculture to industry and later to service.

3.2 The exogeneity of financial deregulation policies

For China, financial deregulation policies are not endogenous to the growth process. In other words, the logic for the government to conduct financial deregulation is not based on the anticipation of future economic growth. Although there are previous works studying the financial deregulation of China (e.g., Brandt and Zhu, 2007; Lardy, 1998; Naughton, 1995), the logic behind the gradual financial deregulation of China may still look like a black box to many. Here we look deep into the Chinese gradual financial deregulation process to examine how it is set-up and what determines its path and pace (i.e., the time and provincial variations in financial deregulation policies implemented). In so doing, it reveals why the financial deregulation policies may be exogenous to the growth process.

The Chinese culture is that policy makers tend to give preferential policies to their hometown and places where they have worked or have other personal or political ties. In addition to culture, government bureaucracies’ bargaining and coordination play an influential part in determining the time and provincial distribution of financial deregulation policies. The political logic behind the Chinese financial deregulation since 1979 has been thoroughly studied by Shirk (2003) who argues that the Chinese financial liberalization was mainly conducted on a political ground: “Every policy bore the marks of being hammered out in Chinese communist institutions: the CCP delegated specific economic policy decisions to government bureaucracies; party leaders used reform policies to compete for power by appealing to officials in the selectorate; bureaucrats articulated the interests of their economic sectors and geographical regions; regions as well as sectors sat around the table; industry had a stronger voice than agriculture, and heavy industry had a stronger voice than light industry; and decisions were made by consensus. The pace, sequencing, content, and form of industrial reform policies from 1979 on reflect this institutional context.” Shirk (2003, p.129) continues, “As one Chinese commentator observed, the actual pattern of economic reform did not reflect economic theories so much as it did ‘the conflict of various kinds of interests, that is the conflict, coordination, and balancing of interests between various trades and industries, between urban and rural areas, between localities, and between localities and the central authorities’ (Wang Depei 1991, 39).”
It is also worth discussing the role of geographical factors in the gradual financial deregulation process of China. Geography is deemed as exogenous to the growth process in the literature. It is commonly agreed that geography can have causal effects on economic growth (e.g., Sachs et al. 1998), even though there is a debate over the channel of causality (e.g., Acemoglu et al. 2001; Sokoloff and Engerman 2000). The coastal and non-coastal location difference in China may lead people to believe that coastal provinces receive more preferential treatments because they have better initial conditions, such as being richer and having better infrastructure. This implies that financial reform policies may be endogenous. On the contrary, we argue that coastal provinces receive more preferential treatment because they have superior geographical locations. Superior geographical locations affect growth through the intermediate channel of financial deregulation.\textsuperscript{14} Politicians make the initiative or move first to turn the superior geographical conditions into realistic growth achievements. Without the intermediate channel of financial deregulation, growth potentials would remain growth potentials, as was the case before the reform in China (North Korea is a living example).

A more formal way of examining the direction of causality between growth and financial reform is to apply tests in Granger (1969) and Sims (1972) causality framework.

The implication of growth regressions is that, if an right-hand-side (RHS) variable is significant, then it means it Granger-causes growth. The reason is because lagged GDP per worker (similar to lagged dependent variable) is always included as a regressor to control for the conditional convergence effect. To formally examine the direction of causality between growth and financial reform, we apply tests in Granger (1969) and Sims (1972) causality framework. Suppose we have already quantified the financial reform policies as in section 3.4. Let us use F-Reform to denote the measure of financial reform policies. Now we estimate the following equation:\textsuperscript{15}

$$\ln(Y_L)_t = f(\ln(Y_L)_{t-1}, F\text{-Reform}_t)$$

where $\ln(Y_L)_t$ is real GDP per worker at the end of period $t$, $\ln(Y_L)_{t-1}$ is real GDP per worker at the beginning of period $t$, and $F\text{-Reform}_t$ is the average of the quantified financial reform policies during period $t$. We interpret financial reform to be Granger-causing growth when a prediction of growth on the basis of its past history can be improved by further taking into account this period’s financial reform, as in Blomström et al. (1996).

We have the following results from estimation (13):

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-test statistic on financial reform indicators</td>
<td>F(1, 78)=3.16</td>
<td>F(1, 50)=10.48</td>
</tr>
<tr>
<td>p-value of F-test</td>
<td>Prob.&gt;F=0.079</td>
<td>Prob.&gt;F=0.002</td>
</tr>
<tr>
<td>Fixed Province Effects</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Fixed Time effects</td>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

\textsuperscript{14}With the panel data of China, it is not hard to show this. However, this is beyond the scope of this paper.

\textsuperscript{15}Year-to-year data with 405 observations and $growth_t = f(growth_{t-1}, growth_{t-2}, F\text{-Reform}_{t-1})$ show financial reform Granger-causes growth. Moreover, we find growth does not Granger-cause financial reform.
We first include only the financial reform policy indicator and real GDP per worker at the beginning of each period (see section 3.4 for details) in the regression. The F-test result for the significance of the financial reform policy index is reported in column (1). We can see that the F-test statistic is 3.16 and the associated p-value of F-test is below 10%. Then we run the regressions again by controlling for both fixed time and fixed province effects. The F-test result for the significance of the financial reform policy index is reported in column (2). We can see that the F-test statistic increases to 10.48 and the associated p-value of F-test is below 1%. These give evidence that even after controlling for real GDP per worker at the beginning of period \( t \) (i.e., eliminating serial correlation by including lagged values of the dependent variable), financial reform during period \( t \) has a significant effect on real GDP per worker at the end of period \( t \). Subtracting the lagged value of dependent variable (i.e., real GDP per worker at the beginning of period \( t \)) from both sides of equation (13), the new dependent variable will measure the average growth rate of period \( t \), which is just the growth regression as in equation (12).

In summary, exogenous factors, such as culture and the conflict and coordination of different geographical regions and government bureaucracies, rather than the consideration of growth potentials dictate the path and logic of financial deregulation. Further, formal tests using only financial reform indicators as independent variable provides evidence that financial reform precedes growth, thus the direction of causality runs from financial reform to economic growth.

3.3 Measuring FDI and weather

The provincial FDI inflow data and the GDP data are available from the Statistical Yearbook of China. The FDI data are in US dollars, we multiply them by the fixed exchange rate of the Chinese currency (yuan) against the US dollar in each year to get the FDI data in Chinese currency. China has adopted the fixed exchange rate regime until year 2005 in which the government allows its currency to appreciate gradually each year. We then calculate the ratios of FDI over nominal GDP in each year as our measure of FDI \( (n^*/N) \), denoted by FDI/GDP.\(^{16}\)

The Weather Yearbook of China provides monthly data on temperature, rainfall, and hours of sunshine for the capital city of the Chinese provinces from 1985 to 1998. The data before 1985 are not available since the Weather Yearbook of China started from 1985. Since we employ the Chinese panel data from 1981 to 1998 and take six year averages to avoid the business cycle phenomena, we will have three sub-periods: 1981-1986, 1987-1992, and 1993-1998. In China most provincial capital city is located in the middle of the province, so we treat the data for capital city as the average for the whole province. Since sub-periods 1987-1992 and 1993-1998 have complete data, we calculate the weather indicators as follows. We take averages of the six-year’s monthly temperature data to get average yearly temperature, denoted by Temper. We calculate “temperature yearly difference”\(^{17}\) for each year and then average over six years to get average “temperature yearly difference”, denoted by Tempdiff. For rainfall and hours of sunshine, we take sum of each year’s monthly data to get yearly data. We then take six year averages of the yearly data to get average yearly rainfall and hours of sunshine, denoted

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\(^{16}\)Qinghai province does not have any FDI for 1981-1986, and the datum from 1987-1992 is used.

