

# Tobin's Q and the Location of Foreign Direct Investment in China

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## Abstract

The aim of this paper is to examine the effects of the Chinese and Hong Kong stock markets on the levels of foreign direct investment into China's regions, utilising dynamic panel estimation techniques. Using a Tobin's Q measure, the results indicate that the effect is significant for both the Chinese and Hong Kong stock markets, but negatively signed, suggesting that FDI into China acts as a substitute for domestic investment. In addition we show that the Arellano-Bovver approach to dynamic panels produces an improvement into the modelling of FDI in China.

**Keywords:** FDI, Tobin's Q, Dynamic panel, Stock market, China, Hong Kong

## 1. Introduction

During the last ten years China has had one of the fastest growing economies in the world, with a corresponding increase in the levels of foreign direct investment (FDI), becoming the second highest recipient of FDI in the world. It is also an illustrative example of a successful transition economy, as over recent years a process of economic liberalisation has been implemented, as China moves to a more market orientated economy with the subsequent development of the instruments of a market economy, such as financial markets and institutions. The main aim of this paper is to evaluate the effect that both the Chinese and Hong Kong stock markets have had in determining levels of FDI across the Chinese regions. In addition I employ two alternative dynamic panel techniques to account for some of the agglomeration effects that are a characteristic of FDI in China.

Since 1997, following the return of Hong Kong to Chinese rule, China has been able to make use of the traditional strength of Hong Kong as one of the world's leading financial centres as a contributing factor to the growth of their economy. In addition China has sought to develop its own domestic stock markets, to further enhance their economy. As Alfaro *et al.* (2004) have demonstrated, financial markets have an important effect on FDI and the extent to which FDI affects growth and prosperity in the domestic economy.

Since Tobin (1969) there has been an extensive body of research into the relationship between domestic investment and the domestic stock market, using Tobin's Q theory. However there is little consensus on whether this relationship holds, using domestic data only. Recently attention has turned to the relationship between Tobin's Q and foreign direct investment (FDI), where Tobin's Q is a measure of the domestic stock market in the source country of the FDI. Blonigen (1997) finds that the Japanese stock market affects Japanese FDI to the USA and De Santis *et al.* (2004) find a positive and significant relationship between the Euro area stock markets and their corresponding FDI flows to the United States, as well as a significant and positive relationship between the US market index and FDI inflows from the Euro area to the USA.

Alfaro *et al.* (2004) have attempted to link a measure of the stock market with FDI flows to determine their effects on economic growth, finding that they had a significant effect on growth, when included as an interaction term with various financial market measures, including ones relating to stock markets. However they also show when included individually, the stock market measures had an insignificant effect on growth. In this study we attempt to build on the existing literature by the inclusion of both Chinese and Hong Kong measures of Tobin's Q into a conventional model of FDI flows into China.

Following the introduction the model specification is discussed in section 2 along with the dynamic panel approach to estimation. In section 3 the data is described and the results discussed, then in the final section we conclude and suggest some policy implications.

## 2. Model and Methodology

As with Cheng and Kwan (2000), the empirical model is based on the partial equilibrium theory to account for any agglomeration effects, which characterise FDI in China:

$$y_{it} - y_{it-1} = \lambda(y_{it}^* - y_{it-1}) \quad (1)$$

This indicates that the change in the level of FDI ( $y_{it}$ ) is proportional to the gap between its desired level ( $y^*_{it}$ ) and actual level. This can be rearranged to form:

$$y_{it} = (1 - \lambda)y_{it-1} + \lambda y^*_{it} \quad (2)$$

Where the term  $(1 - \lambda)$  measures the adjustment and is assumed to be positive, as the adjustment process should be both stable and non-fluctuating. Finally the model requires the determinants of the desired levels of FDI to be specified. In this model, apart from the Tobin's Q variables, we include the conventional determinants of FDI, used extensively in the literature as in Cheng and Kwan. (2000) and Wei *et al.* (1999) among others. The determinants of the desired level of FDI (Note 1) consist of the real per capita GNP, average real wages and expenditure on education per person in each region, the standard of the region's infrastructure, as measured by the length of highways relative to the population of each region and the Tobin's Q measures for the Chinese and Hong Kong stock markets, which are the ratio between the respective stock market indices and the regional industrial price indices. Any agglomeration effects are accounted for by the inclusion of a lagged dependent variable arising from the dynamic panel model.

