Consumption smoothing in Mainland China and Hong Kong

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Abstract

Risk-sharing mechanism among regions is one of the criteria to form a monetary union. This is particularly important when there are significant asymmetric shocks across regions. A high degree of risk-sharing would diversify the asymmetric shocks among regions and income and consumption could therefore be synchronized. As a result, a single monetary policy is sufficient to manage the economies formed by many regions.

This research will first investigate the degree of consumption smoothing through international trade and investments for the Mainland China and Hong Kong Special Administrative Region (HKSAR). Both trade and investments have been booming for the two economies. Therefore, it seems to be natural to explore the risk-sharing mechanisms through trade and investment channels. Indeed, one of the driving forces behind the establishment of the EMU is exactly these real activities among the member countries.

It will then discuss the potential real obstacles to form a monetary union among the Mainland China and the HKSAR. The main difficulties for Mainland China include the capital control, a hugh bad debt of the banking sector, the incomplete reform of the state-owned enterprises and banks, the current corruption situation and the related capital flight problem.

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1. Introduction

Risk-sharing mechanism among regions is one of the criteria to form a monetary union. This is particularly important when there are significant asymmetric shocks across regions (Mundell, 1961; McKinnon, 2004). A high degree of risk-sharing would diversify the asymmetric shocks among regions and income and consumption could therefore be synchronized. As a result, a single monetary policy is sufficient to manage the economies formed by many regions.

Mundell (1973) (implicitly) suggested that an efficient international financial market would provide such a risk-sharing arrangement to achieve the objective of the optimum currency area (OCA). Subsequently, an emerging literature has been built up along this line to investigate, for example, the risk-sharing among the states of the US, countries of EU and of OECD. In the existing literature, the three risk-sharing channels identified include the capital market, credit market, the fiscal transfer, and migration.

Unfortunately, between Hong Kong Special Administrative Region (HKSAR) and Mainland China, all of the above three risk-sharing channels are blocked. Mainland China has always had the capital control, especially for the cross boarder portfolio investment and credit lending. Furthermore, under the Basic Law, the mini-constitution of

HKSAR, no fiscal transfer is required between the Mainland and HKSAR. The migration between the two economies is also limited (Tsang, 2004b).

Even worse, empirical literature on investigating the symmetric versus asymmetric shocks between the Mainland China and HKSAR found that the asymmetric shocks had been dominated the symmetric shocks in goods and services markets as well as credit markets (Ma and Tsang, 2002; Tsang, 2002a).

As a result, according to the both criteria set up by Mundell (1961, 1973), and re-emphasized by McKinnon (2004) recently, the formation of a monetary union between the Mainland China and the HKSAR is less promising.

However, the international trade and investments have been flourishing in both Mainland China and HKSAR since China started the economic reform and implemented the open door policy in 1977 (Ma, 2005; Ma, *et al*, 1998; Tsang and Ma, 1997). The trade growth has been especially strong after Mainland China reformed her exchange rate regime and adopted a *de facto* US dollar peg in 1994. Together with Hong Kong's linked exchange rate system with also pegged to the US dollar, the Mainland currency renminbi and Hong Kong dollar survived from the Asia financial crisis (Tsang and Ma, 2002). Recently the renminbi has been under tremendous revaluation pressure coming from both external sector and politicians of their trading partners (Sun and Ma, 2006).

Therefore, given the importance of trade and investment, it seems it is more natural and convincing to explore the risk-sharing mechanisms through trade and investment channels in this particular context than through fiscal transfer and financial market risk-sharing mechanisms. Indeed, one of the driving forces behind the establishment of the EMU is the real activities of trade and investment, although risk-sharing is a plus by the European financial markets. This is probably due to the fact that the risk-sharing via financial markets or fiscal transfers is limited and incomplete, although all of them do provide additional risk-sharing.