\(^{17}\)“Temperature yearly difference” is the difference between the highest and lowest monthly average temperatures, which measures the fluctuations of temperature.
by Rainfall and Sunshine respectively. We calculate the variance for each year based on the 12
month data and then take six year averages to get the variations for temperature and sunshine,
denoted by Tempvar1 and Sunvar respectively. For temperature, we get an additional variation
by calculating the variance of all six years’ monthly temperature, denoted by Tempvar2.

Since sub-period 1981-1986 only has data for 1985-1986, we get the weather indicators from
the Natural Resources Database of China Academy of Sciences (denoted by CAS-NRD). CAS-
NRD provides weather data for around 600 weather observatories across China. Each weather
observatory has monthly data points on temperature and hours of sunshine for the period of
1951-1980, instead of monthly data for each year. Given the 24 data points each weather
observatory has, we calculate its average temperature, temperature yearly difference, hours of
sunshine, variance of monthly temperatures, and variance of monthly hours of sunshine. Since
each province has around 20 weather observatories in 20 cities/counties, we take averages of the
data over the weather observatories to get the provincial data on Temper, Tempdiff, Sunshine,
and Sunvar. We impose the same temperature variation data for Tempvar1 and Tempvar2.
From CAS-NRD, we calculate the provincial yearly average rainfall of 1951-1980 as the average
rainfall for 1981-1986. Since CAS-NRD does not provide monthly rainfall data, we cannot
measure the variation of rainfall. The correlation among the weather indicators are listed in
table 1. Generally the weather indicators are significantly correlated with one another.

3.4 Measuring financial reform policies

In 1978, China began to reform its backward financial system, adopting the gradual approach.
The ongoing process is enacted by the government of China. Each year, the government chooses
some financial reform policies to conduct in some designated cities and/or rarely provinces.
After those policies mature, the government may spread them to the whole province, further to
several provinces, and finally to the whole country. For example, in 1986, the People's Bank
of China and the National System Reforms Council of China jointly gave notice that the cities
of Guangzhou, Chongqing, Wuhan, Shenyang, and Changzhou should conduct financial system
reform experiments; in 1988, the State Council of China ratified Fujian Province to conduct the
same financial system reform. Many have studied the financial reform of China. For example,
Park and Sehrt (2001) use Chinese provincial data from 1991 to 1997 to test whether financial
reform has increased the efficiency of intermediation by financial intermediaries. They find that
policy lending by state banks did not fall in their data sample. Naughton (1995) and Lardy
(1998) have studied the achievements and challenges of China’s financial reform.

Our objective is to quantitatively evaluate the effect of China’s financial deregulation in
affecting the role of FDI in the process of economic development. As mentioned in section 1.1.,
we locate the financial reform policies from the chapter “Fiscal, Finance, and Insurance” in the
book “The Big Economic Events since China’s Reform and Opening-up (1978-1998)”. Most
policies are conducted at the city level; few are at the province level. The attractiveness of
the financial reform policies in the book lies in its provision for authority and uniformity. With the

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18 The government of China stands for national government agencies, departments, councils, etc.
19 There are other books documenting the financial reform policies in China. The main financial reform policies
are quite similar across those books.
policies located, we divide them into different policy indicators and turn those policy indicators into yearly provincial indices.

The Chinese Economists Society organized an international symposium on Chinese financial reform at the University of Southern California in 1997. The symposium divided Chinese domestic financial reform as follows:

1. Reforms of the banking sector:
   i. Functions of commercial banks and policy banks;
   ii. Regulations of banking institutions in China;
   iii. Roles of foreign banks in enhancing competition and transferring technologies;
   iv. Possibilities of more domestic private banks.

2. Non-bank Financial Institutions and Regulations:
   i. Insurance market;
   ii. Non-bank deposit market, and non-bank deposit-taking institutions;
   iii. Regulations on gray and black credit market for small loans.

These provide guidance in dividing the numerous financial reform policies documented in the chapter of the aforementioned book. The specific divisions of the policies are summarized in table 2. Fiscal reform policies and capital market reform policies in the same chapter are excluded. Capital market reform policies are excluded for two reasons. First of all, Demirguc-Kunt and Levine (2001) show that there is no evidence that banking sector (and/or non-bank sector) is worse than stock market in promoting growth. Previous literature commonly measures and studies banking sector and stock market separately. Secondly, for the period of 1981-1998, the majority of financial reform policies are in the banking and non-banking sectors. One avenue for future work would be to investigate whether stock market affects the role of FDI in affecting economic growth. Last but not least, we do not single out those financial deregulation policies related to FDI as measures of financial deregulation. The argument is that, singling out those policies targeted on FDI would make them more valid as instruments for FDI rather than as independent explanators in the growth regressions. It is possible that financial reform may have an independent effect on growth besides interacting with FDI.

There is no overlap among the policy indicators, that is, each policy is counted once. The formula to construct the policy index for each policy indicator for a province in a particular year, using 1990 as an example, is as follows:

\[
\text{Index} = \sum_j \left( \sum_i \frac{\text{Total Population of City } i \text{ in } 1990}{\text{Total Population of the Province in } 1990} \cdot I_{ci}^{1990} + I_p^{1990} \right) \tag{14}
\]

where \(I_{ci}^{1990}\) is an indicator variable that equals one if city \(i\) receives a financial reform policy \(j\); \(I_p^{1990}\) is an indicator variable that equals one if a financial reform policy \(j\) is conducted in the whole province. Adding together all policies (the \(j\)'s) in and before year 1990 for all the cities (the \(i\)'s) within a province yields its policy index. For example, if a city received a financial reform policy in 1988, the policy would also have effect in 1990, which therefore has to be taken into account. The construction of this index is the same as that of building the index for the new policies in year 1990 and carrying the index to all the years after 1990. Cities’ total population
data are taken from Statistical Yearbook on China’s Cities (1986-1999).  

For each indicator in table 2, its index is built using the formula in equation (13). For indicator Bank, if a deregulation policy is conducted through one of the big four state banks of China, a weight of $\frac{1}{4}$ is imposed on the policy. For indicator Newbank, a weight of $\frac{1}{5}$ is given to the policies as there are already big four state banks in operation. No adjustments are made for the other three indicators. The policy indexes are significantly correlated with one another.

Based on the four indicators built, we add them up to get the measure for the degree of financial deregulation (F-Reform). The degree of financial deregulation (F-Reform) has explicit variations across-province and across-time (see figures 3 and 4). Coastal provinces in general have higher degree of financial deregulation. Among coastal provinces, some have higher degree of financial deregulation than others. There are also large time variations in the degree of financial reform due to incremental reform.

3.5 Measuring all other variables

In equation (12), initial real GDP per worker, $Y_0$, is $\ln\left(\frac{GDP}{L}\right)_{t-1}$ which takes the value of the beginning year of each sub-period. All other variables are six-year averages. $\frac{H}{F}$ denoted by School is measured as secondary school enrollment divided by the total number of workers following Mankiw, Romer and Weil (1992). Secondary school enrollment is the sum of student enrollments for middle schools (grades 7 to 9) and high schools (grades 10 to 12).

