On FDI and Domestic Capital Stock:
A Panel Data Study of Chinese Regions

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This article investigates the regional determinants of domestic gross capital formation among twenty-five Chinese regions for the period between 2004 and 2007. Our empirical results suggest that while inbound FDI flows are the primary factor accounting for the variations in gross capital formation, neither outbound FDI flows nor gross savings can explain the variations.

Introduction

Significant changes in FDI patterns have been witnessed all over the world for the past 30 years. During the period between 1980s and 1990s, the outbound and inbound FDI flows as a percent of GDP increased from 6.4 and 4.7, respectively to double digits (Hejazi and Pauly, 2003). These changes have raised questions regarding international trade (Lipsey and Weiss, 1984; Balasubramanyam et al., 1994; Brainard, 1997), gross capital formation (Caves and Reuber, 1971; Stevens and Lipsey, 1992; Feldstein, 1995; Desai et al., 2005), employment (Mariotti et al., 2003), productivity (Tomiura, 2007), financial development (Hermes and Lensink, 2003; Alfaro et al., 2004), the balance of payments (Razmi, 2008) and overall welfare (Sinha, 2009). There has been a general belief that increased outbound FDI flows reduce domestic gross capital formation whilst increased inbound FDI flows enhance. Previous studies suggest that there exist relationships between FDI and the levels of domestic capital formation. Bosworth and Collins (1999) argue that the ability to attract international capital can offer large potential benefits for developing countries. Foreign capital can be used to augment domestic savings to enable developing countries to increase the rates of capital accumulation. This will improve longer term economic growth, and enhance prosperity for the citizens. In supplement, FDI can facilitate the transfer of managerial and
technological know how to the host countries. Utilizing data from the 1970s and 1980s, Feldstein (1995) suggests that outbound FDI flows reduce total domestic investment in the United States roughly dollar-for-dollar, whereas inbound FDI flows contribute to its total domestic investment by the same magnitude. Desai, et al. (2005) construct a model that is similar with Feldstein (1995), but with a broader sample of countries for the 1980s and 1990s. Their observations represent decade-long average values for each of 20 (in the case of the 1980s) or 26 (for the 1990s) OECD countries. Empirical results indicate that the gross saving/GDP variable is consistent with the finding reported by Feldstein and Horioka (1980) that national saving and investment exhibit close to one-to-one correlation. The two FDI/GDP-related variables are consistent with Feldstein’s findings that outbound FDI flows reduce total domestic investment whereas inbound FDI flows are insignificant in explaining the variations.

Following Desai et al. (2005) methodology, the objective of this paper is to estimate the effects of FDI on the domestic capital stock, utilizing panel data from the nineteen Chinese provinces (Hebei, Shanxi, Liaoning, Jilin, Heilongjiang, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Sichuan, Yunnan, Shaanxi, Gansu), two autonomous regions (Inner Mongolia, Guangxi) and four municipalities (Beijing, Tianjin, Shanghai and Chongqing). In general, the existing literature have utilized cross-country panel data within a region, such as OECD or European bloc for about twenty years (usually expressed in terms of decade-average ratio) to investigate the relationship between FDI and gross capital formation. This paper, however, divides China into thirty-one regions, and sees whether the relationship between FDI and domestic capital formation of these regions within China is different from that within western countries. Concerns over economic impact of rising levels of
foreign direct investment stem from the perception that foreign activities of Chinese enterprises reduce employment and other economic activities within China, especially when unemployment rates have stayed high in recent years. However, these concerns have attracted limited analytic and empirical support. Desai, et al. (2005) suggest that the paucity of this type of analysis reflects the nascent nature of FDI theories and the difficulty, until recently, of analyzing the internal dynamics of multinational firms whose activities expand across boundaries.

Table 1. Chinese outbound FDI flows by region (in US$10,000), 2003 - 2007

<table>
<thead>
<tr>
<th>Region</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>150503</td>
<td>301399</td>
<td>448417</td>
<td>766325</td>
<td>1659315</td>
</tr>
<tr>
<td>Africa</td>
<td>7481</td>
<td>31743</td>
<td>39168</td>
<td>51986</td>
<td>157431</td>
</tr>
<tr>
<td>Europe</td>
<td>14503</td>
<td>15721</td>
<td>59771</td>
<td>154043</td>
<td></td>
</tr>
<tr>
<td>Latin America</td>
<td>103815</td>
<td>176272</td>
<td>646616</td>
<td>846874</td>
<td>490241</td>
</tr>
<tr>
<td>North America</td>
<td>5775</td>
<td>12649</td>
<td>32084</td>
<td>25805</td>
<td>112571</td>
</tr>
<tr>
<td>Oceania</td>
<td>3388</td>
<td>12015</td>
<td>20283</td>
<td>12636</td>
<td>77008</td>
</tr>
<tr>
<td>Total</td>
<td>285465</td>
<td>549799</td>
<td>122618</td>
<td>1763397</td>
<td>2650609</td>
</tr>
</tbody>
</table>

Source: Ministry of Commerce of the People’s Republic of China.