We may define the type of risk-sharing through trade and investment as ‘real risk-sharing’ channel to contrast the traditional ‘nominal risk-sharing’ channels via the financial markets. The real risk-sharing concept is in fact not new in the real world. In the international finance literature, it is well-documented that multinational corporations (MNCs) have explored this real risk-sharing channel across countries (see, for example, Eun and Resnick, 2006). This is partially due to the incompleteness of the financial markets that cannot provide adequate long run financial instruments to hedge the long run risks facing to the MNCs. For example, most of financial derivatives are not more than three-year maturity. Therefore, the MNCs have to hedge their long run risks associated with foreign operations through real activities such as investment structures and international trade.

On the conceptual aspect, Asdrubali (1998) and Asdrubali and Kim (2004c) made a clear distinction between risk-sharing channels that provide ex ante insurance and intertemporal smoothing channels that offer ex post adjustments. It can be argued that the international trade and investments may play a dual role for both types of channels mentioned above. For example, whilst Asdrubali and Kim (2004b) estimate investment and trade as intertemporal smoothing channels, the international finance literature treat them as long term risk hedging channels (Eun and Resnick, 2006). How to disentangle their dual role as both risking-sharing and smoothing channels is an undergoing research (see, for example, Asdrubali and Kim, 2004c) and is beyond the scope of this research.

This project will first investigate the degree of risk-sharing among 28 regions in the Mainland China and the HKSAR through investment and trade channels. This paper makes several important contributions to the methodology of measuring the degree of risk-sharing in the literature. Firstly, the estimation of the structural panel vector autoregressive (SPVAR) model is carefully conducted by the extended dynamic panel GMM approach (Arellano and Bover, 1995). This approach can overcome the inconsistency problem inherited in the OLS and traditional GMM estimators. The extended GMM estimator can also deal with the unit root problem of the panel data, whilst the traditional GMM approach broke down. Secondly, we documented in detail how the standard errors of the impulse response functions are generated, whilst the exiting literature fails to describe the procedure explicitly.

The main findings of this study are that the degree of risk-sharing between Mainland 28 regions and HKSAR through the investment and trade channels is, in the short run, much lower than that within the US states, as well as that among EU 15 and OECD 22 countries through the financial market and fiscal transfer channels. However, in the long run, the degree of risk-sharing between China and HKSAR is slightly higher than that among EU 15 and OECD 22 countries, although it is not as high as that within the US states. Furthermore, it takes much longer time to reach the long run steady-state risk-sharing level through investment and trade channels than the financial market risk-sharing mechanisms.

In the short run, only 27.2% of income shocks to regional GDP are insured between

China and HKSAR, whilst the percentages of shocks that are insured are 83.7% among the US states, 51% within EU 15 members, and 51.1% among OECD 22 countries (Asdrubali and Kim (2004a). In the long-run, 24.8% of shocks to regional GDP are insured between China and HKSAR within 15 years, whilst the percentages of shocks that are insured are 64.2% among the US states, but only 21% within EU 15 members, and 21.3% among OECD 22 countries within 4 to 5 years.

The remainder of the paper is organized as follows. Section 2 introduces the decomposition method to measure the degree of risk-sharing among the mainland Chinese regions and HKSAR. Section 3 provides the econometric estimation and analysis of the risk-sharing. Finally, Section 4 discusses the potential real obstacles to form a monetary union among them. The main difficulties for Mainland China include the capital control, the hugh bad debt of the banking sector, the incomplete reform of the state-owned enterprises, the current corruption situation and the related capital flight problem.

2. Decomposition of cross-sectional variance in regional GDP

One of the decomposition methods was developed by an influential paper of Asdrubali, et al (1996). They adopted a chain decomposition approach to track down the risk-sharing mechanisms among the states in the US through (i) capital market, (ii) fiscal tax-transfer system, and (iii) credit markets. A full risk-sharing from these mechanisms implies final consumption will not vary with the state GDP.

