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FDI, regional differences and economic growth: panel data evidence from China

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This article investigates for China the proposition that economic and technological conditions in a host country modify the relationship of inward foreign direct investment (FDI) with growth. Data are employed for China as a whole, and for 29 provinces in sub-samples, for 1989-1999. We find that host country conditions impact strongly on the growth relationship at both the national and the provincial levels. Our results demonstrate that FDI favours growth in the economically stronger provinces, and that the full benefits of FDI are realized when competition (of both foreign and local origin) in local markets is at its strongest. From our results it is clear that policies need to be crafted at the provincial level to maximize the growth benefits of FDI. Market reform emerges as a very successful general policy that increases growth in a wide range of circumstances and which, our results suggest, is bolstered in its effects by FDI in the more developed provinces.

Introduction

Development economists have long argued that countries pursuing externally oriented development strategies are more likely to achieve higher rates of economic growth than those that are internally focused. A number of studies have examined the relationship between inward FDI and economic growth in the

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developing host countries.[1] A generally accepted conclusion is that FDI has played a significant role in promoting economic growth in host countries because FDI represents "the transmission to the host country of a package of capital, managerial skills, and technical skills" (Johnson, 1972, p. 2). An interesting finding of previous studies is that the economic and technological conditions of a recipient economy influence the extent to which FDI contributes to growth.

FDI in China is one of the most palpable outcomes of China's Open Door Policy, which was adopted in December 1978. Already in 1993, China held a position second only to the United States as the largest host country for FDI (UNCTAD, 1994). By the end of 1998, China had attracted $267 billion worth of FDI, and had approved 324,712 foreign-invested projects (*Almanac of China's Economy*, 1999, p. 81).

The geographical distribution of FDI in China is characterized by its concentration in the eastern coastal area. As shown in table 1, between 1989-1998 the eastern region has attracted most FDI. The central and western regions attracted only 9 per cent and 3 per cent of the total FDI inflows, respectively. In terms of per capita FDI, the central and western regions achieved only $8.63 and $1.67, respectively, far behind the level of the eastern region's $45.98 and the national average of $21.19.

Considerable qualitative evidence on the positive effects of inward FDI on the Chinese economy has been found in recent years (Kueh, 1992; Lardy, 1995; Henley et al., 1999). Shang-Jin Wei (1995) finds statistical evidence that FDI is positively associated with cross-city differences in growth rates in China. In his comment on Wei's work, Wing Thye Woo (1995) argues that FDI is correlated with total factor productivity (TFP) growth because the incidence of FDI is a good proxy for the degree of economic liberalization; and the greater the degree of liberalization, the higher the TFP growth. Other studies draw a conclusion similar to Wei (1995). For example, Stephane Dees' (1998) evidence supports the view that FDI affects China's growth through the diffusion of ideas; Chung Chen et al. (1995) find that FDI has been positively associated with economic growth and the increase of total fixed assets investment in China; Peter J. Buckley et al. (2001) find that FDI improves the performance of Chinese indigenous firms. The above empirical findings point to the collective

[1] For a literature survey, see de Mello, 1997.

importance of the elements in the package of resources associated with FDI (Dunning, 1977, 1993).

The vast land area of China is inevitably associated with enormous contrasts in conditions, both natural and artificial, between provinces. The degree of economic development is substantially different across the provinces of China, and the geographic distribution of FDI is characterized by its concentration in coastal areas. Whilst an overall positive impact of FDI on growth is supported by the empirical literature, China's large absolute size and economic diversity may mean that this finding masks wholly mixed impacts between geographic and economic areas. The aim of this article is to shed some light on how the FDI-growth relationship is affected by regional differences in China at the provincial level.

The article proceeds as follows: the following section reviews the literature; data and methodology are briefly explained next; the empirical results are presented in the subsequent section; and concluding remarks are offered in the last section.

Table 1. Geographical distribution of FDI in China by region,[a] 1989-1998

Year	FDI inflows ($100 million)			FDI inflows per person ($)		
	Eastern region	Central region	Western region	Eastern region	Central region	Western region
1989	28.12	1.17	1.22	5.54	0.46	0.28
1990	29.72	1.22	0.72	5.91	0.45	0.16
1991	38.88	1.68	0.68	7.78	0.61	0.16
1992	97.94	7.25	1.96	19.75	2.64	0.46
1993	236.83	23.80	10.14	48.40	8.79	2.38
1994	290.89	25.99	14.03	59.93	9.71	3.32
1995	324.58	33.24	11.42	67.45	12.57	2.73
1996	365.20	39.21	8.13	76.58	15.01	1.97
1997	385.65	47.90	11.68	81.76	18.55	2.86
1998	394.96	44.21	9.42	86.73	17.52	2.39
Total[b]	2 193 (88%)	226 (9%)	69 (3%)	45.98	8.63	1.67

Source: authors' own calculations from *China Statistical Yearbook* (various issues).

[a] The geographical grouping of the provinces is as follows: eastern region: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shangdonh, Guangdong and Guangxi; central region: Shangxi, Neimenggu, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan; western region: Sichuan, Guizhou, Yunnan, Shanxi, Gansu, Qinghai, Ningxia and Xinjiang.

[b] The bottom row shows the total FDI inflows and percentages and average per capita FDI.

FDI and growth

Many studies discuss the ways in which inward FDI can contribute to the growth of a host country economy (see, for example, Wei, 1995; Balasubramanyam et al., 1996; de Mello, 1997). In general, these studies argue that the impact of FDI on growth is complex. First, through capital accumulation in a recipient economy, FDI is expected to be growth enhancing by encouraging the incorporation of new inputs and technologies into the production function of a host economy. Second, FDI improves the efficiency of locally-owned host country firms via contact and demonstration effects, and their exposure to fierce competition. Last and most importantly, FDI is believed to be a leading source of technological change and human capital augmentation in developing countries. Technological progress takes place through a process of "capital deepening" in the form of the introduction of new varieties of knowledge-based capital goods. It also proceeds via specific productivity-increasing labour training and skills acquisition promoted by transnational corporations (TNCs). A recent embellishment in the growth literature is to highlight the dependence of the domestic growth rate on the state of technology relative to that in the rest of the world (de Mello, 1999).