Control variables are those standard growth factors in growth regressions, which are built as follows. For labor force growth measure, $\ln(n + g + \delta)$, we follow Klenow and Rodriguez-Clare (1997) to use 0.08 for $(g + \delta)$. Fiscal is fiscal expenditure to GDP ratio. Export is nominal value of export to abroad divided by nominal GDP. $\frac{I_Y}{F}$ is the nominal physical capital investment rate. Young (2003) argues that there are problems with the various deflators of China. The Chinese local statistical bureaus tend to under-report the deflators for investment relative to those of GDP. Thus, if one uses investment deflators to measure real investment rate, some provinces would have unreasonably high real investment rate. We assume the deflators of investment and GDP grow at the same rate, which very likely produces a less severe problem for this paper.

There are 31 provinces in China. Before 1997, Chongqing was a city of Sichuan province.

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20The statistical yearbooks after 1986 are not available, and the data of 1986 are used for 1981 to 1986.
21The big four state banks of China are: Bank of China (BOC), the Industrial and Commercial Bank of China (ICBC), China Construction Bank (CCB), and the Agricultural Bank of China (ABC).
22Any weight imposed will be subjective. However, our results are not very sensitive to the specific weights imposed.
23Klenow and Rodriguez-Clare (1997) assume the growth rate is 0.02 and depreciation rate is 0.06. Chow (1993) assumes the depreciation rate for China is 0.04, so do we. Young (2003) shows that the TFP growth of China’s state sectors is still impressive and comparable to those of four Asian Tigers. The family-responsibility system greatly raised the productivity growth of agriculture in China (Lin, 1992). It is reasonable for us to assume the balanced-growth-path TFP growth is 0.04.
24Some studies on Chinese provincial conditional convergence have adopted this approach. There are others (Young 2003; Perkins and Rawski 2008) providing alternative deflator for investment. But currently we follow the former approach. Moreover, section 4 will show that our main results do not depend on whether we include investment rate as a regressor or we have measurement error on investment.
25In China, out of the 31 provincial governments, four are municipalities and four are autonomous regions. This paper delegates the usage ‘province’ to all.
so both of them are excluded from the sample. Hainan was part of Guangdong before it became an independent province. Since there is a complete set of data for Guangdong, it is kept in the data sample while Hainan is dropped. Tibet is excluded because there are no data on FDI and financial deregulation. For financial reform, its complete data after 1998 are not available. Therefore, we use data from 1981 to 1998. In summary, the data sample comprises panel data of 27 provinces and 18 years.

We take six-year averages for the Chinese panel data to avoid the influence from business cycle phenomena, producing three sub-periods: 1981-1986, 1987-1992, and 1993-1998. Each province has three data points. Though with time fixed effects, there may still be much of a problem using year-to-year data that may be subject to the bias from business cycle phenomena. Imai (1996, p.1) states: “the Chinese economy has gone through business cycles of sizable amplitude”. The grouping of years in 6-year intervals for the 18 years matches, to some extent, the political business cycle of China identified by previous works (e.g., Kwan, 2004; Tao, 2003).

The data are gathered from various sources. This paper uses provincial statistical yearbooks and Statistical Yearbook of China for the data on real GDP per worker, secondary school enrollment rate, fiscal expenditure, physical capital investment rate, labor force growth, and export. Table 3 lists the summary statistics of the final data.

4. Empirical results

The purpose of our empirical investigation is to estimate the effects of FDI on economic growth, and to investigate the channel through which FDI may be beneficial for growth. In particular, as discussed in Section 2, we examine whether FDI interacts with the level of domestic financial reform and deepening to affect growth rates. The main regression results indicate that FDI has a positive overall effect on economic growth, although the magnitude of this effect depends on the level of financial deregulation in the host economy; and that whether financial reform has a positive overall effect on growth depends on the level of FDI, and the overall effect is positive in provinces with high level of FDI. The nature of the interaction of FDI with financial deregulation is such that on the one hand, because the direct effect of FDI is strongly positive, higher level of financial deepening strengthens the positive effect of FDI on growth rates, making the overall effect of FDI on growth larger; on the other hand, because the direct effect of financial reform is negative, higher level of FDI inflow raises the positive effect of financial reform on growth rates, increasing the overall effect of financial reform on growth.

4.1 OLS estimation results

The OLS results for the effects of FDI on growth reported in Table 1 are consistent with previous works on FDI (e.g., Borensztein et al., 1998; Alfaro et al., 2004). Regression 4.1 shows that FDI has a positive impact on economic growth, after controlling for initial GDP per worker, human capital, labor force growth, physical capital, government consumption, export, time and province effects. However, the coefficient of FDI in this specification is not statistically significant. Regression 4.2 shows that higher degree of financial deregulation contributes positively to growth and the effect is significant at the 5% level. In 4.3, we put FDI and the financial
deregulation variable together into the regression. Financial deregulation is still significant and positive, but it does not alter the insignificance of FDI.

We interact FDI with financial deregulation and use this as a regressor to test for the significance of financial deregulation in enhancing the positive effect associated with FDI inflows. To ensure that the interaction term does not proxy for FDI or the level of financial deregulation, both of the latter variables were included in the regression independently as in equation (12). In that way, we can test jointly whether these variables affect growth by themselves or through the interaction term. Such specification is adopted in regression 4.4, which shows that the coefficient on FDI is positive but insignificant, while that on the interaction term is positive and significant. The coefficient on financial deregulation becomes negative and insignificant. The hypothesis that the coefficients of both financial deregulation and its interaction with FDI are zero is rejected at the 5% level. The hypothesis that the coefficients of both FDI and its interaction with financial deregulation are zero cannot be rejected outright at the 10% level, which may be due to the endogeneity problem of FDI. The F-test for the joint significance of FDI, financial deregulation and their interaction term shows that these variables jointly significantly impact growth at the 5% level.

In summary, the results from the regressions displayed in Table 4 show strong complementary effects between FDI and financial deregulation on the growth rate of real GDP per worker. This result is consistent with the idea that financial deregulation can increase the growth rate of the province only by interacting with that province’s technological imitation through FDI inflows. The result of the positive coefficient for the FDI variable is nicer than previous works (e.g., Borensztein et al., 1998; Alfaro et al., 2004), but it is puzzling that the coefficient for the financial deregulation variable is negative. In regressions 4.2 and 4.3, financial deregulation exerts a significantly positive effect on economic growth. However, in regression 4.4, when the interaction term is added, its coefficient becomes negative, although insignificant. It is puzzling since the implication is that financial deregulation makes a negative contribution to growth in provinces with a low level of FDI to GDP share. It is not hard to accept that financial deregulation makes no additional contribution to economic growth but it is difficult to believe that, if the province has a very low level of FDI inflow, financial deregulation would actually hurt economic growth. As in Borensztein et al. (1998) and Alfaro et al. (2004), we believe there may exist a nonlinear interaction between FDI and financial deregulation. For instance, the marginal contribution of financial reform to growth is linear in the level of FDI inflows. Then at very low level of FDI inflows (i.e., a low level of technological imitation from abroad), the marginal contribution of financial reform to growth is notably small but it becomes very large at higher levels of FDI. However, a negative intercept (at zero level of FDI) would arise in a linear least squares estimation of this function.