This decomposition approach can be summarized conveniently by the following identities:

GDP = GNP - net factor income

GNP = disposal income (DI) - tax + transfer

DI = savings + consumption (C)

Hence

$$GDP = \frac{GDP}{GNP}\frac{GNP}{DI}\frac{DI}{C}C$$

To decompose the variance of GDP from the above identity, one may take logs and differences, multiply both sides by Δlog(GDP), then to obtain the following cross-sectional variance of GDP:

$$\begin{aligned} \mathrm{var}\{\Delta\log(GDP)\} = \; & \mathrm{cov}\{\Delta\log(GDP), \Delta\log(GDP)-\Delta\log(GNP)\} \\ & + \mathrm{cov}\{\Delta\log(GDP), \Delta\log(GNP)-\Delta\log(DI)\} \\ & + \mathrm{cov}\{\Delta\log(GDP), \Delta\log(DI)-\Delta\log(C)\} \\ & + \mathrm{cov}\{\Delta\log(GDP), \Delta\log(C)\} \end{aligned}$$

Dividing both sides by var{Δlog(GDP)}, we have:

$$\beta_K + \beta_F + \beta_C + \beta_U = 1$$

where β_j are the estimates of the slope in the following panel regressions:

$$\Delta\log(GDP_{i,t}) - \Delta\log(GNP_{i,t}) = \alpha_{K,t} + \beta_K \Delta\log(GDP_{i,t}) + u_{i,K,t}$$

$$\Delta\log(GNP_{i,t}) - \Delta\log(DI_{i,t}) = \alpha_{F,t} + \beta_F \Delta\log(GDP_{i,t}) + u_{i,F,t}$$

$$\Delta\log(DI_{i,t}) - \Delta\log(C_{i,t}) = \alpha_{C,t} + \beta_C \Delta\log(GDP_{i,t}) + u_{i,C,t}$$

$$\Delta\log(C_{i,t}) = \alpha_{U,t} + \beta_U \Delta\log(GDP_{i,t}) + u_{i,U,t}$$

where i is an index of states, $\alpha_{j,t}$ is the time-fixed effect to capture the year-specific impact on the GDP growth rates.

Whilst this approach works for an economy with highly developed financial markets, it does not work well between the Mainland China and the HKSAR with capital control imposed by the Mainland authority and no fiscal transfer between the two economies.

Given the fact that the economic activities have been mainly on trade and investment, we propose an alternative decomposition approach to examine the risk-sharing between the Mainland China and the HKSAR. Our decomposition starts with the following identities:

GDP = domestic absorption (DA) + trade balance

DA = fixed investment + inventory + consumption (C)

DAs = inventory + consumption (C)

In our study, the consumption is final consumption including both private and public consumption. This is different from the consumption definition in the literature for the developed market economies. In Mainland China, government, especially local government, plays an important role in economic activities (see, for example, Li and Ma, 1996; Wu, 2006). Therefore, government consumption is also subject to risk-sharing for the public interests.

From the above identities, we have:

$$GDP = \frac{GDP}{DA}\frac{DA}{DAs}\frac{DAs}{C}C$$

Similar to the derivations of Asdrubali, et al (1996), we have:

$$\begin{aligned}
\text{var}\{\Delta\log(GDP)\} = \; & \text{cov}\{\Delta\log(GDP), \Delta\log(GDP/DA)\} \\
& + \text{cov}\{\Delta\log(GDP), \Delta\log(DA/DAs)\} \\
& + \text{cov}\{\Delta\log(GDP), \Delta\log(DAs/C)\} \\
& + \text{cov}\{\Delta\log(GDP), \Delta\log(C)\}
\end{aligned}$$

Dividing both sides by var{Δlog(GDP)}, we have:

$$\beta_T + \beta_f + \beta_s + \beta_u = 1$$

If there is full risk-sharing after trade channel smoothing (β_T), domestic absorption (DA) should not co-move with GDP. If full risk-sharing is not realized, there is scope for further smoothing by the fixed direct investments (β_f), and inventory (β_s). If there is full risk-sharing after these three real activities channels, consumption (C) should not vary with GDP for any level of aggregate output, i.e., the uninsured component of consumption is zero with β_u=0.

Our approach is different from the intertemporal smoothing approach studied in Asdrubali and Kim (2004b), where they decomposed the GDP by the following identity:

$$I^f + I^s + TB + C = GDP - G \equiv Z$$

where I^f, I^s, TB, C, G and Z are fixed and inventory investments, trade balance, consumption, and private income, respectively. This gives:

$$\frac{\Delta I^f}{\Delta Z} + \frac{\Delta I^s}{\Delta Z} + \frac{\Delta TB}{\Delta Z} + \frac{\Delta C}{\Delta Z} = 1$$

Therefore, their specification of the model is suitable for estimation of the intertemporal smoothing channels, rather than estimating the risk-sharing channels.

