

# On the Empirics of China's Inter-regional Risk Sharing<sup>†</sup>

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## Abstract

This study provides a comprehensive investigation on the mechanisms of risk sharing among China's provinces over the period 1995–2009. Using three empirical techniques, we found that, first, the extent of risk sharing attained by the provinces is relatively limited, and the financial liberalization since the late 1990s has not helped improve the degree of risk sharing. Second, credit market, compared to capital market, capital depreciation, and tax-transfer system, has been the single operative channel of risk sharing in China. Third, there are possibilities for China to gain the benefits of risk sharing from various institutional factors. In particular, though still insignificant, rural-urban migration, formal financial system and fiscal transfer appear to start to promote risk sharing recently. In contrast, FDI seems to be a dis-smoothing factor in China.

## 1. Introduction

Inter-regional risk sharing refers to the ability of institutions in a region to protect their consumption against shocks to their income. It generates potential welfare gains by smoothing volatility of aggregate consumption growth among regions.<sup>1</sup> In the perfect case of full risk sharing, institutions in a region will not be vulnerable to fluctuations in output. All risks are diversified away so that idiosyncratic (region-specific) output shocks may have no impact on consumption levels.<sup>2</sup>

Since the 1990s, substantial empirical literature has tried to examine the mechanisms and measure the extent of consumption risk sharing.<sup>3</sup> Asdrubali *et al.* (1996) was a pioneering study which, using a variance decomposition methodology, collapsed the interstate risk sharing of the United States into three channels including capital market, federal government and credit market. They found considerable extent of risk sharing across the states. Several consequent studies including Arreaza *et al.* (1998), Sorenson and Yosha (1998), Asdrubali and Kim (2004 and 2008), Nakakuki and

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Fujiki (2005) and Lanhard and Sawicki (2006), extended Asdrubali *et al.* (1996)'s analysis to both the intranational and international cases of other OECD countries.

However, it was not until recently, given the financial integration and financial globalization, the literature started to pay attention to the inter-regional risk sharing issue of developing countries. Most recently, cross-country studies of Kose *et al.* (2007 and 2009) found that the degree of risk sharing has been limited for developing countries, and recent financial globalization has not improved the ability of risk sharing even for emerging market economies despite their substantial increases in the volume of cross-border financial flows.<sup>4</sup> Compared to developed countries, examining the mechanism of risk sharing is of more significance to developing countries due to the following two reasons. First, the economic structure of developing countries is often less diversified and the scale of their economies is often small. Accordingly, the developing countries tend to be exposed to income fluctuations more easily. Second, many markets including financial markets do not exist and, of those that do, many work inefficiently in developing countries. It is of considerable interest to investigate the efficacy of various market institutions relative to the government (fiscal system) in consumption smoothing in developing countries.

China offers a good example to study risk sharing in developing countries. On one hand, China has experienced uneven regional development since 1978 economic reform. The rapidly growing coastal region and less rapidly growing (relatively) inland region have presumably experienced different economic fluctuations. For instance, the global financial crisis that started with the meltdown of the United States subprime mortgage market in 2007 slowed down the growth in export-oriented coastal region, but it did not influence the inland region much. The happening posed the concerns for policymakers because macroeconomic tools including both fiscal stimulus package and credit expansion may affect all regions, but not specific regions. On the other hand, China exhibits salient features similar to other developing countries. Despite the extraordinary trade openness and huge amount of FDI inflows, the formal financial system in China has been repressive even after 1978 economic reform. Consequently, the Chinese economy has relied largely on less stable capital and informal finance.

The objective of this study is to examine the patterns of consumption risk sharing in China. We make contributions to the empirical literature in two dimensions. First, we investigate both the extent and channels of risk sharing in a unified framework which combined two influential empirical approaches proposed by Asdrubali *et al.* (1996) and Kose *et al.* (2007 and 2009). The two approaches are consistent but not equivalent to provide different aspects of risk sharing patterns. Second, this study extends the analysis to the changes over time and sub-regions<sup>5</sup> in the degree of intranational risk sharing of an emerging economy, i.e., China.<sup>6</sup> In particular, we extend the analysis to examine the impacts of four groups of institutional factors including urbanization, formal finance, informal finance and local governments' fiscal capacity on risk sharing. Our hypotheses for empirical analysis are as

follows:

1. The smoothed portion of risk sharing is probably limited in China due to the repressive nature of the formal financial system.
2. Important channels found in the literature, in particular, capital market, may not contribute to the risk sharing in China.
3. Informal finance and urbanization might be distinct channels of risk sharing in China.
4. Risk sharing mechanisms might change over time periods and macro-regions.

In section 2, we explain the institutional setting of China's risk sharing. In section 3, we present a comprehensive description of empirical approaches. In section 4, we explain the main feature of dataset used for calibration. This is followed in section 5 by a summary of empirical findings and discussions. We examine how the extent and channels of risk sharing have changed over time and sub-regions using various regression models, and section 6 concludes.

## **2. Institutional Background of China's Risk Sharing**

During past three decades, the economic transformation of the Chinese economy from a centrally planned system to a market-oriented system has brought about remarkable economic growth and efficiency gains. However, the incremental feature of the transition process may result in increasing market fragmentation because the local governments and individuals would try to capture the rent-seeking opportunities inherent in the remaining distortions of economy (Young, 2000).<sup>7</sup> A recent study by Zhang and Tan (2007) argued that as the domestic product markets have become more integrated due to the deepening reforms, rent-seeking behaviors may have shifted to the factor markets, in particular, capital market. Their argument was consistent to Boyreau-Debray and Wei (2004), which found increased degree of capital market fragmentation during reform period. Intuitively, fragmented financial system poses an impediment to inter-regional risk sharing in China.

The risk sharing literature mainly depicts three mechanisms for inter-regional consumption smoothing, i.e., cross-regional asset holdings through stock exchange listings, cross-regional borrowing and lending through credit market, and fiscal transfer. We will examine the institutional background of these three mechanisms separately. In general, given the dominant size of banking sector in whole financial system, credit market might contribute to risk sharing in China despite its low efficiency. The stock exchanges and fiscal transfer presumably do not smooth income shocks because of low capital mobility and relatively small size, respectively.

Regarding the stock exchange, Shanghai Stock Exchange and Shenzhen Stock Exchange were established in the early 1990s in China. Since then, they have been growing very rapidly to become one of the largest stock exchanges in the world in terms of combined total market capitalization. However, until recently, around two-third of the shares in China's stock market was not tradable.

