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DETERMINANTS OF TAIWANESE INVESTMENT IN CHINA: AN AGGLOMERATION ECONOMIES-BASED PERSPECTIVE

George Shih-Ku Chen*

Abstract:
We investigate the impact of agglomeration economies on the distribution of Taiwanese investment in China for the period 1996-2005. We find that the uneven distribution of Taiwanese investment can be explained by agglomeration economies related to industrial linkages, labour-market pooling and monitoring costs. Furthermore, we find evidence that the nature of agglomeration forces attracting Taiwanese investment not only differs across regions but also changes over time. Importantly, we find mild evidence that this investment is affected by a `market crowding effect', or that the benefit from agglomeration decreases once the market size exceeds a critical threshold.

Keywords: Agglomeration economies; China; Taiwanese investment

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*Department of Economics, Monash University. Email: George.Chen@buseco.monash.edu.au
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1 Introduction

In the existing literature, agglomeration economies are generally portrayed as an important determinant of foreign direct investment (FDI), with a positive effect on the business environment. Economic theory offers several mechanisms to explain why agglomeration economies are beneficial to investment. Agglomeration economies may generate pecuniary externalities that reduce production costs, and thereby attract investment (see e.g. Fujita et al., 1999; Fujita and Thisse, 2002; Baldwin et al., 2003; Ottaviano and Thisse, 2004).[1] On the other hand, it has also been suggested that strong agglomeration economies may lead to congestion and high factor costs and may, in fact, deter investment (see e.g. Brakman et al., 1996; Junius, 1999; Fujita and Krugman, 2004).

In this paper, we reexamine the relationship between FDI and agglomeration economies. The previous empirical evidence generally suggests that agglomeration economies (sometimes also referred to as agglomeration forces) have a positive effect on aggregate investment flows (see e.g. Head et al., 1995; Braunerhjelm and Svensson, 1996; Head and Ries, 1996; Guimaraes et al., 2000). Due to the nature of research design used in these studies, however, they have not considered the effect of 'dispersion forces', or forces that work against agglomeration economies, on FDI. We provide new evidence by analysing how these two opposing forces shape foreign investors' location decision. For this purpose, we study the distribution of Taiwanese investment in China.

In the agglomeration economies literature, the spatial distribution of economic activity is the "outcome of a process involving two opposing types of forceKagglomeration (or centripetal) forces and dispersion forces (or centrifugal) forces" (Fujita and Thisse, 2002, p.7). Formally, agglomeration forces can arise in "a situation in which a firm's productivity goes up as the operation size of the sector or the size of economy expands in a single location" (Yang, 2001, p.43). In other words, agglomeration forces differ from increasing returns at the firm level in that reductions in unit production cost occur externally rather than internally (Junius, 1999). Our contribution is to show that the regional distribution of FDI is the result of the interaction

[1] Scitovsky (1954) points out that externalities should be further divided into technological externalities and pecuniary externalities. More precisely, "the former occurs when the effects of non-market interactions which are realised through processes directly affecting the utility of an individual or the production function of a firm. By contrast, the latter refers to the benefits of economic interactions which take place through usual market mechanisms via the mediation of prices" (Fujita and Thisse, 1996, p.345). To state it differently, pecuniary externalities refer to externalities which operate through prices rather than through real resource effects.

between these two opposing forces.

In the empirical analysis, we first examine how agglomeration economies affect the distribution of Taiwanese investment in China. However, the aggregate nature of the data means that those results may be due to the effect of natural endowments rather than the effect of agglomeration economies. In order to control for this possible endowment effect, we split the sample size into the coastal provinces and the interior provinces. Furthermore, we divide the sample period into two sub-sample periods to control for potential biases arising from policy changes. Using provincial-level panel data on Taiwanese investment in China for 1996-2005, we find that agglomeration economies act as a catalyst for an uneven distribution of inward FDI in China. We also find that the nature of agglomeration economies attracting Taiwanese investment has changed since 2000.

Our study builds on previous empirical studies investigating agglomeration economies as a determinant of FDI in China. In general, these studies model agglomeration economies using either one or a combination of the following three indicators. The first indicator is based on the notion of 'localisation economies', or that repeated inter-firm interactions generate pecuniary externalities that enhance productivity growth in regions where these firms congregate (see e.g. Marshall, 1898). Most studies have used the number of manufacturing firms in a province as a proxy for localisation economies. For example, Head and Ries (1996), Belderbos and Carree (2002), He (2002), Cheng and Stough (2006) and Cheng (2007) find that this number has a positive effect on the level of FDI in a Chinese province. In another group of studies, Zhang (2001), Tuan and Ng (2004) and Cheng (2008) use the ratio of manufacturing output-to-provincial output instead. They find that FDI in a Chinese province increases proportionately with this ratio.

The second indicator is based on the notion of 'urbanisation economies', or that repeated inter-personal interactions generate pecuniary externalities that enhance productivity growth in regions in which these people congregate (see e.g. Jacobs, 1969, 1984). Using population density as the measure for urbanisation economies, Wei et al. (1999), He (2002) and Tuan and Ng (2003) find that highly populated provinces tend to attract more FDI. In another study, Wakasugi (2005) uses the number of manufacturing employees as the proxy for urbanisation economies and finds that this number has a positive effect on the level of Japanese investment in a Chinese province.

The third indicator is based on the notion of 'disadvantages of alien status', or that the investors' foreignness to the host location may not place these investors on a level-playing field with indigenous firms (see e.g. Caves, 1971; Dunning, 1992). In order to reduce the extent of this problem, potential foreign investors prefer regions with a high presence of foreign investors due to pecuniary externalities brought about by information spillover from these investors (see e.g. Kinoshita and Mody, 2001; Deichmann et al., 2003). In the empirical literature, this effect is often captured by the number of foreign firms in a province. For example, Head and Ries (1996) find that this number has a positive effect on foreign investors in China. Furthermore, Zhou et al. (2002), Cheng and Stough (2006) and Cheng (2007, 2008) find that, by locating in Chinese provinces with a high level of cumulative Japanese investment, Japanese investors are able to reduce information costs and uncertainties through information spillover. Meanwhile Belderbos and Carree (2002) and Wakasugi (2005) suggest that this nationality agglomeration may also arise as a result of Japanese investors' unique governance structures such as keireitsu. He (2003) includes other major foreign investors in China and finds that this nationality agglomeration is equally prevalent among Hong Kong, Taiwanese and American investors. In a separate study, Sun et al. (2002) measure this effect by calculating the cumulative FDI-to-cumulative investment ratio in each province and find that this ratio actually has a negative impact on FDI in China. They argue that their finding need not be inconsistent with the literature, since "from the point of view of multinational enterprises, there may be diminishing return for FDI in certain 'hot' provinces and it may be better to invest in provinces that are not flooded with FDIs" (Sun et al., 2002, p.99). In other words, their finding can be seen as the evidence for dispersion forces in work.

Our study differs from the existing studies on the nexus of agglomeration economies and FDI in China in two very important aspects. Firstly, as we have already pointed out, a majority of these studies consider only a narrow definition of agglomeration economies. We seek to improve on this by incorporating other types of agglomeration economies into the analysis. Secondly, despite the rise to prominence of Taiwanese investment in China during the 1990s, there is no systematic analysis of the impact of agglomeration economies on Taiwanese investment to date. Knowing the nature of agglomeration economies attracting Taiwanese investment is important for public policy purposes. For example, if Chinese policymakers want to continue attracting Taiwanese investment for regional economic development, then they must formulate policies that promote the types of agglomeration economies pertinent to Taiwanese investors.

This paper is structured as follows: Section 2 provides a conceptual framework showing that the regional distribution of FDI can be driven by the interaction between agglomeration and dispersion forces. Section 3 presents the empirical model and the choice of proxies and data. The results are presented in Section 4, and Section 5 concludes.

