

**Regional Capital Mobility in China: Economic Reform with
Limited Financial Integration**

Jennifer T. Lai^{◇,*}, Paul D. McNelis[§], Isabel K.M. Yan^{◇¹}

◇ Department of Economics and Finance, City University of Hong Kong,
Kowloon, Hong Kong

§ Department of Finance, Fordham University, New York, USA 10019

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Abstract

This paper uses the Campbell-Mankiw (1991) framework for assessing the evolution of regional capital mobility in China between 1978 and 2008, during periods of economic reform. Panel time-varying coefficient methods show that changes in capital mobility across China, driven by market oriented economic reform., have had very little impact on the relation between consumption and net income across regions. Thus, prospects for a global economic stimulus emanating from China, given the relatively low degree of financial integration within the country, appear to be very limited. Domestic consumption in most regions is closely linked with regional net income.

JEL classification: F15; O18; O53; C11; C23

Keywords: Regional capital mobility, China capital market integration, Campbell-Mankiw model, Panel time-varying coefficient model

^{1*} Corresponding author. Email: econlai@gmail.com, tel: (852) 3442-6765, (852) 6154-6913, fax (852) 3442-0284.

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1. Introduction

After Feldstein and Horioka (1980) measured international capital mobility by the correlation between national saving and investment, Feldstein (1983), Murphy (1984), Obstfeld (1986, 1993), and Tesar (1991) documented relatively high saving and investment correlation among the OECD countries. The estimates were generally above 0.5, and in some cases statistically insignificantly different from 1. This evidence for low international capital mobility ran counter to the widely held consensus of relatively high international capital mobility. To reconcile this empirical result with the assumption of high international capital mobility, Cantor and Mark (1988), Mendoza (1991), Backus, et al. (1992), Baxter and Crucini (1993) incorporated adjustment costs for domestic investment, as well as other frictions, into models which also assumed free capital mobility.

Coakley, Kulasi and Smith (1996), argue that these cross-country studies are subject to the current account solvency constraint, which complicates the interpretation of the saving retention rate. As such, another group of papers apply the Feldstein-Horioka (1980) framework to *intra-national* cases. For example, Bayoumi and Rose (1993), Helliwell and Mckitrick (1999), Yamori (1995), and Dekle (1996) use the framework to study provincial and regional capital mobility within a country, which generally is not subject to the same constraint. The first two studies focus on UK and Canada respectively, and the latter two on Japan.

Although the Feldstein-Horioka (1980) framework has been widely adopted as a measure of capital mobility, it falls short in its theoretical foundation. By adopting the permanent income model, with a fraction of current income consumers, originally developed by Campbell and Mankiw (1989, 1990), Shibata and Shintani (1998) constructed an alternative way to measure capital mobility. Instead of focusing on the correlation between national saving and investment, they estimate the correlation between national consumption and net output under the theoretical framework of a small open economy, with permanent income consumers, and restrictions on capital mobility. Decressin and Disyatat (2008) extended this framework. Its advantage over the Feldstein-Horioka approach is it has a solid theoretical model embedded in the partial equilibrium permanent income setup.

In this paper, we gauge the regional capital mobility across China by utilizing the above framework of Campbell and Mankiw (1989, 1990) over the sample period of 1978-2008.

China started its economic reform and opening up policy in 1978. During the last three decades, China has been experiencing a high rate of economic growth, up to 10% on average. Since this reform is market-oriented, many are eager to find out if any effectively integrated capital markets across China has

been established. Put another way, has the degree of capital mobility across China shown any improvement.

To a large extent, the growth miracle of China is driven by export-oriented industry along the coast line of China, while the vast west region is left out². Has this export performance produced any effect on cross region capital mobility? Since China is now under intense international pressure to adjust its huge current account surplus, export dependency will have to give way to enhanced domestic consumption demand in the future. For this reason, a more integrated capital market across regions would facilitate stimulus policies aimed at domestic demand and global rebalancing. Our results show that in the absence of widespread financial integration, there is little hope of a global stimulus originating from China, since changes in domestic consumption across regions closely match changes in regional net income.

