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PRODUCTIVITY AND ECONOMIC GROWTH: AN EMPIRICAL ASSESSMENT OF THE CONTRIBUTION OF FDI TO THE CHINESE ECONOMY

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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 find 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. China's economic growth is found largely due to the rapid expansion of investment in fixed assets. Human capital development becomes increasingly important to the labour productivity growth, and FDI has certain effects on labour productivity but not so strong and significant. Thus, 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 raised the concern over the issue of how to improve economic efficiency and technology transfer in order to sustain China's rapid growth in the long run. It also concerns what kinds of development strategy and industrial policy toward FDI that China is to form.

Keywords: China, Growth, Productivity, FDI, Human Capital
JEL classification: F23, O47, O53

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 from practically null to the second largest recipient of

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foreign direct investment (FDI) worldwide since 1993.[1] Needless to say, 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 (see, for example, Hymer (1960), Findley (1978), and Borenzstein *et al*. (1995)). But it remains an interesting question on 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 increases 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 panel data sets over the period from 1984 to 1997 in this study. China's open-door policy was initiated in the late 1970s, but large FDI inflow did not occur until 1984. We first review briefly FDI patterns and its impact on China's economic development. Then, we intend to 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. Further, 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. We use in this study the percentage changes in all variables in a fixed-effect model to prevent possible dominance of large regions and the heteroscedastic problem.[2] 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. The final section concludes.

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 (see Figure 1).

[1] See Zhang (1999) for a detailed review of FDI in China.

[2] In a cross-sectional analysis, heteroscedasticity is generally expected if the size of the sample varies substantially. Data transformation would be one way to prevent it (Gujarati (1995)). Lin (1992) normalizes the output and other input variables by the number of teams in each province to prevent the heteroscedastic problem and uses a fixed-effect model to study China's agricultural growth during the reform era.

FDI flows into China grew rapidly from 1984 through 1997, increasing at an average annual rate of about 39 percent for realized FDI and 50 percent for contracted FDI. By October 1998, the total realized FDI amounted to US$ 257.78 billion, and the contracted FDI reached US$560.57 billion. The total number of projects approved amounted to 321,034, of which 145,000 were operative (see China Daily, Beijing, November 5, 1998). The growth cycle of FDI in China reflects the confidence build-up process of both foreign investors and the Chinese Government.

FDI in China is characterized by its sources and geographical distribution. Most foreign investment came from other Asian countries and economies, notably Hong Kong, Japan, and Taiwan, which 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. Another notable characteristic is its geographical concentration. During 1984-1996, the bulk of FDI went to the coastal provinces and municipalities (Beijing, Shanghai, and Tianjin), accounting for 88 percent of the total inflows (see Table 1). The inland areas accounted for only slightly over 10 percent of the total, with a concentration of foreign capital in some resource-oriented provinces such as Shaanxi, which alone made up over 3 percent of the total FDI during this period (Zhang (1999)). There is no mystery about this geographical pattern of FDI flows in China. Besides the preferential investment policies, the coastal provinces and major metropolitan cities offered 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	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Region Sum[1)]	2147	2712.4	5886	5064.0	48125	57874	24556	73276
Metropolitan[2)]	144	655.24	461	586.05	5908	5556	4047	15771
(%)	(6.7)[6)]	(24)	(7.83)	(11.6)	(12.3)	(9.6)	(16.5)	(21.5)
Coastal[3)]	1777	1893.8	4926	4032.5	32580	44987	15510	47940
(%)	(83)	(69.8)	(83.7)	(79.6)	(67.7)	(61.7)	(63.2)	(65.4)
Near Inland[4)]	163	90.08	350	290.94	6582	4930	3037	6140
(%)	(7.6)	(3.32)	(5.95)	(5.75)	(13.7)	(8.3)	(12.4)	(8.4)
Far Inland[5)]	63	73.21	148	167.48	3055	2502	1886	2714
(%)	(2.9)	(2.7)	(2.51)	(3.31)	(6.3)	(4.3)	(7.7)	(3.7)

Notes: [1)] The differences between the total (contracted) FDI and the region sum indicate investment in other sectors that include MOFTEC, MOF, CNOOC, CITIC, and other. [2)] The Metropolitan areas include Beijing, Shanghai and Tianjin; [3)] The coastal provinces are Guangdong, Jiangsu, Liaoning, Fujian, Zhejiang, Shandong, Hebei, and Hainan; [4)] Near Inland areas include Henan, Hubei, Anhui, Hunan, Jiangxi, Guangxi, Jilin, and Shanxi; [5)] Far Inland areas include Shaanxi, Sichuan, Heilongjiang, Guizhou, Ningxia, Xinjiang, Yunnan, Gansu, Inner Mongolia, and Qinghai; [6)] Percentage in the total.