Despite the relevant reform launched in 2005, the non-tradable shares still accounted for 31% of the total at the end of 2009.<sup>8</sup>

Compared to the stock markets, the scale and importance of banking sector are more significant for the Chinese economy. Given the rapid economic growth, total bank deposits, in particular, household savings, have been growing rapidly during the reform era. It provides a good source for bank loans. Currently, the Chinese ratio of total bank credit to GDP is among one of the highest in the world. However, the percentage of bank loans made to private sector is low, suggesting that most of the bank credit is issued to the state-owned enterprises (SOEs, hereafter). Allen *et al.* (2005) pointed out that, a large fraction of nonperforming loans (NPLs, hereafter) in China's banking sector resulted from poor lending decisions made for SOEs, some of which were due to political or other noneconomic reasons. One measure taken by the government to solve NPLs problem is the diversification of loan structure. The banks have increased the loans made to individual lenders while the majority is still issued to SOEs in manufacturing industries.<sup>9</sup> By the end of 2004, 10% of all outstanding bank loans were extended to consumers (Allen *et al.* 2008: 529). The size of mortgages, almost 90% of consumer credit, grew 100 times between 1997 and 2006 (Allen *et al.* 2008: 529).

Regarding the fiscal transfer, although 1994 tax system reform<sup>10</sup> to a great extent strengthened the fiscal capacity of the central government, the size of fiscal transfer to local governments has been relatively small compared to other financial flows. For example, in 2009, the total net transfer from the central government to local governments is estimated to be RMB 3011 billion yuan. It accounted for 62% of total government consumption expenditures of local governments, but no more than 10% of total bank loans.<sup>11</sup>

In addition to the above-mentioned three mechanisms, interregional risk sharing might operate via the informal financial system and urbanization process in China. First, due to the repressive nature of formal financial system, private enterprises in China are often denied access to bank credit. Allen *et al.* (2005) and Tsai (2002) argued that self fund-raising activities comprise of alternative financing channels for them. However, those activities are often based on the reputation and long-term business relationships among local communities including friends, families, employees and local business partners. It is thus unclear whether the locally-based informal financing channel promotes inter-regional risk sharing or not. Second, China received large amount of FDI inflows. Guariglia and Poncet (2006) argued that, FDI in the forms of foreign joint-ventures may be used by private enterprises to circumvent the discrimination of the local financial system. However, given the fact that FDI inflows have concentrated in coastal region, the impacts of FDI on inter-regional risk sharing in China is unclear. Third, after-1978 economic growth in China has accompanied rapid economic structural changes and rural-urban migration. Large amount of rural labor shifted out of agricultural sector, and entered into urban industrial sector. The survey conducted by the Ministry of Agriculture and the Ministry of Labor and Social Security showed that, the number of rural migrants increased

from 52.0 million in 1999 to 98.3 million in 2003 (Cai *et al.* 2008: 192). Over the period, about 40% of migrants went to the destinations outside their home provinces (Cai *et al.* 2008: 192). The capital flows in the form of remittances of migrant workers to their families in home provinces may promote inter-regional risk sharing in China.

### 3. Methodology

#### 3.1. Baseline Panel Regression

Empirically, the literature examines the extent of risk sharing based on the dynamics of correlations between consumption and gross regional product. Although gross regional product is the value added, its growth rate is often used as the measurement of output shocks. The standard regression equation employed in the literature is as follows.

$$\Delta \log ca_i^t - \Delta \log(CA_t) = \alpha + \beta (\Delta \log y_i^t - \Delta \log Y_t) + \varepsilon_i^t \quad (1)$$

where  $\alpha$  is the constant,  $ca_i^t$  and  $y_i^t$  denote per capita aggregate consumption and per capita GDP of province  $i$  in year  $t$ ,  $CA_t$  and  $Y_t$  denote national per capita consumption and national per capita GDP in year  $t$ . The degree of risk sharing attained by provinces is equal to  $(1 - \beta)$ . The value should range from 0 (no risk sharing) to 1 (perfect risk sharing).

The equation (1) follows Kose *et al.* (2007 and 2009) by modifying the original specification for cross-country analysis. The growth rates of  $CA_t$  and  $Y_t$ , respectively, measure the national averages of consumption and output fluctuations. They are deducted from the corresponding provincial variables because the average fluctuations (risks) are considered to be common for all provinces, and can not be shared. Accordingly, the differences between provincial variables and national variables capture the idiosyncratic (province-specific) fluctuations in the provincial consumption and GDP.

#### 3.2. Measuring the Channels of Risk Sharing

Asdrubali *et al.* (1996) proposed an approach based on a panel analysis of the cross-sectional variance of gross regional output. At the conceptual level, Asdrubali *et al.* (1996) classify four channels through which income shocks get smoothed. First, capital markets. Facilitated by the transactions in capital markets, institutions in a region can hold the claims to the productive assets in other regions. Second, patterns of capital depreciation. In the National Accounts, depreciation is computed based on the fixed accounting rules, and since the capital-output ratio is typically countercyclical, depreciation in the National Accounts data will constitute a larger fraction of output in recession and a smaller fraction in booms, resulting in the dis-smoothing effect (Arreaza *et al.* (1998: 64)). Third, taxation and the inter-governmental fiscal transfer system. Fourth, credit market. The institutions adjust their asset portfolios through saving and dis-saving behaviors in response to the income shocks. Their

behaviors induce intertemporal smoothing effects when they borrow or lend at national credit market.

Consider an identity as below:

$$GRP^i = \frac{GRP^i}{GNP^i} \cdot \frac{GNP^i}{RI^i} \cdot \frac{RI^i}{DRI^i} \cdot \frac{DRI^i}{(C^i+G^i)} \cdot (C^i+G^i) \quad (2)$$

where all magnitudes are in per capita terms,  $i$  is the subscript of province,  $GRP^i$  is the GDP of province  $i$ ,  $GNP^i$  is the GNP of province  $i$ ,  $RI^i$  is the income of province  $i$ ,  $DRI^i$  is the disposable income of province  $i$ ,  $C^i$  is the private consumption of province  $i$ , and  $G^i$  is the public consumption of province  $i$ . With full risk sharing, consumption in each province is a fixed proportion of aggregate output, regardless of the income fluctuations. If full risk sharing is achieved through capital market smoothing,  $RI^i$  would not comove with  $GRP^i$ .<sup>12</sup> Otherwise, there is the scope for further smoothing through other channels. Similarly, if full risk sharing is achieved at the level of capital depreciation,  $DRI^i$  would not comove with  $GRP^i$ . Finally, if full risk sharing is achieved through the combination of four channels,  $(C^i+G^i)$  would not comove with  $GRP^i$ .