This paper is organized as follows. Section 2 briefly explains the panel data estimation, which is applied to test the above relations. Section 3 describes the data used in the empirical work, and addresses the quality of the data series. Section 4 presents the empirical estimates, diagnostic tests and discussions. Section 5 summarizes the major findings.

Model Specification

The aim of this section is to arrive at a set of regional determinants that explains the variations in the gross capital formation in the People’s Republic of China. Our model specification is an extension of Feldstein and Horioka (1980), which incorporates outbound and inbound FDI variables (see also Feldstein, 1995; Desai et al., 2005). Utilizing panel data from twenty-five Chinese regions over the period between 2004
and 2007, this paper controls for region-specific effects and helps reduce the biases associated with omitted variables. Specifically, the estimated equation takes the following form:

\[ gcf_{it} = \alpha_0 + \alpha_1 ofdi_{it} + \alpha_2 ifdi_{it} + \alpha_3 gs_{it} + \lambda_i + \epsilon_{it}. \]

where

- \( gcf_{it} \) represents the ratio of gross capital formation (investment in fixed assets and inventories) to GDP.
- \( ofdi_{it} \) represents the ratio of outbound FDI flows to GDP.
- \( ifdi_{it} \) represents the ratio of inbound FDI flows to GDP.
- \( gs_{it} \) measures the ratio of gross saving (GDP less final consumption) to GDP.
- \( \lambda_i \) is the time-invariant region effects.
- \( \alpha_0, \alpha_1, ..., \alpha_3 \) represent the intercept term and regression coefficients associated with their respective variables.
- \( \epsilon_{it} \) is the stochastic disturbances.

The static panel data model is then estimated in linear form, together with the use of either fixed effects or random effects. A panel approach has a number of advantages over a single time series or cross-section method of estimation, for it allows researchers to employ more observations and have a greater degree of freedom. In a fixed effects model, it intends to control for omitted variables that differ among cases but are constant over time, and allows for the use of the changes in the variables over time to estimate the effects of the independent variables on the dependent variable. This is equivalent to generating dummy variables for each of the cases and including them in a standard linear regression to control for these fixed “case effects.” Its major drawback is that this model uses a large number of dummy variables that reduce the degree of freedom.

Alternatively, the random effects model treats the omitted individual specific factors
as random variables rather than the constant term. It implies that the unknown region-specific factors are better explained through the error term rather than the constant. If the omitted variables are fixed among cases but vary over time, then the random effects model should be employed. This model has a very strong assumption that $\text{cov}(\alpha_i, x_i) = 0$, which implies the intercept terms are unrelated to the regions’ specific explanatory variables, and the random-effects estimator is a weighted average of fixed and between effects. If the panel data contains data for a very long time period, both fixed and random effects models should produce similar results.

Hausman (1978) proposes a test based on the difference between the random effects and fixed effects estimates. Since the latter is consistent when $\lambda_i$ and explanatory variables are correlated, but random effects is inconsistent, a statistically significant difference is interpreted as evidence against the random effects assumption. While fixed effects always give consistent results but they may not be the most efficient model to run, random effects will provide better $p$-values as they are a more efficient estimator. The Hausman test checks a more efficient model against a less efficient but consistent model to make sure that the more efficient model also gives consistent results. It tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If the tests are significant, then it is recommended to use the fixed effects, random effects otherwise.

**Data Sources**

The majority of panel data used in the empirical estimation are collected by and obtained from the National Bureau of Statistics, People’s Republic of China. These include yearly data of GDP, gross capital formation (investment in fixed assets plus
increase in inventories), outbound FDI flows, inbound FDI flows and gross saving. These data are also available online at http://www.stats.gov.cn, http://www.fdi.gov.cn and http://www.infobank.cn. Data availability allows 31 regions, including 22 provinces, five autonomous regions and four municipalities. As disaggregate FDI figures have not been published until 2004, all variables are taken for the 2004-2007 period, yielding a total of 124 observations. Due to some missing figures in six (Hainan, Guizhou, Tibet, Qinghai, Ningxia and Xinjiang) out of thirty-one regions in some years, their observations are deleted from sample so that the remaining twenty-five regions for four years reduces the actual sample size to 100 only.