Boyreau-Debray and Wei (2005) have applied the Feldstein-Horioka (1980) framework to provincial level saving and investment data in China from 1952 to 2001. Their results show that there was no improvement in the provincial capital mobility across China over this period, even if they included the post-reform period from 1978 to 2001. Li (2010) applied the panel cointegration method to provincial data during 1978 to 2006 under the same framework. He came to the same conclusion as in Boyreau-Debray and Wei (2005), namely, that capital market integration within China is low and practically no improvement in the degree of domestic capital mobility has appeared.

Like those two studies on China listed above, we use panel data across provinces and regions in China to improve the efficiency and power of the statistical analysis. In contrast to these studies, we use a panel time-varying coefficients model where the parameters evolve over time. Since China has experienced continuous economic reform in the last few decades, allowing the coefficients to evolve with these policy reforms captures the continuous process of structural change.

Section 2 presents the theoretical model specification, while Section 3 discusses the dataset and the results from panel data model estimation. Section 4 presents the time-varying coefficient model and the estimation results.

2. Theoretical Model

We apply Campbell and Mankiw (1990)'s framework to assess the regional capital mobility. This framework was first utilized by Shibata and Shintani (1998) and later extended by Decressin and Disyatat (2008).

²The central government realized this unbalanced growth among different regions in China, so they implemented several policies to develop the west region. For example, in 2000, the central government launched a large scale policy "Develop The West" to finance public and private projects in west region.

First, we denote provincial GDP, investment, private consumption and government expenditure as Y, I, C and G respectively. Also we denote “foreign” asset holdings of a province as W^3 . We treat each province as if they operate independently as a kingdom. Then for one province, its budget constraint is given by:

$$\begin{aligned} W_{t+1} &= (1+r)W_t + Y_t - C_t - I_t - G_t \\ &= (1+r)W_t + X_t - C_t \end{aligned}$$

The variable r represents national interest rate, which is assumed to be a constant, X_t is the net output of this province defined as $X \equiv Y - I - G$. Based on national income accounting identity, we obtain:

$$CA_t \equiv r \cdot W_t + X_t - C_t$$

where CA is the “current account” of the province⁴.

We assume that the utility function for a representative consumer is quadratic, and that the discount rate equals the national interest rate. Optimal consumption under perfect capital mobility has the following representation:

$$C_t^p = r \left\{ W_t + \left(\frac{1}{1+r} \right) \sum_{i=0}^{\infty} \left(\frac{1}{1+r} \right)^i E_t X_{t+i} \right\}$$

Taking the first difference of eq.(2.3), we obtain eq.(2.4):

$$\Delta C_t^p = \frac{r}{1+r} \sum_{i=0}^{\infty} \left(\frac{1}{1+r} \right)^i (E_t - E_{t-1}) X_{t+i}$$

In eq.(2.4), we observe that $(E_t - E_{t-1}) X_{t+i}$ is the revision of expectation from time $t-1$ to time t when new information comes in at time t . This is unpredictable at time $t-1$. As such, it implies that current consumption is the best predictor of tomorrow’s consumption, as Hall (1978) noted:

$$\Delta C_t^p = \varepsilon_t$$

Under the extreme case of financial autarky where capital mobility is strictly prohibited, consumption of a province is restricted by its own net output:

$$C_t^a \leq X_t$$

If we assume the equality holds in (2.6) and substitute it to eq. (2.2), we have the following expression for the trade balance, given by TB_t :

$$TB_t \equiv CA_t - r \cdot W_t = 0$$

³Here “foreign” means other provinces as well as foreign countries.

⁴Here the “current account” is the pseudo-“current account” for a province, as it includes exports and imports of this province with other provinces as well as foreign countries.

Under financial autarky, provincial savings equal provincial investment.