Source: Almanac of China's Foreign Economic Relations and Trade, various issues.

FDI has been playing increasingly an important role in China' s economic development in the last two decades. 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 investment 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 (in percentage)

Year	Share in China' s total urban employment	Share in China' s total exports	Share in China' s total trade	Share in Guangdong' s total exports	Share in China' s total investment on fixed assets
1983	-	-	-	-	0.87
1984	-	-	-	-	1.52
1985	0.05	1.17	-	-	2.09
1986	0.10	1.55	-	9.1	2.32
1987	0.15	2.54	5.61	11.2	2.36
1988	0.22	3.68	8.11	16.1	2.64
1989	0.33	6.83	12.46	27.9	3.05
1990	0.45	13.50	17.42	35.3	3.74
1991	1.08	16.77	21.35	38.9	4.20
1992	1.41	20.42	26.44	44.2	7.64
1993	1.80	27.51	34.27	38.3	12.71
1994	2.41	28.68	37.03	39.9	18.27
1995	2.69	31.51	39.09	44.3	16.11
1996	2.73	40.72	47.30	51.1	15.12

Sources: SSB: *Statistical Yearbook of China*, various years; Guangdong Statistical Bureau, *Statistical Yearbook of Guangdong*, various years.

On the other hand, in terms of Gross Output Value of Industry (GOVI), foreign investment 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 investment enterprises in the national GOVI increased from less than one percent in 1988 to 11.1 percent in 1993, and 16.7 percent in 1996, while the share of state-owned enterprises declined during this period from about 50 percent in 1993 to 36.3 percent in 1996.[3] Most notably, foreign investment enterprises produced more than half of Guangdong's GOVI in 1995 and 1996. It is apparent that 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 investment 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 labour force were employed by FDI activities by the end of 1996.[4] FDI activities unquestionably contributed to the overall increases in incomes, but also to the disparity in income across the regions. In addition, foreign investments were considered 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 relation to East Asian economic growth, Krugman (1994), based on Young (1995), argues that East 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 labour force and capital. Their findings are very different from that of the World Bank (1993). The latter incorporates an average school enrolment rate to represent human capital into the Cobb-Douglas production function, and 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) also 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) tests the

[3] By 1999, the share of foreign investment enterprises in national GOVI has increased to 18.2 percent, but the share of the state-owned enterprises declined to 28.2 percent. See China Statistical Yearbook, 2000.

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

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.

A. Causal Relationship between FDI and Economic Growth

In this section we intend to test for causality in the relationships between FDI and productivity growth. Testing for causality between variables in the Granger sense of the world implies the specification of the dynamic relationship which links them.

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 dynamic relationships between the variables (if individually I(1) processes):

$$\Delta X_t = k_0 + \sum_{i=1}^{m} d_i \Delta X_{t-i} + \sum_{j=1}^{n} r_j \Delta Y_{t-j} + n_{1t}, \qquad (1)$$

$$\Delta Y_t = h_0 + \sum_{i=1}^{p} f_i \Delta Y_{t-i} + \sum_{j=1}^{q} y_j \Delta X_{t-j} + n_{2t}, \qquad (2)$$

where (v_{1t}, v_{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) which incorporates the information provided by cointegrating relationships into causality analysis that usually focuses on short-term dynamics. 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-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, various issues, and China Industrial Statistics Yearbook, various issues. We use value added per employee as the proxy for labour 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
Productivity Growth	Productivity Growth L1[1)]	1.256 (0.087)*	$F(2, 235) = 17.82^{*2)}$
	L2	-0.4221 (0.084)*	$R^2 = 0.834$
	L3	-0.0058 (0.012)	
	FDI L1	3.691 (0.857)*	
	L2	-1.284 (1.017)	
FDI	Productivity Growth L1	0.0294 (0.007)*	$F(3, 235) = 5.86^{*1)}$
	L2	-0.0211 (0.007)*	$R^2 = 0.559$
	L3	0.00007 (0.001)	
	FDI L1	0.289 (0.073)*	
	L2	0.0843 (0.086)	

Notes: [1)] Li (i = 1,2,3) indicates the lagged term which is determined by Akaike's FPE criterion. [2)] The F-statistics is calculated by using: $F = \{SSR_r - SSR_u\}/m\}/\{SSR_r/(T-k)\}$ when we estimate first unrestricted model and then restricted model. The standard errors are in the parentheses. [3)] * (**, ***) indicates significant at the 1% (5%, 10%) significance level.

It is shown that both equations generate a F-statistics value which exceeds the critical value at the 1% significance level. We have found a bidirectional causal relationship between FDI and labour productivity across the regions in China. Our results suggest that changes in FDI intensity Granger-cause changes in productivity and vice versa, changes in labour 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 labour has low nominal wage rate but in a place where labour productivity is higher. This also has implication to the geographical concentration of FDI in China's coastal areas.