Previous works have found an interaction effect between FDI and some other factors in the domestic economy. Cohen (1993), Romer (1993), and Borensztein et al. (1998) find a positive

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26 Alfaro et al. (2004) also have an insignificantly negative estimated coefficient for their financial market indicators in cross-country regressions.

27 As in Borensztein et al. (1998), we do not proceed with the estimation of a general nonlinear functional form since it is not a promising prospect due to the degrees of freedom as well as multicollinearity problems.
interaction between FDI and human capital. Alfaro et al. (2004) show a positive interaction between FDI and domestic financial system. Our work complements theirs by showing the existence of an interaction effect between FDI and institutional reform in the host economy. We repeat the regressions in Borensztein et al. (1998) for the Chinese provinces, but it seems that there is no evidence of an interaction effect between FDI and human capital. It may be because human capital does not vary as much as that across countries.

4.2 Endogeneity issues and LIML estimation

We have already argued that our panel data regressions may be subject to the endogeneity problem of FDI. To avoid the bias on the estimated coefficients, we apply instrumental variable techniques to avoid the endogeneity problem. For the Chinese panel data, we can find a good instrument which is highly correlated with FDI but not with the error term in these regressions, that is, the aforementioned and constructed weather indicators. The weather indicators are exogenous to the growth process and they have significant effects on FDI.

Andrews and Stock (2005) state that a decade ago 2SLS was always used without thought about the strength of instruments, but now the common approach is to use 2SLS if instruments are strong and to adopt a robust strategy if instruments are weak. Moreover, in the presence of many instruments, Stock and Yogo (2002) provide critical values for testing weak instruments that are an improvement over Staiger and Stock’s (1997) rule of thumb. Stock and Yogo (2002) show that LIML estimation is far superior to 2SLS when researchers have weak instruments. Therefore, taking account of the possibility of weak instruments, we proceed with LIML estimation and report the results from 2SLS for comparison. Throughout, the results are very similar for LIML and 2SLS. Stata10 has already incorporated the recent theoretical developments concerning weak instruments and provided the estimation command of ivreg2. In reporting the results, we use 2SLS to denote for the results from standard 2SLS regressions in stata (from command ivreg). We use 2SLS-ivreg2 and LIML to denote for the results from 2SLS regressions and limited-information maximum likelihood estimation respectively from stata command ivreg2 that deals with weak instruments.

First of all, we run corresponding 2SLS regressions for Table 4. After we add FDI, financial reform and their interaction term which is supposed to be the correct specification in our analysis, we use LIML estimation. The first 2SLS regression includes FDI together with other control variables. We instrument FDI with the weather indicators. The second 2SLS regression includes FDI, F-Reform together with other control variables. We instrument FDI with the weather indicators. The third 2SLS regression includes FDI, F-Reform, their interaction term together with other control variables. We instrument FDI with the weather indicators. The fourth is LIML estimation with FDI, F-Reform, their interaction term together with other control variables. We then run IV LM redundancy test to drop three instruments. So the fifth is LIML estimation with FDI, F-Reform, their interaction term together with other control variables, and the four instruments are log(Sunshine), log(Rainfall), Sunvar and Tempvar2. The corresponding first stage results are reported in columns 5.1 to 5.4 in Table 5, and the corresponding second stage results are listed in columns 6.1 to 6.5 in Table 6 respectively.
The first stage results in Table 5 show that the p-values of the F-test on the joint significance of the weather instruments are below 5% in columns 5.1 to 5.3. These evidence that the weather indicators jointly have significant effects on FDI. Moreover, in the presence of weak instruments, Hahn and Hausman (2005) show that the ratio between the finite sample biases of two-stage least squares and ordinary least squares with a troublesome explanator is (Murray 2006)

$$\frac{\text{Bias}(\beta^{2SLS}_1)}{\text{Bias}(\beta^{OLS}_1)} \approx \frac{l}{n R^2}$$

where $l$ is the number of instruments, $n$ is sample size and $\bar{R}^2$ is the first-stage partial R-squared of excluded instruments. According to columns 5.1 to 5.3, our $n\bar{R}^2$ is 27, 30 and 25 respectively, which is much larger than our number of instruments, 7. These show that 2SLS regression is favored over OLS one. The first-stage results also show that some instruments have no significant effects on FDI, so we run the redundancy test for each of the seven instruments. We then run redundancy test for the three instruments (log(Temper), Tempdiff, and Tempvar1) that have the highest p-values of redundancy tests. As reported in column 5.4 of table 5, the p-value of redundancy test on log(Temper), Tempdiff, and Tempvar1 is 0.586, meaning the three instruments are redundant and excluding them from our group of instruments does not affect our identification. With the four remaining instruments, we report the first-stage results in column 5.4 in Table 5 and second stage results in column 6.5 in Table 6. We can see that the F-test statistic on the instruments gets larger and the associated p-value decreases below 1%, meaning the four instruments have strong effects on FDI.

The second-stage results of the instrumental variable estimation are reported in Table 6. Regressions 6.1 to 6.5 show that the instrumental variable estimation yields different results to those obtained by OLS estimation. Without the interaction term in the regression, the estimated coefficients on FDI are still insignificantly positive but become much larger in magnitude as in regressions 6.1 and 6.2. In regression 6.3, the estimated coefficient on FDI is still positive but becomes significant at the 5% level. The interactive term between FDI and financial deregulation is still positive but becomes significant at the 1% level. The estimated coefficient on financial deregulation is still negative but becomes significant at the 10% level. After overcoming the endogeneity problem of FDI, the hypothesis that the coefficients of both FDI and its interaction with financial deregulation are zero can be rejected outright at the 5% level. The hypothesis that the coefficients of both financial deregulation and its interaction with FDI are zero is rejected at the 1% level. The F-test for the joint significance of FDI, financial deregulation and their interaction term shows that these variables jointly significantly impact growth at the 5% level.

In regression 6.4, we repeat the IV regressions in 6.3 but use LIML estimation. Our weak identification (Cragg-Donald) test statistic is 2.33 which is smaller than the critical value for the 25% maximal LIML size, meaning we accept the null hypothesis that the seven instruments are weak. The endogeneity test on FDI yields a p-value below 1%, showing strong evidence of the endogeneity of FDI. Our LIML results are better than those from 2SLS estimation. The estimated coefficient on FDI becomes significant at the 1% level. The interactive term between FDI and financial deregulation remains significant at the 1% level. The estimated
The hypothesis that the coefficients of both FDI and its interaction with financial deregulation are zero can be rejected outright at the 1% level. The hypothesis that the coefficients of both financial deregulation and its interaction with FDI are zero is rejected at the 1% level. The test for the joint significance of FDI, financial deregulation and their interaction term yields a p-value of chi-square being almost zero, evidencing that these variables jointly significantly impact growth. Sargan over-identification test yields a p-value of 0.29, meaning we accept the null that the instruments work on growth only through FDI. That is, it evidences that the instruments are valid. The 2SLS results from ivreg2 are reported in 7.1 in table 7. The results are almost identical to those in 6.4. We can see that the Stock-Yogo critical values get much larger, meaning it accepts the null of instruments being weak more likely.