In a real world, capital is neither fully mobile nor fully immobile. As such, consumption could be expressed as somewhere between the two extreme cases in eq.(2.3) and (2.7):

$$\begin{aligned} C_t &= (1 - \lambda)C_t^p + \lambda C_t^a \\ &= (1 - \lambda)C_t^p + \lambda X_t \end{aligned}$$

In eq.(2.8), λ measures the degree of capital mobility. If $\lambda = 0$, $C_t = C_t^p$ and capital is fully mobile. If $\lambda = 1$, $C_t = C_t^a$ and capital is extremely immobile.

The smaller the λ , the higher the degree of capital mobility. Thus, estimating λ provides another way to measure the degree of capital mobility in China. However, from eq.(2.3) we observe that C_t^p is determined by the expected future net output, which is unobservable. To render this model estimable, we take the first difference of eq.(2.8) and use eq.(2.5) to obtain the following eq.(2.9):

$$\Delta C_t = (1 - \lambda)\Delta C_t^p + \lambda\Delta X_t = (1 - \lambda)\varepsilon_t + \lambda\Delta X_t$$

Since we are dealing with panel data, we rewrite eq.(2.9) as:

$$\Delta C_{it} = (1 - \lambda_i)\Delta C_{it}^p + \lambda_i\Delta X_{it} = (1 - \lambda_i)\varepsilon_{it} + \lambda_i\Delta X_{it}$$

This yields the following equation for panel data:

$$\Delta C_{it} = \gamma_i + f_t + \lambda_i \cdot \Delta X_{it} + \xi_{it}$$

We estimate eq.(2.11) and test whether λ_i equals zero or not for each region in China.

3. Data and panel estimation results

3.1 Data

We use private consumption and net output data of 30 provinces⁵ in China over 1978 to 2008 from statistical yearbooks and complemented it by the provincial level statistical yearbooks when necessary. To come up a balanced panel, 6 provinces are deleted due to missing data. Further, as some provinces experienced abnormal GDP growth rate according to the data⁶, we further deleted 3 provinces which have this problem in order to keep the data as clean as possible.

⁵This includes 3 municipalities, and 27 provinces. Hong Kong and Macau SARs are not included.

⁶Our original dataset consists data points prior to 1978. Before 1978, 3 provinces experienced abnormal GDP growth around 100 percent based on the data. After 1978, the data became quite reasonable for all provinces as no such abnormal trend is observed. Based on this, we infer that provinces has abnormal data before 1978 are more likely to have data quality problem after 1978, so we delete them from our dataset. Kwan and Chow (1996) argued that although Chinese economic data maybe very inaccurate, they are not as bad as one regards, because they fits into the theoretical economic model generally well. Carsten Holz (2005) provides more elaborate discussion on this data quality issue.

Table 1: Grouping of 21 provinces into 9 regions

Region.	Provinces Included
1	Beijing, Tianjin, Hebei
2	Shanxi, Shandong
3	Liaoning, Jilin, Heilongjiang
4	Shanghai, Jiangsu, Zhejiang
5	Hunan
6	Henan, Anhui
7	Guangdong, Fujian
8	Guangxi, Yunan
9	Shaanxi, Xinjiang, Inner Mongolia

The data for net output is constructed from subtracting investment and government expenditure from GDP. Both private consumption and net output are deflated by GDP deflator and by population, as in Shibata and Shintani(1998). In order to observe the capital mobility across regions, we group the 21 provinces into 9 regions according to their level of economic development and geographical vicinity. Our sample consists of 9 regions in China over the sample period from 1978 to 2006⁷.

Campbell and Mankiw (1990) argue that aggregate time series on consumption and output appear to be closer to log-linear than linear, so we take logarithmic transformations of both consumption and net output and then first difference the logarithmic series. . We apply the panel bootstrap unit root test of Chang (2004) on Δc_{it} and Δx_{it} (differenced logged consumption and net output), which allows for cross sectional dependence. Table 2 shows that the test does not reject the null hypothesis of stationarity of the series⁸.