B. Contribution of FDI to TFP and Efficiency Change

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

$$Y_{it} = AK^{a}L^{b}H^{d}F^{g}, \tag{3}$$

where a , b , d , and g denote the elasticity of domestic physical capital, labour, human capital and FDI. *Y*, *A*, *K*, *L*, *H*, and *F* denote output of the economy, the level of technology (also TFP), physical capital, labour, human capital and FDI, respectively. We impose the following restriction under the assumption of constant return to scale:

$$a + b + d + g = 1 . \quad (4)$$

The growth of output per head can be expressed as follows:

$$(y - l) = a + a\,(k - l) + d\,(h - l) + g\,(f - l) + m_{it} , \quad (5)$$

where lowercase letters indicate rates of change of the variables concerned. Note that b 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:

$$a = (y - l) - a\,(k - l) - d\,(h - l) - g\,(f - l) + m_{it} . \quad (6)$$

Note that Equation (6) is an extension of the conventional model for TFP. For the latter, FDI is not a factor of production for consideration. 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 labour input, and secondary school enrolment rate for human capital. We also include a dummy variable in our model estimation with a value of one for 1989 and zero for the rest. Due to a lack of FDI data in Tibet, we can only include twenty-eight regions in this study.

The results are reported in Table 4. As seen from Table 4, all estimated coefficients of production factors are positive and significant at 1% significance level except the FDI variable. The dummy variable is not significant. 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. As a matter of fact, 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.

Table 4. Contribution to Growth with Panel Data Regressions

Independent Variables	Coefficient
Physical Capital	0.554 (0.028)*
Human Capital	0.452 (0.027)*
FDI	0.0001 (0.002)
$R^2 = 0.968$	
SER = 0.119	
F = 269	
No. of observation = 271	

Notes: * (**, ***) indicates significant at the 1% (5%, 10%) significance level. The standard errors are in the parentheses.

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 labour quality, the higher the labour 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 labour productivity but not so strong and significant. One tentative explanation is that the kinds of FDI China attracted involve less technology transfer and are labour-intensive 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, real-estate development and service-related industries. 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 indicates that China has experienced some technological progress through technology transfer via FDI, but it is still far lower than the desired level.

Table 5 presents the growth rate of TFP in each region. It is noted that our estimation obtains positive TFP growth in all regions except Jiangxi. In particular, the coastal areas experienced a relatively fast increase in TFP during the period from 1984 to 1997, with the only exception of Shanghai. 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 and report in Table 6 the results for some selected regions. It is noted that the model has a much higher explanation power for the coastal and metropolitan areas than for the rest of

China. All the estimates are well determined at least at the 10 percent significant level in the coastal and metropolitan areas with the exception of a few regions. From the evidence presented in Table 6, one can conclude that the rapid inflow of FDI had a positive and significant effect on the economic growth of the regions where human capital had been significantly developed, such as Beijing, Fujian, Guangdong, Shandong, Tianjin, and Hebei. Those regions with poor and insignificant human capital lack the absorption ability of new knowledge and technology, resulted in low technology diffusion and transfer. This is evidenced from the negative and/or statistically insignificant estimates of FDI for the inland and far inland regions. These regions' economic growth relies significantly on the increases in physical capital investment, a large portion of that was injected through the government fiscal allocation of resources. This implies that inefficiency and technology transfer via FDI are still the major concern for China's technological progress. It also has important implications for China's education policy in those less developed regions.

Table 5. TFP Growth in Regions in 1984-1997

Regions	TFP	Regions	TFP
Coastal and Metropolitan Areas		Shanxi	0.0706
		Guangxi	0.0433
Beijing	0.0313		
Fujian	0.0310	*Far Inland*	
Guangdong	0.0559		
Jiangsu	0.0912	Ningxia	0.0632
Shandong	0.0604	Qinghai	0.0516
Shanghai	0.0093	Shaanxi	0.0742
Tianjin	0.0471	Gansu	0.0040
Zhejiang	0.0627	Guizhou	0.0471
Liaoning	0.0219	Heilongjiang	0.0732
Hebei	0.0590	Inner Mongolia	0.0488
		Sichuan	0.0764
Near Inland		Xinjiang	0.0684
		Yunnan	0.0643
Henan	0.0337		
Hubei	0.0537		
Hunan	0.0334		
Anhui	0.0162		
Jiangxi	-0.0181		
Jilin	0.0871		