In regression 6.5, we repeat the LIML regressions in 6.4 but use four remaining instruments. The p-value of the endogeneity test on FDI is still below 5%, rejecting the exogeneity of FDI. Our weak identification test statistic increases to 4.07, which is larger than the critical value for the 15% maximal LIML size, meaning we can reject the null that the four instruments are weak. With the strong instruments, the LIML regression in 6.5 produces similar size estimates for our interested variables to those in 6.3 and 6.4. The significance levels are identical to those to in 6.4. The p-value of Sargan over-identification test is still above 10%. Our results are robust to different combination of instruments, which also justifies the validity of instruments (Murray 2006). The 2SLS results from ivreg2 are reported in 7.2 in table 7. The results are very similar to those in 6.5. We can see that the Stock-Yogo critical values get much larger than our weak identification test statistic of 4.07, meaning we accept the null that our instruments are weak.

Although we have argued and shown that financial reform leads economic growth, the interaction term contains FDI so that it is subject to some degree of endogeneity problem. We also instrument FDI and the interaction term with the weather indicators. The first stage results are reported in 5.2 for FDI and 5.5 for the interaction term in Table 5. The second stage results are presented in 7.3 and 7.4 in Table 7 for 2SLS-ivreg2 and LIML respectively. The p-value of the F-test on the joint significance of the weather instruments in 5.5 is much larger than 10%, meaning that the F-test rejects the null hypothesis that the weather instruments jointly have significant effects on the interaction term between FDI and F-Reform. Therefore, we should prefer treating the interaction term as exogenous to regarding it as endogenous. In other words, LIML results in 5.3 and 5.4 for the first stage and 6.4 and 6.5 for the second-stage are our benchmark ones. From 7.3 and 7.4, we can see that the endogeneity test p-value is 0.13 and 0.09 respectively, meaning we accept that the interaction term is exogenous at the 5% level. Nevertheless, our findings on FDI, financial reform and their interaction term remain.

To get an estimate of how important FDI has been in promoting growth, one can ask the hypothetical question of how much a one standard deviation increase in the FDI variable would increase the growth rate of a province receiving the mean level of F-Reform in the sample.\(^{28}\)

\(^{28}\)In this paper we centered the data of FDI and financial reform to avoid multicollinearity problem. Therefore, the mean value of log(FDI/GDP) and that of F-Reform are zero. The standard deviation of log(FDI/GDP) is 2.40, and that of F-Reform is 2.24.
6.3 from 2SLS are similar in magnitudes to those in 6.5. Using regression 6.3, we find that having a one standard deviation increase in FDI would have allowed provinces to experience an annual growth rate increase of 3.0\% points during the 18-year-period, where the net effect being measured is \((\beta_1 + \beta_2 \times \text{mean}(F\text{-Reform}))\sigma_{\log(FDI/GDP)}\).

Similarly, we can get an estimate of how important the financial reform has been in enhancing the growth effects of FDI. Using regression 6.3, if provinces receiving the mean level of \(\log(FDI/GDP)\) in the sample had a one standard deviation increase in the F-Reform variable, they would have experienced an annual growth rate decrease of 2.2\% points during the 18-year-period, where the net effect being measured is \((\beta_2 \times \text{mean}(\log(FDI/GDP))) + \beta_3 \sigma_{\log(F\text{-Reform})}\). If we examine individual observations, it turns out that 13 out of the 81 observations would have experienced an annual growth rate increase given a one standard deviation increase in the F-Reform variable. This is because these observations have high and positive value of \(\log(FDI/GDP)\). The highest value of \(\log(FDI/GDP)\) comes from Guangdong (Canton) province for the period of 1993-1998, so it would have experienced an annual growth rate increase of 1.4\% points given a one standard deviation increase in the F-Reform variable. For comparison, all observations would have experienced an annual growth rate increase following a one standard deviation increase in the \(\log(FDI/GDP)\) variable.

We have argued intuitively the validity of weather conditions being instruments for FDI in section 3.1. Sargan tests have shown the validity of our instruments, although Sargan test is weak in the presence of weak instruments (see Staiger and Stock 1997, Hahn and Hausman 2002). Note that our regression in 6.5 shows no evidence of weak instruments. It may still be suspected that why rainfall, for example, is a good instrument. The reason is because if the coast has more rainfall than the interior then there would be a spurious correlation between rainfall and growth. We have run our regressions again by dropping rainfall from our group of instruments. The results are almost identical to those in columns 6.3 to 6.5 of Table 6. As stated in Murray (2006), when the 2SLS results are robust to different (alternative) combination of instruments, the credibility (validity) of the instruments is enhanced.

### 4.3 FDI, domestic investment and export

To further investigate the contribution of FDI to economic growth, we analyze its relationship with total domestic investment. This is important because there exists financial repression in China during this period. It is desirable to see whether FDI would ‘crowd out’ or ‘crowd in’ investment from domestic sources by competing in product markets or financial markets. To examine this, we analyze the effects of FDI on total domestic gross capital formation (not including FDI). Regression 8.1 in table 8 presents an estimation of the determinants of total domestic investment. The results show that FDI has a significantly negative effect on total domestic investment, implying that FDI will ‘crowd out’ domestic investment. The interaction between FDI and financial reform turns out to be statistically significant and negative for the determination of total domestic investment. Financial deregulation is significantly good for total domestic investment. Moreover, we examine whether our results are affected by whether

\[ \text{In regressions with FDI, we always instrument FDI with the weather indicators.} \]
we control for total domestic investment in the regression. The results do not differ qualitatively from those obtained with the inclusion of total domestic investment. However, as seen from Table 6, domestic capital accumulation has no significant effects on growth. Therefore, this crowding out effect of FDI on domestic investment would be insignificant as well.

We also investigate two issues. The first is whether financial reform interacts with domestic investment to promote economic growth. This is implemented in regression 8.3. The interaction term between domestic investment and financial reform is not statistically significant, while the rest of the coefficients are very similar to those obtained in specifications in which this term is not included. In regression 8.4, we include the interaction between domestic investment and financial reform and that between FDI and financial reform. The estimated coefficients on both FDI and the interaction between FDI and financial reform are significant at the 1% level with slightly larger magnitudes compared to those in regression 6.4. The interaction term between domestic investment and financial reform has an estimated significant (at the 1% level) but negative coefficient.

The second issue that we investigate is whether financial reform interacts with export to promote growth. Our measure of export is the provincial export to foreign countries (i.e., trade with the outside world) as a share of GDP. The large literature on the trade-growth nexus believes trade as a measure of openness is good for growth (e.g., Frankel and Romer, 1999). As pointed out in the introduction, in 1986, the nominal FDI to GDP ratio is around 3.3% and 0.01% for Guangdong province and Gansu province respectively, a 323 to 1 ratio. But the ratio shrinks to 34 to 1 in 1998. Their nominal export to GDP ratio is 23.0% and 2.5% respectively, a 9 to 1 ratio in 1986, while the ratio increases to 22 to 1 in 1998. Since both FDI and export are measures of openness, it is desirable to examine whether there is a complementarity between domestic financial reform and export. This would allow us to find out which part of opening-up interacts with reform to promote economic growth. In regression 8.5, we replace FDI with export and conduct OLS regression once again. In regression 8.6, we instrument export with the weather indicators. The results show that there is no complementary effect between export and financial reform in the process of economic development.