Series name	<i>FOLS</i>	<i>FGLS</i>	<i>KOLS</i>	<i>KGLS</i>
Δx_{it}	124.2613 ^{a,b}	396.4957	124.2613	369.4957
	(0.000)	(0.000)	(0.001)	(0.054)
Δc_{it}	117.3770	794.3826	117.3770	794.3826
	(0.000)	(0.000)	(0.001)	(0.043)

- a. Test statistics are followed by p-value in brackets.
- b. Sample period spans from 1978 to 2008.

3.2 Estimation results

We estimate eq.(2.11) assuming that both time and individual effects are present. We estimate the following model:

$$\Delta c_{it} = \gamma_i + f_t + \lambda \cdot \Delta x_{it} + \xi_{it}$$

⁷. As an attempt to account for government subsidy to household, we collected “price subsidy” data from China statistical yearbooks to calculate the subsidy-adjusted private sector consumption. As this item includes both subsidy to household and enterprises, we dropped this item in the subsequent estimation. However, based on our estimation, whether or not this data is included has apparently very little effect upon the estimation results.

⁸We also performed various panel unit root tests on the log differenced series of consumption and net output, verifying that they are both stationary. Test results are available upon request.

The logs of both consumption and net output in lower-case letters. We assume that both individual and time effects are present.

From eq.(2.4) and (2.5), we note that Δx_{it} and ξ_{it} in eq.(3.1) are correlated. Thus, in presence of this endogeneity, a simple ordinary least squares (OLS) estimator is biased and inconsistent. We utilize the GMM estimator with appropriate instrumental variables (IVs). The results appear in Table 3. The IV method is applied for increasing longer lags.

Table 3: Panel A: Whole time period 1978-2008				
IV^a	estimated λ (S.D)	Hansen's J test (P-values)	Relevance of the IV	
			R^2 (centered)	F -test statistics
1	0.2699 (0.3429)	0.0328 (0.9838)	0.0222	2.8257 (0.0612)
2	0.2895 (0.2798)	0.2408 (0.9406)	0.0342	2.1066 (0.0807)
3	0.2746 (0.2222)	2.2707 (0.8932)	0.0453	1.7953 (0.1010)
4	0.2206 (0.1748)	2.2507 (0.9723)	0.0541	1.5448 (0.1432)
5	0.1728 (0.1392)	1.9014 (0.9970)	0.0571	1.2417 (0.2662)
Table 3: Panel B: Sub period 1: 1978-1993				
1	0.4412 (0.3940)	0.1288 (0.9376)	0.0280	1.7710 (0.1745)
2	0.4232 (0.4468)	0.1942 (0.9956)	0.0249	0.7161 (0.5826)
3	0.2743 (0.1729)	2.2707 (0.5931)	0.0949	1.7641 (0.1140)
4	0.1657 (0.1472)	2.2507 (0.7299)	0.1289	1.6600 (0.1432)
5	0.0146 (0.1216)	1.9014 (0.2552)	0.1627	1.5349 (0.1427)
Table 3: Panel C: Sub period 2: 1994-2008				
1	0.1889 (0.3230)	1.8726 (0.3921)	0.0371	2.3686 (0.0979)
2	0.3206 (0.1847)	1.8786 (0.7581)	0.0891	2.9590 (0.0226)*
3	0.3556 (0.1697)	3.3499 (0.7638)	0.0951	2.0849 (0.0600)
4	0.3747 (0.1702)	4.4889 (0.8105)	0.1004	1.6323 (0.1229)
5	0.1799 (0.1312)	7.1277 (0.7133)	0.1069	1.3771 (0.1995)

1. $\{\Delta c_{it-2}, \Delta x_{it-2}\}$;

2. $\{\Delta c_{it-2}, \Delta c_{it-3}, \Delta x_{it-2}, \Delta x_{it-3}\}$;
 3. $\{\Delta c_{it-2}, \dots, \Delta c_{it-4}, \Delta x_{it-2}, \dots, \Delta x_{it-4}\}$;
 4. $\{\Delta c_{it-2}, \dots, \Delta c_{it-5}, \Delta x_{it-2}, \dots, \Delta x_{it-5}\}$;
 5. $\{\Delta c_{it-2}, \dots, \Delta c_{it-6}, \Delta x_{it-2}, \dots, \Delta x_{it-6}\}$.
- b. * and ** represent 5% and 1% significance level, respectively.