The per capita GNP is included to account for the wealth of a particular region, in effect the higher the wealth, the greater the level of FDI as the greater the domestic demand for the goods and services provided by the firm receiving the FDI. This has been used as a measure for the development and wealth of a region in other similar studies, such as Fung *et al.* (2002) and Coughlin and Segev (2000). The length of roads measures the level of infrastructure within a particular region. The more developed a region's infrastructure, the more attractive it will be as a target for any FDI, as the lower will be its transport costs. It is expected that the average wage will have a negative impact on FDI flows as noted in Fung *et al.* (2002) and Cheng and Kwan (2000), as the FDI is aimed at the cheapest labour and finally we expect the education or labour quality variable measuring the amount of human capital in each region to also have a positive effect on FDI flows, as found by studies from Broadman and Sun (1997), Coughlin and Segev (2000) and Fung *et al.* (1997), as this produces a skilled and attractive workforce for the foreign investor.

The use of the lagged dependent variable should pick up the agglomeration effects, whereby FDI tends to be attracted to areas that have already been the recipient of FDI. Again we would expect this variable to have a positive effect on FDI. The positive relationship is expected because not only can foreign firms take advantage of economies of scale, but the existence of foreign firms already in a region acts as a positive signal to other firms when considering where to invest. However on the other hand, the Chinese Government has recently used fiscal inducements to attract FDI to other locations, outside the established areas for FDI in China, if this has been successful, then the agglomeration effects would not be expected to be significant.

### 2.1 Tobin's Q and FDI in China

The relationship between the domestic Tobin's Q and FDI inflows is less certain, as it depends on whether FDI compliments domestic investment or acts as a substitute. In theory it is argued that FDI inflows would have a positive relationship with the domestic stock market. For instance De Santis *et al.* (2004) argue that the domestic stock market is a proxy for levels of technology. Countries with high levels of technology are more likely to receive FDI, as the investors seek to benefit from the accompanying positive spill-over effects from the technology. However it could also be the case that in some countries, particularly less developed countries with low levels of technology, the FDI has a negative relationship with domestic stock prices (Note 2). For instance a fall in the domestic stock market could in theory lead to a reduction in domestic investment, requiring the authorities to seek investment funds from overseas by offering incentives (Note 3) and reducing barriers to FDI. So although theory suggests a complimentary relationship between FDI and the domestic economy, the FDI could be a substitute for domestic investment. The empirical evidence however suggests that FDI acts as both a substitute and compliment (De Mello, 1999), depending on how technologically and economically advanced the recipient country or region is. The main model takes the following form:

$$fdi_{i,t} = \alpha_0 + \alpha_1 gnp_{i,t} + \alpha_2 fdi_{i,t-1} + \alpha_3 e_{i,t} + \alpha_4 rl_{i,t} + \alpha_5 tq_{it} + \alpha_6 w_{i,t} + u_t \quad (3)$$

Where  $i$  and  $t$  stand for the region and time period respectively. The  $fdi$  is real foreign direct investment into a specific Chinese region,  $gnp$  is real per capita GNP for each region,  $w$  is the average real wage,  $e$  is the education expenditure per person in each region,  $rl$  is the per capita length of roads and  $tq$  is the respective Tobin's q for the Chinese and Hong Kong stock markets (All variables in logarithms). The Tobin's q variables are formed from the ratio between the main stock market index and the price index of investments in fixed assets by region. Although the stock market indexes are common to all regions, the price indexes are specific to each region, hence providing a reasonable amount of variation for this variable across the regions.

## 2.2 The dynamic panel approach

The use of the Arellano-Bond (1991) approach to dynamic panel estimation has been used before to account for agglomeration effects (Cheng and Kwan, 2000) and is also used to estimate the model including the Tobin's  $q$  effect. In addition the Arellano-Bover (1995) approach to dynamic panel estimation is also used, as it potentially has some benefits over the former approach, with respect to the dataset used in this study. The dynamic panel approach captures the agglomeration effects through the lagged dependent variable, as discussed and which Cheng and Kwan (2000) found to have a highly significant effect. A further reason for using a dynamic panel is to remove the individual effects in the panel as well as to account for the potential endogeneity of the explanatory variables. Generalised Method of Moments (GMM) is used to estimate both dynamic panel approaches, sometimes using different numbers of instruments for each period. These instruments can not only include strictly exogenous variables, but in addition period specific instruments such as lagged values of the dependent variable and other pre-determined variables.