5. Conclusions

Following the argument of Graham and Krugman (1991), for developing countries in particular, it is likely that the higher efficiency of FDI would result from a combination of advanced management skills and more modern technology. As found by previous works (e.g., Borensztein et al., 1998), FDI may be the main channel through which advanced technology is transferred to developing countries. Developing countries, however, often have different types of economic distortions that may jeopardize the role of FDI as a means for advanced technology transfer. For example, widespread bureaucratic corruption and delay, rampant rent seeking, lax contract enforcement, and unstable macroeconomic environment may create serious barriers for the inflow of FDI. These existing distortions may increase the entry cost or decrease the profit margin of FDI. Therefore, they may result in lower inflow of FDI. On the flip side, the technological imitation and absorptive capability of a developing country requires the removing of those existing
distortions. Eliminating those distortions would facilitate the inflow of FDI and the speed of technological diffusion from leading economies.

Hence, the empirical investigation of the complementarity between FDI and domestic financial reform in the process of economic development is appealing. We investigated these issues in a sample that comprises FDI inflows from abroad to the Chinese provinces following its reforming and opening-up in 1978. We find that the effect of FDI on economic growth is dependent on the level of financial deregulation in the host province. In the absence of the interaction between FDI and financial reform, FDI itself does not significantly contribute to economic growth. However, after we consider the interaction between FDI and financial reform, FDI contributes to economic growth through the strong complementarity between FDI and financial reform. Although both export and FDI measure the degree of openness, there is no significant interaction between export and financial reform in promoting growth. Moreover, although foreign financing (FDI) and domestic investment both measure capital accumulation, the same interaction is either insignificant or negative between domestic investment and financial reform.

How financial deepening may affect economic development is not well understood in the literature. McKinnon (1973) and Shaw (1973) first highlight the role of financial deepening in promoting domestic capital accumulation. We find that financial reform itself exerts a significant effect on growth and a somewhat significant effect on domestic capital accumulation. Since domestic capital accumulation has no significant effects on growth, it should no be the channel of financial reform impacting growth. After including the interaction term between FDI and financial reform in the regression, we find that financial deepening has a significantly negative effect on growth. That is, considering the direct negative effect, financial deepening mainly spurs growth through facilitating technological diffusion via FDI to China. These further our understanding of the role of financial deregulation in economic development. Overall, for developing countries, it may be more desirable for them to open their borders to attract more inflows of FDI, rather than to increase trade with the rest of world, as well as to conduct domestic reform to achieve a faster catch-up with leading economies.

References


[59] *Natural Resources Database* [China Academy of Social Sciences]. Beijing, China.


Table 1. Correlation among the weather indicators

<table>
<thead>
<tr>
<th></th>
<th>log(Rainfall)</th>
<th>log(Temper)</th>
<th>log(Sunshine)</th>
<th>Tempdiff</th>
<th>Tempvar1</th>
<th>Tempvar2</th>
<th>Sunvar</th>
</tr>
</thead>
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<td>log(Temper)</td>
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<td>1.00</td>
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<td></td>
</tr>
<tr>
<td>log(Sunshine)</td>
<td>-0.71***</td>
<td>-0.61***</td>
<td>0.67***</td>
<td>1.00</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Tempdiff</td>
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<td>-0.66***</td>
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<td>0.67***</td>
<td>1.00</td>
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<td>-0.70***</td>
<td>0.67***</td>
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<td>0.98***</td>
<td>1.00**</td>
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<td>-0.72***</td>
<td>0.68***</td>
<td>0.98***</td>
<td></td>
<td>1.00***</td>
<td>1.00</td>
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<td>0.26**</td>
<td>-0.32***</td>
<td>-0.11</td>
<td>-0.08</td>
<td>-0.11</td>
<td>1.00</td>
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</table>

*** indicates significant at the 0.01 level, ** at the 0.05 level

Table 2: Domestic financial deregulation policy indicators

<table>
<thead>
<tr>
<th>Domestic financial deregulation</th>
<th>Indicators</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banking Sector</td>
<td>Bank</td>
<td>Banking sector general reforms and policies; Banking deregulation policies that might affect sectoral allocation of credit;</td>
</tr>
<tr>
<td></td>
<td>Newbank</td>
<td>The set-up of specific new banks;</td>
</tr>
<tr>
<td></td>
<td>Resi-bank</td>
<td>The remaining banking sector policies;</td>
</tr>
<tr>
<td>Non-bank Sector</td>
<td>Nonbank</td>
<td>Non-bank deposit-taking institutions; Insurance market;</td>
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</table>

Table 3: Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
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<td>Annual Growth (%)</td>
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<td>2.26</td>
<td>2.00</td>
<td>12.00</td>
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<td>ln(FDI/GDP)</td>
<td>-1.31</td>
<td>2.40</td>
<td>-7.86</td>
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<td>F-Reform</td>
<td>1.41</td>
<td>2.24</td>
<td>0</td>
<td>11.49</td>
</tr>
<tr>
<td>ln(GDP/L)_{t-1}</td>
<td>7.39</td>
<td>0.62</td>
<td>6.21</td>
<td>9.42</td>
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<tr>
<td>ln(School)</td>
<td>2.25</td>
<td>0.24</td>
<td>1.76</td>
<td>2.84</td>
</tr>
<tr>
<td>ln(n + g + \delta)</td>
<td>2.32</td>
<td>0.14</td>
<td>1.93</td>
<td>2.61</td>
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<tr>
<td>ln(I/GDP)</td>
<td>3.67</td>
<td>0.22</td>
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<tr>
<td>ln(Fiscal)</td>
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<td>0.38</td>
<td>1.68</td>
<td>3.48</td>
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<td>ln(Export)</td>
<td>2.02</td>
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<td>4.49</td>
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</table>

Observations: 81. The panel data comprises 27 provinces and 18 years.

We cut the 18 years into three sub-periods and take six year averages to avoid the influence from business cycles. Except for F-Reform and $ln\left(\frac{GDP}{L}\right)_{t-1}$, all other variables are multiplied by 100 before taking logarithm.
<table>
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<th>Regression number</th>
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<th>4.3</th>
<th>4.4</th>
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<td>OLS</td>
<td>OLS</td>
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<tr>
<td>ln FDI/GDP</td>
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<td>0.11</td>
<td>0.38</td>
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<td></td>
<td>(0.24)</td>
<td>(0.23)</td>
<td>(0.26)</td>
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<tr>
<td>F-Reform</td>
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<td>0.42**</td>
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<td>(0.19)</td>
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<td>(ln FDI/GDP) × F-Reform</td>
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<td></td>
<td>0.22**</td>
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<td></td>
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<td>(0.11)</td>
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<tr>
<td>ln(GDP/\ L_{t-1})</td>
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<td>(1.87)</td>
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<td>ln(School)</td>
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<td>4.72***</td>
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<td>(1.84)</td>
<td>(1.73)</td>
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<td>ln(I/GDP)</td>
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<td>Province FE</td>
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<td>Yes</td>
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</tbody>
</table>

F-statistic for financial deregulation 4.80  (Prob>F) (0.013)
F-statistic for FDI 2.37  (Prob>F) (0.105)
F test on ln(FDI/GDP), F-Reform and (ln(FDI/GDP) × F-Reform) prob. of F = 0.032
R-square 0.83 0.84 0.84 0.86
Observations: 81 81 81 81

***Significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level
Table 5: Regressions between growth of per worker GDP, FDI, and financial deregulation