2 Agglomeration Economies and the Distribution of Foreign Direct Investment – A Conceptual Framework

In this section we show how agglomeration economies can shape the regional distribution of FDI. To begin with, let us suppose that the world consists of two regions, two sectors, and two factors of production. The two regions, home (H) and foreign (F), are assumed to be identical in every aspect, except that region H has a higher level of initial labour endowment. For ease of exposition, we call one of these two sectors the manufacturing (M) sector and let it produce differentiated goods under monopolistic competition and increasing returns to scale. In contrast, we call the other sector the agricultural (A) sector and let it produce a homogeneous good under perfect competition and constant returns to scale. To keep our discussion manageable, we assume that, in order to produce one M-sector variety, both capital (K) and labour (L) are required. However, in terms of the A-sector output, only L is required in the production process. For the purpose of this study, we let K be the only factor of production that is free to move between these two regions. In other words, we can infer the regional distribution of the M-sector by examining the pattern of interregional flow of K. In order to highlight the importance of location choices, we let interregional trade in A-sector output be costless, while trade in the M-sector output entails some positive trade costs.

Baldwin et al. (2003, p.9) define agglomeration forces as those that show "the tendency of a spatial concentration of economic activity to create economic conditions that foster the spatial concentration of economic activity". In our model, the first type of agglomeration force is related to our assumption of initial labour endowment. Recall that we have assumed this endowment is larger in region H than region F. If we also assume that all workers spend their income locally, then we expect the market size in region H to be larger than region F. Krugman (1991) shows that this difference in market size generates pecuniary externalities associated with increasing returns at the firm level that encourages some M-sector firms in region F to relocate to region H. Formally, Ottaviano and Thisse (2004) refer to this logic as the 'market access effect' and we can state it as follows:

Hypothesis 1 *Consider an economic space that consists of two regions, two sectors, and capital as the only factor of production that is interregionally mobile. If these two regions only differ in terms of initial labour endowment, then pecuniary externalities associated with increasing returns at the firm level will attract capital from the small region to the large region.*

The second type of agglomeration force is related to the production function of the M-sector. Recall that we have assumed both L and K are required to produce one M-sector variety. To make our model closer to reality, let us also assume that one unit of the 'M-sector composite good', which is comprised of all existing M-sector varieties, is now required as the intermediate input for producing one M-sector variety. Fujita et al. (1999) suggest that this good is introduced to capture the notion of industrial linkages, with more M-sector varieties included in this good indicating a more complex system of industrial linkages. This system's complexity can be an important agglomeration force because it generates pecuniary externalities through more varieties of intermediate inputs in, and lower procurement costs of, the M-sector composite good (Ottaviano and Puga, 1998). Applying this reasoning to our example, if we assume that the number of M-sector varieties in a region increases proportionately with the number of workers in that region, and that these varieties are used in the production of other M-sector varieties, then we expect larger initial labour endowment to give rise to a more complex system of industrial linkages in region H Krugman and Venables (1995). These linkages, in turn, generate pecuniary externalities that attract some M-sector firms in region F to relocate to region H (Fujita et al., 1999). Formally, Baldwin et al. (2003) refer to this logic as the 'vertical linkage effect' and we can state it as follows:

Hypothesis 2 *Consider an economic space that consists of two regions, two sectors and capital as the only factor of production that is interregionally mobile. If these two regions differ only in terms of initial labour endowment, then pecuniary externalities associated with cheaper and* *more varieties of intermediate inputs at the region level will attract capital from the small region to the large region.*

The third type of agglomeration force is related to the supply and demand of specialised workers. As Marshall (1898) points out, a higher probability of finding employment in related industries encourages specialised workers to congregate in regions with a large contingent of firms demanding their services.[2] Symmetrically, firms also benefit from locating in these highly agglomerated regions as it increases their probability of obtaining specialised services. Krugman (1991) shows that these two forces work in opposite directions due to specialised workers competing for the limited employment opportunity in these regions. This depresses the cost of specialised services, which encourages more firms to locate in these regions. Furthermore, Rotemberg and Saloner (2000) suggest that, in order to secure employment, specialised workers in these regions are more willing to invest in human capital at their own expense. This human capital formation, in effect, implies that firms in these regions are paying a lower wage rate for these specialised workers. In our example, this means that region H has a lower effective wage rate than region F, which attracts some M-sector firms in region F to relocate to region H. Formally, Dumais et al. (2002) refer to this logic as the 'labour-market pooling effect' and we can state it as follows:

Hypothesis 3 *Consider an economic space that consists of two regions, two sectors and capital as the only factor of production that is interregionally mobile. If these two regions differ only in terms of initial labour endowment, then pecuniary externalities associated with securing low-cost specialised workers will attract capital from the small region to the large region.*

In theory, these agglomeration forces, working in tandem, should lead to 'catastrophic agglomeration', or that all M-sector firms end up locating in one region only (Baldwin et al., 2003). However, such a view neglects the fact that there are also dispersion forces working against economic agglomeration. For example, some firms may not enter highly agglomerated regions because competition over limited supply of factors of production in that region can increase factor prices, which reduces the benefits from agglomeration (Fujita et al., 1999; Fujita and Krugman, 2004). While negative externalities, such as congestion and pollution, in these

[2]Marshall (1898) makes an implicit assumption that the demand for specialised workers is not perfectly correlated across locations.

regions may deter firms from entering there Brakman et al. (see e.g. 1996). From another perspective, Johansson and Quigley (2004) suggest that R&D-intensive or large firms are reluctant to locate in these regions because they tend to be the contributors of knowledge spillover yet receive little monetary reward in return. These forces explain why, in reality, economic activities are dispersed across different locations rather than concentrated in a few locations.

In our example, one of the key dispersion forces preventing catastrophic agglomeration of the M-sector firms can be related to the interregional trade in the M-sector output. Recall that we assume this trade entails some positive trade costs. In the literature, dispersion forces of this kind are generally modelled by 'iceberg trade costs', or the physical quantity of the good arriving at the final destination decreases with the distance it has to travel (see e.g. Yang, 2001). However, these costs make exporting the M-sector output from region H to region F more difficult, which leaves a niche market in region F for some local M-sector firms to serve. This explains why we do not expect all M-sector firms to concentrate in region H. Formally, Fujita and Thisse (2002) refer to this logic as the 'trade cost effect' and we can state it as follows:

Hypothesis 4 *Consider an economic space that consists of two regions, two sectors and capital as the only factor of production that is interregionally mobile. If these two regions differ only in terms of initial labour endowment, then the existence of positive trade costs will not attract capital from the small region to the large region.*

Another important dispersion force pertinent to the regional distribution of FDI in our model is 'monitoring costs', or the costs associated with maintaining foreign subsidiaries. These costs partly explain the stylised fact that despite some regions with favourable factor endowment, they still fail to attract FDI because the costs of maintaining a physical presence there are too high. In our example, this means that the presence of monitoring costs may deter some M-sector firms in region F from relocating to region H, since these costs can be so great that they more than offset any pecuniary externalities to be gained following the relocation. Formally, Robert-Nicoud (2002) refer to this logic as the 'monitoring cost effect' and we can state it as follows:

Hypothesis 5 *Consider an economic space that consists of two regions, two sectors and capital as the only factor of production that is interregionally mobile. If these two regions differ only* *in terms of initial labour endowment, then the presence of positive monitoring costs will not attract capital from the small region to the large region.*

In summary, our conceptual framework suggests that the regional distribution of FDI is positively influenced by the effects of market access, industrial linkages, and labour-market pooling, but it is negatively influenced by the effects of trade costs and monitoring costs.