Table 2, shows the results for the whole sample as well as the results for two sub samples: 1978-1994, and 1995 to 2008. We cut the whole sample at 1994 since that is the year China implemented several economic policies that have far-reaching effects..

First, tax redistribution reform began at this time, to reallocate tax revenue between central government and provincial governments. Secondly, the exchange rate regime was reformed by combining the formally two exchange rates into one unified exchange rate, which became the so-called managed floating exchange rate of RMB. Since eq.(3.1) assumes homogenous λ over time and across sectors, splitting the whole sample into two sub-samples is one way to gauge if the degree of capital mobility also changed at this time of fiscal and exchange-market reform.

From Table 2 we observe that for most of the time, whether it is for the whole time period, or for the sub periods, the estimated λ is positive and insignificantly different from zero. Comparing the estimated values of λ between sub sample 1 and sub sample 2, we find that sub sample 2 usually has a smaller λ than sub sample 1 that suggesting some clue of improvement of capital mobility across time, although both are not significantly different from zero.

This estimation result indicates that regional capital mobility across China over the period is high over the period as a whole. The reforms of 1994 have little effect on this parameter. .

However, in the model we estimated in Table 2, capital mobility indicator λ is constrained to be homogenous across different provinces and within a certain sample period (according to eq. (3.1)), which may not be a justifiable assumption as China undergoes a gradual economic reform and growth route. Thus, we also estimate a time varying coefficient model.

4. A Panel Time-Varying Coefficients Model

4.1 The model

To better understand the evolution of provincial capital mobility, we turn to a a panel time-varying coefficients model. This model allows for heterogeneity in the intensity of capital mobility among provinces and regions, which is very likely to be the case considering the great disparity in the provincial government policies and level of development. Secondly, despite the great heterogeneity among provinces, it is still reasonable to view the capital mobility for different provinces and regions as following a same dynamic process because of

the integration of markets and the common national policies they share. Thirdly, unless the time dimension (T) is large relative to the cross-section dimension (n), it is very difficult to estimate cross-section specific coefficients with any degree of precision. It is therefore a common practice to assume a structure on the different slopes, so that they follow the same dynamic process. Finally, in contrast to the fixed-coefficient panel models, time varying coefficient models not only capture cross-sectional heterogeneity but also give information on the time path of the coefficient that reflects the evolution of the degree of capital mobility across sectors within the overall estimation period. There is thus no need to focus on one discrete "structural change" event (such as 1994).

The model is as follows:

$$\begin{aligned}\Delta c_{it} &= \gamma + \lambda_{it} \cdot \Delta x_{it} + \xi_{it} \\ \xi_{it} &\sim N(0, \sigma_{\xi}^2) \\ \lambda_{it} &= \lambda_{it-1} + \varepsilon_{it} \\ \varepsilon_{it} &\sim N(0, \sigma_{\lambda}^2) \\ \lambda_{i0} &= .9\end{aligned}$$

As the dynamic process of the slope coefficient captures both region-specific and time effects, the constant term γ is the same for all provinces.

As a form of Bayesian estimation, the coefficient itself follows a stochastic process. We employ Kalman filtering technique with maximum likelihood estimation to obtain the cross sector time-varying slope coefficient.

To initialize the time-varying estimation, we assume that the degree of capital mobility at the start of the sample period is relatively low, with $\lambda_0 = .9$. We also need hyperparameters for the estimation process. We use a genetic algorithm evolutionary stochastic search to estimate the values of the hyperparameters σ_{λ}^2 and σ_{ξ}^2 , which maximize the likelihood function of the model [See Hsiao and Pesaran (2004) for a fuller treatment of random coefficient panel data models]. Hasegawa and Kozumi (2001) have shown that there is little difference in the results if an instrumental variable is used, or not, in the estimation. For consistency with the GMM estimation, we make use of the instrumental variables in the Bayesian time-varying parameter model for Δx_{it} . Results without instrumental variables closely match those obtained with instrumental variables.

