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The Impact of Inward FDI in China on Domestic Investment with Chinese Regular Financial Deregulation: A Quantitative Study Using Panel Data

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Abstract

This paper try to examine that inward foreign direct investment (FDI) in China affects domestic investment (DI) depends on the level of financial deregulation. Using the panel data, instrumenting FDI with weather indicators (validity supported by over-identification tests), and the limited-information maximum likelihood (LIML) results recommend that both FDI and its relations with financial deregulation have a significant negative effect on DI. It indicates that in China, FDI significantly crowds out DI, and higher level of financial deregulation strengthens the crowding-out effect. Even after controlling for other growth factors, and time and province effects, the results are robust.

Keywords: Foreign Direction Investment, Financial Deregulation, Crowding out, Panel Data.

UNCTAD data reveals the fact that over the past several decades foreign direct investment (FDI) has increased spectacularly (see UNCTAD). [1] The most important motivation is that governments at all levels of development have been making efforts to attract more FDI. The reason is that technology diffusion via FDI plays an indispensable 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). In the incidence of increasing inward FDI, [2] its implication on the host economy is significant to comprehend. This study attempts to examine, how inward FDI impact domestic investment (DI) at the economy-wide level. [3] On the other hand, the results are varied in the literature regarding how inward FDI affects DI. Lipsey (2000) and Areskoug (1976) determine that inward FDI crowds out DI, whereas Kim and Seo (2003) and Ang (2009) authentication that inward FDI increases DI. Wang (2008) demonstrates that the effect may depend on whether the host economy is a developed one or a less developed one. This study attempts to investigate that the consequence of inward FDI on DI may depend on financial deregulation.[4]

The most important motivation to believe financial deregulation in the FDI-DI nexus is two-fold.[5] Firstly, many countries, developing as well as developed ones, have also deregulated their financial services over the past several decades (e.g. Riedel and Turley, 1999; Jbili *et al.* 1997; He, 2007; Cummins and Rubio-Misas 2006).[6] Financial distortions can enforce severe barriers on the entry of FDI (Borensztein *et al.* 1998; Gastanaga *et al.* 1998). Financial deregulation, therefore, promotes the inflow of FDI through eliminating financial distortions (Desai *et al.* 2004).[7] Exceptionally, financial system was found to interrelate with FDI in affecting economic development (e.g., Alfaro *et al.* 2004; Hermes and Lensink 2003). Consequently, there may exist a feasible interaction between FDI and financial deregulation in affecting

DI. Neglecting financial deregulation and its interaction with FDI not only enforces one serious source of omitted variable bias, but also does not agree to capture the effect of FDI on DI. Secondly, according to Braunstein and Epstein (2002) and Huang (2003), in China, FDI crowds out DI though Tang *et al.* (2008) and Sun (1998) explain that FDI increases DI in China.

Using the Chinese experience that provides a natural experiment with both large inflows of FDI and significant financial deregulation, this study consider the role of financial deregulation to correctly identify the effect of inward FDI on DI. As a priority of its agenda, the Chinese government has not only put attracting more FDI but also made continuous efforts to reform its backward unhealthy financial system to facilitate the inflow of FDI since 1978 (see subsection 1.1).[8] The following discusses the promising instrument at play by means of which financial deregulation may influence how FDI affects DI in China. Earlier literature has acknowledged two contrasting forces by which inward FDI is ambitious to influence DI, which applies to China. In one side, multi-national corporations (MNCs) that have improved technology and management practices compete with domestic firms in labor, product and financial markets. The antagonism from foreign firms may crowd out DI (Borensztein *et al.* 1998; Harrison and McMillan, 2003 [9]). On the other hand, a linkage effect (Markusen and Venables, 1999) or a 'contagion' effect (Findlay, 1978) may make inward FDI crowd in DI. For China, there exists financial repression in the Chinese economy and many Chinese firms are inefficient state-owned enterprises (SOEs) (see Lardy, 1998; Naughton, 1998).

Therefore, the crowding-out may dominate the crowding-in, yielding a net negative effect of FDI on DI. Financial deregulation changes the two forces differently. Firstly, the Chinese financial deregulation has facilitated the inflow of FDI (Head and Ries, 1996; Branstetter and Feenstra, 2002), and this makes the Chinese firms enjoy greater positive externality from more foreign firms. We refer to this as an extensive margin, which is more likely to strengthen the second force (the crowding-in). However, financial deregulation also directly reduces tax rates or the financing costs of FDI, which intensifies the competition between foreign and Chinese firms. Branstetter and Feenstra (2002), for example, evidence that the Chinese liberalization policies have given preferential tax and administrative treatment to foreign firms. We call this an intensive margin, which tends to reinforce the first force (the crowding-out). If the intensive margin dominates the extensive margin, financial deregulation would reinforce the crowding-out effect of FDI on DI, otherwise, financial deregulation would mitigate the crowding-out effect of FDI on DI.