3 Econometric Analysis

3.1 Dependent Variable

The dependent variable in our study is the annual inflow of Taiwanese investment to each of the 24 Chinese provinces from 1996 to 2005.[3] The state of Taiwanese investment is regularly reported by the Ministry of Economic Affairs (MOEA) in Taiwan and the Ministry of Commerce (MOFCOM) in China. However, as Yang and Tu (2004) point out, MOEA consistently underestimates this investment due to non-reporting and under-reporting. In contrast, van Hoesel (1999) and Tung (2002) argue that MOFCOM's figures may be more reliable because for Taiwanese investors to qualify for fiscal incentives and preferential treatment, they must disclose information such as country of origin to the Chinese authorities. In our study, we use MOEA figures on the basis that most Taiwanese investors registered with MOEA generally operate genuine businesses in China and are active in the China-Taiwan bilateral trade (see e.g. Tung, 2003). Furthermore, we do not use MOFCOM figures as they contain many dubious investment projects such as those projects financed by 'roundabout' Chinese capital rather than capital originating in Taiwan (see e.g. Pomfret, 1994). In terms of the sample period, we choose the period 1996-2005 on two grounds. The first is related to the availability of data; MOEA only began to report on the state of Taiwanese investment at the provincial level since 1996. And the second is that this period contains year 2000; a year in which the governments on both sides of the Taiwan Strait changed their attitude toward this development.

[3] We exclude Tibet from the sample due to its unique political status. Provinces including Guangxi, Gansu, Ningxia, Qinghai, Shannxi and Xinjiang are excluded from the sample because there was no Taiwanese investment reported in these provinces throughout the sample period. Also, we treat Hong Kong and Macao as source countries as they are the leading contributors of the stock of FDI in China.

3.2 Measuring Agglomeration Economies

3.2.1 Market Access

We propose three measures for the market access effect. Our first measure for market access is gross provincial output (GPP), on the basis that it is positively related to local residents' purchasing power (see e.g. Zhang, 2001; Fung et al., 2002; Sun et al., 2002; Fung et al., 2005; Gao, 2005; Zhang, 2005). However, some researchers argue that its use may ignore the effect of population size (see e.g. Chen, 1996; Cheng and Kwan, 2000). In order to control for this, we use provincial GPP per capita as our second measure for market access, which is arguably a more direct measure for local residents' purchasing power. For many service-based foreign investors in China, population size presents the pool of potential clients (Zhu, 2005). To capture this, we use provincial population density as our third measure for market access (see e.g. He, 2002). We expect these three measures for market access to have a positive impact on the distribution of Taiwanese investment in China.

3.2.2 Industrial Linkages

We propose three measures for the industrial linkage effect. Our first measure for industrial linkages is provincial manufacturing output, on the basis that it is positively related to the manufacturing varieties being produced locally (Qu and Green, 1997). In relation to this, some researchers suggest that these manufacturing varieties may also increase with the number of local manufacturing firms (see e.g. Head and Ries, 1996; He, 2002; Zhou et al., 2002; Wakasugi, 2005). Based on this, our second measure for industrial linkages is the number of manufacturing firms at the provincial level. Our third measure is related to the stylised fact that many foreign investors extend their inter-personal and inter-firms networks established in the home countries to the host countries (Chang and Park, 2005). As such, our third measure for industrial linkages use both provincial cumulative FDI and provincial cumulative investment originating from a particular country (see e.g. Head and Ries, 1996; Wakasugi, 2005; Cheng and Stough, 2006; Cheng, 2007). We expect these three measures to have a positive impact on the distribution of Taiwanese investment in China.

3.2.3 Labour-Market Pooling

We propose two measures for the labour-market pooling effect. The first measure for labour-market pooling is provincial average real wage rate (see e.g. Chen, 1996; Head and Ries, 1996; Qu and Green, 1997; Cheng and Kwan, 2000; Coughlin and Segev, 2000). However,Sun et al. (2002) argue that this wage rate may not be an accurate proxy due to unique institutional features in China's wage structure, such as housing subsidies, health insurance, and cash bonuses. In order to control for this, we also use provincial efficiency wage rate as a proxy for the labour-market pooling effect (see e.g. Chen, 1997; Wei et al., 1999; Wei and Liu, 2001; He, 2002; Ljunwall and Linde-Rahr, 2005). We expect these two measures to have a negative impact on the distribution of Taiwanese investment in China.

3.2.4 Trade Costs

We propose three measures for the trade cost effect. Our first measure for trade costs is provincial highway density, on the basis that an extensive highway network reduces the costs of shipping intermediate and final goods in and out of production facilities (see e.g. Cheng and Kwan, 2000; Ljunwall and Linde-Rahr, 2005). Based on similar logic, our second measure for trade costs is provincial railway density, with a higher density indicating lower transportation costs (see e.g. Chen, 1996; Head and Ries, 1996; Sun et al., 2002). However, some researchers suggest that, for export-orientated foreign investors, a better indicator for trade costs should be the linkages between different modes of transportation (see e.g. Chen, 1997; Zhang, 2001; Gao, 2005). To take this into account, we propose the combined length of railways, highways, and waterways at the provincial level as our third measure for trade costs. We expect these three measures to have a positive impact on the distribution of Taiwanese investment in China.

3.2.5 Monitoring Costs

We propose two measures for monitoring costs. Our first measure for monitoring costs is provincial telephone density, on the basis that the share of local residents who have access to telephone sets reduces monitoring costs (Head and Ries, 1996). Our second measure for monitoring costs is based on the provincial output of postal and telecommunication industries and the number of employees in these industries at the provincial level (Wei and Liu, 2001). In general, higher provincial output of, and more local employees in, postal and telecommunication industries suggest a better communication infrastructure, which is necessary for reducing monitoring costs. We expect these two measures to have a positive impact on the distribution of Taiwanese investment in China.

3.3 Data Description

The dependent variable in our analysis is the annual flow of Taiwanese investment to a Chinese province. The figures for this investment are obtained from various issues of *Statistics on Approved Indirect Mainland Investment by Year and Area* published by MOEA. Since these figures are stated in terms of US dollars, we convert them into the Chinese currency, *Renminbi* (RMB), using the yearly average US dollar/RMB exchange rate, before deflating them to 1990 prices using the GDP deflator for the relevant province.

Table 1 provides summary statistics of 18 commonly proposed proxies for these forces identified in Section 3.2, with the data taken from various issues of China Statistical Yearbook. In constructing Table 1, we convert GPP, GPP per capita, provincial manufacturing output and provincial output of postal and telecommunication industries into 1990 prices using the gross domestic product (GDP) deflator for the relevant province. Similarly, we convert provincial wage rates into 1990 prices using the consumer price index (CPI) for the relevant province. In order to obtain the respective densities, we adjust the population size, the total length of railways and highways and the number of telephone sets for the relevant province's landmass. In terms of the figures for cumulative FDI and Taiwanese investment in each province, we make 1996 our reference point and use the GDP deflator for the relevant province to deflate the stock of these investments. Finally, the numbers of foreign-invested and Taiwanese enterprises in the province are year-end figures.

[Insert Table 1]

According to our discussion in Section 3.2 and in Table 1, the market access effect can be measured by GPP (*Gpp*), GPP per capita (*Pgpp*) and provincial population density (*Popd*). The trade cost effect can be measured by provincial railway density (*Rwayd*), provincial highway density (*Hwayd*) and the combined provincial transportation density (*Wayd*). The industrial linkage effect can be measured by provincial manufacturing output (*Moutput*), provincial number of manufacturing firms (*NMF*), provincial number of manufacturing workers (*Mworker*), provincial cumulative foreign capital (*CFDI*), provincial cumulative Taiwanese investment (*CTDI*), provincial number of foreign-invested enterprises (*NFDI*) and provincial number of Taiwanese-invested enterprises (*NTDI*). The labour-market pooling effect can be measured by provincial average wage rate (*Awage*) and provincial efficiency wage rate (*Ewage*). The Monitoring cost effect can be measured by provincial telephone density (*Teld*), provincial output of postal and telecommunication industries (*Toutput*) and provincial number of postal and telecommunication employees (*Tworker*).