To obtain the measurement of smoothing extent through each of four channels, taking logarithm and differences, multiplying both sides of equation (2) by  $\Delta \log GRP^i$  and taking expectations, we obtain the following equation<sup>13</sup>:

$$\begin{aligned} \text{var}\{\Delta \log GRP\} = & \text{cov}\{\Delta \log GRP, \Delta \log GRP - \Delta \log GNP\} + \text{cov}\{\Delta \log GRP, \Delta \log GNP - \Delta \log RI\} \\ & + \text{cov}\{\Delta \log GRP, \Delta \log RI - \Delta \log DRI\} + \text{cov}\{\Delta \log GRP, \Delta \log DRI - \Delta \log(C+G)\} \\ & + \text{cov}\{\Delta \log GRP, \Delta \log(C+G)\} \end{aligned} \quad (3)$$

Dividing the both sides of equation (3) by the variance of  $\Delta \log GRP$ , we obtain:

$$1 = \beta_K + \beta_D + \beta_T + \beta_C + \beta_U \quad (4)$$

where  $\beta$  are the OLS coefficient estimates of following regressions:

$$\Delta \log GRP_t^i - \Delta \log GNP_t^i = v_{K,t} + \beta_K \Delta \log GRP_t^i + \varepsilon_{K,t}^i \quad (5)$$

$$\Delta \log GNP_t^i - \Delta \log RI_t^i = v_{D,t} + \beta_D \Delta \log GRP_t^i + \varepsilon_{D,t}^i \quad (6)$$

$$\Delta \log RI_t^i - \Delta \log DRI_t^i = v_{T,t} + \beta_T \Delta \log GRP_t^i + \varepsilon_{T,t}^i \quad (7)$$

$$\Delta \log DRI_t^i - \Delta \log(C_t^i + G_t^i) = v_{C,t} + \beta_C \Delta \log GRP_t^i + \varepsilon_{C,t}^i \quad (8)$$

$$\Delta \log(C_t^i + G_t^i) = v_{U,t} + \beta_U \Delta \log GRP_t^i + \varepsilon_{U,t}^i \quad (9)$$

where  $v$  indicates the time fixed effect. The  $\beta$  coefficients in equation (5)–(9) capture the incremental amount of consumption smoothing achieved respectively through capital market, capital depreciation, tax-transfer system and credit market, while  $\beta_U$  captures the amount not smoothed. The time fixed

effects capture year-specific impacts on the growth rates of provincial gross output. The  $\beta$  coefficients are the weighted averages of year-by-year cross-sectional regressions.

To capture the differences in the risk sharing patterns across broad regions, the equation (10) – (14) can be derived from the above regressions following Sorensen and Yosha (2000).<sup>14</sup>

$$(\Delta \log GRP_i^i - \overline{\Delta \log GRP_i^i}) - (\Delta \log GNP_i^i - \overline{\Delta \log GNP_i^i}) = \omega_{K,i} + \beta_K (\Delta \log GRP_i^i - \overline{\Delta \log GRP_i^i}) + \varepsilon_{K,i}^i \quad (10)$$

$$(\Delta \log GNP_i^i - \overline{\Delta \log GNP_i^i}) - (\Delta \log RI_i^i - \overline{\Delta \log RI_i^i}) = \omega_{D,i} + \beta_D (\Delta \log GRP_i^i - \overline{\Delta \log GRP_i^i}) + \varepsilon_{D,i}^i \quad (11)$$

$$(\Delta \log RI_i^i - \overline{\Delta \log RI_i^i}) - (\Delta \log DRI_i^i - \overline{\Delta \log DRI_i^i}) = \omega_{T,i} + \beta_T (\Delta \log GRP_i^i - \overline{\Delta \log GRP_i^i}) + \varepsilon_{T,i}^i \quad (12)$$

$$(\Delta \log DRI_i^i - \overline{\Delta \log DRI_i^i}) - (\Delta \log (C+G)_i^i - \overline{\Delta \log (C+G)_i^i}) = \omega_{C,i} + \beta_C (\Delta \log GRP_i^i - \overline{\Delta \log GRP_i^i}) + \varepsilon_{C,i}^i \quad (13)$$

$$(\Delta \log (C+G)_i^i - \overline{\Delta \log (C+G)_i^i}) = \omega_{V,i} + \beta_V (\Delta \log GRP_i^i - \overline{\Delta \log GRP_i^i}) + \varepsilon_{V,i}^i \quad (14)$$

where  $\omega$  is the cross-section (province-specific) fixed effect,  $\overline{\Delta \log GRP_i^i}$ ,  $\overline{\Delta \log GNP_i^i}$ ,  $\overline{\Delta \log RI_i^i}$ ,  $\overline{\Delta \log DRI_i^i}$  and  $\overline{\Delta \log (C+G)_i^i}$  represent the averages of corresponding variables for a given group of provinces at time  $t$ . For each given group of provinces, aggregate output fluctuations are removed from the provincial fluctuations to obtain the smoothable province-specific output fluctuations.

### 3.3. Measuring the Effects of Institutional Factors

To analyze the impacts of institutional factors on the extent of risk sharing, we follow Kose *et al.* (2007 and 2009) and employ a standard risk sharing regression model which incorporates the interaction terms of idiosyncratic components of output changes with institutional factors as follows.

$$\Delta \log ca_i^i - \Delta \log (CA_i) = \alpha + \mu (\Delta \log y_i^i - \Delta \log Y_i) + \gamma Ins_i (\Delta \log y_i^i - \Delta \log Y_i) + \varepsilon_i^i \quad (15)$$

where  $Ins_i$  represents various measures of institutional factors in province  $i$ . Similar to the analyses in previous two sections, the degree of risk sharing attained by provinces is equal to  $(1 - \mu - \gamma Ins)$ . A negative value of interaction term,  $\gamma$ , indicates that the greater the degree of relevant institutional factors, the higher the amount of risk sharing achieved. The regression includes both province fixed effects and time effects to control idiosyncratic province-specific noise and obtain average estimate over the time period.

## 4. Dataset

We use a dataset that includes 31 provinces and province-level cities of mainland China. The

dataset is constructed largely based on the provincial national accounts. Our measures of output and consumption include per capita GDP, per capita GNP, per capita regional income, per capita disposable regional income, per capita private consumption and per capita public consumption (Table 1). All data are at provincial level and converted into constant (1995) prices using provincial CPI.<sup>15</sup> The nominal terms of the series are available at an annual frequency during 1995–2009.