The basic shortcoming of conventional neo-classical growth models, as far as FDI is concerned, is that long-run growth can only be achieved by technological progress, which is considered to be exogenous. FDI would only affect output growth in the short run and, in the long run, under the conventional assumption of diminishing returns to capital inputs with a given technology, FDI would have no permanent impact on output growth. Within the new growth framework, FDI is treated as one of the factor inputs along with labour and (domestic) capital and is expected to promote growth in the long run. Whether or not technological progress is best described as exogenous to the world as a system, the role of FDI in diffusing technology (both hard and soft) to developing countries appears clear.[2] Under either interpretation, technology created in the developed

[2] The development literature does not much concern itself with the motive for FDI. However, there are reasons for believing that FDI should not be regarded as homogeneous to the degree to which it bears technology. This is likely to be influenced by the motive for FDI. For instance, it is expected that the greater the extent to which market power is a motive, then the lower the incentive for technology transfer. This motive would be more prominent in markets where competition is lower (Buckley and Clegg, 1991).

world is exogenous to a developing country. Consequently, a positive relationship between FDI and long run growth in a developing host country should be expected.

The lessons from developed economies are that the productivity of foreign capital is dependent on initial conditions in a host country. Eduardo Borensztein et al. (1998) highlight the twin roles of the introduction of advanced technology and the degree of absorptive capability in the host country as determinants of economic growth. Luiz R. de Mello (1997) argues that an increase in the productivity of FDI can only be achieved if there is already a sufficiently high level of human capital in a recipient economy. These authors agree that preconditions in recipient economies help convert new capital effectively into higher levels of output in the host countries.

It is also important to evaluate the extent of complementarity between domestic investment and FDI. Under complementarity, innovations embodied in FDI may create, rather than reduce, rents accruing to older technologies (Young, 1993). If FDI is expected to affect growth positively, some degree of complementarity with domestic investment needs to be at work.

It should be pointed out that the direction of causation may run either way. FDI may be drawn to regions of faster growth or greater potential because their growth prospects have made it more attractive to foreign TNCs. De Mello (1997) envisions a case in which the size of the consumer market in a recipient economy is getting larger, as a result of faster growth leading to rapid increases in the potential purchasing power of consumers in a host country. Consequently, it is tenable that growth itself may be an important determinant of FDI in addition to those listed above.

Within an evaluation of the impact of FDI-induced technological change on growth in developing countries, Magnus Blomström, Robert Lipsey and Mario Zejan (1994) find that the positive and statistically significant impact of FDI is stronger, the higher the level of development in a host country. Pursuing the effects of preconditions in a developing host country, Borensztein et al. (1998) find that FDI is more productive than domestic investment only when the host country has a minimum threshold stock of human capital. However, de Mello (1999) found a positive impact for FDI on output growth regardless of the technological status of a host country as a technological leader or follower, but this result did not apply when

growth was replaced by technological change (measured by TFP). In this case, FDI exerted a positive impact on TFP only for technological leaders, while a negative relationship arose between FDI and TFP for technological followers.

The findings reviewed above collectively suggest that the way in which FDI affects growth is likely to depend on the economic and technological conditions in a host country. The evidence to date points to an increasing relationship between the level of development in a recipient economy and the productivity benefits associated with inward FDI.

Empirical findings have so far not offered clear-cut conclusion with respect to the causality between FDI and growth. The surge of FDI might be associated with domestic policy variables, and this was evidenced in the case of Latin America (Elias, 1990). De Mello (1996) finds that FDI plays a determinant role in increasing both output and TFP in Chile, while capital accumulation and TFP growth precede FDI in Brazil. In both cases the direction of the relevant causalities cannot be determined. The direction of causality between FDI and growth may well depend on the determinants of FDI. If the determinants have strong links with growth in the host country, growth may be found to cause FDI, while output may grow faster when FDI takes place in other circumstances (de Mello, 1997).

The model and data

The conventional approach to investigating the relationship between growth and FDI involves running regressions for the rate of output growth on the rate of FDI growth. Often, additional explanatory variables (for example, the rate of growth of the domestic capital stock, domestic labour force growth) are included in order to control for other influences upon the rate of economic growth. As we have noted, such models are often presented in terms of a production function-type of framework that treats FDI (foreign capital) as a factor input.

Conventional neo-classical growth models in the Solovian tradition predict that the elasticity of output with respect to capital should be equal to the share of capital in total output. However, empirical estimations of this relationship have commonly been flawed. As is well known, in the case of cross-country and time-series estimations, the correlation between the error term and the regressors in standard growth accounting-based time-series production function

estimations leads to simultaneity and omitted variables biases. Owing to these biases, cross-sectional estimates frequently point to a much higher value of capital elasticity than is predicted on the basis of the growth models. For example, the correlation between capital per capita and the error term leads to capital elasticity estimates that are well above the capital share in output (Young, 1992, 1995). By including more theoretically germane explanatory variables in our equation, the biases associated with the omission of variables can be substantially reduced.