3.4 Econometric Model

The main problem in Table 1 is that the proposed variables tend to overlap with each another. In order to reduce the problem of multicollinearity in our analysis, it is important to retain only those variables pertinent to the distribution of Taiwanese investment in China. To facilitate this data reduction procedure, we calculate the Pearson pair-wise correlation coefficients by transforming these variables into their natural logarithm and stacking them across provinces. Gujarati (1995) suggests that, as a rule of thumb, the potential for multicollinearity arises when the Pearson pair-wise correlation coefficient exceeds 0.60. A visual inspection of Table 2 reveals that there is a high degree of correlation among the proposed variables (as highlighted in bold). In order to avoid spurious results, we eliminate pairs that have a Pearson pair-wise correlation coefficient higher than 0.60.[4] Specifically, we select *Popd* as the proxy for the market access effect, *Hwayd* as the proxy for the trade cost effect, *Mworker* as the proxy for the industrial linkage effect, *Ewage* as the proxy for the labour-market pooling effect and *Teld* as the proxy for the monitoring cost effect. Table 3 indicates that these five selected variables are not highly correlated with each other.

[Insert Table 2]

[Insert Table 3]

Given these five selected variables, we write the reduced-form specification of the annual flow of Taiwanese investment to a Chinese province for the period 1996-2005 as follows: $TI_{it} = f(x_{it})$,

[4]We also perform factor analysis using Varimax with Kaiser Normalisation on the 18 variables listed in Table 2 and find that these five selected variables explain approximately 90 percent of the variances in the table.

where TI_{it} is the annual flow of Taiwanese investment to province i at time t and x_{it} is a vector of these selected variables. In addition, we introduce a policy dummy variable (*Policy*) to capture the effect of policy change on Taiwanese investment in China. We assign a value of zero to this variable for the period 1996-2000 to reflect the severe restrictions on Taiwanese investment, and a value of one to this variable for the period 2001-2005 to reflect a more liberal policy framework on this investment. We expect a positive sign on this variable, on the basis that relaxations in laws and regulations by the Taiwanese government should encourage Taiwanese investment, all things being equal. Taken together, the annual flow of Taiwanese investment to province i at time t can be written as follows:

$$TI_{it} = f(Popd, Hwayd, Mworker, Ewage, Teld, Policy) \tag{1}$$

We select panel data analysis to estimate equation (1) on two grounds. Firstly, panel data analysis is able to control for heterogeneity of cross-sectional observations by allowing for individual-specific effects (Davidson and MacKinnon, 2004). And secondly, panel data analysis provides more variability, higher degrees of freedom and efficiency, and less collinearity among variables (Hsiao, 1989). It is worth noting that we considered both random effect and fixed effect models, but since the Hausman test ($\chi^2 = 0.002$) rejected the random effect model, we report only the result of the fixed effect model. Formally, the fixed effect model in our analysis can be specified as follows:

$$\begin{aligned} ln(TI_{it}) = \alpha + \beta_1 ln(Popd_{it}) + \beta_2 ln(Hwayd_{it}) + \beta_3 ln(Mworker_{it}) \\ + \beta_4 ln(Ewage_{it}) + \beta_5 ln(Teld_{it}) + \beta_6 (Policy) + \epsilon_{it} \end{aligned} \tag{2}$$

where ϵ_{it} is the disturbance term associated with province i at time t. However, in estimating equation (2), we need to address two types of individual-specific effects. The first is the 'individual time-invariant effect', or variables that remain unchanged for a given province through time, but vary across provinces. Some examples of this include a province's cultural affinity with, and geographic proximity to, Taiwan. To control for this, we allow the intercept terms, α_i, to vary across provinces in equation (2). And the second is the 'period individual-invariant effect', or variables that remain unchanged across all provinces at a given point in time, but vary through time. Some examples of this include changes in the laws and regulations governing Taiwanese investment. We control for this by introducing the *Policy* dummy variable in equation (2).

Before estimating equation (2), two important issues need to be addressed. The first is related to the time-series observations in our panel data. In order to avoid spurious results, it is important to check for the order of integration to ascertain that these selected variables have not entered the steady state long-run solution to the general model (see e.g. Barrell and Pain, 1996). There are three common procedures for testing a unit root in a panel data setting; namely, the Maddala and Wu (1999) Augmented Dickey-Fuller (ADF) Fisher Chi-square test, the Breitung (2000) t-test and Im et al. (2003) (IPS) t-bar test. Before applying these tests, we demeaned our data to control for cross-sectional dependence in the disturbance terms (Smyth, 2003). Among these three panel unit root tests, the t-bar test is most appropriate for our purpose as it does not require all provinces to converge towards the equilibrium value at the same speed (Narayan and Smyth, 2007). Nevertheless, Table 4 reports the results for these three procedures. In general, all variables are stationary at the 10 percent level of significance. This result suggests that we do not need to check for panel co-integration, and that we can assess the significance of a variable in our model using the level series.

[Insert Table 4]

Another potential problem in estimating equation (2) is related to possible cross-sectional heteroskedasticity in province-specific characteristics. We control for this by using the generalised least square (GLS) method proposed in Greene (2000). Specifically, we compute the GLS estimators by first running ordinary least square (OLS) on the entire sample for each province. Next, we estimate the variance components using the residuals from the OLS estimates. Finally, we use these estimated variances to compute the parameters of the equation and adjust these GLS coefficients' statistical significance by the standard White (1980) heteroskedasticity-consistent standard errors and covariance matrix correction procedure. While it is common for time-series analysis to control for autocorrelation, we do not think it poses a serious problem in estimating equation (2) given the short time series and the long time interval of the data (see e.g. Gujarati, 1995).

We also perform regressions on the first-differenced data. The rationale behind this is to allow us to examine the impact of the growth rate of a variable on the distribution of Taiwanese investment in China. Apart from estimating the full sample period, we also use year 2000 as the reference year to divide the full sample period into two sub-sample periods; namely, 1996-2000 and 2001-2005. This split of sample period enables us to investigate the impact of policy changes since 2000 on the nature of agglomeration economies attracting Taiwanese investment. In these sub-sample period analyses, we drop the Policy variable from equation (2). In relation to this, since more than two-thirds of the stock of Taiwanese investment is found in the coastal provinces, this may be the reason for the results obtained. To test this hypothesis, we perform a separate set of tests that excludes the coastal provinces and compare their results with the full sample.

4 Results

4.1 Full sample period: 1996-2005

Table 5 reports both the estimated results for equation (2) for all provinces and interior provinces. Model (1) estimates the fixed effect regression allowing a different intercept for each province and Model (2) re-estimates this regression using the first-differenced data. In Model (1), except for Popd, the OLS estimates are consistent with our a priori expectation. In general, the OLS estimates lend support to our hypothesis that both industrial linkages (*Mworker*) and monitoring costs (*Teld*) are important agglomeration forces attracting Taiwanese investment from 1996 to 2005. These results are also consistent with previous findings by Wei and Liu (2001) and He (2002). In contrast, the OLS estimates suggest that market access (*Popd*), trade costs (*Hwayd*) and labour-market pooling (*Ewage*) do not influence Taiwanese investment over the same period. In addition, the policy change in 2000 did not have any material impact on Taiwanese investment, as the OLS estimate for Policy is not statistically significant at any conventional level. However, these mixed results do not mean that our conceptual framework is misspecified; rather it may be due to our choice of the White correction for heteroskedasticity, which cannot control for group-wise heteroskedasticity (Wooldridge, 2000). To address this issue, we perform a standard Lagrange Multiplier (LM) test on the fixed effect regression and find that homoskedasticity across provinces can be easily rejected at the 1 percent level of significance.