**Table 1 List of Variables**

Variables	Definition	Sources
<i>GRP</i>	Gross regional product (provincial GDP), in per capita term	SNA52-04, CSY, FYC, TYC
<i>GNP</i>	Provincial gross national product, in per capita term. $GNP = GRP + \text{Net factor income from other provinces and abroad}$	
<i>RI</i>	Regional income, in per capita term. $RI = GNP - \text{Capital depreciation}$ .	
<i>DRI</i>	Disposable regional income, in per capita term. $DRI = RI + \text{Net transfer from the central government}$ .	
<i>C+G</i>	C, private consumption; G, government consumption, in per capita terms. $C + G = DRI - \text{Saving}$	
<b>Measures of institutional factors</b>		
<b>Urbanization</b>		
<i>Urbanization_1</i>	1 minus the ratio of the gross output value of farming, forestry, and husbandry to GDP	CCS60
<i>Urbanization_2</i>	The ratio of year-end permanent population to household registered population	CCS60, ACP, PSY
<b>Formal finance</b>		
<i>Formal_finance_1</i>	The ratio of total loans in financial institutions to GDP	ACFB
<i>Formal_finance_2</i>	The ratio of total deposits in financial institutions to GDP	
<b>Informal finance</b>		
<i>Informal_finance_1</i>	The ratio of fixed assets investment financed by self-raised funds to total fixed assets investment	RE17, PSY, CSY
<i>Informal_finance_2</i>	The ratio of fixed assets investment financed by foreign funds to total fixed assets investment	
<i>Informal_finance_3</i>	The ratio of FDI (total amount actually utilized) to GDP	CCS60, PSY, CSY
<b>Fiscal capacity</b>		
<i>Fiscal_transfer</i>	The ratio of net transfer from central government to provincial government to local government consumption expenditure	FYC, TYC
<i>Tax</i>	The ratio of total taxes collected in the locality to local government consumption expenditure	

Note: SNA52-04 refers to the *Data of Gross Domestic Product of China, 1952-2004*. CSY refers to the *China Statistical Yearbook*, various issues. FYC refers to the *Finance Yearbook of China*, various issues. TYC refers to the *Tax Yearbook of China*, various issues. CCS60 refers to the *China Compendium of Statistics: 1949-2008*. ACP refers to the *Almanac of China's Population*, various issues. PSY refers to provincial statistical yearbooks, various provinces and various issues. ACFB refers to the *Almanac of China's Finance and Banking*, various issues. RE17 refers to *China Regional Economy: A Profile of 17 Years of Reform and Opening-up*.



In order to estimate provincial *GNP*, we first compute provincial savings by the following equation:

$$S=I+(G-TA)+NX \quad (16)$$

where *S* is the savings, *I* is the investment by private sector, *TA* is the total taxes, *NX* is the net outflow of goods and services to other provinces and abroad. Following the definitions of *GRP*, *GNP*, *RI* and *DRI* presented in Table 1, we then calculate the disposable regional income (*DRI*) by adding savings (*S*) to total consumption (*C+G*). The regional income (*RI*) is consequently computed by deducting net transfer (from the central government to local governments)<sup>16</sup> from the disposable regional income (*DRI*). Finally, we computed the provincial GNP by adding capital depreciation to regional income (*RI*).

To investigate the effects of institutional factors on patterns of risk sharing, we construct nine indices in total to capture four salient characteristics of China as a developing economy (Table 1). The first characteristic is urbanization. We use two ratios to measure the extent of urbanization at the provincial level. *Urbanization\_1* is constructed as 1 minus the ratio of the gross output value of farming, forestry, and husbandry to GDP, where a higher value indicates a higher portion of non-farming income, i.e., higher level of urbanization. *Urbanization\_2* is the ratio of year-end permanent population to household registered population, where a higher value indicates a higher portion of net migration inflow. Since higher portion of migration entails more remittances to their presumably less developed home provinces, the ratio is used to capture the effects of inter-provincial labor flow, in particular, rural-urban labor migration.

The second characteristic is formal finance. We use two ratios to capture the development of formal financial system in China. Given the importance of banking sector over capital market in China, the two ratios are constructed to reflect the level of financial intermediation. *Formal\_finance\_1* is the ratio of total loans in financial institutions to GDP. *Formal\_finance\_2* is the ratio of total deposits in financial institutions to GDP.

The third characteristic is informal finance. We use three ratios to capture the accessibility to capital flows outside the domestic formal financial system. *Informal\_finance\_1* is the ratio of fixed assets investment financed by self-raised funds to total fixed assets investment. It captures the availability of domestic informal financing channels at the provincial level. It is reported that in some provinces such as Zhejiang, the informal financing activities are more active compared to others. *Informal\_finance\_2* is the ratio of fixed assets investment financed by foreign funds to total fixed assets investment. *Informal\_finance\_3* is the ratio of FDI (total amount actually utilized) to GDP. *Informal\_finance\_2* and *Informal\_finance\_3* capture the accessibility to foreign funds. They are also closely related to the level of trade openness at the provincial level.

The fourth characteristic comprises two measures of fiscal capacity of provincial governments. *Fiscal\_transfer* is the ratio of net fiscal transfer (from central government to provincial governments)

to local government consumption expenditure. *Tax* is the ratio of total taxes collected in the locality to local government consumption expenditure. The former is also a proxy for central government capacity to adjust regional disparity.

To analyze the changes of risk sharing extent over time and the effects of geographic factors, we first divide the sample into two sub-periods – 1995–2001 and 2002–2009. We put 2001 as a borderline year because China has become a member of WTO at the end of the year. Despite a five-year grace period based on WTO commitments to remove the geographic and business restrictions on foreign financial institutions gradually, the financial system in China has been liberalized largely since 2001. The entry of foreign banking institutions into Chinese domestic currency businesses was fully opened up in December 2006.<sup>17</sup> In the meantime, the big state-owned commercial banks were restructured into shareholding banks, and overseas strategic investors, based on a Qualified Foreign Institutional Investors (QFII) system,<sup>18</sup> were introduced to diversify their stock-holding structure. Moreover, the government recapitalized big state-owned commercial banks, and used the overseas and/or domestic listing as a tool to gain the global reputation for them. It is thus of our interest to examine the effects of financial liberalization on risk sharing through the comparison of two time periods.

Next, we divide 31 provinces and province-level cities into two groups – 12 coastal provinces and 19 inland provinces. The 12 coastal provinces comprise Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan, and Chongqing. The 19 inland provinces comprise Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang.

