An Assessment of the Contribution of FDI to China's Economic Development and Productivity Growth

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Abstract We estimate the contribution of FDI to the efficiency and productivity growth in a cross-region regression framework, utilising China's provincial data from 1984 to 1997. We found a bidirectional causal linkage between FDI and productivity growth across the regions in China, suggesting that changes in FDI intensity Granger-cause changes in productivity, and vice versa. This finding helps to explain the geographical concentration of FDI in China's coastal areas. Our results show that China's economic growth is largely due to the rapid expansion of investment in fixed assets and human capital development. FDI has certain effects on labor productivity but not so strong and significant. It implies that the contribution of FDI to China's technological progress through technology transfer is still not noticeable, and many regions in China still experience inefficiency. This has important implications for China in order to sustain China's growth in the long run.

1. INTRODUCTION

In the past two decades, China has experienced a drastic growth with a growth rate of 9.8 percent per annum. Equally remarkable, China has been very successful in attracting foreign capital, emerged as the second largest recipient of foreign direct investment (FDI) worldwide since 1993. The inflow of FDI has been pivotal to China's economic development and industrialization, as FDI not only expands the volume of production with capital accumulation and trade expansion but also improves the efficiency of production through technology transfer. Then, it is interesting to ask how important the contribution of FDI to China's total factor productivity growth (TFP) is. This issue is critical to Krugman's (1994) argument that Asia's growth would reach its limit since its growth relies on the increase in inputs, not on TFP.

The purpose of this paper is to estimate the contribution of FDI to the efficiency and productivity growth across the regions in China. We intend to use China's provincial data from 1984 to 1997 in this study. We first identify the causal linkage between FDI and productivity growth by using some recent econometric techniques designed to evaluate the existence and the direction of causality. Then, we examine the possibility of China's sustainable growth by using a model which incorporates domestic physical capital, labour, human capital and FDI in the production function. This will be able to measure the technological progress and the rate of technology transfer through FDI, since FDI brings technological progress, while domestic investment does not (Hymer, 1960). It has important implications for China when forming its development strategy and industrial policy toward FDI.

2. RAPID EXPANSION OF FDI IN CHINA

China started its efforts to attract foreign investment in 1979. The period from 1979 to 1983 was more or less a period of learning and experimentation with foreign investment, with realized and contracted FDI amounting to approximately US$2.68 billion and US$7.45 billion, respectively. FDI flows into China grew quickly since 1984. By October 1998, the total realized FDI amounted to US$257.8 billion and the contracted FDI US$560.57 billion, increasing at an average annual rate of about 39 percent and 50 percent, respectively. The total number of projects approved amounted to 321,034, of which 145,000 were operative.[1]

The major source countries/areas of FDI in China was other Asian countries and economies, notably Hong Kong, Japan, and Taiwan, which

[1] See *China Daily*, Beijing, November 5, 1998

accounted for about 58 percent, 8.1 percent, and 7.9 percent, respectively, over the period from 1979 through 1996. The United States ranked next to Japan. FDI breakdown in terms of geographical location shows that the bulk went to the coastal provinces and municipalities (Beijing, Shanghai, and Tianjin), accounting for 88 percent in 1984-1996 (see Table 1). The inland areas accounted for only slightly over 10 percent of total FDI, with a high concentration in some resource-rich provinces such as Shaanxi. The latter alone made up over 3 percent of the total FDI during this period (Zhang, 1999). There is no mystery about this geographical distribution since, besides the preferential investment policies, the coastal provinces and major metropolitan cities offer many advantages in terms of infrastructure and labour force quality. These are areas economically better developed than other regions, with the best commercial and industrial infrastructure facilities.

Table 1: Geographical Pattern of FDI (Contracted) in China (in millions of U.S. dollars)

	1984	1988	1992	1996
Region	2712	5064	57874	73276
Metropolitan[1] (%)	655 (24)	586 (12)	5556 (10)	15771 (22)
Coastal[2] (%)	1894 (70)	4033 (80)	44987 (62)	47940 (65)
Near Inland[3] (%)	90 (3)	291 (6)	4930 (8)	6140 (8)
Far Inland[4] (%)	73 (3)	167 (3)	2502 (4)	2714 (4)

Note: [1] The Metropolitan areas include Beijing, Shanghai and Tianjin; [2] The coastal provinces are Guangdong, Jiangsu, Liaoning, Fujian, Zhejiang, Shandong, Hebei, and Hainan; [3] Near Inland areas include Henan, Hubei, Anhui, Hunan, Jiangxi, Guangxi, Jilin, and Shanxi; [4] Far Inland areas include Shaanxi, Sichuan, Heilongjiang, Guizhou, Ningxia, Xinjiang, Yunnan, Gansu, Inner Mongolia, and Qinghai. *Source*: Almanac of China's Foreign Economic Relations and Trade, various issues.