For these reasons we eschew a growth accounting exercise, and construct our model as follows. Let province *i* and time *j* operate within the following equation, so enabling the impact of FDI on growth to be estimated:

$$Y_{it} = \alpha + \beta_1 K_{dit} + \beta_2 K_{fit} + \beta_3 L_{it} + \beta_4 H_{it} + \beta_5 M_{it} + \beta_6 E_{it} + \beta_7 I_{it} + \varepsilon_{it} \qquad (1)$$

The estimation of equation (1) without due consideration of possible region-specific or time-specific effects could generate misleading results. In the context of panel data, the existence of unobservable growth determinants that are specific to regions can be acknowledged and taken into account in the estimation procedure. Therefore, we estimate equation (1) in the form of what is usually referred to as a fixed effect (FE) model. We do not use a random effects model here since this would require that the omitted variables are uncorrelated with the specified right-hand side variables — an unrealistic assumption in the context of our model.[3] The FE model is as follows:

$$Y_{it} = \alpha_i + \gamma_1 K_{dit} + \gamma_2 K_{fit} + \gamma_3 L_{it} + \gamma_4 H_{it} + \gamma_5 M_{it} + \gamma_6 E_{it} + \gamma_7 I_{it} + \phi_{it} \qquad (2)$$

where Y is the growth rate of GDP;[4] K_d is the growth rate of the domestic capital stock (proxied in the usual way by the share of investment in output); and K_f is the growth rate of the stock of FDI;[5]

[3] There is considerable debate regarding the choice between the fixed effects (FE) model and random effects (RE) model. A common and convenient way forward is to regard the FE regression as a better and less biased one (Griliches, 1984).

[4] The reliability of Chinese statistics is open to question *(Financial Times*, 2002a, 2002b). There appears to be an upward bias in the GDP data arising from over-reporting, and in the FDI data arising from "disguised FDI". This latter can arise where investment ostensibly from, for example, Hong Kong (China) in fact has a mainland Chinese ultimate beneficial owner (Lan and Young, 1996). These inflationary tendencies may mitigate each other to some extent.

[5] The definition of domestic investment is investment in fixed assets, which contribute the greatest part of the capital invested in Chinese-owned firms. This can be considered commensurable with the Chinese data on FDI, which are defined differently from the IMF definition (IMF, 1977), as all expenditures that add to the capital of a firm. The Chinese FDI data have the benefit of not being influenced by the financial positioning between the parent firms and affiliates.

L is the growth rate of the labour force; H is human capital (proxied by the share of university and college students in the population). In contrast with previous studies, our model includes some supplementary variables that have been introduced into the above equation, to capture the determinants of the Solovian type of residual, and thus improve the quality of our estimations. These variables are: the level of marketization, M (proxied by the share of number of employees in private enterprises and self-employed individuals in total employment); the growth rate of provincial exports (E); and the growth rate of provincial imports (I). Finally, α captures province-specific unobserved inputs, which are assumed to be constant over time, and ϕ is a white noise error term.[6]

Positive relationships are expected between the dependent variable and all explanatory variables. If the model specification is reasonable, the estimated coefficient of K_f (i.e. γ_2) will indicate the direction and magnitude of the impact of FDI on economic performance.

It would be of great interest to experiment with a lag structure in this model, although this would be unusual with panel data in circumstances such as our own. We have 261 observations in the full sample, but a relatively short time series covering 1989-1998. If we were to employ lags, this would adversely affect the number of usable observations particularly in the sub-samples, which are the focus of our analysis. Furthermore, there is no prima facie evidence to suggest that lags would yield a benefit, as argued in UNCTAD (1999, p. 332): "Current growth in a period is always positively and significantly related to FDI inflows in the same period … there is much stronger evidence that the growth rate and FDI inflows coincide in time".

Before the data are described and the estimates reported, a few remarks concerning the model are necessary. It is not the purpose of this article to offer either a new theory or specification of the linkages between FDI and growth. Rather, the main objective is to shed fresh light on these linkages at the provincial (sub-national) level by extending a model that is already familiar from studies at the national level. However, our study does employ additional and theoretically pertinent variables, thereby enabling us to focus on a broader range of issues. Although our model cannot be considered

[6] See, for example, Hsiao (1986) for a discussion of panel data methods.

to be perfect, it can claim to be well justified in the light of our discussion above.

While equation (2) captures the impact of most of the important variables, it does not account for the possibility of bi-directional relationship between growth and FDI highlighted in the recent literature. To capture these possible temporal causality relationships, the technique of Granger-causality can be employed (Granger, 1969, 1980). The test involves estimating the following regressions:

$$Y_t = a_0 + \sum_{j=1}^{8} a_j Y_{t-j} + \sum_{j=1}^{8} b_j K_{f,t-j} + u_t \qquad (3)$$

$$K_{ft} = c_0 + \sum_{j=1}^{8} c_j K_{f,t-j} + \sum_{j=1}^{8} d_j Y_{t-j} + v_t \qquad (4)$$

where K_{ft} and Y_t are stationary time series and u_t and v_t are uncorrelated error terms. By equation (3), K_f Granger causes Y if $b_j \neq 0$. By equation (4), Y Granger causes K_f if $d_j \neq 0$. By-directional Granger causality is obtained if $b_j \neq 0$ and $d_j \neq 0$.

The estimation of equation (2), (3) and (4) is based on a panel of data for 29 out of 31 of China's provinces over the period 1989-1998 for realized FDI.[7] Tibet was excluded because of a lack of reliable data, while Chongqing and Sichuan provinces were included as one combined province, as they were aggregated together in the source data for most of the period. The panel data set yields a total of 261 observations when growth rates are calculated. The data were compiled from various volumes of the *Chinese Statistical Yearbook*, *China Foreign Economic Statistical Yearbook and China Industrial Statistical Yearbook*.