The econometric advantages of using the Chinese experience are as follows. First and foremost, the Chinese experience allows us to find suitable instruments for FDI to overcome its endogeneity problem.[10] The endogeneity problem can be avoided by applying the instrumental variable (IV) technique. Borenstein *et al.* (1998), for example, argue that the fundamental problem is that there are no ideal instruments. We use a series of weather indicators as instruments whose validity is supported by over-identification tests. To deal with weak instruments, we use limited-information maximum likelihood (LIML) estimation in STATA [10] that implements the recent theoretical development on weak instruments (e.g. Stock and Yogo, 2002; Hahn and Hausman, 2005).[11] Second, the market-oriented reform since 1978 has put China on the path to sustained industrialization. There is no structural break in China after 1978 as found by previous works (Weeks and Yao, 2003; Li, 2000), so we are studying a consistent regime. Third, China has adopted the gradual approach to financial reform contrast to 'shock therapy' adopted elsewhere.[12] Resultantly, the Chinese financial reform has cross-section and time-series variations that 'shock therapy' lacks and can be quantified. The time variation allows us to control for unobserved province effects, presenting a more convincing result.

Our object is to examine empirically the effects of FDI on DI. We employ a framework of cross-province regressions utilizing data on gradual financial deregulation across Chinese provinces and FDI inflows to Chinese provinces from 1981 to 1998. Using weather indicators as instruments for FDI, our LIML results show the following. First, FDI has a significant causal crowding-

out effect on DI, which depends on the level of financial deregulation. Specifically, the estimated coefficients on FDI and its interaction with financial deregulation are significantly negative. It means FDI crowds out DI in China, and financial deregulation has enhanced the crowding-out effect of FDI on DI. Moreover, the estimated coefficient on financial deregulation is significantly positive.

The results are robust to the controlling for the variables commonly used in previous literature (Borensztein *et al.* 1998; Mankiw *et al.* 1992). Particularly, the results are robust to the controlling for time and province effects. The validity of weather indicators as instruments is supported by over-identification tests. To get an estimate of how important FDI has been in crowing out DI, we find that having a one standard deviation increase in ln(FDI/GDP) would have caused a province receiving the mean level of financial reform in the sample to experience an annual domestic investment rate decrease of 0.26% points during the 18-year-period. In contrast, without considering financial deregulation, the estimated coefficients on FDI are insignificant in both OLS and LIML estimations. The results and methodology of this paper are in contrast with those in previous literature.

First, this paper finds a significant interaction effect between financial deregulation and FDI in affecting DI, which previous works on the FDI and DI nexus ignored. For instance, Lipsey (2000) evidences that inward FDI is negatively related to DI in the OECD countries. Areskoug (1976) finds FDI to be partially substituting for DI in most developing countries. Kim and Seo (2003) find no evidence that FDI crowds out DI in Korea. Ang (2009) finds FDI to be complementary to private DI in Malaysia. Without considering the interaction between financial reform and FDI in affecting DI, one may get contradicting results, especially for China.

For instance, Sun (1998) finds a positive impact of FDI on DI for the period 1979-96 in China, and Tang *et al.* (2008) also evidence that FDI crowds in DI for the period 1988-2003 in China. In contrast, Braunstein and Epstein's (2002) 1986-99 province-level panel data evidence that FDI crowds out DI in China. Huang (2003) also finds that FDI crowds out DI in China. All these works on China ignore financial reform and its interaction with FDI. Moreover, we directly address the potential endogeneity problem of FDI by using the IV technique. In contrast, Kim and Seo (2003), Ang (2009) and Tang *et al.* (2008) use vector auto-regression (VAR) technique to avoid this problem.

Inflows of FDI and Regular Financial Deregulation in China

Since 1978, China has begun the reform and opening-up process that put China on the path of fast and sustained industrialization. China's average annual growth of real GDP per worker in the past three decades is roughly 8%, highest in the world. The economic success of China is driven by its reform and opening-up (see He, 2007; He and Sun, 2009).[13]

Concerning reform, China has adopted the gradual approach to financial reform contrast to 'shock therapy' adopted elsewhere. The Chinese gradual financial deregulation studied by previous works (Lardy, 1998; Naughton, 1995, 1998; Shirk, 2003; Brandt and Zhu, 2007) refers to the following. Across time, it involves a gradual implementation of piece-meal financial deregulation policies over a long period of time. Common themes of the piece-meal policies include the provision of more autonomy in credit allocation to state-owned banks, and the relaxation of geographical and legal restrictions on the entry of new financial intermediaries. Across provinces, it refers to a process that allows some provinces to implement some piece-meal financial deregulation policies first.