FDI played an increasingly important role in China's economic development in the last eighteen years. It is evidenced from Table 2 that FDI contributed significantly to China's employment, export expansion, and total fixed capital investment since the mid-1980s. The contribution of foreign investment to capital formation and export expansion is more noticeable in the coastal provinces, given the uneven geographical distribution of FDI in China. For instance, FDI in Guangdong Province accounted for about 16 percent of its total fixed capital formation before 1992, and 23 percent in 1996. In Jiangsu and Fujian Provinces, foreign invested enterprises took a share of 20 to 45 percent in their total exports in the 1990s.

Table 2: Contribution of FDI Firms to China's Employment, Exports and Total Investment on Fixed Assets (TIFA) (in percentage)

Year	Employment	Exports	TIFA	GD's exports
1984	--	--	1.52	--
1985	0.05	1.17	2.09	--
1986	0.10	1.55	2.32	9.1
1987	0.15	2.54	2.36	11.2
1988	0.22	3.68	2.64	16.1
1989	0.33	6.83	3.05	27.9
1990	0.45	13.50	3.74	35.3
1991	1.08	16.77	4.20	38.9
1992	1.41	20.42	7.64	44.2
1993	1.80	27.51	12.71	38.3
1994	2.41	28.68	18.27	39.9
1995	2.69	31.51	16.11	44.3
1996	2.73	40.72	15.12	51.1

Sources: Statistical Yearbook of China, and *Statistical Yearbook of Guangdong*, various years.

On the other hand, in terms of Gross Output Value of Industry (GOVI), foreign invested enterprises produced 15.6 billion yuan in 1988. This figure rose rapidly to 346 billion yuan in 1993, 1,097 billion yuan by 1995, and 1,211.7 billion yuan by 1996. As a result, the share of foreign invested enterprises in the national GOVI increased from less than one percent in 1988 to over 10 percent in 1993, and 12.2 percent in 1996, while the share of state-owned enterprises declined during this period. Most notably, foreign invested enterprises produced more than half of Guangdong's GOVI in 1995 and 1996. Undoubtedly FDI has become one of the most important driving forces for China's national and regional economic development.

In terms of employment, foreign investment enterprises employed about 38,000 Chinese staff and workers in 1984. By 1997, nearly 18 million of people were directly employed by foreign invested enterprises, accounting for 10 percent of all urban employment (China Daily, November 5, 1998). In Guangdong Province, over 1.3 million people, or about 12 percent of its total industrial labor force were employed by FDI activities by the end of 1996.[2] FDI activities unquestionably contributed to the overall increase in incomes, but also to the disparity in income across regions. In addition, foreign investments are believed to be an effective means to ensure more dynamic and appropriate technology transfers, gain access to international markets, and improve the efficiency of local enterprises through spill-over effects and direct competition in the domestic market.

3. ESTIMATION OF TECHNOLOGICAL PROGRESS

The standard model of economic growth seeks to explain the long term trend in the potential output of an economy by breaking it down into (a) a part that can be explained by the growth in production inputs, and (b) another part that can be explained by improvements in efficiency (Kendrick, 1961; and Solow, 1957). In relating to East Asian economic growth, Krugman (1994), based on Young (1994), argues that Asia's growth could be fully explained by the growth in inputs rather than by TFP growth or technological progress. This type of growth easily reaches its limit when it is not possible to further expand labor force and capital. Their findings are very different from that of the World Bank (1993). The latter finds that human capital accumulation is an important factor for output growth, especially in developing countries, and East Asia's high growth is led by the high growth rate of TFP.

A few studies so far have investigated the contribution of FDI to TFP and efficiency change. Hymer (1960) notes that FDI brings a package of capital, management and new technology to the host economy. Findley (1978) postulates that FDI increases the rate of technological progress through a "contagion" effect from the more advanced technology and management skills of foreign firms. Borenzstein et al (1995) test the effect of FDI on economic growth using an endogenous growth model. The results show that FDI is an important vehicle for transferring technology, and has a crowding-in effect to domestic investment. They also find that FDI has positive effects on economic growth only when the level of education is higher than a given threshold.