Table 2. Definitions and data sources used in the empirical work

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Capital Formation</td>
<td>Gross capital formation is measured as investment in fixed assets and its net changes in inventories.</td>
<td>China National Bureau of Statistics.</td>
</tr>
<tr>
<td>Outbound FDI</td>
<td>Total FDI outflows</td>
<td>China National Bureau of Statistics.</td>
</tr>
<tr>
<td>Inbound FDI</td>
<td>Total FDI inflows</td>
<td>China National Bureau of Statistics.</td>
</tr>
<tr>
<td>Gross Saving</td>
<td>Gross saving is measured as GDP less final consumption expenditure.</td>
<td>China National Bureau of Statistics.</td>
</tr>
</tbody>
</table>

Empirical results

Equation (1) is estimated by fixed effects and random effects regressions, respectively, and the estimated coefficients (along with the \( t \)-statistics), goodness for fit measures, and diagnostic tests appear in Table 2. Although the Hausman test \( (p = 0.4595) \) “spuriously” indicates that the random effects regression is more appropriate for the China model, its interpretation needs extra caution. These results, however, hold only asymptotically. Wooldridge (2002) argue that when applying asymptotic analysis to panel data methods, it is important to remember that asymptotic analysis are useful insofar as
they provide a reasonable approximation to the finite sample properties of estimators and statistics. If $N$ is sufficiently large relative to $T$, and it is assumed rough independence in the cross section, then asymptotic analysis should provide suitable approximations. Nevertheless, a priori it is difficult to know whether $N \to \infty$ asymptotics works well with, say 25 regions in China and $T = 4$. With large geographical regions, such as states and regions, the random sampling assumption in the cross section dimension is conceptually flawed so that researchers cannot treat their sample as random sample from a large population. Then it often makes sense to consider each $\lambda_i$ as a separate intercept to estimate for each cross sectional unit. In this sense, researchers should use fixed effects: using fixed effects is mechanically the same as allowing a different intercept for each cross sectional unit. However, even there can be seemingly large differences between the random effects and fixed effects estimates due to large standard errors, the Hausman statistic may fail to reject. Generally speaking, fixed effects is always much more convincing than random effects for policy analysis using aggregate data (Wooldridge, 2006).

In respect of these arguments, since our data series used in the empirical estimation is rather short, and the unit of observation is large geographical unit, our discussions will be focused on the estimated coefficients from fixed effects regression only. Empirical results indicate that with three time dummies, the model explains approximately 40% of the variations in gross capital formation (as a ratio of GDP) in twenty-five Chinese regions. The variable outbound FDI/GDP is statistically insignificant, which is not consistent with the findings of Feldstein (1995) and Desai et al. (2005) that FDI outflows reduce domestic capital formation almost dollar for dollar. The coefficient 1.6237 on the inbound FDI flows is statistically significant, which is not consistent with
the findings of Feldstein (1995) and Desai et al. (2005) that FDI inflows do not enhance domestic capital growth. Meanwhile, its coefficient is estimated to be much bigger than one. Eventually, the variable gross saving/GDP is also statistically insignificant, which is not consistent with the findings of Feldstein (1995) and Desai et al. (2005) that national savings and investment rates exhibit close to one-to-one correlation.

Table 3. Domestic investment and FDI

<table>
<thead>
<tr>
<th></th>
<th>$\alpha_0$</th>
<th>$o_{fdi_{it}}$</th>
<th>$i_{fdi_{it}}$</th>
<th>$gs_{it}$</th>
<th>$Y_{2004}$</th>
<th>$Y_{2005}$</th>
<th>$Y_{2006}$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE</td>
<td>0.3819*</td>
<td>0.1877</td>
<td>1.6237*</td>
<td>0.1735</td>
<td>-0.0453*</td>
<td>-0.0206**</td>
<td>-0.0044</td>
<td>0.4044</td>
</tr>
<tr>
<td></td>
<td>(6.40)</td>
<td>(0.04)</td>
<td>(2.76)</td>
<td>(1.50)</td>
<td>(-4.46)</td>
<td>(-2.13)</td>
<td>(-0.46)</td>
<td></td>
</tr>
<tr>
<td>RE</td>
<td>0.4121*</td>
<td>-1.6881</td>
<td>0.7577</td>
<td>0.1756</td>
<td>-0.0475*</td>
<td>-0.0244**</td>
<td>-0.0070</td>
<td>0.3845</td>
</tr>
<tr>
<td></td>
<td>(7.36)</td>
<td>(-0.37)</td>
<td>(1.56)</td>
<td>(1.61)</td>
<td>(-4.55)</td>
<td>(-2.48)</td>
<td>(-0.73)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Figures in the parentheses are $t$-statistics. * indicates statistically significant at 1% confidence level; ** indicates statistically significant at 5% confidence level.