The first part of our investigation of the FDI-growth relationship involves testing equation (3) and (4) to examine the causal relationship between FDI and growth. The second part of our analysis then analyses the bi-directional effects using the full sample of 29 provinces to obtain parameter estimates for China as a whole. The third part of our analysis groups the full sample of provinces into sub-samples based on differences in characteristics between the provinces. These characteristics are: (1) membership of geographic region; (2)

[7] Realized FDI is investment that has been made, as opposed to planned FDI.

economic development levels, proxied by GDP per capita; (3) levels of technological capability, proxied by R&D/GDP; (4) the level of infrastructure, employing the rankings of Amy Y. Liu et al. (1999), which use electricity usage per capita, number of telephones per capita, road-to-land ratio and wage level to measure infrastructure conditions; (5) the degree of inward FDI concentration (FDI intensity), proxied by FDI/total domestic investment); (6) the degree of State-owned enterprise (SOE) concentration (SOE intensity), proxied by the share of SOEs' sales in total sales in the manufacturing sector; and (7) the degree of competition from Chinese locally-owned firms, proxied by the growth rate of sales by domestically-owned firms. This measure follows Blomström, Kokko and Zejan (1994), on which we have improved by calculating the sales of only locally-owned firms. This involves removing the sales of all foreign affiliates, including international joint ventures and wholly-owned affiliates, which gives us a pure measure of Chinese locally-owned sales.

The provinces in the sample are differentiated; in the case of the economic criteria, this involves assigning a rank. Following ranking, the provinces are divided into various pairs of mutually exclusive groups: provinces with high and low income per capita; provinces with high and low technological capability; provinces with better and poorer infrastructure; provinces with high and low levels of FDI intensity; provinces with high and low SOE intensity; and, finally, provinces with high and low degrees of domestic competition. The analysis of these contrasting sub-samples serves to determine how these differences affect the FDI-growth relationship across provinces.

Empirical Results

We first employ the Granger causality test to examine the relationship between FDI and growth. Equations (3) and (4) were estimated by ordinary least square (OLS) procedure. We chose two year-long lag periods based on the final-prediction-error (FPE) criterion (Akaike, 1969). All the variables were found to be covariance stationary.

We first test if FDI (K_f) Granger causes growth (Y) by estimating the unrestricted equation (3), and restricted equation (3)

by dropping lagged K_f. The F statistic yields a value of 11.548,[8] which exceeds the critical value of $F_{0.01} = 5.53$. Thus, we can reject the null hypothesis ($b_j = 0$) and conclude that adding lagged values of K_f does improve the statistical results. This signals that FDI Granger causes growth. The same procedure was carried out with respect to equation (4) and the result indicates that growth Granger does not cause FDI (F statistic 3.25, below the critical value of $F_{0.01} = 5.53$).

We now analyze the effects of FDI on growth. Table 2 presents the results for the broad panel from the estimation of equation (2) in which the growth of GDP is generated by growth in domestic investment, FDI, employment, exports and imports, as well as the level of human capital and degree of marketization. In regressions (2.3) to (2.8) various interaction terms are added into the equation to examine whether some variables exert a joint effect on growth.

Table 2 reveals several interesting results concerning the effects of FDI on economic growth. Regressions (2.1) and (2.2) indicate that FDI has a positive impact on economic growth. The addition of some ancillary variables, i.e. the level of marketization, and the growth rates of exports and imports in regression (2.2) does not reduce, but rather increases, the significance of the FDI variable. The level of human capital, proxied by the ratio of number of college students to the total population, does not seem to contribute to growth in regressions (2.2) to (2.8). This variable, although commonly employed in empirical research, might not perform as expected as a proxy for human capital in the case of China. It might be argued that in China the efficiency with which the stock of technical knowledge is translated into technologies in the market, via the higher education system, is very low. This is likely to be a legacy of central planning, which is well known to have been inimical to the commercialization of ideas. Another possible reason is that the rigidity of personnel management systems in State-owned firms prevents well-educated employees from contributing fully to the firm performance. In additional regressions that were run using average wages in each region, in place of the student-population ratio, the results do not change significantly. The

[8] The F statistic can be calculated using: $\frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/n-k}$, where m in the present case is equal to the number of lagged K_f terms and k is the number of parameters estimated in the unrestricted regression.

insignificant role of human capital in growth found here appears to be consistent with the studies by Wei (1995) that investigated the role of FDI and human capital in economic growth in China. In contrast with the result for human capital, we find as expected that investment (especially domestic investment) and marketization have a positive impact on growth.

The specification in regression (2.3) replaces the FDI variable with the product of FDI and human capital, and yields a coefficient that is positive and statistically highly significant. While this specification follows closely from the framework developed in the second section, the significance of the interaction term may be the result of the omission of other relevant factors, in particular, the FDI variable by itself. Thus, it is necessary to include FDI and human capital individually alongside their product. In this way, we can test jointly whether these variables affect growth by themselves or through the interaction term. This specification is adopted in regression (2.4),

Table 2. FDI and growth of GDP, full sample, 1990-1998

Variable	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)	(2.8)
K_d	0.049 (3.60)***	0.046 (3.45)***	0.046 (3.32)***	0.045 (3.38)***	0.023 (1.65)*	0.029 (1.64)*	0.046 (3.58)***	0.047 (3.63)***
K_f	0.007 (4.09)***	0.008 (4.32)***		0.005 (1.77)*		0.002 (0.52)		-0.005 (-1.08)
L	0.057 (0.39)	0.096 (0.66)	0.106 (0.73)	0.099 (0.68)	0.119 (0.83)	0.114 (0.79)	0.071 (0.50)	0.061 (0.43)
H	12.77 (2.25)**	-1.889 (-0.26)	-3.874 (-0.53)	-2.684 (-0.37)	-2.228 (-0.31)	-2.17 (-0.30)	-2.79 (-0.39)	-3.121 (-0.44)
M		0.312 (3.63)***	0.315 (3.63)***	0.319 (3.70)***	0.312 (3.65)***	0.314 (3.67)***	0.241 (2.91)**	0.199 (2.18)**
E		0.017 (1.19)	0.015 (1.08)	0.017 (1.18)	0.016 (1.14)	0.016 (1.16)	0.018 (1.28)	0.017 (1.26)
I		0.023 (3.76)***	0.025 (3.99)***	0.023 (3.78)***	0.023 (3.79)***	0.023 (3.75)***	0.022 (3.58)***	0.022 (3.58)***
$K_f H$			2.810 (4.02)***	1.059 (0.87)				
$K_d K_f$					0.025 (4.57)***	0.019 (1.51)		
$K_f M$							0.186 (5.33)***	0.270 (3.19)***
N	261	261	261	261	261	261	261	261
$\overline{R}^2$	0.34	0.41	0.41	0.41	0.42	0.42	0.44	0.44