4.2 Estimation results

Figures 1-a, 1-b and 1-c depict all the time-varying slope coefficients over 1982 to 2008 for the 9 regions in China.

Figure 1a: Time varying λ_{it} for Regions 1-4.

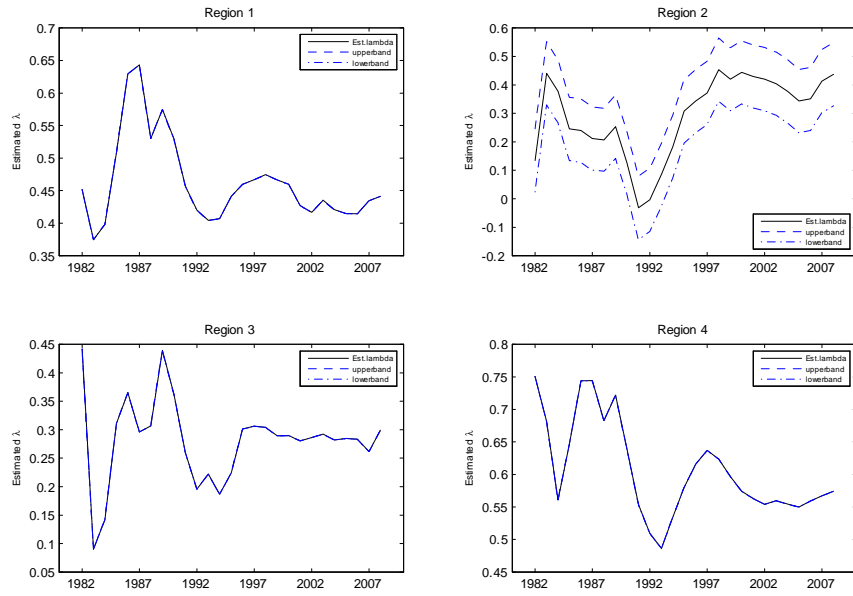


Figure 1 b: Time varying λ_{it} for Regions 5-8

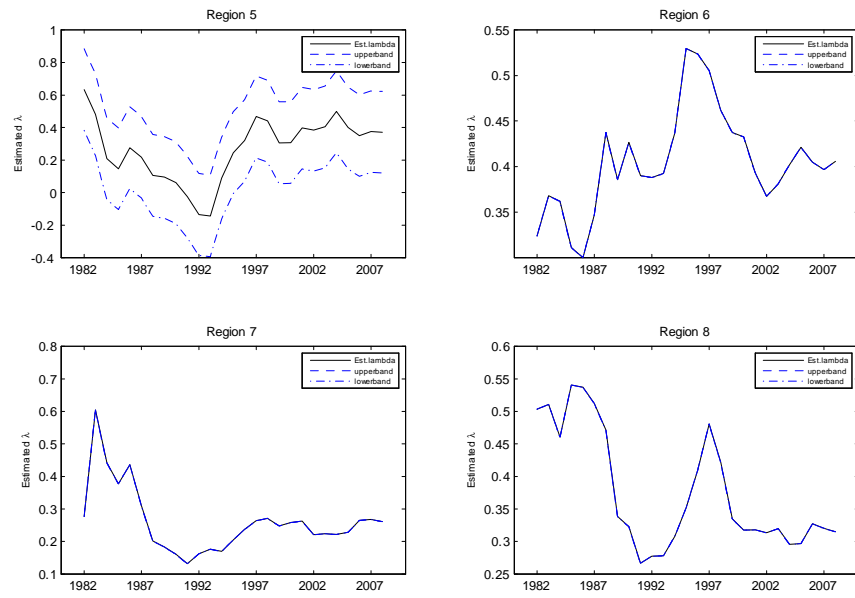
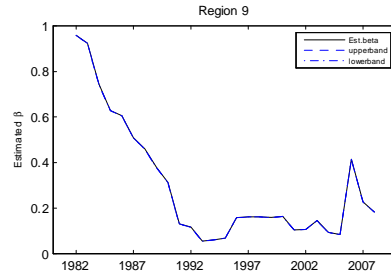