## 5. Results and Discussions

### 5.1. Benchmark results from Baseline Calibration

Table 2 presents the estimation results of baseline panel regression (equation (1)) using annual data. Panel A and B report the average degree of unsmoothed part of risk sharing using regressions which respectively include province fixed & time effects and only time effects. In order to investigate the changes in the extent of risk sharing over time, we trace the evolution of estimates of  $\beta$  over full sample (1995–2009) and two sub-periods (1995–2001, 2002–2009) separately. The extent of risk sharing in China during 1995–2009 is approximately 45.6% (46.6%), depending on the estimation methods, with the remaining 54.4% (53.4%) of the shocks to gross provincial output unsmoothed. In addition, the amount of risk-sharing has not improved much in the second time period (2002–2009) despite the slight decline of unsmoothed portion, from 55.6% (54.5%) to 51.0% (52.8%). These two facts indicate that the degree of risk sharing among Chinese provinces is rather limited, and the financial liberalization after China's WTO accession appear not to improve the degree of risk sharing.

**Table 2 Inter-provincial Risk Sharing: Baseline Calibration**

Panel A: total interprovincial risk sharing (time effects&amp;province fixed effects)

	1995–2009							
	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>				
Not smoothed	0.544 (6.714***)	0.136	434	2.554***				
	1995–2001				2002–2009			
	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>
Not smoothed	0.556 (5.116***)	0.115	186	1.667**	0.510 (4.016***)	0.103	248	1.750***

Panel B: total interprovincial risk sharing (time effects)

	1995–2009							
	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>				
Not smoothed	0.534 (7.484***)	0.176	434	7.617***				
	1995–2001				2002–2009			
	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>
Not smoothed	0.545 (5.798***)	0.175	186	7.532***	0.528 (5.265***)	0.165	248	7.081***

Note: \*\*\*, \*\* and \* indicate the statistical significance at the 1, 5 and 10 percent levels, respectively.

## 5.2. Channels of Risk Sharing Patterns in China

Table 3 presents the results for the extent of risk sharing through various channels and also separately for coastal region and inland region. Panel A and B report the estimation results for equation (5)–(9) and equation (10)–(14), respectively. Province fixed and time fixed effects are included occasionally to account for the province-specific and year-specific impacts in common.

Among the four channels defined by Asdrubali *et al.* (1996), we focus on the comparison of tax-transfer system and other channels because it measures the capacity of fiscal system in regional income redistribution. This issue is extremely important for current China due to the enlarging regional income disparity and also the government's efforts to address it since the start of the 10th five-year master plan in 2001. Panel A in Table 3 shows that tax-transfer system has not been a statistically significant channel for Chinese provinces to share risks. This suggests that the government income redistribution has played little role in risk sharing in China. In contrast, the credit market appears to be the only significant operative channel in risk sharing. During 1995–2009, on average, approximately 49.0% (48.8%) of the shocks to gross provincial output has been smoothed through the credit market. Not surprisingly, given the prolonged dominance of banking sector in China's financial system, capital market appears not to be an operative channel in risk sharing in China

**Table 3 Channel Decomposition of Risk Sharing: All Provinces and Sub-regions**

Panel A: channel decomposition of total interprovincial risk sharing (1995–2009)

	OLS (time effects&province fixed effects)				OLS (time effects)				US (1964–1990)	UK (1975–1999)
	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>		
Capital markets	– 0.042 (–0.588)	0.115	434	2.273***	–0.018 (–0.273)	0.098	434	4.367***	0.39	0.46
Capital depreciation	– 0.049 (–1.713*)	0.114	434	2.268***	–0.040 (–1.540)	0.119	434	5.188***	—	—
Tax-transfer system	0.058 (0.909)	0.161	434	2.882***	0.036 (0.603)	0.073	434	3.445***	0.13	– 0.01
Credit market	0.490 (6.612***)	0.212	434	3.644***	0.488 (7.357***)	0.224	434	9.950***	0.23	0.36
Not smoothed	0.544 (6.714***)	0.179	434	3.143***	0.534 (7.484***)	0.216	434	9.559***	0.25	0.19

Panel B: subregions (1995–2009, OLS, province fixed effects)

	Coastal provinces				Inland provinces			
	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>	$\hat{\beta}$	<i>adj. R</i> <sup>2</sup>	<i>obs.</i>	<i>F-stat.</i>
Capital markets	0.073 (0.627)	0.024	168	1.335	–0.089 (–0.974)	0.020	266	1.281
Capital depreciation	–0.049 (–1.220)	–0.035	168	0.530	–0.054 (–1.381)	0.012	266	1.168
Tax-transfer system	–0.102 (–1.010)	0.053	168	1.781*	0.133 (1.661*)	0.121	266	2.917***
Credit market	0.550 (4.105***)	0.103	168	2.605***	0.509 (5.876***)	0.095	266	2.468***
Not smoothed	0.528 (4.745***)	0.116	168	2.825***	0.500 (4.568***)	0.038	266	1.553*

Notes: 1. \*\*\*, \*\* and \* indicate the statistical significance at the 1, 5 and 10 percent levels, respectively.

2. The estimation results for the United States and the United Kingdom are taken from Asdrubali *et al.* (1996) and Labhard and Sawicki (2006) respectively. The numbers from the two studies are generalised least squares estimates.

notwithstanding its rapid development during past two decades.

The last two columns in Panel A (Table 3) provide a comparison between China and two developed economies – the United States and the United Kingdom. Compared to China, the degree of risk sharing in the two economies is much higher. In addition, capital markets appeared to be more significant than credit market. In the case of the United States, during the period 1964–1990, 39% of shocks to the per capita gross product of individual state were smoothed through capital markets, 13% were smoothed by the federal tax-transfer, 23% were smoothed through credit market, with the remaining 25% of shocks unsmoothed. In the case of the United Kingdom, during the period 1975–

1999, only 19% of shocks were not smoothed. The credit market appears to play a more active role in risk sharing to smooth 36% percent of total shocks, and percentage of risk shared by market institutions is 82% in total.

Panel B of the Table 3 shows the results for sub-regions. The findings are consistent with the results for full sample. Credit market remains to be the only operative channel for risk sharing. In particular, the extent of risk sharing appears to be slightly higher in coastal provinces compared to inland provinces. With regard to capital market, it is not a viable channel in coastal region although both the Shanghai Stock Exchange and Shenzhen Stock Exchange are located in the region. This suggests that the geographical proximity of coastal provinces to the stock exchanges have not contributed to the risk sharing in China. In addition, due to the underdevelopment and low capital mobility of the Chinese stock exchanges, cross-regional asset holdings through capital market are presumably not significant in China.