Most policies are conducted at the city level; few are at the province level (see below and He, 2007). Resultantly, the Chinese financial reform has cross-section and time-series variations. However, despite the financial reform in 1978, there still exists financial repression in the Chinese economy and the Chinese financial system is still unhealthy (Lardy, 1998; Naughton, 1995, 1998; Shirk, 2003). Before 1978, China had an underdeveloped financial system in which the government played a dominant role (Lardy 1998, ch. 3; Naughton 1995, ch. 1). Interest rates were set administratively; monetary policy was

conducted through direct allocation of credit and refinancing. The primary financial intermediaries were state banks that were obliged to lend to SOEs with little concern for its profitability. The situation has been only gradually changed since 1978, because of the gradual approach to reform adopted by the Chinese government. Shirk (2003, p. 26) shows: "In China, iron and steel and machine building, the backbone heavy industries, were given priority, consuming more than one-third of total investment in industrial capital construction (Statistical Yearbook 1990, 168)." Given the presence of financial repression, FDI may `crowd out' investment from domestic sources as argued in Borensztein *et al*. (1998). The following presents a brief summary of the most important financial deregulation policies related to FDI that are cited from He and Sun (2009). The original source is 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.

"In 1983, the People's Bank of China announces that foreign financial institutions can apply to set up permanent institutions in Beijing and Special Economic Zones (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 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..."

As a result, financial liberalization in China has two effects on FDI. On the one hand, financial deregulation has promoted the inflows of FDI. This, through the aforementioned extensive margin, tends to increase the crowding-in effect of FDI on DI. The FDI inflow to China has dramatically increased since 1978 and become one important source of external financing by the late 1990s. China's FDI inflows comprise the dominant share of total FDI inflows to East Asia. As a result, the share of world FDI inflows to East Asia increased steadily from 2% in 1979 to 17% in 1994(UNCTAD).

Moreover, the increasing inflow of FDI is unevenly distributed across Chinese provinces. For Guangdong (Canton) province, its ratio of FDI to GDP increases steadily over time. It becomes higher than domestic investment rate after 1992 and reaches 18% in 1994 (UNCTAD). In contrast, Shanxi province's ratio of FDI to GDP is below 1.5% in 1998, although it increases over time, while its domestic investment rate reaches 32% by 1998. On the other hand, one can observe that those financial deregulation policies directly reduce tax rates or the financing constraints and costs of FDI. Resultantly, financial liberalization has favored FDI more in its competition with DI in labor, product and financial markets. This is the aforementioned intensive margin that tends to increase the crowding-out effect of FDI on DI. The paper is divided as follows. Section 2 presents the empirical formulation and the data used in the empirical analysis; Section 3 presents the regression results, and Section 4 concludes.

Data

To provide an account of the data needed in the empirical analysis, we first give the empirical specification and then discuss the endogeneity problem of FDI and its identification strategy. We follow Borensztein *et al.* (1998) and Wang (2008) to get our empirical specification:

$$\ln(I/GDP)_{i,t} = \beta_0+\beta_1 \ln(FDI/GDP)\ i,t +\beta_2 [(FDI/GDP)_{i,t} \times \text{F-Reform}_{i,t}] + \beta_3 \text{F-Reform}_{i,t} + \beta_4 (\ln GDP/L)_{i,t-1} + \beta_5 \ln(School)_{i,t} + \beta_6 \ln(n+g+\delta)_{i,t} + \beta_7 \ln(Export)_{i,t} + \beta_8 \ln(Fiscal)_{i,t} + u_i + \theta_t + \varepsilon_{i,t} \quad (1)$$

where I/GDP is nominal investment rate; FDI/GDP is foreign direct investment to GDP ratio; F-Reform is the measure of the degree of financial deregulation; $\ln(GDP/L)_{i,t-1}$ is initial real GDP per worker; School is human capital investment rate; $\ln(n+g+\delta)$ measures labor force growth; Export and Fiscal are export and fiscal expenditure to GDP ratios respectively; u_i and θ_t are the fixed province and time effect respectively. The subscript i stands for i -th province.

The empirical specification is similar to previous works that study how FDI affects DI (see Borensztein *et al.* 1998, p. 129; Wang, 2008, p. 3). Borensztein *et al.* (1998) includes initial GDP, schooling, and government consumption together with other variables in the regression. Following Borensztein *et al.* (1998), Wang (2008) argues that growth rate should be included in the regression. Mankiw *et al.* (1992) theoretically derive that growth can be expressed as a function of initial GDP and the other control variables in equation (1). We include these independent control variables to avoid potential omitted variable biases.