[Insert Table 5]

In order to obtain more robust results, we re-estimate Model (1) using the GLS procedure. The GLS regression reveals that, except for provincial highway density (*Hwayd*), all estimates become highly significant. For instance, a 1% increase in provincial number of manufacturing worker (*Mworker*) leads to a 2.17% increase in Taiwanese investment, which is significant at any conventional level. Similarly, a 1% increase in provincial telephone density (*Teld*) leads to a 0.50% increases in Taiwanese investment, which is significant at the 5 percent level of significance. Moreover, the policy change in 2000 (*Policy*) leads to a 0.30% increase in Taiwanese investment, which is significant at the 5 percent level of significance. Taken together, these GLS estimates confirm our hypotheses that the distribution of Taiwanese investment is affected by the effects of labour-market pooling and monitoring costs, as well as the change in the Taiwanese government's attitude towards this investment in 2000.

Furthermore, there are two important results to note with respect to the GLS estimates in Model (1). The first is related to the provincial efficiency wage rate (*Ewage*), which now enters significantly with a negative sign into Model (1) at the 5 percent level of significance. Specifically, a 1% increase in *Ewage* leads to a 1.68% reduction in Taiwanese investment. This result is consistent with previous findings by Chen (1997), Wei et al. (1999), Wei and Liu (2001) and Ljunwall and Linde-Rahr (2005). The second is related to provincial population density (*Popd*), which enters significantly with a negative sign into Model (1) at the 5 percent level of significance. Specifically, a 1% increase in *Popd* leads to a 1.59% reduction in Taiwanese investment. This result contradicts the existing literature that generally finds a positive sign on this variable (see e.g. Wei et al., 1999; He, 2002). One potential explanation for this mixed finding could be that, after China's accession to the World Trade Organisation (WTO) in 2000, the Chinese government has allowed foreign investors greater access to its domestic market. Many market-seeking foreign investors have entered highly populated provinces in order to tap into a larger pool of potential clients. This, however, creates excess demand for factors of production, such as land and labour, and puts upward pressure on factor prices in these provinces (Qu and Green, 1997). This surge in factor prices discourages many export-orientated Taiwanese investors from entering these provinces as it restricts their ability to supply competitively priced goods in the world market. In addition, negative externalities such as pollution, congestion and high crime rates in densely populated provinces have deterred many Taiwanese investors (Zhu, 2005).

Finally, restrictions imposed by the Taiwanese government on Taiwanese investors in service industries may have marginalised the importance of the market-access effect (Tung, 2003). These reasons may explain why some Taiwanese investors prefer to produce in, and export from, less densely populated provinces. Taken together, our finding of a negative market-access effect need not be inconsistent with the NEG literature, which suggests that the market-crowding effect will set in once the market size surpasses a critical threshold (see e.g. Baldwin et al., 2003).

Model (2) in Table 5 examines whether the distribution of Taiwanese investment in China is affected by the growth rate. We report only the GLS results because our earlier discussion suggests that the OLS results are biased and inconsistent. For the GLS results, except for *Popd*, all variables entered significantly into the regression at the 5 percent level of significance. Specifically, this investment is higher in provinces with a higher growth rate of *Hwayd*, *Mworker* and *Teld*, but it is lower in provinces with a higher growth rate of *Ewage*. These results are consistent with our earlier findings for the fixed effect regression; namely, this investment is positively affected by industrial linkages (*Mworker*) and monitoring costs (*Teld*), while it is negatively affected by labour-market pooling (*Ewage*).

Since Taiwanese investment is concentrated in the coastal provinces, this may be the reason for the results obtained so far. Indeed, as Bao et al. (2002) point out, the location attributes in China vary markedly between the coastal provinces and the interior provinces. In order to test that hypothesis, we perform regressions excluding the coastal provinces. Model (3) in Table 5 shows that the fixed effect GLS estimates are qualitatively the same as those obtained for the entire sample. Specifically, the GLS estimates in Model (3) show that Taiwanese investment is positively affected by the effects of industrial linkages (*Mworker*) and labour-market pooling (*Ewage*), while it is negatively affected by the effect of monitoring costs (*Teld*). Importantly, for the interior provinces, we also find a negative and statistically significant coefficient on *Popd*, indicating that the force of market crowding is stronger than the force of market access.

For Table 5, it is worth noting that, although the adjusted R^2 for the GLS estimate of Model (3) has decreased compared to Model (1), it still explains more than half of the variation in Taiwanese investment in the interior provinces. This finding suggests that, the coastal provinces' proximity to the world market, as captured by the intercepts of individual provinces, may be another factor explaining the concentration of Taiwanese investment in the coastal provinces. This result is also consistent with Ljunwall and Linde-Rahr (2005); namely, the nature of agglomeration forces attracting Taiwanese investment differs between the coastal provinces and the interior provinces in China.

In short, findings in Table 5 suggest that industrial linkages, labour-market pooling and monitoring costs affect the distribution of Taiwanese investment in China for the period 1996-2005. Furthermore, the large magnitude of the coefficient on *Mworker* suggests that industrial linkages are by far the most important agglomeration force determining the distribution of Taiwanese investment for the period studied.

4.2 Sub-sample period: 1996-2000

As pointed out by Naughton (1996) and Sun et al. (2002), the nature and source of FDI in China significantly changed following the introduction of the Open Door policy in 1978. In addition, at the turn of the century, the Taiwanese government relaxed laws and regulation governing Taiwanese investment in China. In order to take these considerations into account, we split the entire sample period into the pre- and post-2000 periods. The results of the earlier period from 1996 to 2000 are shown in Table 6.

[Insert Table 6]

Both the OLS and GLS results in Model (1) of Table 6 indicate that *Ewage* still enters significantly with a negative sign. For the OLS regression, the *Ewage* estimate is -8.81 with a t-value of -2.39. For the GLS regression, this estimate is -7.97 with a t-value of -5.00. These estimates are significantly higher than those obtained for the full sample period. This is also true for Mworker, which still enters significantly with a positive sign. For the OLS regression, the *Mworker* estimate is 7.22 with a t-value of 1.55. For the GLS regression, this estimate is 6.40 with a t-value of -5.00. In contrast, *Hwayd* and *Teld* now enter insignificantly. One way to interpret these results is to recall that, for the period 1996-2000, the majority of Taiwanese investment in China originated from export-orientated, manufacturing industries (see e.g. Tung, 2000). For those investors, the importance of industrial linkages (Mworker) and labour-market pooling (Ewage) outweighs other considerations such as trade costs (*Hwayd*) and monitoring costs (*Teld*). It is worth noting that for Model (2), the GLS estimates for *Popd*, *Hwayd*, *Mworker*, *Ewage* and *Teld* are statistically significant at the 10 percent of level of significance. This lends support to our hypotheses that Taiwanese investment increases faster in provinces with strong agglomeration forces, such as market access, industrial linkages and labour-market pooling, but decreases faster in provinces with strong dispersion forces such as trade costs and monitoring costs.

Models (3) and (4) in Table 6 report the results excluding the interior provinces. The results from these models are similar to those presented in Models (1) and (2) in Table 6. In general, Taiwanese investment is higher in interior provinces with a higher level and growth rate of Mworker, but it is lower in provinces with a lower level and growth rate of Ewage. To put it differently, Taiwanese investors prefer interior provinces with strong industrial linkages and labour-market pooling effects. However, Taiwanese investment is lower in highly populated provinces (*Popd*). One possible explanation for this could be that Taiwanese investors want to avoid competition for a limited supply of factors of production in those provinces.

In short, for the period 1996-2000, the distribution of Taiwanese investment in China was predominantly driven by the effects of industrial linkages and labour-market pooling. In addition, for this period, our baseline fixed effect model is a better candidate for explaining the distribution of Taiwanese investment in the coastal provinces than the interior provinces.