3.1 Causal Relationship between FDI and Economic Growth

In this section we intend to test for causality in the relationships between FDI and productivity growth. To test for causality between two variables, X_t and Y_t, we follow the classical procedures of Granger (1969, 1986) and Engle and Granger (1987). The methodology differs whether the variables are cointegrated or not. If X_t and Y_t are not cointegrated, then the standard Granger-causality test is used to examine the causal relationships between them. This test is based on the estimation of the following equations (if individually I(1) processes):

$$\Delta X_t = \kappa_0 + \sum_{i=1}^{m} \delta_i \Delta X_{t-i} + \sum_{j=1}^{n} \rho_j \Delta Y_{t-j} + \nu_{1t} \quad (1)$$

$$\Delta Y_t = \eta_0 + \sum_{i=1}^{p} \phi_i \Delta Y_{t-i} + \sum_{j=1}^{q} \psi_j \Delta X_{t-j} + \nu_{2t} \quad (2)$$

where (ν_{1t}, ν_{2t}) is a serially independent random vector with zero mean and finite covariance matrix. To ascertain the presence of unidirectional, bidirectional or no causal relationships between variables of interest, we can test the joint significance of coefficients of the causal variables in each equation by means of a classical F-test. However, if the two time series appear to be cointegrated, causality has to be investigated within the framework of an error correction model (ECM). Since we use cross-section panel data in this study, tests of unit root and cointegration do not have to be necessarily conducted.

Results

We use annual data collected from China□s twenty

[2] The Statistical Yearbook of Guangdong Province, 1997.

nine regions covering the period from 1984 to 1997, which have been carefully pooled. The major sources of data are the Statistical Yearbook of China, and China Industrial Statistics Yearbook We use value added per employee as the proxy for labor productivity. Realized FDI in each region has been collected and divided by total employment in that specific region. The results of the Granger-causality procedure are reported in Table 3.

Table 3: Results of the Bivariate Granger-Causality Tests for FDI and Productivity Growth

Dependent Variable	Causal variable	Coefficients	Statistics for causality test
PG[1]	PG L1[2]	1.26 (0.08)*	F(2, 235)
	L2	-0.42 (0.08)*	=17.8*[3]
	L3	-0.01 (0.01)	
	FDI L1	3.69 (0.86)*	$R^2 = 0.83$
	L2	-1.28 (1.02)	
FDI	PG L1	0.03 (0.01)*	F(3, 235)
	L2	-0.02 (0.007)*	=5.9*
	L3	0.0001 (0.001)	
	l	0.29 (0.07)*	$R^2 = 0.56$
	L2	0.08 (0.08)	

Note: [1] PG stands for productivity growth; [2] L_i indicates the lagged terms which is determined by Akaike's FPE criterion; and [3] The F-statistics is calculated by using: F= $\{SSR_r - SSR_u)/m\}/\{SSR_u/(T-k)\}$ when we estimate first unrestricted model and then restricted model. The standard errors are in the parentheses. * indicates significant at the 1% significance level.

It is shown that both equations generate a F-statistic value which exceeds the critical value at the 1% significance level. We have found a bidirectional causal relationship between FDI and labor productivity across the regions in China. Our results suggest that changes in FDI intensity Granger-cause changes in productivity and vice versa, changes in local productivity Granger-cause changes in FDI. This finding is in line with our casual observation that MNEs locate their operations not necessarily in a place where labor has low normal wage rate but in a place where labor productivity is higher. It also has implication to the geographical concentration of FDI in China□s coastal areas.

3.2 Contribution of FDI to TFP and Efficiency Change

We treat FDI as a factor of production in addition to capital, labor and human capital. The production function to be estimated in this study is assumed to be of a Cobb-Douglas function:

$$Y_{it} = AK^{\alpha}L^{\beta}H^{\delta}F^{\gamma} \qquad (3)$$

where α, β, δ, and γ denote the elasticity of domestic physical capital, labor, human capital and FDI. Y, A, K, L, H, and F denote output of the economy, the level of technology (also TFP), physical capital, labor, human capital and FDI. We impose the following restriction under the assumption of constant return to scale:

$$\alpha + \beta + \delta + \gamma = 1 \qquad (4)$$

The growth of output per head can be expressed:

$$(y - l) = a + \alpha(k - l) + \delta(h - l) + \gamma(f - l) + \mu_{it} \qquad (5)$$

where lowercase letters indicate rates of change of the variables concerned. Note that β is erased by equation (4). TFP change can be then found as the residual of growth of output per worker after deducting the contributions of human capital, physical capital and FDI, which is expressed as follows:

$$a = (y - l) - \alpha(k - l) - \delta(h - l) - \gamma(f - l) + \mu_{it} \qquad (6)$$

Note that equation (6) is an extension of the conventional model for TFP. Equation (6) is used for estimation in this study.

Empirical Results

In addition to our earlier discussion of data sources, we use total investment on fixed assets as a proxy for physical capital, total employment for labor input, and secondary school enrollment rate for human capital. Due to a lack of FDI data in Tibet, we can only include twenty-eight regions in this study.