Nonetheless, we have checked our results by including only initial GDP per worker in the regression, and the results reported in Table 5 show that our main findings still hold. We employ the Chinese panel data from 1991 to 2008 and take six-year averages to avoid the influence from business cycles, ending up with three sub-periods: 1991-96, 1997-2002, and 2003-08.

Endogeneity of FDI and its Identification Strategy

We are aware that our regressions presented below may be subject to the endogeneity problem of FDI. For example, there may exist omitted variables that affect the domestic investment rate and the inflow of FDI 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. Previous works (Tang *et al.* 2008; Kim and Seo, 2003; Ang, 2009) use VAR technique to avoid this endogeneity problem. In contrast, we overcome the endogeneity problem of FDI by applying the IV technique. An ideal instrument would be a variable that is highly correlated with FDI but not with the error term in the regressions. We use a series of weather indicators as instruments. He and Sun (2009) have argued why weather indicators are plausible instruments for FDI. The argument there is that, following Goldsmith and Sporleder (1998), foreign firms' locational choice in China is partly affected by weather conditions. Some FDI inflows are directed towards agriculture and agriculture-related labor intensive industries since China is a developing country with a large agricultural sector, which is consistent with the sectoral composition of world FDI summarized by World Bank. Nevertheless, we will use over-identification tests to check whether weather indicators are valid instruments. In addition, we will use LIML estimation to cope with weak instruments.

The Data

Our dependent variable is I/GDP, which is the nominal domestic physical capital investment rate. The data are constructed using the Statistical Yearbook of China (SYC). The reason to use nominal investment rates is available in He (2007).

We calculate the ratio of nominal FDI to nominal GDP in each year as our measure of FDI, denoted as FDI/GDP. The data are also from the SYC. We have seven weather indicators. Rainfall, Temper and Sunshine are yearly rainfall, temperature and hours of sunshine respectively. Tempdiff is the difference between the highest and the lowest monthly temperatures in a year. We calculate the variance for each year based on the 12-month data to get the variations for temperature and sunshine, denoted by Tempvar1 and Sunvar respectively. All data except Tempvar 2 are six-year averages.

For Tempvar 2, it is calculated as the variance of all six years' monthly temperature. The data sources are the Weather Yearbook of China and the Natural Resources Database of China Academy of Sciences. The detailed construction of the data is from He (2009). Generally the weather indicators are significantly correlated with one another. The financial reform policy indicators are from He and Sun (2009). Basically, He (2007) divides China's provincial financial reform policies into five groups (three groups of policies on the

reform of the banking sector, one group on the reform of non-bank sector and one group on the deregulation of the capital market). The five groups of policies are measured into five indicators. He and Sun (2009) add up the first four indicators (i.e., excluding capital market reform policies) to get the measure for the degree of financial deregulation (F-Reform). The reason is that, previous literature has studied the banking (and non-banking) sector and the capital market separately and found no evidence that one is more efficient than the other in promoting economic development. The data on the remaining variables are from He (2007). All of our variables have explicit variations across-province and across time. Table 1 lists the summary statistics of the final data.

Table 1: Descriptive Statistics

	Mean	*Standard deviation*	*Minimum*	*Maximum*
ln(I/GDP)	3.68	0.23	3.15	4.33
ln(FDI/GDP)	-1.32	2.42	-7.76	2.74
F-Reform	1.42	2.23	0	11.48
$\ln(GDP/L)_{t-1}$	7.38	0.63	6.22	9.43
ln(School)	2.26	0.23	1.75	2.85
ln(n+g+δ)	2.33	0.15	1.94	2.62
ln(Fiscal)	2.52	0.37	1.67	3.47
ln(Export)	2.03	0.91	-0.12	4.48

Note: *The panel data encompass 27 provinces and 18 years. We separate the 18 years into three sub-periods and take six-year averages to stay away from the influence from business cycles, ending up with 81 observations. Except for F-Reform and In* $(GDP/L)_{t-1}$*, all other variables are multiplied by 100 before taking logarithm.*

Empirical Results

OLS Estimation Results: The OLS results for the effects of FDI on domestic investment rate are reported in Table 2. Regression 2.1 shows that FDI has a positive impact on domestic investment rate, after controlling for initial GDP per worker, human capital investment rate, labor force growth, government consumption and export to GDP ratios, and time and province effects. However, the estimated coefficient of FDI in this specification is not statistically significant. In regression 2.2, we include the financial deregulation variable, F-Reform, as an additional regressor. The regression shows that higher degree of financial deregulation increases domestic investment rate, which is significant at the 5% level, but it does not alter the insignificance of FDI.