4.3 Sub-sample period: 2001-2005

We examine the impact of changes in the cross-Strait policy by studying the distribution of Taiwanese investment in China for the period 2001-2005. The OLS and GLS regressions in equation (2) are re-estimated for the fixed effect (Model 1) and the first-differenced data (Model 2) models. The results are reported in Table 7. Model (1) provides some interesting results. First, consistent with our a priori expectations, Hwayd enters significantly in the GLS regression at any conventional level of significance. For the GLS estimate, a 1% increase in *Hwayd* leads to a 2.02% increase in Taiwanese investment. A similar result is also found for *Teld.* For the GLS estimate, a 1% increase in *Teld* increases Taiwanese investment by 1.34%. These results can be attributed to the Taiwanese investors adapting 'just-in-time' (JIT) logistic chain and decentralised production systems since 2000 (see e.g. Ohmae, 2002; Zhu, 2005). To achieve these objectives, an extensive coverage of highway networks and telecommunication infrastructure is necessary. In other words, the increase in importance of trade costs and monitoring costs on Taiwanese investment since 2000 can be attributed to changes in Taiwanese investors' business strategies and practices.

[Insert Table 7]

For the first-differenced data, Model (2) provides similar qualitative results to Model (1). Specifically, for the GLS results, a province with a higher growth rate of *Teld*, *Ewage* and *Popd* attracts more Taiwanese investment. This is consistent with our findings for the GLS estimates in Model (1); namely, both trade costs and monitoring costs are the main determinants of distribution of Taiwanese investment for the period 2000-2005.

Finally, Models (3) and (4) in Table 7 report the results excluding the interior provinces, which are qualitatively the same as those for the entire sample. Specifically, for the period 2000-2005, a 1% increase in *Hway* leads to a 5.52% increase in Taiwanese investment. The large magnitude of the *Hwayd* coefficient is consistent with the hypothesis that extensive transportation network coverage is necessary for reducing trade costs in shipping goods from the interior provinces to the world market. This findings is also consistent with Kang and Lee (2007), who find that transportation costs in shipping intermediate inputs from China back to Korea is an important consideration for many Korean vertical integration-based investors. Similarly, because it is more difficult for Taiwan head offices to monitor their Chinese subsidiaries located in the interior provinces compared to those in the coastal provinces, a sound telecommunication infrastructure (*Teld*) effectively reduces monitoring costs, i.e., a 1% increase in *Teld* leads to a 1.13% increase in Taiwanese investment. This result is consistent with the Japanese investors experience in China (Belderbos and Carree, 2002; He, 2002).

Overall, for the period 2001-2005, trade costs and monitoring costs are important determinants of the distribution of Taiwanese investment in China. Furthermore, as for the earlier period 1996-2000, the baseline fixed effects GLS model explains the distribution of Taiwanese investment in the coastal provinces better than the interior provinces.

4.4 Model Fitness

Given the high explanatory power of the baseline fixed effects GLS model, it is informative to also examine its predictive power. To achieve that end, we examine the residuals generated by the baseline model for the full sample period 1996-2005. A standardised residual exceeding a t-statistic value of 1.65 is regarded as a significant outlier. In general, a positive outlier indicates that a province receives more than the predicted amount of Taiwanese investment in a particular year. Similarly, a negative outlier indicates that a province receives less than the predicted amount of Taiwanese investment in a particular year. In addition, we calculate the standard deviation of time-series residuals for each province to assess the performance of the baseline model. Consistent with the conventional interpretation, a smaller standard deviation of time-series residual indicates a better performance of the baseline model in that province.

Table 8 presents the standardised residuals of individual provinces across time, as well as the time-series standard deviation of residuals, σ. Specifically, standard deviations are markedly smaller for coastal provinces compared to interior provinces. These results suggest that the baseline model may perform better for the coastal provinces, which provides further support for our earlier finding that determinants of Taiwanese investment in China differ between coastal and interior provinces. However, it is also possible that these significant outliers obtained for the interior provinces may be due to some of these provinces receiving no inflow of Taiwanese investment in some years. These 'zero' observations can potentially bias the predictive power of our baseline model.

[Insert Table 8]

5 Conclusions

Taiwanese investment in China has increased substantially during the period 1996-2006. In general, the distribution of Taiwanese investment can be attributed to industrial linkages, labour-market pooling and monitoring costs. Specifically, Taiwanese investment is higher in provinces with sound industrial linkages, lower labour cost and better telecommunication infrastructure. These findings are consistent with previous studies examining the determinants of FDI in China. Importantly, we find evidence that there is a market crowding effect in play for this investment.

This is consistent with the NEG literature, which predicts that aggregate investment may actually fall if market size exceeds a critical threshold due to competition among foreign investors for a limited supply of productive factors. In addition, we find evidence that changes to the laws and regulations with respect to Taiwanese investment by the Taiwanese government are responsible for the systematic increase in this investment since 2000.

We also provide evidence that agglomeration forces for the distribution of Taiwanese investment in China changed over time. We find that the effects of industrial linkages and labour-market pooling were important factors attracting Taiwanese investment before 2000, but bear no significant relationship after that. We suggest that these findings partly reflect the fact that before 2000, this investment mostly originated from exported-orientated manufacturing industries. For those investors, investing in provinces with an ample supply of cheap manufacturing workers is of paramount importance in enhancing their international competitiveness.

Furthermore, we find that the effects of trade costs and monitoring costs have increased in importance since 2000. We argue that these changes in the nature of agglomeration forces partly reflect the changing management philosophy of Taiwanese investors. We also have mild evidence that market-seeking has become an important motivation for the increase of Taiwanese investment in China since 2000.

Finally, we find evidence suggesting that the nature of agglomeration forces differ distinctly between Taiwanese investment in the coastal provinces and that found in the interior provinces. This divergence can be partly explained by the Open Door policy that favours the development of FDI in the coastal provinces. As a result, Taiwanese investment in the coastal provinces remained steady throughout the period 1996-2005. In contrast, during the same period, Taiwanese investment experienced extreme fluctuations in the interior provinces.

In sum, several policy implications can be drawn from the findings in this chapter. Firstly, as we have shown, both the effects of trade costs and monitoring costs have gained in importance in recent years. This means that in order to attract more Taiwanese investment, China needs to improve transportation network and telecommunication infrastructure rather than solely relying on fiscal incentives and preferential treatment. Secondly, China should not focus on using low labour cost as the source of its international competitiveness. Our finding suggests that, from 2000 onwards, industrial upgrading among Taiwanese investors in China have rendered labour costs less of a concern. This means that China should continue improving its labour quality. Thirdly, China should strengthen its industrial base to facilitate the development of decentralised production systems. This is important because weak industrial linkages can be detrimental to the productivity of the entire production system with increasing degrees of specialisation and division of labour. Finally, China should continue to pursue economic reforms. Our finding indicates that the growth rate of a market does have a positive impact on the growth rate of Taiwanese investment. Indeed, market access could become the most important agglomeration force as China continues to open up its domestic market to the rest of the world.