Similar to Asdrubali, Sørensen, and Yosha (1996), β_j in our model may be estimated as the slopes in the following panel model:

$$\Delta\log(GDP_{i,t}/DA_{i,t}) = \alpha_{T,t} + \beta_T \Delta\log(GDP_{i,t}) + \varepsilon^T_{i,t}$$

$$\Delta\log(DA_{i,t}/DAs_{i,t}) = \alpha_{f,t} + \beta_f \Delta\log(GDP_{i,t}) + \varepsilon^f_{i,t}$$

$$\Delta\log(DAs_{i,t}/C_{i,t}) = \alpha_{s,t} + \beta_s \Delta\log(GDP_{i,t}) + \varepsilon^s_{i,t}$$

$$\Delta\log(C_{i,t}) = \alpha_{u,t} + \beta_u \Delta\log(GDP_{i,t}) + \varepsilon^u_{i,t}$$

However, as Asdrubali and Kim (2004a, 2004b) pointed out, this procedure is very restrictive as it does not allow for the possibility of endogeneity of income, and for different insurance mechanisms in the short-run and long-run. In this paper, a structural panel vector autoregressive (SPVAR) model is therefore estimated instead accommodate these factors.

Suppose X_t is a vector of all the variables from the above static panel model that are arranged in the following order:

$$X_t = [\ \log(GDP_{i,t}), \log(GDP_{i,t}/DA_{i,t}), \log(DA_{i,t}/DAs_{i,t}), \log(DAs_{i,t}/C_{i,t})\ ]'.$$

The SPVAR model is then given as:

$$\Theta_c X_t = \Theta_0 Z_t + \Sigma^N_{n=1} \Theta_n X_{t-n} + E_t$$

where Θ_c, Θ_0, and Θ_n are the structural parameters, N is the lag of the model, Z_t is an exogenous variable such as time trend, and E_t is the residual vector.

Then the following identity gives the values of $\log(C_{i,t})$:

$$\log(C_{i,t}) \equiv \log(GDP_{i,t}) - \log(GDP_{i,t}/DA_{i,t}) - \log(DA_{i,t}/DAs_{i,t}) - \log(DAs_{i,t}/C_{i,t}).$$

A SPVAR will treat all variables in the model endogenously. The structural shocks can be recovered from the residuals of the reduced-form estimation of the PVAR model. Following Sims (1980) and Asdrubali and Kim (2004a, 2004b), we assume the contemporaneous parameter matrix Θ_c of the SPVAR has the following recursive structure:

$$\Theta_c = \begin{bmatrix} 1 & 0 & 0 & 0 \\ q_{21} & 1 & 0 & 0 \\ q_{31} & q_{32} & 1 & 0 \\ q_{41} & q_{42} & q_{43} & 1 \end{bmatrix},$$

which implies that the causal relationship among the four variables in the model is:

		(1)		(2)		(3)		(4)
		Fixed investment		Inventory investment		Trade		Uninsured
log(GDP)	→	log(DA/DAs)	→	log(DAs/C)	→	log(GDP/DA)	→	log(C)

Under this causal relationship, the idiosyncratic shock of logGDP is assumed to be the original source of the risk that is to be diversified by the risk-sharing channels and is contemporaneously exogenous to all other variables. The first risk-sharing channel (1) in our model is the fixed investment channel. This is because the fixed investment takes time to build and has installation costs. Furthermore, most of the investments are irreversible (Dixit and Pindyck, 1994). Hence the feedback from consumption and trade to fixed investment would have a time lag. For a similar reason, the second risk-sharing channel (3) would be inventory investment, which is more flexible than the fixed investment, but less flexible than consumption and trade. As a result, the third channel (3) of risk-sharing in our model is the international trade channel. Finally, if all of these three channels cannot share the risk completely, the remaining part of the risk is the uninsured component of consumption (4).