First-Stage Results. Observations: 81

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<th>First-Stage Regression number</th>
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<th>5.4</th>
<th>5.5</th>
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<td>6.3; 6.4</td>
<td>6.5</td>
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<td>ln FDI GDP</td>
<td>ln FDI GDP</td>
<td>ln FDI GDP</td>
<td>ln FDI GDP</td>
<td>(ln FDI GDP)×F-Reform</td>
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<tr>
<td>log(Sunshine)</td>
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<td>$-3.89^{**}$</td>
<td>$-3.15^{**}$</td>
<td>$-3.29^{**}$</td>
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<td></td>
<td>(1.58)</td>
<td>(1.54)</td>
<td>(1.45)</td>
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<td>log(Rainfall)</td>
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<td>(0.08)</td>
<td>(0.01)</td>
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</table>

Partial R-squared on excluded instruments: 0.34, 0.37, 0.31, 0.29

F-test on Instruments
- $F(7,39) = 2.8$, $F(7,38) = 3.1$, $F(7,37) = 2.3$, $F(4,40) = 4.1$, $F(7,38) = 1.5$
- (Prob>F) = 0.017, 0.010, 0.045, 0.007, 0.185

IV LM Redundancy Test: 1.93
- Chi-sq(3) P-val = 0.587

Time FE: Yes, Yes, Yes, Yes, Yes
Province FE: Yes, Yes, Yes, Yes, Yes
$R^2$(Centered): 0.96, 0.96, 0.97, 0.97, 0.96

Other RHS variables in first-stage regression number
- 5.1: ln(GDP), ln(School), ln(n+g+δ), ln(Fiscal), ln(Export)
- 5.2, 5.5: F-Reform, ln(GDP), ln(School), ln(n+g+δ), ln(Fiscal), ln(Export)
- 5.3, 5.4: F-Reform, (ln FDI GDP)×F-Reform, ln(GDP), ln(School), ln(n+g+δ), ln(Fiscal), ln(Export)

***Significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level, (Standard error in parentheses)
### Table 6: Regressions between growth of per worker GDP, FDI, and financial deregulation

Second-Stage Results. Dep. Var.: Average annual growth rate of real GDP per worker. Observations: 81

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Regression number</th>
<th>Estimation Method</th>
<th>6.1</th>
<th>6.2</th>
<th>6.3</th>
<th>6.4</th>
<th>6.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(FDI/GDP)</td>
<td></td>
<td>2SLS-ivreg</td>
<td></td>
<td></td>
<td>1.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LIML (ivreg2)</td>
<td></td>
<td></td>
<td></td>
<td>1.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.43)</td>
<td>(0.53)</td>
<td>(0.50)</td>
<td>(0.41)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.48**</td>
<td>-0.98*</td>
<td>-1.26**</td>
<td>-0.96**</td>
<td></td>
</tr>
<tr>
<td>F-Reform</td>
<td></td>
<td></td>
<td>(0.21)</td>
<td>(0.56)</td>
<td>(0.49)</td>
<td>(0.42)</td>
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</tr>
<tr>
<td>(ln(FDI/GDP) × F-Reform)</td>
<td></td>
<td></td>
<td>0.40***</td>
<td>0.49***</td>
<td>0.39***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln(GDP/L_t-1)</td>
<td></td>
<td></td>
<td>-3.87*</td>
<td>-4.48**</td>
<td>-4.91**</td>
<td>-4.79***</td>
<td>-4.93***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.13)</td>
<td>(2.05)</td>
<td>(2.12)</td>
<td>(1.73)</td>
<td>(1.53)</td>
</tr>
<tr>
<td>ln(School)</td>
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<td></td>
<td>5.39***</td>
<td>5.25***</td>
<td>2.12</td>
<td>1.75</td>
<td>2.16</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(1.97)</td>
<td>(1.89)</td>
<td>(2.18)</td>
<td>(1.80)</td>
<td>(1.58)</td>
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<tr>
<td>ln(n+g+δ)</td>
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<td></td>
<td>-5.73**</td>
<td>-4.83*</td>
<td>-6.93***</td>
<td>-7.22***</td>
<td>-6.90***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.41)</td>
<td>(2.35)</td>
<td>(2.52)</td>
<td>(2.07)</td>
<td>(1.82)</td>
</tr>
<tr>
<td>ln((1/GDP))</td>
<td></td>
<td></td>
<td>1.19</td>
<td>-1.14</td>
<td>-1.59</td>
<td>-1.97</td>
<td>-1.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.84)</td>
<td>(2.91)</td>
<td>(3.01)</td>
<td>(2.48)</td>
<td>(2.18)</td>
</tr>
<tr>
<td>ln(Fiscal)</td>
<td></td>
<td></td>
<td>2.17</td>
<td>0.22</td>
<td>-0.38</td>
<td>-0.60</td>
<td>-0.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.85)</td>
<td>(1.95)</td>
<td>(2.03)</td>
<td>(1.67)</td>
<td>(1.47)</td>
</tr>
<tr>
<td>ln(Export)</td>
<td></td>
<td></td>
<td>-0.38</td>
<td>-0.38</td>
<td>-0.84</td>
<td>-0.85</td>
<td>-0.84*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.65)</td>
<td>(0.63)</td>
<td>(0.66)</td>
<td>(0.54)</td>
<td>(0.47)</td>
</tr>
</tbody>
</table>

Endogeneity Test P-Value= 0.002 0.016

Weak Identification Test

Stock-Yogo Critical value:
- 10% maximal LIML size: 4.18 5.44
- 15% maximal LIML size: 3.18 3.87
- 20% maximal LIML size: 2.73 3.30
- 25% maximal LIML size: 2.49 2.98

Sargan overID Test P-Value= 0.23 0.29

Test on reform (Prob>chi or F) (0.006) (0.000) (0.000)

Test on FDI (Prob>chi or F) (0.028) (0.001) (0.002)

Test on ln(FDI/GDP), F-Reform prob. of F prob. >chi prob. >chi and (ln(FDI/GDP) × F-Reform) = 0.015 = 0.0001 = 0.0002

Time FE Yes Yes Yes Yes Yes
Province FE Yes Yes Yes Yes Yes

$R^2(Centered)$ 0.81 0.83 0.82 0.77 0.82

6.1-6.4’s instruments: Tempdiff, Tempvar1, Tempvar2, log(Temper), log(Rainfall), Sunvar, log(Sunshine)

6.5’s instruments: Tempvar2, log(Rainfall), Sunvar, log(Sunshine)

***Significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level (Standard error in parentheses)
Table 7: Regressions between growth of per worker GDP, FDI, and financial deregulation

Second-Stage Results. Dep. Var.: Average annual growth rate of real GDP per worker Observations: 81