The explanation of channels above closely follows the definition in Asdrubali *et al.* (1996); however, we have to be careful when we interpret it in China's context. Asdrubali *et al.* (1996)'s definition of channels are largely based on their observations of the United States. The tax-transfer channel measuring the fiscal transfer from central government to the local is probably the only one that has same connotation in both countries. Regarding other channels, the interpretation in China's context is complex and not as clear as the case of the United States. First, Asdrubali *et al.* (1996) attributed the difference between *GRP* and *GNP* to the transactions in capital markets. Given highly developed capital markets, in the United States, the cross-holding of productive assets (in particular, corporate equity) among regions is mostly facilitated by stock exchange listings. In addition, as a developed economy, the portion of capital income in total net factor income is presumably much larger than labor income. However, these arguments may not be viable in China's context, especially due to the underdeveloped stock market and corporate bond market in China. Second, the interpretation of credit market might bear controversy as well. In the United States, consumer credit is prevalent, so the difference between disposable regional income and regional consumption is most likely attributed to the saving and dissaving behaviors of individuals through credit market. However, in the Chinese case, consumer credit is far less popular. Loan made to enterprises in manufacturing industries is still the dominant type of bank credit in China. As a result, it is difficult to attribute the two differences, i.e., the difference between *GRP* and *GNP*, and the difference between disposable regional income and regional consumption, to the mechanisms of capital and credit market clearly in China. The reality how the around 50% of risks shared in China is complex and might be a mixture of roles played by various institutional factors. In 5.3, we present our exploration on the issue.

### 5.3. The Effects of Institutional Factors on Risk Sharing Patterns in China

Finally, we report the results for different institutional factors in Table 4. As pointed out by Kose

Table 4 Measures of Institutional Factors and Risk Sharing

Risk sharing and various components (OLS, time effects&amp;province fixed effects)

	All provinces						Coastal provinces		Inland provinces	
	1995-2009		1995-2001		2002-2009		1995-2009		1995-2009	
	$\hat{\beta}$	adj. R <sup>2</sup> obs. F-stat.	$\hat{\beta}$	adj. R <sup>2</sup> obs. F-stat.	$\hat{\beta}$	adj. R <sup>2</sup> obs. F-stat.	$\hat{\beta}$	adj. R <sup>2</sup> obs. F-stat.	$\hat{\beta}$	adj. R <sup>2</sup> obs. F-stat.
Income shock	0.133 (0.304)	0.136 434 2.517***	-0.585 (-1.105)	0.137 186 1.795***	0.333 (0.375)	0.099 248 1.698**	0.435 (0.703)	0.250 168 3.145***	-0.148 (-0.195)	0.073 266 1.632**
Income shock × urbanization_1	0.546 (0.959)	1.734 (2.202**)	1.188 (0.698)	0.110 186 1.616**	0.219 (0.201)	0.099 248 1.697**	0.116 (0.159)	0.258 168 3.233***	0.923 (0.866)	0.073 266 1.632**
Income shock	0.838 (1.144)	0.135 434 2.495***	0.608 (0.655)	0.110 186 1.616**	0.608 (0.655)	0.099 248 1.697**	1.335 (1.979**)	0.258 168 3.233***	-2.112 (-0.641)	0.073 266 1.627**
Income shock × urbanization_2	-0.289 (-0.404)	-0.289 (-0.404)	-0.619 (-0.372)	0.110 186 1.616**	-0.097 (-0.107)	0.099 248 1.697**	-0.770 (-1.210)	0.258 168 3.233***	2.620 (0.794)	0.073 266 1.627**
Income shock	0.814 (3.289***)	0.137 434 2.529***	1.250 (2.778***)	0.124 186 1.707**	0.612 (1.676*)	0.099 248 1.700***	0.803 (2.342***)	0.254 168 3.187***	0.942 (2.290**)	0.073 266 1.650**
Income shock × formal_finance_1	-0.253 (-1.157)	-0.253 (-1.157)	-0.652 (-1.589)	0.124 186 1.707**	-0.091 (-0.298)	0.099 248 1.700***	-0.218 (-0.844)	0.254 168 3.187***	-0.455 (-1.112)	0.073 266 1.650**
Income shock	0.644 (3.521***)	0.135 434 2.502***	0.284 (0.957)	0.115 186 1.648**	0.641 (2.271**)	0.100 248 1.706***	0.774 (3.324***)	0.258 168 3.232***	0.420 (0.924)	0.070 266 1.605**
Income shock × formal_finance_2	-0.069 (-0.615)	-0.069 (-0.615)	0.220 (0.986)	0.115 186 1.648**	-0.080 (-0.519)	0.100 248 1.706***	-0.133 (-1.205)	0.258 168 3.232***	0.066 (0.185)	0.070 266 1.605**
Income shock	0.671 (2.871**)	0.135 434 2.500***	1.086 (4.120***)	0.137 186 1.795***	0.121 (0.259)	0.102 248 1.722***	0.547 (1.437)	0.250 168 3.144***	0.656 (2.132**)	0.071 266 1.615**
Income shock × informal_finance_1	-0.236 (-0.582)	-0.236 (-0.582)	-1.138 (-2.202**)	0.137 186 1.795***	0.665 (0.861)	0.102 248 1.722***	-0.030 (-0.044)	0.250 168 3.144***	-0.281 (-0.537)	0.071 266 1.615**
Income shock	0.553 (5.494***)	0.134 434 2.491***	0.648 (4.277***)	0.113 186 1.640**	0.477 (2.917***)	0.100 248 1.700***	0.512 (3.363***)	0.250 168 3.146***	0.644 (4.390***)	0.079 266 1.688**
Income shock × informal_finance_2	-0.273 (-0.150)	-0.273 (-0.150)	-1.717 (-0.875)	0.113 186 1.640**	1.531 (0.327)	0.100 248 1.700***	0.358 (0.188)	0.250 168 3.146***	-6.837 (-1.500)	0.079 266 1.688**
Income shock	0.475 (4.276***)	0.136 434 2.514***	0.471 (3.396***)	0.115 186 1.647**	0.411 (2.212**)	0.101 248 1.715***	0.411 (1.618)	0.252 168 3.161***	0.455 (3.050***)	0.071 266 1.613**
Income shock × informal_finance_3	2.846 (0.903)	2.846 (0.903)	6.040 (0.977)	0.115 186 1.647**	3.251 (0.734)	0.101 248 1.715***	2.565 (0.528)	0.252 168 3.161***	4.293 (0.486)	0.071 266 1.613**
Income shock	0.605 (4.638***)	0.135 434 2.501***	0.526 (2.519**)	0.109 186 1.612**	0.596 (3.000***)	0.100 248 1.707***	0.480 (3.083***)	0.252 168 3.159***	0.581 (2.568**)	0.071 266 1.610**
Income shock × fiscal_transfer	-0.096 (-0.605)	-0.096 (-0.605)	0.060 (0.169)	0.109 186 1.612**	-0.124 (-0.562)	0.100 248 1.707***	0.131 (0.498)	0.252 168 3.159***	-0.098 (-0.403)	0.071 266 1.610**
Income shock	0.623 (4.209***)	0.135 434 2.502***	0.494 (2.425**)	0.110 186 1.616**	0.611 (2.471**)	0.100 248 1.704***	0.682 (3.193***)	0.254 168 3.187***	0.703 (2.795**)	0.073 266 1.633**
Income shock × tax	-0.081 (-0.642)	-0.081 (-0.642)	0.080 (0.358)	0.110 186 1.616**	-0.090 (-0.475)	0.100 248 1.704***	-0.119 (-0.845)	0.254 168 3.187***	-0.255 (-0.892)	0.073 266 1.633**