The essential difference between the Arellano-Bond and Arellano-Bover approaches is that the former differences the variables to remove the individual effects, whereas the latter keeps the variables in their original level form using orthogonal deviations to remove these effects. Bond (2002) suggests the Arellano-Bover approach may have advantages over the Arellano-Bond method, as it has better small-sample properties, providing more accurate estimation in small samples and as long as the time series component is small, as in this case, the estimator does not require time stationarity.

## 3. Data and Results

The data covers 28 regions of China, from 1997 to 2003 using annual data. We begin the data in 1997 to account for the effect of Hong Kong passing into China's control and the subsequent influence of its stock market. We included all the regions in China except Tibet, Qinghui and Chongqing, which were excluded due to lack of data. All the data is taken from the *National Bureau of Statistics of China*, the FDI data is total foreign direct investment, wages are the average wage, GNP is per capita GNP, the length of roads is simply the total length of the highways in each region and educational attainment is measured by the amount spent on education per person in a region. The stock market indices are the main market indices for the Shanghai, Shenzhen and Hong Kong stock markets, China having two main stock markets. The replacement (Note 4) cost of capital is represented by the regional price index of investment in fixed assets. The Hong Kong stock market is the dominant market in East Asia during the time period tested and has a market capitalisation of roughly four times that of the Shanghai and Shenzhen markets combined throughout this time.

### 3.1 The Chinese and Hong Kong stock markets

Even before 1997, there were some tentative relations between the Chinese and Hong Kong markets, since 1993 Chinese enterprises were able to raise capital in the Hong Kong markets, but after 1997 these relationships have steadily increased. However the Chinese and Hong Kong economies have retained many of their differences since 1997, in particular Hong Kong retains its distinctive market economy and remains the most open economy in the world, having had the highest index of economic freedom in the world since 1995. So despite the unification of China and Hong Kong, the economies and stock markets are still fundamentally different in many important respects.

### 3.2 The model estimated using Arellano-Bond approach

The results in Table 1 have been estimated using the Arellano-Bond (Note 5) (1991) 2-step estimation technique, which uses a panel generalised method of moments (GMM) approach, with White period standard errors and covariances to ensure the error term is Gaussian. The results generally follow the standard pattern in that in all the models, per capita real regional income is positive and significant, as is the length of roads variable, suggesting FDI is attracted to wealthy regions with developed infrastructure. Although the per capita income coefficients are higher than Cheng and Kwan (2000), they are similar to those in Wei *et al.* (1999). The agglomeration effect is also positive and significant, indicating that FDI follows areas that have already attracted large amounts of it in the past. The coefficient is about 0.1 in all three tests, indicating a reasonable self-reinforcing effect of the FDI past values on the current value.

The real wages tend to be negative and significant, whereas levels of education are generally insignificant and with a mix of signs. This is perhaps a surprising result as other studies have found that the worker quality and levels of education are an important determinant of FDI, such as in Fung *et al.* (2002). Although this finding coincides with other studies, such as Cheng and Kwan (2000), who despite using a slightly different measure of regional education levels, find little evidence that it has a significant effect on FDI.

The stock market variables however are all negative and significant, suggesting that on the whole FDI has been a substitute for domestic investment, regardless of which stock market measure is used. This lends further support to other studies that have found that FDI tends not always to compliment domestic investment (De Mello, 1999) and can produce a negative relationship with domestic stock markets (Klein and Rosengren, 1994). The Hong Kong stock market result produces a more significant Q variable than the other Chinese markets, this could be due to the greater importance of the Hong Kong stock market to the Chinese and international economies as a whole, particularly with regard to FDI as Hong Kong has historically had an important role in facilitating China's FDI flows. The Sargan tests of the over-identifying restrictions indicate acceptance of the null hypothesis that the restrictions are valid.

### 3.3 The model estimated using the Arellano-Bover approach

Table 2 contains the results from the models estimated with the Arellano-Bover approach to dynamic panel models. In all three sets of results there is a marked improvement in terms of the significance of the variables. The variables are now significant and correctly signed, with some slight changes in the magnitude of the coefficients. In particular the education variable is now significant, which is a more intuitively acceptable result, suggesting that FDI is attracted to areas where the population is more skilled, which was not found in the Cheng and Kwan (2000) study. This result may suggest that the use of the Arellano-Bover approach has some advantages over the Arellano-Bond approach, when examining FDI in China and using dynamic panel methods to account for agglomeration effects in general.