Table 6. Contribution to Economic Growth in Selected Regions, 1984-1997

Regions	Physical Capital	Human Capital	FDI	R^2 -adjusted
Coastal and Metropolitan Areas				
Beijing	0.561 (0.149)*	0.591 (0.143)*	0.126 (0.068)**	0.777
Fujian	0.613 (0.110)*	0.413 (0.116)*	0.065 (0.038)***	0.973
Guangdong	0.368 (0.264)***	0.522 (0.116)*	0.125 (0.075)***	0.975
Jiangsu	1.165 (0.296)*	0.148 (0.164)	-0.327 (0.295)	0.741
Shandong	0.578 (0.160)*	0.413 (0.151)*	0.016 (0.011)***	0.993
Shanghai	0.605 (0.105)*	0.542 (0.093)*	0.083 (0.101)	0.889
Tianjin	0.526 (0.135)*	0.818 (0.245)*	0.387 (0.220)***	0.883
Zhejiang	0.902 (0.202)*	0.022 (0.135)	0.015 (0.076)	0.780
Liaoning	0.862 (0.127)*	0.105 (0.190)	-0.200 (0.189)	0.841
Hebei	0.699 (0.208)*	-0.107 (0.141)	0.329 (0.194)***	0.860
Selected Inland and Far Inland Regions				
Henan	1.069 (0.337)*	-0.012 (0.250)	-0.172 (0.374)	0.767
Hubei	1.002 (0.248)*	-0.202 (0.172)	-0.210 (0.248)	0.680
Jilin	0.744 (0.164)*	0.410 (0.182)**	-0.036 (0.184)	0.695
Jiangxi	0.953 (0.336)*	0.266 (0.238)	-0.191 (0.326)	0.487
Ningxia	0.235 (0.418)	-0.436 (0.558)	0.302 (0.350)	0.656
Shaanxi	0.704 (0.218)*	-0.332 (0.266)	-0.075 (0.262)	0.603
Sichuan	0.984 (0.356)**	0.185 (0.102)***	-0.061 (0.488)	0.575
Yunnan	0.654 (0.375)***	-0.141 (0.320)*	-0.042 (0.313)	0.355

Notes: * (**, ***) indicates significant at the 1% (5%, 10%) significance level. The standard errors are in the parentheses.

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 covering 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 labour 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 physical investment in fixed assets, especially in the regions where human capital is not significantly developed such as the inland and far inland areas. Human capital development becomes increasingly important to the labour productivity growth. FDI has certain effects on labour 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. On the other hand, the low TFP growth implies that many regions in China still experience inefficiency. This has raised the concerns 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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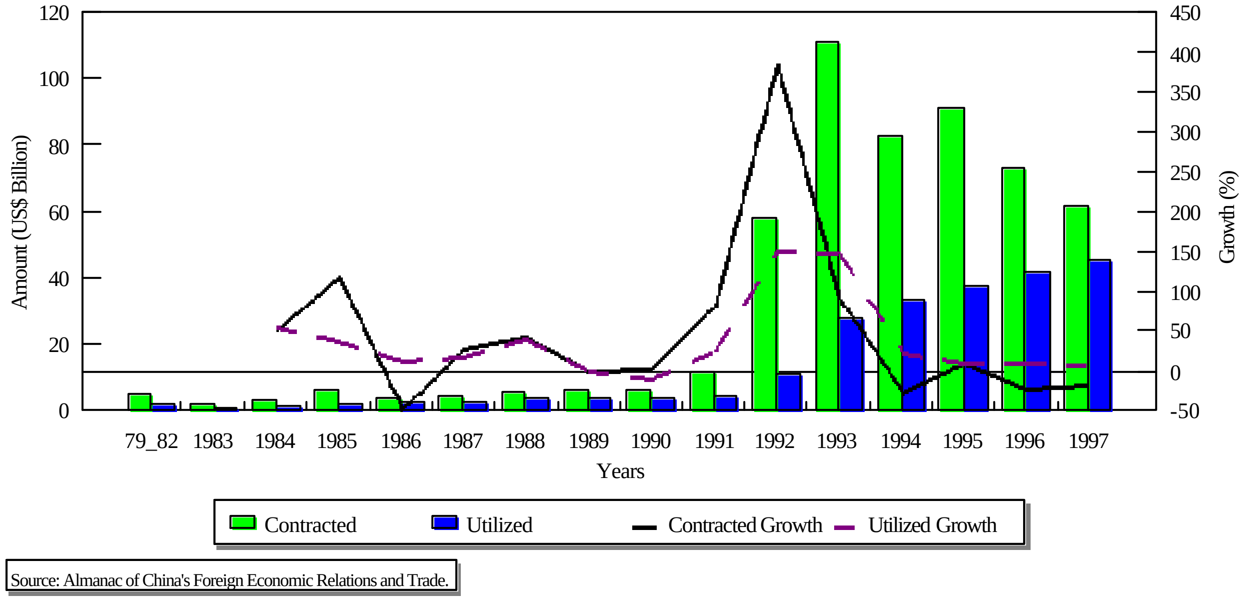

Figure 1. Trends of FDI Flows in China