Table 2. OLS Regressions Between Domestic Investments Rate and FDI
Dependent variable: average annual domestic investment rate, ln(I/GDP).

Regression number:

	2.1	2.2	2.3
Estimation Method:			
	OLS	OLS	OLS
Independent Variable			
ln(FDI/GDP)	0.003	(0.013)	0.007
	(0.013)	0.008	(0.015)
F-Reform		.023**	0.019
		(0.024)	(0.010)
ln(FDI/GDP)×F-Reform			0.001
			(0.006)
ln(GDP/L)t-1	0.22**	0.16	0.16
	(0.10)	(0.10)	(0.10)
ln(School)	0.18*	0.16	0.15
	(0.100	(0.09)	(0.11)
ln(n+g+δ)	-0.29**	-0.22*	-0.22*
	(0.12)	(0.12)	(0.12)
ln(Fiscal)	0.25***	0.13(0.10)	0.13
	(0.09)		(0.10)
ln(Export)	-0.08**	-0.07**	0.07**
	(0.03)	(0.03)	(0.03)
F-statistic for FDI (Prob>F)			0.17
			(0.84)
F-statistic for financial			2.82
Deregulation (Prob>F)			(0.071)
F test on ln(FDI/GDP), F-Reform			1.89
And ln(FDI/GDP)×F-Reform (Prob>F)			(0.14)
Time FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
R-square (centered)	0.94	0.95	0.95
Observations	81	81	81

Note: ****Significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level.*

(Standard error in parentheses).

In regression 2.3, we interact FDI with financial deregulation and use this as a regressor. 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. In that way, we can test jointly whether these variables affect domestic investment rates by themselves or through the interaction term. It shows that the coefficient on FDI is still insignificant, and that on either financial reform or the interaction term is insignificantly positive. The hypothesis that the coefficients of both FDI and its interaction with financial deregulation are zero cannot be rejected at the 10% level. The hypothesis that the coefficients of both financial deregulation and its interaction with FDI are zero can be rejected at the 10% level. The F-test for the joint significance of FDI, financial deregulation and their interaction term shows that these variables jointly have an insignificant effect domestic investment rate at the 10% level.

Endogeneity Issues and LIML Estimation: We have already argued that our panel data regressions may be subject to the endogeneity problem of FDI. We apply the IV technique to address the endogeneity problem. The instruments we use are the aforementioned and constructed weather indicators.

Table 3. Regressions between Domestic Investment and FDI

(First-Stage Results)

First-Stage Dependent Variable: ln(FDI/GDP). Observations: 81				
First-Stage Regression number				
	3.1	2.3	3.3	3.4
Corresponding Second-Stage Regression number				
Independent Variable	4.1	4.2	4.3	4.4
ln (Sunshine)	-3.84**	-3.80**	-3.08**	-3.06**
	(1.57)	(1.56)	(1.49)	(1.46)
ln (Temper)	0.20	0.09	0.07	
	(0.45)	(0.46)	(0.43)	
ln (Rainfall)	1.70**	1.82**	1.39*	1.43**
	(0.74)	(0.74)	(0.71)	(0.66)
Tempdiff	0.05	-0.01	0.08	0.09
	(0.32)	(0.33)	(0.31)	(0.30)
Tempvar1	0.09	0.06	-0.01	-0.02
	(0.09)	(0.09)	(0.09)	(0.09)
Tempvar2	-0.06	-0.03	0.02	0.03
	(0.07)	(0.07)	(0.07)	(0.07)
Sunvar	0.0002	0.0002	0.0002	0.0002
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Partial R-squared on excluded Instruments	0.3293	0.3364	0.2553	0.2547
Bias ($\beta_{1\ 2SLS}$)/Bias ($\beta_{1\ OLS}$)	7/27 = 0.26	7/27 = 0.26	7/21 = 0.34	6/21 = 0.29
F-test Statistic on Instruments (Prob>F)	F(7,40) = 2.8	F(7,39) = 2.8	F(7,38) = 1.9	F(6,39) = 2.2
	(0.018)	(0.018)	(0.104)	(0.061)
IV LM Redundancy Test				0.061
Chi-sq (1) P-val=				(0.805)
Time FE	Yes	Yes	Yes	
Province FE	Yes	Yes	Yes	
R^2 (centered)	0.96	0.96	0.97	0.97

Notes: *Other RHS variables in first-stage regression number:*
3.1: ln(GDP/L)t-1, ln(School), ln(n+g+δ), ln(Fiscal), ln(Export);
3.2: F-Reform, ln(GDP/L)t-1, ln(School), ln(n+g+δ), ln(Fiscal), ln(Export);
3.3, 3.4: F-Reform, ln(FDI/GDP)×F-Reform, ln(GDP/L)t-1, 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).*

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. Stock and Yogo (2002) show that LIML estimation is far superior to 2SLS in the presence of many weak instruments.