Source: authors' calculations.
Note: Figures in parentheses are t-statistics (two-tailed tests); ***, ** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

which shows that the coefficient on FDI is still positive and significant, while the interaction term is no longer significant. This means that the significance of the interaction term is likely to be the result of the omission of the FDI variable itself. Thus, we are unable to link the significance of the $K_f H$ variable in regression (2.3) to the so-called "threshold" effect, i.e. we need to be cautious in averring that in China FDI might promote growth only when human capital reaches a certain level, at least on the basis of our data. However, this does not necessarily mean that the effect of FDI on economic growth has nothing to do with conditions in the host country or local economy. In fact, as we will see later, the effect of FDI on growth in this study is closely associated with provincial differences with respect to technological and market, or industry, conditions.

Domestic investment has been one of the most important factors supporting the continuous economic growth in China since the Open Door Policy. This is reflected throughout table 2 where the K_d variable is positive and statistically significant in all the equations. Similar to the results in column (2.3) and (2.4) with respect to the FDI-human capital variable, the interaction term between domestic and foreign investment is significant in equation (2.5) where the FDI variable is absent, but insignificant in equation (2.6) where the FDI variable is also included. This casts doubt on the existence, as is usually assumed in the literature, of a complementary relationship between the two types of investment. The insignificance of the $K_d K_f$ variable may be related to the structure of domestic investment in China. Investment in infrastructure has been extensive and should, in principle, serve to enhance the role of FDI in promoting growth. However, in practice a substantial share of investment in fixed assets in China is accounted for by industrial projects and real assets that have been State-funded and which have relatively little opportunity to interact positively with incoming foreign capital.

We find that market-oriented reform has been one of the major forces driving economic growth in China. This is reflected in table 2 where the marketization variable in all the equations is positive and statistically significant. It is interesting to see the role of the interaction between FDI and marketization. In contrast to the cases of $K_f H$ and $K_d K_f$, the positive and significant performance of the interaction variable $K_f M$ is invariant of whether the FDI variable is included or excluded in the relevant equations. In addition, the increased value of $\overline{R}^2$ in equations (2.7) and (2.8) also justifies our

inclusion of the marketization variable and of the interaction term $K_f M$ in these regressions.

Of the two trade variables, only that for imports attains significance. These two variables should be interpreted with caution as they refer to trade at the level of the province. As such they are not exclusively concerned with trade in the international sphere — they include inter-provincial trade — and so do not measure only the international trade that brings the Chinese host economy and foreign economies into contact. This dilution of the variables may account for the lack of significance of exports. However, the across-the-board significance of imports is perhaps best understood as a special aspect of market liberalization. Provinces of China have customarily been segmented by restrictive local distribution monopolies. Those provinces with the fastest growth in imports are likely to be those that have embraced liberalization in trade, and that have also provided environments most conducive to economic growth. Our results indicate that the Chinese economy is still at a stage in which growth for the country as a whole has been mainly driven by the expansion of domestic investment and by market-oriented reform, rather by imported technology and the stock of human capital.

As discussed in the preceding section, the FDI-growth relationship may vary across provinces due to various differences specific to the characteristics of these regions. The impact of these differences can be explored by dividing the full sample into sub-samples. Tables 3, 4 and 5 show the results from the estimation of equation (2) for sub-samples to investigate how provincial differences affect the FDI-growth relationship.

Table 3 examines the difference in the way in which our standard model performs between the regions of China. The designation of China on such a regional basis underpins the Open Door Policy, and so the contrasts that arise in table 3 essentially arise from the timetable for the rolling out of that policy, as well as from the underlying economic attractiveness of the provinces within the regions. It is therefore not surprising that, within each of the three classes of region, there is limited variation in economic and policy characteristics. The result is that all but one of the explanatory variables supplementary to domestic investment and FDI fail to reach significance.

Government development policy has managed to foster economically convergent provinces by region. Within these regions the driving force behind growth is confirmed as springing from domestic and foreign investment. Moreover, the significance of these relationships rises in the geographical movement from west to east, as does the size of the adjusted R squared. Therefore, domestic investment contributes insignificantly to growth in the provinces of the western region, significantly in the central region and yet more significantly and strongly in the east. Across the regions, the significance of the impact of FDI parallels that of domestic investment, but is somewhat higher within each region. The strength of the FDI-growth relationship clearly rises from west to east. This suggests that FDI in some way is differentiated from domestic investment. On the basis of theory, we can interpret this as being the result of FDI conferring a package of new resources, in which the elements are qualitatively and quantitatively different from domestic investment.

Although the size of the coefficients on FDI lies below that for domestic investment (where both are significant), it attains its zenith in the eastern region. The key conclusion from the equations in table 3 is that the importance of FDI in driving growth rises in step with the development policy programme of the Government of China.