Note: \*\*\*, \*\* and \* indicate the statistical significance at the 1, 5 and 10 percent levels, respectively.

*et al.* (2007 and 2009), the inability of developing countries to attain improved risk sharing through financial globalization is possibly related to the weakness in the domestic policy environment or structural factors. We focus on four groups of interaction terms which reflect the institutional characteristics including urbanization, formal finance, informal finance and fiscal capacity. For the full sample, sub-periods, and sub-regions, Table 4 shows that none of the interaction coefficients is significant, and in some cases, they are positive – implying a dis-smoothing effect of corresponding variable. It is therefore difficult to conclude that our four institutional factors have helped improve the risk sharing among Chinese provinces over the period 1995–2009.

However, notwithstanding statistically insignificant, the signs of the interaction coefficients generate interesting insights into future risk sharing patterns in China. In general, for the full sample over the period 1995–2009, the interaction coefficients are negative – implying a possibility for these factors to play a significant role in risk sharing in the future in China. Regarding urbanization, industrialization as represented by *Urbanization\_1* seems more likely to be a dis-smoothing factor in China, while higher labor flows seem more likely to lead to the improvement of risk sharing. Regarding financial markets, both formal financial system and informal financial system seem more likely to help improve the risk sharing in China except for the FDI flows. This is possibly because FDI flows heavily concentrate in coastal provinces during the whole economic reform period. Comparing the changes of coefficients over two sub-periods, formal finance appears more likely to improve risk sharing in the second sub-period (2002 – 2009), while the informal finance seems more likely to contribute in the first sub-period (1995–2001) with FDI as an exception. In the case of the comparison between coastal provinces and inland provinces, formal financial system seems more likely to improve risk sharing in the former, while the latter possibly relies more on informal financial system. This possibly suggests that formal financial system supports the more rapidly growing coastal region, while left the relatively less developed inland region behind. So the informal financial system possibly has filled the void in inland provinces. Regarding the effects of fiscal capacity, the signs of the both interaction terms respectively representing fiscal transfer and tax appear to be negative only in the second sub-period 2002 – 2009. In particular, fiscal transfer from the central government to local government seems more likely to contribute to the risk sharing in inland provinces than coastal provinces. This is possibly related to the changes in macro-economic policies in China since the late 1990s which address more balanced development between coastal and inland regions, between urban and rural areas, especially, using fiscal transfer as a tool to tackle regional disparity issue.<sup>19</sup>

## 6. Conclusion

This study examined the patterns of risk sharing among Chinese provinces over the period 1995–

2009 using three empirical techniques. First, we documented the general extent of risk sharing. The estimation results indicate that, the degree of risk sharing is limited, with over 50% of the output shocks unsmoothed in China. The financial liberalization since the late 1990s has not helped improve the risk sharing. Second, we investigate the channels through which the risk sharing is attained and the possible differences in the patterns of different regions. The results suggest that, among capital market, capital depreciation, tax-transfer system and credit market, credit market is by far the single significant channel of inter-regional risk sharing in China. Capital markets and fiscal transfers, by contrast, do not significantly contribute to the sharing of output fluctuations. Moreover, there is no difference in patterns of risk sharing between coastal provinces and inland provinces. Third, we examine the effects of various institutional factors including urbanization, formal finance, informal finance and fiscal capacity on the extent of risk sharing. The estimation results indicate that, up to now, these institutional factors have not exerted significant impacts on the improvement of risk sharing in China; however, there are possibilities for China to enjoy the benefits of risk sharing from these factors in the future. In particular, though insignificant currently, rural-urban migration, formal financial system and fiscal transfer appear to promote risk sharing since 2002.

Given the fact that the literature has largely focused on the patterns of international risk sharing or intranational risk sharing in developed countries, our empirical results bear the implications for developing countries. Different from developed countries, the degree of risk sharing attained by regions within a certain developing country might be limited due to the under-development of domestic financial system. In addition, the foreign capital inflow as represented by FDI might deteriorate the risk sharing in developing countries if it flocks to certain region and leaves others behind. However, the country-specific characteristics related to each country's development path might play a role in improving risk sharing in developing countries. Thus, in order to gain the benefits from improved risk sharing, it is possibly important for the developing countries to address those institutional factors as well as financial liberalization issue.