Therefore, we proceed with LIML estimation by using the command of ivreg 2 in STATA10. Moreover, Stock and Yogo (2002) provide critical values that improve over Staiger and Stock (1997) for testing weak instruments.

We run corresponding LIML regressions for Table 2. After we include FDI, financial reform and their interaction term, which is supposed to be the correct specification in our analysis, we run IV LM redundancy test to see if we can drop some

instruments. The corresponding first stage results are reported in columns 3.1 to 3.4 in Table 3, and the corresponding second stage results are listed in columns 4.1 to 4.4 in Table 4 respectively.

The first stage results in Table 3 show that the p-values of the F-test on the joint significance of the weather instruments are below 5% in columns 3.1 and 3.2. These evidence that the weather indicators jointly have significant effects on FDI. However, the p-values of the F-test on the joint significance of the weather instruments are above 5% in columns 3.3 and 3.4. These show that the weather instruments may be weak. 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)

$$\text{Bias}\,(\beta_1^{\,2SLS})/\text{Bias}\,(\beta_1^{\,OLS}) \approx l/(nR^2)$$

where l is the number of instruments, n is sample size and R^2 is the first-stage partial R-squared of excluded instruments. According to columns 3.1 to 3.4, our nR^2 is 27, 27, 21 and 21 respectively, which is much larger than our number of instruments (6 or 7). These show that 2SLS regression is favored over OLS one. Since Stock and Yogo (2002) prove that LIML is far superior to 2SLS in the presence of weak instruments, we use LIML estimation.

The second-stage results of the IV estimation are reported in Table 4. The LIML estimation yields different results to those obtained by OLS estimation. Without the financial reform and the interaction term in the regression, the estimated coefficient on FDI is still insignificantly but becomes negative as in regression 4.1. The endogeneity test on FDI shows that we accept the null that it is exogenous at the 10% level. Weak identification test statistic is 2.81, which is larger than the Stock-Yogo 20% maximal LIML size critical value, meaning we can reject the null that the instruments are weak. The p-value of Sargan over-identification test is below 10%, meaning we reject the null that the instruments work on DI only through FDI (i.e. the instruments are invalid). In contrast, after we include financial reform in regression 4.2, the estimated coefficient on FDI is still negative but becomes significant at the 5% level, showing that FDI crowds out DI. Weak identification test statistic increases to 2.82, however, the over-identification test shows that the instruments are invalid.

In regression 4.3, we further include financial reform and its interaction with FDI. The endogeneity test on FDI shows that we reject the null that FDI is exogenous at the 1% level. The estimated coefficient on FDI remains significantly negative at the 5% level with larger magnitude (in absolute value). The estimated coefficient on financial deregulation is still positive but becomes significant at the 5% level with much larger magnitude. The estimated coefficient on the interaction term is significantly negative at the 5% 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 at the 10% level. The hypothesis that the coefficients of both financial deregulation and its interaction with FDI are zero is rejected at the 5% level. The F-test for the joint significance of FDI, financial deregulation and their interaction term shows that these variables together significantly impact domestic investment rate at the 5% level. Weak identification test statistic decreases to 1.86, which is smaller than the Stock-Yogo 20% maximal LIML size critical value, meaning we accept the null that the instruments are weak. Still, the over-identification test shows that the instruments are invalid.

Table 4: IV Regressions Between Domestic Investments

Rate and FDI (Second-Stage Results)

Second stage dependent variable: average annual domestic investment rate, ln(I/GDP)				
Second Stage Regression Number				
	4.1	4.2	4.3	4.4
Estimation Method				
Independent Variable	LIML	LIML	LIML	LIML
ln(FDI/ GDP)	-0.029	-0.06**	-0.11**	-0.09**
	(0.023)	(0.03)	(0.05)	(0.04)
F-Reform		0.016	0.10**	0.08**
		(0.010)	(0.04)	(0.03)
ln(FDI/ GDP)×F-Reform			-0.02**	-0.02*
			(0.01)	(0.01)