Table 4: Economic Growth with Panel Data Regression

Independent Variables	Coefficient

Physical Capital Human Capital FDI	0.554 (0.028)* 0.452 (0.027)* 0.0001 (0.002)
$R^2 = 0.968$; SER = 0.119 F = 269; N = 271	

As seen from Table 4, all estimated coefficients of production factors are positive and significant at 1% significance level except the FDI term. It is found that about 97 percent of China's growth in value added can be explained by the rapid expansions of investment on fixed assets, human capital and FDI inflows. Increases in physical capital, as expected, have a strong and significant impact on economic growth. Over half percent of China's growth is actually due to increase in physical capital. The most recent example is that, to reach its target growth rate of 8 percent, China invested 180 billion yuan in fixed assets in 1998.

Education level has become an increasingly important factor to account for China's growth. This finding lends support to the recent endeavour of the government in improving the whole nation's education level, and is in line with the observation: the higher labor quality, the higher the labor productivity.

As discussed earlier, FDI contributes to the host economy not only physical capital, but also technology, management know-how and international marketing network. It is therefore expected that FDI affects economic growth positively and significantly. The coefficient of FDI represents essentially the rate of technological progress realized by technology transfer via FDI. Our result shows that FDI has certain effects on labor productivity but not so strong and significant. One tentative explanation is that the kinds of FDI China attracted involve less technology transfer and are labor-intentive in nature with low value added, aiming at China's cheap resources. A significant portion of FDI in China was actually injected into resource-extracting and processing industries, which are labor-seeking, and real-estate development and service-related industries (see Zhang, 1999). On the other hand, the contribution of foreign investment to China's total capital formation became more noticeable only since 1993 when a share of about 12 percent of the total investment in fixed assets was accounted by FDI. This contribution is still quite small in the near inland and far inland areas. This finding implies that China has experienced some technological progress through technology transfer via FDI, but it is still far from the desired level.

Table 5: Growth of TFP in 1984-1997

Regions	TFP	Regions	TFP
Coastal and Metropolitan		Anhui	0.0162
		Jiangxi	-0.0181
Beijing	0.0313	Jilin	0.0871
Fujian	0.031	Shanxi	0.0706
Guangdong	0.0559	Guangxi	0.0433
Jiangsu	0.0912		
Shandong	0.0604	*Far Inland*	
Shanghai	0.0093		
Tianjin	0.0471	Ningxia	0.0722
Zhejiang	0.0627	Qinghai	0.0516
Liaoning	0.0219	Shaanxi	0.0824
Hebei	0.059	Gansu	0.004
		Guizhou	0.0471
Near Inland		Heilongjiang	0.0854
		Inner Mongolia	0.0488
Henan	0.0837	Sichuan	0.0764
Hubei	0.0537	Xinjiang	0.0684
Hunan	0.0334	Yunnan	0.0707

Table 5 presents the growth rate of TFP. It is noted that our estimation obtains positive TFP growth in all regions except Jiangxi. In particular, the coastal areas experienced a rapid increase in TFP during the period from 1984 to 1997, with the only exception of Shanghai, and the far inland areas show an even stronger TFP growth. It is generally observed that the rate of technological progress can be expressed in term of the growth rate of TFP and the coefficients of FDI. We then re-estimate the economic growth function including FDI term for Shanghai and some selected regions. It is found that all the three coefficients of physical capital, human capital and FDI are positive and significant at least at 10 percent critical level for the cases of Shanghai, Fujian, Guangdong, Shandong, Tianjin, Sichuan, and Zhejiang. The estimate of FDI is either negative or not significant for Yunan, Ningxia, Jiangxi, Shaanxi, and Hubei. This implies that inefficiency and technology transfer via FDI are still the major concern for China's technological progress.

4. Conclusion

The purpose of this paper is to examine the contribution of FDI to the efficiency and productivity growth across the regions in China. Using an annual data set collected from China's twenty-nine provinces during 1984-1997, we found the bidirectional causal linkage between FDI and productivity growth across the regions in China. Our results suggest that changes in FDI intensity Granger-cause changes in productivity, and vice versa, changes in local productivity Granger-cause changes in FDI. This finding helps to explain the geographical concentration of FDI in China's coastal areas.

Our empirical results show that China's economic growth is largely due to the rapid expansion of investment in fixed assets. Human capital development becomes increasingly important to the labor productivity growth, and so does FDI. However, the insignificant estimate of FDI indicates that its contribution to China's technological progress through technology transfer is still not noticeable. Moreover, the low TFP growth implies that many regions in China still experience inefficiency. This has raised the concern over the issue of how to improve economic efficiency and technology transfer in order to sustain China's growth in the long run. It also concerns what kinds of development strategy and industrial policy toward FDI that China is to form.

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