Table 3. Geographical regions and the FDI-growth relationship, 1990-1998

Variable	Eastern region (3.1)	Central region (3.2)	Central region (3.3)
K_d	0.045 (2.63)**	0.061 (1.80)*	0.015 (0.78)
K_f	0.041 (7.14)***	0.010 (3.08)*	0.002 (1.84)*
L	0.385 (1.38)	0.241 (0.97)	-0.127 (-1.04)
H	2.295 (0.26)	20.53 (0.62)	25.93 (1.71)*
M	0.318 (0.13)	0.305 (1.37)	-0.045 (-0.26)
N	108	81	72
$\overline{R}^2$	0.50	0.37	0.27

Source: authors' calculations.
Note: Figures in parentheses are t-statistics (two-tailed tests); ***, ** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

Accordingly, FDI should be expected to become still more important to China's development aspirations in the future. The pattern of significance and strength that we observe in the coefficients suggests that domestic investment leads chronologically in creating growth. Surprisingly, this leadership does not apply in the least-developed provinces of the eastern region. It is possible that in these provinces the quality (and perhaps also the quantity) of domestic investment is so low that its impact on growth is negligible.

The human capital variable is unique among the supplementary variables in attaining significance for the provinces of the western region. This signals that between the most economically backward provinces, increases in investment in human capital make a positive contribution to economic growth.

For a deeper understanding of the true impact of the economic and policy variables, we must reclassify the provinces by their economic characteristics, rather than by simple membership of geographical region. Proceeding along these lines we are able to produce tables 4 and 5. The results in equations 4.1 and 4.2, which divide the sample of provinces by GDP per capita, bear a strong resemblance to those in table 3 precisely because development levels rise in the movement from the western region to the eastern region. Thus, we find again that domestic investment is of primary importance in driving economic growth in the less developed provinces. What can be considered as a standard result is obtained for the FDI variable, i.e. that its growth-promoting effects are evident in the developed rather than in the less-developed provinces, which is in line with the result in table 3. This is analogous to the common finding for export-led growth in the development literature. Here, the FDI variable captures an interaction between the domestic and the international sectors, analogous to exporting, and the results show that this interface promotes growth ¾ but contingent upon local development being in the higher end of the distribution. The degree of marketization appears as a significant variable in the low, but not in the high, GDP per capita regions. This result underscores the role played by the movement towards private sector economic activity in the growth process in the poorest provinces. It appears that, in the rich provinces, where the degree of marketization is already very high, the variation in this variable is no longer critical to the growth process, i.e. the main part of the benefits have already been reaped.

Table 4. Provincial economic differences and the FDI-growth relationship: sub-sample results, 1990-1998

Variable	GDP per capita		R&D expenditure/GDP		Level of infrastructure	
	High (4.1)	Low (4.2)	High (4.3)	Low (4.4)	High (4.5)	Low (4.6)
K_d	0.049	0.060	0.035	0.066	0.028	0.093
	(2.60)***	(2.76)***	(2.26)***	(3.19)***	(1.56)	(4.13)***
K_f	0.009	0.001	0.007	0.010	0.005	0.001
	(2.47)***	(1.37)	(3.28)***	(3.30)***	(2.96)***	(0.89)
L	0.331	-0.112	-0.075	0.394	0.064	0.359
	(1.33)	(-0.67)	(-0.52)	(1.45)	(0.33)	(1.53)
H	0.614	6.563	1.466	0.212	-0.223	-23.28
	(0.06)	(0.35)	(0.21)	(2.47)***	(-0.03)	(-0.74)
M	0.195	0.279	0.25	0.334	0.157	0.464
	(1.50)	(1.85)*	(2.49)***	(3.14)***	(1.30)	(2.19)**
N	126	135	126	135	126	135
$\overline{R}^2$	0.31	0.33	0.38	0.39	0.37	0.31

Source: authors' calculations.

Note: Figures in parentheses are t-statistics (two-tailed tests); ***, ** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

In equations 4.3 and 4.4 the provinces are reclassified by provincial research-and-development capability (R&D effort), producing some fresh results. Domestic investment and FDI promote growth in both high and low-research provinces and, at this point, it might be helpful to reflect upon the nature of the data on research. Pure and applied research will be conducted by domestic and foreign-invested firms, and by Government research institutes. There is a well-understood relationship between R&D and growth in locations in which research levels are considerable. But where R&D is low, both in intensity and in absolute terms, our results call to mind that the presence of a relatively few provinces, with effort at the higher end of the low distribution, might be sufficient to lead to a positive relationship with growth.

The human capital variable assumes significance for the sub-sample of provinces with low — but not high — research effort. It appears that growth is promoted by an expansion in the number of tertiary students at the lower end of the distribution, i.e. in the relatively large quantum leap from low participation rates to moderate

rates. From this we can infer that an increase in human capital in the low-research provinces has a synergistic effect with such meagre provincial resources as there are, to stimulate an expansion in growth. In contrast, we find that within the high-research provinces an increase in the abundance of human capital is no longer critical for growth.

The key policy finding from equations 4.3 and 4.4 concerns the influence of marketization. In both high and low-research provinces, marketization augments economic growth. This implies that this policy is of commensurate value whatever the research status of the province, and therefore that it can be pursued with universal benefit to growth. This benefit may derive from the way that private enterprise pursues more aggressively the exploitation of research outputs than does State enterprise.

Turning to equations 4.5 and 4.6, in which provinces are classified by level of infrastructure, we see that some sharp contrasts emerge between the high and low sub-samples. Growth is promoted by domestic investment in the low infrastructure group, but not in the high group. This points to the conclusion that it is domestic investment in infrastructural projects that is playing a leading role in the early stages of the growth process. These projects may well lie in the State sector and, accordingly, this hints at the pivotal part played by the State in raising socially productive capital. For its part, foreign (and therefore also private) capital and knowledge, conferred via FDI, furthers growth in high — but not low — infrastructure provinces. This leads one to believe that, to be productive, FDI calls for an adequate level of infrastructure to be in place. Lastly, in equation 4.6, we find that marketization promotes growth where infrastructure levels are low, suggesting that this policy can be pursued with benefit notwithstanding impoverished provincial foundations. In provinces that are well founded in this respect, marketization has no impact (in equation 4.5), it being probable in these cases that marketization rates have probably already converged, and may lie reasonably close to an upper boundary.