ln(GDP/L) t-1	0.19** (0.09)	0.12 (0.10)	0.15	0.15 (0.12)
ln(School)	0.15* (0.08)	0.10 (0.09)	0.26** (0.13)	0.24** (0.11)
ln(n+g+δ)	-0.31*** (0.09)	-0.27** (0.11)	-0.17 (0.14)	-0.18 (0.13)
ln(Fiscal)	0.25*** (0.07)	0.16* (0.10)	0.20* (0.12)	0.19* (0.11)
ln(Export)	-0.09*** (0.03)	-0.10*** (0.03)	-0.08** (0.04)	0.08** (0.03)
FDI Endogeneity				
Test P-Value	0.217	0.049	0.0045	0.0031
Test on FDI (Prob>chi)			(0.064)	(0.067)
Test on reform (Prob>chi)			(0.033)	(0.026)
Test on ln(FDI/ GDP), ln(FDI/ GDP)×F-Reform			prob. >chi =0.0225	prob>chi =0.0152
Weak Identification				
Test Value	2.81	2.82	1.86	2.22
Stock-Yogo Critical value:				
10% maximal LIML size	4.18	4.18	4.18	4.45
20% maximal LIML size	2.73	2.73	2.73	2.87
Sargan over ID Test				
P-Value	0.0637	0.0097	0.0812	0.12
Time FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
R-square (centered)	0.94	0.92	0.88	0.90
Observations	81	81	81	81

Notes: *4.1-3's Instruments: Tempdiff, Tempvar1, Tempvar2, ln(Temper), ln(Rainfall), Sunvar, ln(Sunshine). 4.4's Instruments: Tempdiff, Tempvar1, Tempvar2, ln(Rainfall), Sunvar, ln(Sunshine).*
****, **, *, significant at the 0.01, 0.05, 0.10 level respectively. (standard error in parentheses).*

The first-stage results also show that some of the instruments have no significant effects on FDI. As a result, we run the redundancy test for each of the seven instruments and find ln(Temper) has the highest p-value in redundancy test. As reported in column 3.4 of table 3, the p-value of redundancy test on ln(Temper) is 0.805, meaning this instrument is redundant and excluding it from our group of instruments does not affect our identification. With the six remaining instruments, in regression 4.4 we repeat the LIML estimation for regression 4.3. The first-stage results are in column 3.4 in Table 3. We can see that the F-test statistic on the instruments gets larger and the associated p-value is below 10%. The second stage results are in column 4.4 of Table 4, which are very similar to those in regression 4.3. Weak identification test statistic is 2.22, which is smaller than the Stock-Yogo 20% maximal LIML size critical value of 2.87, meaning we accept the null that the instruments are weak. However, in regression 4.4, the p-value of over-identification test is above 10%, meaning we accept the null that the instruments work on DI only through FDI (i.e., the instruments are valid). To get an estimate of how important FDI has been in crowing out DI, one can ask the hypothetical question of how much a one standard deviation increase in the FDI variable would decrease the domestic investment rate of a province receiving the mean level of F Reform in the sample.14 Using regression 4.3, we find that having a one standard deviation increase in FDI would have caused the province to experience an annual domestic investment rate decrease of 0.26% points during the 18-year-period, where the net effect being measured is [β 1+β 2×mean(F-Reform)] Type equation here. ln(FDI/GDP). Similarly, if provinces receiving the mean level of ln(FDI/ GDP) in the sample had a one standard deviation increase in the F-Reform variable, they would have experienced an annual domestic investment rate increase of 2.2% points.

Robustness Checks

As argued, our empirical specification follows Borensztein et al. (1998) and Wang (2008) who study how FDI impacts DI. Nonetheless, to check whether our results are affected by the inclusion of other independent variables, we repeat the regressions by including only initial real GDP per worker. According to the OLS and LIML results reported in Table 5, without controlling for the financial deregulation and its interaction with

FDI, FDI has no significant effect on DI (at the 10% level). In contrast, after controlling for financial deregulation and its interaction with FDI, the estimated coefficients on FDI and its interaction with financial reform become significant at the 10% level. The results are similar to those in regression 4.3 in Table 4. The over-identification test yields a p-value less than 10%, meaning the instruments are correlated with omitted variables such as those in equation (1). Therefore, results in regressions 4.3 and 4.4 should be put more emphasis.

Table 5: Robustness Checks

OLS and LIML second stage dependent variable: average annual domestic investment rate, ln(I/GDP)

Estimation Method				
Independent Variable	OLS	OLS	LIML	LIML
ln(FDI/GDP)	0.001	0.014	-0.029	-0.137*
	(0.016)	(0.016)	(0.034)	(0.072)
F-Reform		0.03		0.12**
		(0.02)		(0.05)
ln(FDI/GDP)×F-Reform		0.002		-0.023*
		(0.005)		(0.014)
ln(GDP/L)t-1	0.36***	0.20*	0.32***	0.21
	(0.12)	(0.11)	(0.11)	(0.14)
Weak Identification Test Value			2.29	2.01
Stock-Yogo Critical value 25% maximal LIML size			2.29	2.49
Sargan over-ID Test (P-Value)			(0.0662)	(0.0179)
Time FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
R-square (centered)	0.91 (Unadjusted)	0.94 (Unadjusted)	0.90	0.81
Observations	81	81	81	81

Notes: *Instruments: Tempdiff, Tempvar1, Tempvar2, ln(Temper), ln(Rainfall), Sunvar,*

ln(Sunshine).