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Regression number</th>
<th>Estimation Method</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>7.1 7.2 7.3 7.4</td>
<td>2SLS-ivreg2 2SLS-ivreg2 LIML</td>
</tr>
<tr>
<td>ln(FDI)</td>
<td>1.26*** (0.38)</td>
<td>1.09*** (0.38)</td>
</tr>
<tr>
<td>ln(GDP)</td>
<td>-0.98** -0.87**</td>
<td>2.13** -3.18**</td>
</tr>
<tr>
<td>F-Reform</td>
<td>(0.41)</td>
<td>(0.40)</td>
</tr>
<tr>
<td>ln(GDP)×F-Reform</td>
<td>0.40*** 0.37***</td>
<td>0.71*** 1.00</td>
</tr>
<tr>
<td>ln(GDP/L)_{t-1}</td>
<td>-4.91*** -4.96***</td>
<td>-5.39*** -5.68**</td>
</tr>
<tr>
<td>ln(School)</td>
<td>2.12 (1.54)</td>
<td>2.28 (1.48)</td>
</tr>
<tr>
<td>ln(I/GDP)</td>
<td>-1.59 -1.43</td>
<td>-1.75 -2.11</td>
</tr>
<tr>
<td>ln(Fiscal)</td>
<td>-0.38 -0.29</td>
<td>-0.79 -1.23</td>
</tr>
<tr>
<td>ln(Export)</td>
<td>-0.84* -0.84*</td>
<td>-1.25** -1.58*</td>
</tr>
<tr>
<td>Endogeneity Test on FDI P-Val</td>
<td>0.002 0.016</td>
<td>0.016</td>
</tr>
<tr>
<td>Endogeneity Test on interaction</td>
<td>P-Val=0.13</td>
<td>P-Val=0.09</td>
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<tr>
<td>Weak Identification Test</td>
<td>2.33 4.07</td>
<td>0.91</td>
</tr>
<tr>
<td>Stock-Yogo Critical value:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10% maximal LIML size</td>
<td>31.50 24.58 23.72 3.90</td>
<td></td>
</tr>
<tr>
<td>25% maximal LIML size</td>
<td>9.93 8.31 7.91 2.35</td>
<td></td>
</tr>
<tr>
<td>Sargan overID Test P-Value=</td>
<td>0.17 0.28</td>
<td>0.41 0.52</td>
</tr>
<tr>
<td>Test on reform (Prob&gt;chi)</td>
<td>(0.0000) (0.0000) (0.0006) (0.003)</td>
<td></td>
</tr>
<tr>
<td>Test on FDI (Prob&gt;chi)</td>
<td>(0.0006) (0.002) (0.005) (0.012)</td>
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</tr>
<tr>
<td>Test on ln(FDI/GDP), F-Reform and (ln(FDI/GDP)×F-Reform)</td>
<td>prob. &gt;chi prob. &gt;chi prob. &gt;chi prob. &gt;chi</td>
<td></td>
</tr>
<tr>
<td>prob. &gt;chi prob. &gt;chi prob. &gt;chi prob. &gt;chi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time FE</td>
<td>Yes Yes Yes Yes</td>
<td></td>
</tr>
<tr>
<td>Province FE</td>
<td>Yes Yes Yes Yes</td>
<td></td>
</tr>
<tr>
<td>$R^2$ (Centered)</td>
<td>0.82 0.83 0.76 0.64</td>
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</tr>
</tbody>
</table>

7.1,7.3-4’s instruments: Tempdiff, Tempvar1, Tempvar2, log(Temper), log(Rainfall), Sunvar, log(Sunshine)
7.2’s instruments: Tempvar2, log(Rainfall), Sunvar, log(Sunshine)

***Significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level (Standard error in parentheses)
Table 8: FDI, domestic investment and export

8.1’s Dep. Var.: Average ln(\(\frac{I}{GDP}\))

8.2, 8.3, 8.4, 8.5, 8.6’s Dep. Var.: Average Annual Growth Rate of Real GDP per Worker

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>8.1</th>
<th>8.2</th>
<th>8.3</th>
<th>8.4</th>
<th>8.5</th>
<th>8.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(FDI)</td>
<td>-0.11** (0.05)</td>
<td>1.27*** (0.46)</td>
<td>2.14*** (0.54)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ln(GDP)</td>
<td>0.10** (0.04)</td>
<td>-1.02** (0.45)</td>
<td>0.63** (0.26)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-Reform</td>
<td>(0.04)</td>
<td>(0.45)</td>
<td>(0.26)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ln(FDI)\times F-Reform)</td>
<td>-0.02** (0.01)</td>
<td>0.40*** (0.12)</td>
<td>0.85*** (0.17)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln((\frac{GDP}{L}))_t-1</td>
<td>0.15 (0.12)</td>
<td>-5.17*** (1.50)</td>
<td>-5.57*** (1.96)</td>
<td>8.19*** (1.76)</td>
<td>-4.75** (1.93)</td>
<td>-1.70 (2.85)</td>
</tr>
<tr>
<td>ln(School)</td>
<td>0.26** (0.13)</td>
<td>1.87 (1.59)</td>
<td>5.10*** (1.76)</td>
<td>1.06 (1.73)</td>
<td>5.09*** (1.83)</td>
<td>4.97** (2.36)</td>
</tr>
<tr>
<td>ln(n+g+δ)</td>
<td>-0.17 (0.14)</td>
<td>-6.58*** (1.78)</td>
<td>-5.04** (2.19)</td>
<td>-8.59*** (2.01)</td>
<td>-4.98** (2.22)</td>
<td>-8.14** (3.21)</td>
</tr>
<tr>
<td>ln(Fiscal)</td>
<td>0.20* (0.12)</td>
<td>-0.59 (1.47)</td>
<td>0.20 (1.83)</td>
<td>-2.07 (1.63)</td>
<td>0.61 (1.86)</td>
<td>4.37 (2.95)</td>
</tr>
<tr>
<td>ln(Export)</td>
<td>-0.08** (0.04)</td>
<td>-0.73 (0.45)</td>
<td>-0.33 (0.60)</td>
<td>-0.22 (0.52)</td>
<td>-0.60 (0.58)</td>
<td>-6.15** (2.65)</td>
</tr>
<tr>
<td>ln(Export)\times F-Reform</td>
<td>(0.44)</td>
<td>(2.73)</td>
<td>(2.35)</td>
<td>(2.73)</td>
<td>(5.44)</td>
<td></td>
</tr>
</tbody>
</table>

| Weak Identification Test | 1.86 | 3.47 | 2.20 |     |     | 1.28 |
| Stock-Yogo Critical value: | 10% maximal LIML size: 4.18 | 5.44 | 4.18 | 4.18 |     |     |
|                           | 20% maximal LIML size: 2.73 | 3.30 | 2.73 | 2.73 |     |     |
| Time FE                  | Yes | Yes | Yes | Yes | Yes | Yes |
| Province FE              | Yes | Yes | Yes | Yes | Yes | Yes |
| R-square(centered)       | 0.88 | 0.82 | 0.85 | 0.80 | 0.85 | 0.53 |
| Observations             | 81 | 81 | 81 | 81 | 81 | 81 |

8.1, 8.4, 8.6’s Instruments: Tempdiff, Tempvar1, Tempvar2, log(Temper), log(Rainfall), Sunvar, log(Sunshine)

8.2’s Instruments: Tempvar2, log(Rainfall), Sunvar, log(Sunshine)

***Significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level (Standard error in parenthese)
Fig. 1. Provincial FDI/GDP Ratios and Financial Deregulation (1981-1998)
Illustration: see subsection 3.4 for the definition and measure of financial deregulation.

Fig. 2. Provincial domestic and foreign direct investment rates (1981-1998)
Illustration: GD and GS stand for Guangdong province and Gansu province respectively. I/GDP is domestic physical capital investment to GDP ratio.
Fig. 3. Provincial Distribution of Financial Reform Policy Index Bank (1987-92)
Illustration: see subsection 3.4 for the measure of financial reform policy index Bank.

Fig. 4. Provincial Distribution of Financial Reform Policy Index Bank (1983-98)
Illustration: see subsection 3.4 for the measure of financial reform policy index Bank.