The data by province can also be investigated in terms of regional differences in industrial characteristics that relate primarily to the activities of enterprises. This is the purpose of table 5. Equations 5.1 and 5.2 reclassify provinces by the share of FDI in provincial capital formation. In this way we can discern how the determinants of growth contrast between highly invested provinces and low FDI intensity provinces. Domestic investment remains a powerful factor

in both categories of province, though attaining a higher significance in the highly-invested provinces. This hints at the possibility of a complementary relationship with FDI at the provincial level. In equation 5.1, where provincial FDI intensity is high, the impact of FDI on growth is significantly positive, but there is no such effect where FDI intensity is low. This indicates that FDI's contribution to growth is contingent upon there being a sufficient share of FDI in economic activity. This might be in the same industry — in which case the need for critical mass is implicated — or in different industries, in which event a network of suppliers may be present. This suggestion, that a critical foreign competitive mass is needed to realize the growth benefits of FDI, might link to the incentive for rapid technology and knowledge transfer that comes with effective competition between foreign owned producers.

There are two further significant variables in equation 5.1, namely the growth rate of the labour force and the degree of marketization. The labour force variable captures increases in the

Table 5. Provincial differences in industrial characteristics and the FDI-growth relationship: sub-sample results, 1990-1998

Variable	FDI/total investment		SOE's sales/total sales		Growth of sales by domestically-owned firms	
	High (5.1)	Low (5.2)	High (5.3)	Low (5.4)	High (5.5)	Low (5.6)
K_d	0.051	0.048	0.048	0.044	0.047	0.082
	(2.79)***	(2.29)**	(2.84)***	(1.99)**	(2.66)***	(3.50)***
K_f	0.016	0.001	0.018	0.001	0.010	0.0004
	(4.92)***	(0.85)	(5.87)***	(0.63)	(3.88)***	(0.63)
L	0.529	-0.166	0.469	-0.001	0.348	0.023
	(2.06)**	(-1.12)	(1.67)*	(-0.01)	(1.31)	(0.14)
H	-3.406	32.99	-0.948	18.79	-3.856	21.43
	(-0.35)	(1.94)*	(-0.10)	(1.20)	(-0.39)	(1.29)
M	0.466	0.0048	0.357	0.106	0.307	0.068
	(3.07)***	(0.04)	(2.95)***	(0.76)	(1.83)*	(0.53)
N	126	135	126	135	126	135
$\overline{R}^2$	0.38	0.33	0.41	0.27	0.38	0.29

Source: authors' calculations.
Note: Figures in parentheses are t-statistics (two-tailed tests); ***, ** and * denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

abundance of labour of working age. There are two sources of domestic labour growth, one is natural population growth and the other is immigration. The first lays outside the policy domain in the time frame of our study, but not so the second source. The inference is that immigration into highly foreign-invested provinces should be promoted for its positive impact on growth.

The remaining significant variable in equation 5.1 is marketization. Marketization promotes economic growth in high, but not low, foreign-invested provinces. From this we can infer that when the provincial economy is highly foreign-invested, then the expansion of private enterprise contributes significantly to growth. The precise process through which this occurs cannot be elucidated through this present research. It may involve the stimulation, through various means, by foreign affiliates of local private firms' value-adding activities. Again, the competitive process may be pivotal in this finding. The greater the presence of foreign affiliate competitors the more keen the competition, and the more beneficial market reform may be for all producers in the Chinese market.

In equation 5.2, apart from the domestic investment variable, the only significant variable is that for human capital. This significance, in the context of a low foreign-invested environment, suggests a pattern of economic growth drawing on improvements in the quality of labour, and echoes our earlier finding for the western region provinces. It appears that modest improvements in human capital have value in encouraging the early stages of economic growth.

In equations 5.3 and 5.4, the data are re-ordered according to the proportion of State-owned enterprise sales in total sales. This procedure separates provinces in which most of the economic activity is still in State hands from those in which the private sector is now very considerable, owing to the rapid growth of private enterprise. While the domestic investment variable attains significance in both equations, we find that the two equations otherwise contrast markedly. There are four significant variables in equation 5.3, but just one in equation 5.4. Counter to intuition, we find that the FDI variable exerts a significant positive effect on economic growth in those provinces in which State-owned activity is high, rather than where it is low. Here we must reflect on the pattern of inward FDI into China. Typically, much foreign capital has been directed to joint ventures

with State-owned enterprises rather than with enterprises spawned in the private sector. The largest foreign invested projects in China conform to this characterization. This provides a tenable account of why the contribution of FDI to growth has been greatest where SOE activity has been highest, but we cannot conclude that this is the true basis for this finding.

The two further significant variables in equation 5.3 shed more light. The growth rate of the labour force and the degree of marketization both promote economic growth in high State-sector provinces. This again points to the importance of increases in the stock of labour, and possibly of migration, for growth and to the general benefits to be derived from marketization. As this latter variable is based on the proportion of employees who are not in the State sector, we can infer than the movement towards employment in private enterprise in provinces dominated by State enterprise brings considerable benefits for economic growth. The sole significance of the domestic investment variable in equation 5.4 suggests that most of the growth in private enterprise in provinces with low SOE shares has been Chinese-owned enterprise.

The final two equations in table 5 (equations 5.5 and 5.6) divide provinces into those with high and low growth rates of sales by domestically-owned firms, which is intended to reflect the degree of competition from Chinese locally-owned firms. The reasoning is that, where sales by local firms are growing fastest, this will be the result of the growth of Chinese-owned enterprise, which produce substantial volumes of output for the local market. Equation 5.5 duly reports that the FDI variable contributes significantly to growth when domestic competition in local goods markets is keenest. Once again, competition is seen to associate with a positive FDI-growth relationship, this time within the context of domestic competition. Marketization also, within the same environment, promotes growth. In contrast, equation 5.6 reveals that where the degree of Chinese-owned competition is least that no variable, apart from that for domestic investment, records a significant effect on economic growth. The inference to be made here is that, in the absence of effective local competition, the economic factors and policies that would otherwise be relied upon to generate growth are rendered ineffective. This again points to the importance of promoting competitive market structures.