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Appendices

Table 1: Summary statistics, by variable

Effect	Variable	Symbol	Sign	Mean	S.D.	Min.	Max.
Market	Gross provincial product (RMB billion)	*Gpp*	+	4.404	2.920	0.588	6.159
access	Gross provincial product per capita (RMB)	*Pgpp*	+	3.665	3.044	0.271	4.440
	Population density (person/km2)	*Popd*	+	1.455	0.259	0.402	2.554
Trade	Railway density (km/km2)	*Rwayd*	+	-1.867	-2.409	-1.161	0.301
cost	Highway density (km/km2)	*Hwayd*	+	4.644	3.589	0.337	5.224
	Total railways and highways density (km/km2)	*Wayd*	+	-0.457	-1.367	0.121	0.263
Industrial	Manufacturing output (RMB billion)	*Moutput*	+	4.404	2.920	0.588	6.159
linkages	Number of manufacturing workers (10,000 people)	*Mworker*	+	6.078	4.829	0.357	6.893
	Number of manufacturing firms (count)	*NMF*	+	3.661	4.605	0.435	2.790
	Cumulative FDI (RMB 10,000)	*CFDI*	+	9.762	8.802	0.498	10.909
	Number of foreign enterprises (count)	*NFDI*	+	3.694	2.775	0.481	4.782
	Cumulative Taiwanese investment (RMB10,000)	*CTDI*	+	5.512	3.320	0.818	7.510
	Number of Taiwanese enterprises (count)	*NTDI*	+	3.694	2.775	0.481	4.782
Labour-market	Average real wage rate (RMB)	*Awage*	-	3.674	3.281	0.174	4.159
pooling	Efficiency wage rate (RMB)	*Ewage*	-	2.649	2.206	0.207	3.220
Monitoring	Telephone density (Telephone set per 1,000 people)	*Teld*	+	0.990	-0.042	0.406	1.772
cost	Postal and telecommunication output (RMB billion)	*Toutput*	+	3.255	1.848	0.600	4.963
	Number of telecommunication and postal workers (10,000 people)	*Tworker*	+	5.348	4.542	0.236	5.750

Note: These descriptive statistics are based on the logged value and since log 0 is undefined, 10-4 is used to replace the zero whenever it occurs in the dataset. The panel data comprises observations of 29 provinces across the period 1996-2005.

Table 2: Pearson pair-wise correlation coefficient matrix, by variable

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. *Prgp*	1.00																	
2. *Popd*	0.59	1.00																
3. *Grp*	**0.83**	**0.90**	1.00															
4. *Hwayd*	-0.45	-0.52	-0.54	1.00														
5. *Lwayd*	0.62	**0.86**	**0.85**	-0.38	1.00													
6. *Rway*	0.59	0.65	0.69	-0.60	0.59	1.00												
7. *Mworker*	0.18	0.31	0.31	0.21	0.08	0.17	1.00											
8. *Indout*	**0.83**	**0.93**	**1.00**	-0.54	**0.85**	0.69	0.31	1.00										
9. *Teld*	**0.86**	0.39	0.65	-0.26	0.56	0.50	0.01	0.65	1.00									
10. *Telout*	**0.85**	**0.89**	**0.98**	-0.55	**0.85**	0.69	0.26	**0.98**	0.69	1.00								
11. *Tworker*	0.12	0.16	0.18	0.28	-0.08	0.11	**0.84**	0.18	-0.07	0.12	1.00							
12. *CNFDI*	0.67	0.63	**0.72**	-0.24	0.58	0.25	0.47	**0.72**	0.43	**0.72**	0.35	1.00						
13. *CNTDI*	0.39	0.05	0.21	0.21	0.26	0.15	-0.19	0.21	0.68	0.24	-0.22	-0.06	1.00					
14. *CFDI*	**0.76**	0.66	**0.78**	-0.22	0.64	0.31	0.44	**0.78**	0.56	**0.79**	0.34	**0.97**	0.09	1.00				
15. *CTDI*	**0.77**	0.60	**0.75**	-0.15	0.65	0.26	0.26	**0.75**	**0.73**	**0.76**	0.12	**0.78**	0.47	**0.84**	1.00			
16. *Ewage*	-0.01	0.08	0.04	-0.42	0.11	0.22	0.11	0.04	-0.06	0.06	-0.16	0.03	-0.31	-0.02	-0.07	1.00		
17. *Awage*	**0.77**	0.41	0.62	-0.19	0.59	0.37	-0.10	0.62	**0.86**	0.63	-0.17	0.35	**0.74**	0.49	**0.73**	-0.05	1.00	
18. *LNMF*	0.43	0.47	0.52	0.04	0.36	0.28	0.49	0.52	0.39	0.50	0.37	0.47	0.25	0.51	0.53	-0.21	0.34	1.00

Table 3: Pearson pair-wise correlation coefficients, by selected variable

	Popd	*Hwayd*	*Mworker*	*Ewage*	*Teld*
Popd	1.00				
Hwayd	-0.52	1.00			
Mworker	0.31	0.21	1.00		
Ewage	0.08	-0.42	0.11	1.00	
Teld	0.39	-0.26	0.01	-0.06	1.00

Table 4: Panel unit root tests, by selected variable

Variable	Breitung t-test	IPS t-bar	Maddala and Wu ADF-test
TI	-4.791***	-2.797***	82.324**
	(0.000)	(0.002)	(0.002)
Popd	-1.926**	-3.466***	243.930***
	(0.027)	(0.000)	(0.000)
Hwayd	-3.297**	-7.179***	60.670*
	(0.038)	(0.000)	(0.100)
Mworker	-2.411**	-9.549***	127.499***
	(0.002)	(0.000)	(0.000)
Ewage	-8.181***	-3.038***	129.195***
	(0.000)	(0.001)	(0.000)
Teld	-7.882***	-2.240**	145.963***
	(0.000)	(0.013)	(0.557)

Note: Asterisks denote the rejection of the null hypothesis: unit root at the 1%(***), 5%(**), and 10%(*) level of significance. Test equations include individual effects and individual linear trends, automatic selection of lags based on AIC:0-2.

Table 5: Regression results, 1996-2005, by all provinces and interior provinces

	All provinces				Interior provinces			
	Fixed effect (Model 1)		First-differenced (Model 2)		Fixed effect (Model 3)		First-differenced (Model 4)	
	OLS	GLS	OLS	GLS	OLS	GLS	OLS	GLS
Popd	-1.962	-1.593	1.605	0.900	-2.981	-4.371	0.944	-0.746
	(-1.088)	(-2.210)**	(0.523)	(0.892)	(-1.154)	(-1.908)*	(0.170)	(-0.368)
Hwayd	0.618	0.200	0.153	-0.820	0.884	-0.110	-0.835	-1.744
	(1.509)	(0.817)	(0.260)	(-2.375)**	(0.840)	(-0.170)	(-0.574)	(-0.697)
Mworker	3.307	2.166	5.366	4.928	5.14	5.097	6.066	5.338
	(1.781)*	(2.890)***	(2.554)***	(4.570)***	(2.076)**	(3.366)***	(2.074)**	(3.148)***
Ewage	-2.550	-1.680	-4.560	-4.201	-4.417	-4.768	-5.446	-5.157
	(-1.620)	(-2.391)**	(-2.248)**	(-4.063)***	(-2.144)**	(-3.488)***	(-1.953)*	(-3.149)***
Teld	0.931	0.504	2.860	2.357	0.962	0.683	2.653	2.019
	(2.101)**	(2.132)**	(3.831)***	(4.510)***	-1.468	(1.799)*	(2.776)***	(4.547)***
Policy	0.114	0.298	0.606	0.48	0.284	0.508	1.079	1.341
	(0.330)	(2.194)**	(1.691)*	(4.443)***	(0.535)	(1.433)	(1.568)	(3.234)***
Adjusted R^2	0.685	0.853	-0.121	0.201	0.465	0.571	0.110	0.065
F-statistic	18.940***	48.843***	0.879	2.861***	7.094***	10.346***	0.657	1.439
D-W	1.986	1.880	2.660	2.570	2.006	1.954	2.660	2.583
N	240	240	216	216	130	130	117	117

Note: t-statistics are in parenthesis. ***, **, and * denote the 1, 5, and 10 percent level of significance, respectively. The 'all provinces' sample includes Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Sichuan, Guizhou and Yunnan. The 'interior provinces' sample includes Hebei, Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan Sichuan, Guizhou and Yunnan.