****, **, *, significant at the 0.01, 0.05, 0.10 level respectively.*

(Standard error in parentheses).

Conclusion

Since technology diffusion via FDI plays an essential role in the process of economic development (e.g. Nelson and Phelps, 1966; Findlay, 1978; Borensztein *et al.* 1998), it is important to examine how inward FDI affects DI. The results are mixed in previous literature (Lipsey, 2000; Areskoug, 1976; Kim and Seo, 2003; Ang, 2009). Moreover, the results for the same period of China are also mixed (Sun, 1998; Tang *et al.* 2008; Braunstein and Epstein, 2002; Huang, 2003). We intend to contribute by considering the role of financial liberalization and its interaction with FDI using the Chinese gradual financial reform and opening-up experience. We investigated these issues in a sample that comprises FDI inflows from abroad to the Chinese provinces following the reforming and opening-up in 1978.

Instrumenting FDI with weather indicators (validity supported by over-identification tests), our LIML estimation results suggest that both FDI and its interaction with financial deregulation have a significant negative effect on DI. The nature of the interaction of FDI with financial deregulation is such that, because the direct effect of FDI is strongly negative, higher level of financial deepening strengthens the negative effect of FDI on domestic investment rates, making the overall crowding-out effect of FDI on domestic investment rates even larger. The results are robust even after controlling for other growth factors, and time and province effects. One possible explanation is as follows. FDI may have a crowding-in effect on DI through a 'linkage' (Markusen and Venables, 1999) or a 'contagion' (Findlay, 1978) effect as well as a crowding-out effect on DI by competing in labor, product and financial markets (Borensztein *et al.* 1998). Given the presence of financial repression in the Chinese economy (Lardy, 1998; Naughton, 1998), the crowding-out effect dominates (Harrison and McMillan, 2003). The Chinese financial reform is aimed at attracting more FDI via giving FDI preferential tax and administrative treatments to facilitate the diffusion of technology from abroad (Branstetter and Feenstra, 2002). This increases the crowding-out of FDI on DI more than it does the crowding-in of FDI on DI, ending up making financial reform reinforce the crowding-out effect of FDI on DI.

End Notes

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

[2] We differentiate between the inflow of FDI and outward FDI, and focus on inward FDI. There are works studying how outward FDI affects domestic investment (e.g., Desai *et al.* 2005; Hejazi and Pauly, 2003).

[3] There are also numerous micro or firm level studies on how inward FDI affects DI (e.g., Aitken and Harrison, 1999; Harrison and McMillan, 2003; Keller and Yeaple; 2003).

[4] In this paper, financial deregulation, financial reform, and financial liberalization are interchangeable.

[5] Eid (2008) shows that financial development is the leading channel via which FDI positively impacts the Egyptian growth rate.

[6] Riedel and Turley (1999), Jbili *et al.* (1997), and He (2007) study the financial reform in Vietnam, Morocco and Tunisia, and China respectively. Cummins and Rubio-Misas (2006) study the Spanish insurance services deregulation. Other examples in developed countries are USA's Granun-Leach-Bliley Act of 1999 and Japan's "Big Bang" financial deregulation in 1996.

[7] Desai *et al.* (2004) evidence that liberalization that removes capital controls increases the inflow of FDI.

[8] For instance, the leader and designer of the reform and opening-up of China is Deng, who emphasized the importance of technological adoption and imitation from leading countries in 1975 (Deng, 1975).

[9] Harrison and McMillan (2003) evidence that borrowing by foreign firms crowd out domestic 13 firms mainly via financial markets rather than product markets.

[10] For instance, the endogeneity problem of FDI arises if FDI and DI are both affected by some common but omitted variables in the process of economic development. See subsection 2.1 for details.

[11] In the presence of weak instruments, Stock and Yogo (2002) confirm that LIML is far superior to 2SLS estimation. See Murray (2006) for a survey of the literature on weak instruments.

[12] Dewatripont and Roland (1992) first study the gradual approach to reform.

[13] He (2007) shows that financial reform promotes the economic growth of China mainly through more efficiently allocating capital among sectors rather than increasing the volume of capital (i.e., investment). He and Sun (2009) find that not only financial reform and inward FDI, but also their interaction promotes the economic growth of China for the period 1978-1998.

[14] In this paper we centered the data of FDI and financial reform to avoid multicollinearity problem. Therefore, the mean value of ln(FDI/ GDP) and that of F-Reform are zeroes. The standard deviation of ln(FDI/GDP) is 2.40, and that of F-Reform is 2.24.

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