Conclusions

We find two main strands in our conclusions arising from this study of the FDI-growth relationship in China. Firstly, conditions in the host economy profoundly impact upon the growth relationship. This applies to China at the national as well as at the provincial level. The role of the market reform process deserves special attention, as it pervades the growth process, enabling resources, whatever quality or quantity, to be employed with an efficiency superior to that under State planning and control. Secondly, the quality and quantity of resources is crucial to promoting growth, as witnessed by the significance of domestic and foreign investment and, on occasion, labour growth and human capital.

In agreement with earlier research, our results support the view that externally-oriented development strategies promote economic growth. We have specifically found support for FDI as a channel in this process. The imperative to treat China as a country of discrete provinces is evident from the pattern of results in our estimations. In the full sample, the lack of significance of human capital obscures a subtle relationship which differs between the provinces. We find no evidence of the human capital threshold-effect for FDI, as posited in the development literature. However, we do find that human capital appears to be significant for growth in the less-developed western provinces, and in provinces with low research capability. In other words, the effect of human capital is to favour growth in the economically weaker provinces, i.e. it is independent of FDI. The finding that, in contrast, FDI favours growth in the economically stronger provinces, may partly account for the belief in a "threshold effect".

The findings for each of the variables employed, to some extent, carry some implications for policy; in the context of this study, the implications point to ways to maximize the growth benefits of FDI. It is clear that policy needs to be crafted to suit the characteristics of provinces. However, some policies are more generally applicable than others. Firstly, there is no indication in these data that a stage has been reached in which the growth of domestic investment has become secondary in the growth process, although the contribution of inward FDI can be considerable. Foreign investment appears to be supportive of market reform and growth, but specifically in provinces that have already attained greater development. We find that the full

benefits of FDI are felt when competition in the local market is keen from both foreign and domestic firms. We can no more than surmise that competition, from whichever source, is likely to reduce the incentive to incoming firms to exploit market power, thereby increasing the likelihood of technology and knowledge transfer.

Where it attains significance, the labour variable points to the value of expansion in the workforce, and possibly of inward migration, for economic growth. As we have noted, human capital plays a subtle role in promoting growth. On the basis of our findings, it seems clear that the economically weaker provinces should follow an education policy to raise the stock of human capital, as the greatest returns to growth from such a policy accrue to this group.

Market reform emerges as a successful general policy that betters growth in a wide range of circumstances and which, our results suggest, is bolstered in its effects by FDI in the more developed provinces. The view that inward FDI and the level of marketization are complementary in their action on growth is supported in our study. Accordingly, FDI can be viewed as an integral part of the market reform process towards the promotion of growth. The explicit policy of the Government of China has been to develop first the eastern coastal provinces, and subsequently to roll the programme of reform and marketization westwards through the interior towards the western provinces. The Western Region Development Programme of the Government of China (*Almanac of China's Economy*, 1999) has placed emphasis on investment in infrastructure, the attraction of inward FDI and the upgrading of human capital through education and inward migration. Our results lend support to the FDI and human capital policies, in view of the fact that growth has been responsive to the appropriate variables targeted by the Government.

The key role of liberalization appears to be reinforced by our findings for the variable on the growth of imports. We argue that it is probable that imports reflect an underlying process of liberalization in the host economy, and capture the movement to more effective competition in final markets.

Provinces in China are comparable in economic size to large sovereign developing countries. The political unity of China has meant that a unique opportunity exists to manage the development process, while learning from the experience of the more advanced provinces.

China is moving from a command economy based on central planning and State-owned enterprise towards a market economy in most sectors of activity. This gives the Government of China an unusual degree of control over the market reform process, at least as compared with the many developing countries that have never employed comprehensive State ownership. Perhaps for this reason, our findings reveal especially clear-cut effects on growth arising from market reform policy and the degree of competition in final markets.

Amongst our findings there have been no contrary signs, nor statistical problems that would call into question the reliability of the results. We should, however, note the limitations of this research. The study relies on a small sample. Although the number of provinces is given, the number of years for which suitable data are available must be considered the crucial limiting factor. The FDI-growth relationship is inevitably investigated over a short period of time. On the other hand, in a country such as China in which conditions have changed rapidly, estimation over a longer period would require a thorough exploration of the stability of the relationship. We should also note that there is believed to be a degree of overlap, but not a high degree, between the data on the provinces. The variables employed in this study are, however, believed to be robust and trustworthy, drawing in their construction on a lineage of comparable variables that appears in earlier studies on the FDI-growth relationship in developing countries. One advantage for our study in researching China using these variables is that it is reasonable to have more confidence in the comparability of data collected within one developing country than between a number of separate developing countries.

The low level of FDI in services in China to date justifies the focus on the manufacturing sector in this article. Services FDI has been customarily restricted owing to the official view that the services sector is less productive than manufacturing, and that domestic Chinese enterprises have been far too weak to bear foreign competition. In the future, it will be increasingly the case that research on FDI in services will be needed to investigate the growth process in a comprehensive fashion.

Our findings point collectively, and strongly, to the importance of competition in output markets for the realization of the full growth benefits of FDI. The reform process has clearly borne fruit, but it is naturally bounded when very high degrees of marketization are

achieved. At this upper boundary, the barriers to efficiency that we have been unable to address in this article may become of key importance to future growth. In our study, we cannot capture the full range of factors that impede foreign business in China. Such factors would relate to bureaucratic and discriminatory obstacles, poor intellectual property protection, as well as discretionary measures towards foreign investors. These are substantial issues, and ones that must be addressed in the implementation of China's membership of the World Trade Organization. ■

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