Table 6: Regression results, 1996-2000, by all provinces and interior provinces

	All provinces				Interior provinces			
	Fixed effect (Model 1)		First-differenced (Model 2)		Fixed effect (Model 3)		First-differenced (Model 4)	
	OLS	GLS	OLS	GLS	OLS	GLS	OLS	GLS
Popd	-7.527	-4.789	-0.319	3.756	-12.227	-10.360	-6.879	-9.089
	(-1.190)	(-1.962)*	(-0.022)	(2.898)***	(-1.641)	(-3.648)***	(-0.380)	(-2.122)**
Hwayd	-0.400	0.713	-0.327	-1.083	-1.699	-3.609	1.188	-4.109
	(-0.292)	(1.361)	(-0.195)	(-1.731)*	(-0.544)	(-0.992)	(0.131)	(-1.858)*
Mworker	7.216	6.295	11.062	10.058	10.081	9.375	13.139	11.296
	(1.547)	(3.787)***	(1.556)	(18.576)***	(1.808)*	(2.731)***	(1.249)	(4.353)***
Ewage	-8.810	-7.968	-8.912	-8.204	-10.580	-8.840	-8.834	-7.925
	(-2.388)**	(-4.957)***	(-1.133)	(-9.560)***	(-1.791)*	(-2.270)**	(-0.807)	(-2.289)**
Teld	0.604	0.544	4.343	4.440	1.949	1.557	5.171	6.290
	(0.422)	(1.453)	(2.391)**	(10.515)***	(0.968)	(0.970)	(2.293)**	(5.858)***
Adjusted R^2	0.572	0.805	-0.171	0.705	0.23	0.548	-0.286	0.258
F-statistic	6.702***	18.635***	0.502	9.129***	2.104**	5.473***	0.346	2.023**
D-W	2.373	1.961	2.487	2.515	2.464	2.182	2.541	2.502
N	120	120	96	96	120	120	96	96

Note: t-statistics are in parenthesis. ***, **, and * denote the 1, 5, and 10 percent level of significance, respectively. The 'all provinces' sample includes Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Sichuan, Guizhou and Yunnan. The 'interior provinces' sample includes Hebei, Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan Sichuan, Guizhou and Yunnan.

Table 7: Regression results, 2000-2005, by all provinces and interior provinces

	All provinces				Interior provinces			
	Fixed effect (Model 1)		First-differenced (Model 2)		Fixed effect (Model 3)		First-differenced (Model 4)	
	OLS	GLS	OLS	GLS	OLS	GLS	OLS	GLS
Popd	0.471	0.330	0.065	0.844	-0.109	-0.680	-1.607	-0.642
	(0.448)	(0.750)	(0.448)	(2.223)**	(-0.103)	(-1.038)	(-0.917)	(-2.605)**
Hwayd	1.950	2.024	2.508	0.659	3.245	5.522	3.039	2.299
	(1.531)	(3.136)***	(3.684)***	(1.486)	(0.951)	(3.707)***	(1.848)*	(1.884)*
Mworker	-0.147	-0.35	-1.812	-1.483	3.245	0.965	-3.446	-1.279
	(-0.163)	(-0.595)	(-0.548)	(-1.510)	(0.951)	(1.201)	(-0.719)	(-0.616)
Ewage	0.785	0.805	2.378	2.034	-0.676	-0.514	3.929	1.841
	(0.935)	(1.468)	(0.739)	(2.147)**	(-0.561)	(-0.680)	(0.754)	(0.901)
Teld	1.738	1.335	1.614	1.409	1.335	1.13	0.694	1.071
	(10.255)***	(9.402)***	(2.907)***	(5.329)***	(4.526)***	(7.056)***	(0.754)	(3.561)***
Adjusted R^2	0.849	0.956	-0.038	0.422	0.786	0.92	-0.108	0.186
F-statistic	25.004***	94.583***	0.843	4.115***	14.625***	43.745***	0.64	1.843*
D-W	2.357	2.05	3.018	2.9	2.674	2.274	2.909	2.804
N	120	120	96	96	120	120	96	96

Note: t-statistics are in parenthesis. ***, **, and * denote the 1, 5, and 10 percent level of significance, respectively. The 'all provinces' sample includes Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Sichuan, Guizhou and Yunnan. The 'interior provinces' sample includes Hebei, Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan Sichuan, Guizhou and Yunnan.

Table 8: Standardised difference between actual and predicted FDI(based on Model (1)), 1996-2006

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	s
Coastal provinces											
Beijing	2.43***	-1.25	-0.74	0.71	-0.20	-1.44	-1.76*	-0.87	1.98**	1.13	1.48
Tianjin	-1.70*	-1.46	-0.47	1.50	0.13	0.96	0.01	-0.37	1.30	0.11	1.07
Liaoning	-1.55	-1.28	1.26	3.49***	0.15	-0.05	-1.4	-1.78	0.81	0.36	1.62
Shandong	-1.30	-1.53	-1.03	1.28	0.47	0.10	0.72	0.25	0.61	0.44	0.95
Jiangsu	0.04	-0.26	-0.12	0.27	-0.77	-0.16	0.23	-0.14	0.57	0.34	0.38
Shanghai	-0.49	0.19	-0.67	-1.06	-0.92	-0.96	1.41	0.70	1.70*	0.09	1.00
Zhejiang	0.61	-0.62	-0.01	0.12	0.09	-0.77	0.34	-0.34	0.32	0.28	0.45
Fujian	-1.34	-0.85	-0.81	-0.67	-0.6	-0.15	0.97	1.03	1.42	0.99	1.00
Guangdong	-1.03	-0.60	-0.73	-0.69	-0.81	-0.7	0.96	0.99	1.54	1.07	1.00
Guangxi	0.94	-2.82***	-2.78***	2.60***	0.42	1.84*	-3.94***	-3.55***	-2.02**	0.30	4.39
Hainan	-0.63	-3.28***	-2.92***	0.78	-1.05	-0.67	-0.21	-0.89	0.90	0.80	1.45
Interior provinces											
Inner Mongolia	0.62	-6.47***	-7.69***	0.79	0.76	1.34	2.17**	2.53***	3.15***	2.81***	3.85
Jilin	8.54***	-3.79***	-2.62***	8.04***	1.15	0.54	-2.35***	-2.67***	-2.80***	-4.02***	4.68
Heilongjiang	8.46***	-2.82***	-2.23**	-5.56***	7.28***	-0.77	3.81***	-4.24***	-3.42***	-0.52	4.87
Anhui	-0.19	-0.83	-2.56***	1.98**	-3.17***	2.31***	-2.14**	-1.09	-2.15**	-2.16**	4.49
Jiangxi	7.44***	-3.07***	-0.06	0.57	-0.11	-0.45	-0.93	-2.05**	-0.19	-1.15	2.82
Henan	0.09	-1.93	-1.37	2.25**	1.37	2.31**	-0.11	-1.27	-0.71	-0.66	1.51
Hubei	1.25	-1.76	-1.42	-0.14	4.03***	-0.18	2.05**	-1.26	-1.12	-1.45	1.89
Hunan	-2.07**	-1.92*	-0.38	1.61	3.82***	-1.22	0.95	-0.20	-0.45	-0.12	1.76
Sichuan	1.01	-1.37	-0.01	-0.78	-0.83	-0.04	0.58	0.37	0.23	0.85	0.78
Guizhou	2.70***	-4.92***	-3.50***	3.16***	2.94***	0.31	-2.12**	-1.91*	5.22***	-1.89**	3.36
Yunnan	-0.88	-3.78***	-1.96*	1.16	3.58***	-1.13	0.60	0.12	2.06**	0.23	2.08
Shanxi	4.33***	-2.08**	-1.78*	-2.15**	4.62***	1.23	-0.34	-0.06	-2.00**	-1.78*	2.60

Note: ***, **, and * denote 1%, 5%, and 10% level of significance, respectively.