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## Notes

- 1 To give a simple example, for instance, with effective inter-regional risk sharing mechanism, after 2008 Sichuan earthquake in China and 3-11 earthquake in Japan in 2011, residents living in the epicenter may receive interests and dividend income from out-of-province (prefecture) investment funds and government subsidies after the earthquakes. Consequently, their levels of consumption will not fall by as much as output in the year.
- 2 Note that inter-regional risk sharing is unrelated to the income redistribution. Income redistribution tackles the permanent income inequality, while risk sharing in our context denotes a less exposure to the temporary volatility of regional income. Each individual region is better off when the risks are shared within a group of regions. It is similar to an insurance mechanism across regions.
- 3 See for example, Obstfeld (1994 and 1996), Lewis (1996 and 1997), Asdrubali *et al.* (1996), Arreaza *et al.* (1998), Sorensen *et al.* (1998), Sorensen and Yosha (1998 and 2000), Asdrubali and Kim (2004 and 2008), Nakakuki and



- Fujiki (2005), Lanhard and Sawicki (2006), Kose *et al.* (2007 and 2009), and Flood *et al.* (2009). Kose *et al.* (2007) provides a comprehensive review of empirical literature.
- 4 The dataset of Kose *et al.* (2007 and 2009) includes 21 developed and 48 developing countries.
  - 5 Specifically, we extend the analysis to coastal region and inland region respectively. We provide a careful comparison of differences in risk sharing mechanisms of two regions.
  - 6 Following Asdrubali *et al.* (1996)'s approach, Kajitani (2005) examined the risk sharing in China. He found that, during the period 1980–1998, 12.7% of shocks to the per capita gross provincial product were smoothed on average through the fiscal transfers, 37.5% were smoothed by the credit market, and the capital market was not a viable channel. In contrast, during the period 1999–2002, credit market was the single viable channel. It smoothed 54.6% of shocks to the per capita gross product. However, compared to this study, Kajitani (2005) bears the following three shortcomings. First, Kajitani (2005) assumed that provincial GDP equals to provincial GNP due to the missing data of the net flows of capital and labor income at the provincial level. The assumption may generate bias in the final estimation results. Second, Kajitani (2005) did not shed light on the impacts of institutional characteristics of China as a developing country. Third, Kajitani (2005) did not shed light on the impacts of geographical factors despite the well-known differences in economic development between coastal provinces and inland provinces.
  - 7 For example, accompanied by the fiscal decentralization, local governments throughout the country sought to develop industries of high profit margin. The resulting interregional competition due to duplicative industrial structures led the local governments to impose trade protection measures against each other.
  - 8 Computed based on the data of *China Statistical Yearbook, 2010*. The non-tradable shares consist of state-owned shares (*guoyougu*) and corporation-owned shares (or legal person shares, *farengu*), which are illiquid and traded off-exchange at a substantial discount of net asset value. State-owned shares are shares held by the government through a designated government agency. Legal person shares, which are the shares held by legal entities (domestic and/or overseas economic entities including companies and organizations, but not individuals). Legal person shares are created when a company uses state assets to invest in a company limited by shares (Fan, Wu and Groenewold (2003: 27–28). The Chinese government has taken active measure to transform non-tradable shares to tradable shares (state shares reduction (*guoyougu jianchi, or quanliutong*)). The first attempt started in July 2001 was abandoned one year later after the initiation on June 24, 2002 since it triggered a 45% market trash. The second trial, started from April 2005, has taken a gradual way. In April 2005, four enterprises including Tsinghua Tongfang, Sany Heavy Industry (*Sanyi Zhonggong*), Zijiang Enterprise (*Zijiang Qiye*) and Jinniu Energy (*Jinniu Nengyuan*) was selected to run a pilot scheme of the reform, while was followed by a second round of reform covering 42 enterprises conducted in June. Later on, more and more companies were approved to initiate the reform. The shares which finished the state shares reduction reform have been termed as G shares.
  - 9 To be accurate, “industrial loans” and “commercial loans” in China’s statistics.
  - 10 As a result of fiscal decentralization after 1978–reform, the local government revenue accounted for 70% of total government revenue in China during 1978–1993. To increase the weakened fiscal capacity of central government, tax system reform was initiated in 1994, which divided the tax into two parts, i.e., tax collected by local governments and tax collected by central government. After the reform, the ratio of local government revenue to total revenue decreased to 44.3% in 1994 and the level sustained in later years.
  - 11 Computed based on the author’s dataset, see section 4 for details.
  - 12 The difference between GDP and GNP refers to the net inflow of capital and labor income to a region. Therefore, more generally, the capital market smoothing channel also consists of the effects via labor income flows.
  - 13 The derivation process is available upon request. It is based on the fact that  $E(X^2) = \text{Var}(X) + [E(X)]^2$  and  $E(XY) = \text{Cov}(X, Y) + E(X)E(Y)$ .
  - 14 Sorensen and Yosha (2000) argued that the patterns of risk sharing may differ across regions because of the geographic distance. For example, eastern states in the United States may benefit more from income smoothing through capital markets due to their proximity to Wall Street. It is easier for the residents in a state to hold property and financial claims in adjacent states.

- 15 The changes of consumption possibilities in a region can arise from both changes in output and local prices. It is therefore important to select appropriate price indices not to eliminate smoothing/dis-smoothing effects arising from the changes in local prices. Labhard and Sawicki (2006: 20) argued that only using a deflator based on consumption prices would capture the true value of output in terms of consumption possibilities. They mentioned that, if a region is a major producer of a particular commodity, its nominal output will be associated to the variation in the price of that commodity. Since GDP deflator reflects the movements in the price of commodities, deflating the region's nominal output by GDP deflator would lead to mis-measurement of the impact on consumption possibilities.
- 16 Net transfer from the central government to the local governments are computed as the difference between the transfers from central to local and the remittances from local to the central.
- 17 According to Garcia-Herrero *et al.* (2005: 22), the time table for opening the financial sector under WTO commitments is as follows. While, the restrictions on providing banking services in foreign currency were removed immediately after the WTO accession.

	Foreign banks can begin to offer services in domestic currency to		
	Foreign companies and individuals	Chinese domestic companies	Chinese individuals
Shanghai, Shenzhen	1996	2003	2006
Tianjin, Dalian	2001	2003	2006
Guangzhou, Qingdao, Nanjing, Wuhan	2002	2003	2006
Jinan, Fuzhou, Chengdu, Chongqing	2003	2003	2006
Kunming, Zhuhai, Beijing, Xiamen (Amoy)	2004	2004	2006
Shantou (Swatow), Ningbo, Shenyang, Xi'an	2005	2005	2006
Lift all geographical restrictions	2006	2006	2006

- 18 Qualified Foreign Institution Investors (QFII) is the system which allows the foreign institutional investors approved by the China Securities Regulatory Commission (CSRC) to invest in China A shares and other RMB-denominated securities. The relevant regulations were promulgated in November 2002, and revised in 2006 to attract the long-term investors to invest in the Chinese domestic securities market. Especially, the investors including pension funds, insurance funds, mutual funds, charitable funds and other long-term asset management institutions are given priority to encourage mid to long-term investments in China.
- 19 For example, the 11th five-year master plan (2006–2010) clearly states that the fiscal transfer from the central government to under-developed regions is not sufficient enough, and it is one of the reasons of regional unbalanced development.

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