Figure 1 c Time varying λ_{it} for Regions 9

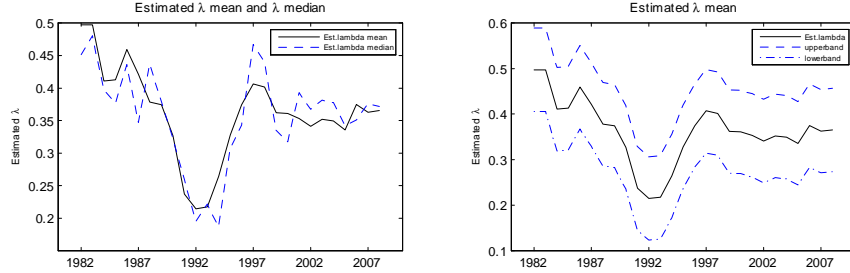


Time varying λ_{it} for 9 regions.

From the figure we observe a generally downward trend of the estimated λ_{it} for the 9 regions, which indicates that over the sample period, the degree of regional capital mobility across China has increased.

In Figure 2, we present the mean and the median of the estimated time-varying λ_{it} , which also shows a slightly downward trend over the sample periods, consistent with increasing capital mobility.

Figure 2: Estimated Mean and Median of λ_{it}



We note that the mean and median of the estimated λ_{it} bounced back around 1994 and this upward trend lasts around 1997. Then it goes down again around 1997. This is mainly due to the relatively high inflation period in China between 1993 to 1996⁹. Subsequent government stabilization policies reduced the investment and transfers to regions, while overall output growth slowed¹⁰.

We also see that the two most developed regions (Beijing, Tianjin, Hebei, and Shanghai, Jiangsu, Zhejiang) have a higher λ_{it} than other regions, most of which are relatively under developed (with the exception of the Guangzhou-Fujian region). This result implies that these two regions are to some extent self-contained in their regional capital markets, and relatively isolated from the integration of national capital market.

5. Conclusion

This paper examined the degree of capital mobility across different regions in China over the period 1978 to 2008 by utilizing the permanent income model developed by Campbell and Mankiw (1989, 1990).

⁹During 1993 to 1995, the inflation rate was above 10%. In 1993 it went up to 14.7% from 1992's 6.4%. In 1994, it reached the highest level at 24%. After that, it gradually went down to 17.1% in 1995 and to 8.3% in 1996. In 1997, inflation rate was 2.8%.

¹⁰In order to curb inflation rate from above 10% to below 3% (the target of the central bank of China), central government stepped in to use administrative order to constrain investment in both public and private sector. Meanwhile, the central bank of China raised interest rates twice in 1993 to help curb the inflation.

We first estimated a time-invariant coefficient panel data model by the generalized methods of moment (GMM). This gives us a positive and insignificantly different from zero estimates of λ for the whole sample, sub sample 1 as well as sub sample2. We could also observe a slightly decrease in λ from sub sample 1 to sub sample2.

Further, when we employ a panel time-varying coefficients model, the results show clearly that there is a gradual improvement in capital market integration across different regions in China. However, the two most developed regions, Beijing, Tianjin and Hebei, and Shanghai, Jiangsu and Zhejiang show relatively large λ estimates, indicating that there is still some segregation between developed regions and other regions in China. As such, the Chinese government may have to put more efforts in order to achieve balanced economic growth and prosperity across regions, and to facilitate an integrated capital market across regions. Without such broader policy reform, there is still limited prospect of any global economic stimulus emanating from China.

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