Apparently, our estimated results contradict with previous studies, however, they are indeed very intuitive. Empirical results demonstrate that China’s gross capital formation has been grossly driven by inbound FDI flows but not outbound FDI flows. In many developed countries, such as the US, firms transfer their production lines to developing countries that have lower factor prices, such as wages, with much of their production assembled abroad being exported back to home countries or other countries. Hejazi and Pauly (2003) suggest that the impact of such type of outbound FDI flows on domestic production is ambiguous. On the one hand, the former is stimulated at the expense of latter; on the other hand, there is possibly an offsetting effect within the multi-national enterprises (MNEs) that demand for exports of intermediates results in domestic production, hence, stimulating gross fixed capital formation. In general, previous studies, such as Feldstein (1994) and Desai et al. (2005) confirm that outbound FDI flows reduce gross capital formation in home countries.

For China, the main reasons to invest in foreign countries are (i) China needs to
secure natural resources to fuel rapid growth; (ii) Large domestic firms export large volumes, and need business services like shipping and insurance; (iii) China’s major enterprises need to acquire global brands, like Lenovo’s acquisition of IBM’s personal computer business or the SAIC and Nanjing purchase of MG Rover; (iv) Large State-owned enterprises (SOEs) which are losing their monopoly position at home country, need to globally diversify to survive; and (v) Given increasing wages and stricter environment protection regulations, some Chinese enterprises seek to move their labor-intensive operations to cheaper overseas locations to enjoy lower factor costs, such as Vietnam and Africa (Davis, 2009).

Although the detailed decomposition of Chinese outbound FDI flows by industry has been concealed, official figures show that by the end of 2005, business services accounted for the biggest share of China’s outbound FDI stock at a level of 28.9 percent, which were followed by wholesale and retail, mining and petroleum, transportation and storage, and manufacturing. Moreover, the amount of outbound FDI flows has been very negligible when compared with inbound FDI flows during the period under investigation. Within twenty-five Chinese regions, the outbound FDI flows as a percent of inbound FDI flows ranges from less than 1 percent to 9.7 percent, with the exceptions of Heilongjiang and Gansu in some years. The insignificance of outbound FDI flows has been attributed to its small amount of investment by Chinese firms, together with different levels of governments.

Figures 1 and 2 portrays the composition of inbound FDI flows in China, which suggest that while the relative importance of the secondary sector (mostly manufacturing) is decreasing and the tertiary sector is increasing, the manufacturing industry has still been ranked number one in terms of the amount of investment actually
utilized. According to Borensztein (1998), this is beneficial for the host country (China, in this case) as her economic growth is indeed enhanced through improved productivity, caused by the transfer of managerial and technological know how and better workflows when domestic employees move from foreign to domestic firms, given a sufficiently abundant existing stock of human capital. In recent years, especially after China’s joining the WTO, the persistent increase in inbound FDI flows in the tertiary sector also benefits China from accelerated diffusion of managerial skills, employment training, an access to market, and more job opportunities.

Figure 1. Inbound FDI flows by sector in China (US$0.1 billion)
Turning to gross saving, it is just the residuals from investment minus (net) FDI. In China, the saving rates have been very stable and high, fluctuating around 20 - 30 percent recently. Hence, the size effect of a marginal increase in saving rate (and also gross saving) is very negligible and insignificant in explaining the variations in gross capital formation (as a percent of GDP).

Conclusions

Utilizing panel data of twenty-five Chinese regions over the period between 2004 and 2007, the current study applies the fixed effects regression to analyze the relationships between gross capital formation, outbound FDI flows, inbound FDI flows and gross savings. It is quite natural to assert that outbound FDI flows are stimulated at the expense of domestic investment. In opposite to previous studies, however, Chinese evidence suggest that the variable outbound FDI/GDP is statistically insignificant,
which is not consistent with the findings of Feldstein (1995) and Desai et al. (2005) that FDI outflows reduce domestic capital formation almost dollar for dollar. The coefficient on the inbound FDI flows is statistically significant, which is not consistent with the findings of Feldstein (1995) and Desai et al. (2005) that FDI inflows do not enhance domestic capital growth. Meanwhile, its coefficient is estimated to be much bigger than one. Eventually, the variable gross saving/GDP is also statistically insignificant, which is not consistent with the findings of Feldstein (1995) and Desai et al. (2005) that national saving and investment rates exhibit close to one–to-one correlation.

Notes

1. Hainan, Guizhou, Tibet, Qinghai, Ningxia and Xinjiang are deleted from sample because the outbound FDI figures for these six regions are not fully available for the period between 2004 and 2007.

References