## 4. Conclusion

The results from this study into FDI in China tend to support previous studies, with respect to the main determinants of FDI, as they are mostly significant and correctly signed, with the initial exception of the education measure variable. However the inclusion of a measure of the domestic stock markets, using a Tobin's Q variable appears to suggest that they have a significantly negative effect on FDI in China and thus FDI acts indirectly as a substitute for domestic Chinese investment. This could be due to China encouraging FDI as a means of improving the technological base and thus productivity of its economy at the expense of domestic investment or alternatively reflect the economic downturn in the Far East following the financial crisis of 1997 and consequent decline in stock markets and domestic investment in the area, facilitating a greater reliance on FDI.

The policy implications of these results are that they emphasise a possible financial dimension to the debate over factors attracting FDI to transition economies such as China and the inter-relationship between FDI and domestic investment. They possibly also suggest that FDI can crowd out the less productive domestic investment, which in turn affects domestic company earnings and thus their stock market value. In addition these results suggest the use of the Arellano-Bover approach to dynamic panel estimation, to account for agglomeration effects, can produce an overall improvement in the way FDI is modelled. In this study this method has produced a significant education variable, which is correctly signed in all models, as well as improving the significance of the other variables.

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### Notes

Note 1. Other determinants of FDI in China have been suggested in other studies such as Blonigen (2005), including the real exchange rate, but in general those included here (excluding the Tobin's Q variable) have been found to be the most successful (Also the Chinese exchange rate against the US dollar was fixed during this time span and both had low inflation levels.) In addition other proxies for the levels of education and infrastructure have been used, but it tends to make little difference which proxy is adopted, which was also the case in these tests when other proxies were tried.

Note 2. Klein and Rosengren (1994) suggest a different reason for the theoretical relationship between stock prices and FDI being negative, arguing stock prices act as a measure of wealth. According to the imperfect-capital-market-theory, the negative relationship between FDI and relative wealth, as well as the real exchange rate, is because when domestic wealth levels are lower than abroad, it is easier to obtain investment funds from abroad where wealth is relatively more abundant, resulting in an increase in FDI.

Note 3. Fiscal incentives have been used in a number of Chinese regions to attract FDI, particularly investment in technological sectors, although how they affect levels of FDI is open to debate, as discussed by Wei *et al.* (1999).

Note 4. This specific price index was not complete for two provinces, which were Guangdong and Hainan, for these two cases the main cpi was used as a proxy. As both regions have been important recipients of FDI, they were included despite the lack of this data series. When the models were estimated with and without these two regions, the results were not materially different.

Note 5. A further disadvantage of the Arellano-Bond approach is that it does not allow for the inclusion of time-invariant variables, such as specific dummy variables for individual regions, in the model. See Arellano and Bond (1991) and Bond (2002) for further discussion on dynamic panel models.

Table 1. Determinants of FDI in China using the Arellano-Bond Approach

Variables	Shanghai SM	Shenzen SM	Hong Kong SM
GNP	1.541** (0.307)	1.290** (0.295)	1.348** (0.314)
E	-0.876 (0.503)	-0.414 (0.433)	0.011* (0.356)
W	-0.374 (0.629)	-0.837 (0.558)	-1.486** (0.396)
RL	0.488* (0.241)	0.605** (0.198)	0.772** (0.102)
TQ	-0.364** (0.079)	-0.244** (0.064)	-0.242** (0.041)
FDI(-1)	0.082* (0.044)	0.103** (0.044)	0.110** (0.040)
OIR	0.485	0.387	0.383

Notes: Where GNP is per capita GNP, E is per capita expenditure on education, W are real wages, RL is length of highway per capita, TQ is Tobin's Q, FDI is foreign direct investment. The three tests use the stock markets in the Tobin's Q variable listed at the top. OIR is the Sargan test of overidentifying restrictions (p-values reported), where the instruments used, include lagged values of the variables. Standard errors in parentheses, \*\* (\*) indicates significance at the 1% (5%) significance level.

Table 2. Determinants of FDI in China using the Arellano-Bover Approach.

Variables	Shanghai SM	Shenzen SM	Hong Kong SM
GNP	0.917* (0.348)	0.857* (0.328)	1.025** (0.394)
E	0.912* (0.332)	1.00* (0.354)	0.754** (0.378)
W	-1.972* (0.384)	-2.077* (0.404)	-2.017* (0.400)
RL	0.329* (0.104)	0.321* (0.110)	0.369* (0.112)
TQ	-0.219* (0.050)	-0.169* (0.052)	-0.261* (0.058)
FDI(-1)	0.079** (0.036)	0.082** (0.038)	0.061 (0.037)
OIR	0.388	0.373	0.457

Notes: See Table 1.