Furthermore, we can see that the static panel model is a special case of the SPVAR model with some zero restrictions imposed on the matrix Θ_c: $\theta_{32}=\theta_{42}=\theta_{43}=0$.

The SPVAR model is estimated from its reduced form:

$$X_t = \Theta_c^{-1} \Theta_0 Z_t + \Sigma^N_{n=1} \Theta_c^{-1} \Theta_n X_{t-n} + \Theta_c^{-1} E_t$$

If most of the variables in X_t have a unit root, the following first-differenced model of PVAR is employed to conduct the impulse response analysis:

$$\Delta X_t = \Theta_c^{-1} \Theta_0 \Delta Z_t + \Sigma^N_{n=1} \Theta_c^{-1} \Theta_n \Delta X_{t-n} + \Theta_c^{-1} \Delta E_t$$

Since the exogenous variable is just a time trend, its first-difference is a unit constant. Hence we can rewrite the reduced-form of the SPVAR as:

$$\Delta X_t = \Theta_c^{-1} \Theta_0 + \Sigma^N_{n=1} \Theta_c^{-1} \Theta_n \Delta X_{t-n} + U_t,$$

where $U_t \sim N(0,\Omega)$, is the residual of the reduced-form PVAR. However, a Cholesky decomposition of Ω will give a lower-triangular matrix P with standard deviations on the principle diagonals such that $PP'=\Omega$ (Hamilton, 1994, p.323). Hence one-unit shock of the residual from the reduced-form model is the same as one-standard-deviation shock of the structural residual, i.e.,

$$U_t = P\Delta E_t$$

The GMM estimator (Arellano and Bover, 1995) is applied to estimate the reduced-form of the SPVAR. It is shown that the extended GMM developed by Arellano and Bover (1995) is consistent for a dynamic PVAR even if X_t has unit roots.

3. Estimation results

3.1 Data source

The data source of Mainland China is mainly from "the Comprehensive statistical data and materials on 50 years of new China" (National Bureau of Statistics, 1999), supplemented by the Statistical Yearbook of China and CEIC database. The frequency of the time series is annual and the sample period is 1978 to 2004, which covers the whole period of economic reform in Mainland China. According to her Constitution, Mainland China is divided into provinces, autonomous regions and municipalities directly under the central government. Subject to the data availability, there are 22 provinces, 3 autonomous regions, and 3 municipalities, a total of 28 regions, in this study for Mainland China (see

Table 1 for details). Two autonomous regions of Tibet and Ningxia and one municipality of Chongqing are not included in the sample due to insufficient data. The corresponding time series for the Hong Kong Special Administrative Region (HKKSAR) are obtained directly from the Census and Statistics Department of Hong Kong Government. Altogether, including Hong Kong SAR, there are 29 regions in our sample. The regional GDP, consumption, gross fixed investment and inventory are divided by the regional population and then are deflated by the CPI (with base year 2000) to get the real, per capita series.

3.2 Panel unit root test

Before we carry out the estimation of our structural panel VAR model, it is important to examine whether there is any unit root, or non-stationarity, in our time series. In a seminal paper, Granger and Newbold (1974) argued that if a time series is nonstationary, the traditional significance tests could be misleading and the relationship found from these tests might be spurious. That is, researchers might accept a false relationship when, in fact, there might be none. Similar problems had been identified in the VAR model (Ohanian, 1988; Toda and Phillips, 1993). Therefore, a panel unit root test developed by Im, Pesaran, Shin (IPS) (2003) is applied to all the variables of our model. This panel unit root test is flexible to allow for individual effects and individual trends (see Table 2).

Under the null hypothesis that the variable has a unit root for all regions and the alternative hypothesis that the variable has no unit root at least for one region, the test statistics are reported in Table 2. It is shown that two variables of log(GDP) and log(DAs/C) have unit roots for all 29 regions in Mainland China and Hong Kong. For the other two variables of log(GDP/DA)] and log(DA/DAs), each has unit roots for 24 regions and has no unit root for the remaining 4 regions.

3.3 Panel cointegration test

Given the fact there are unit roots in most of the variables and most of the regions, the traditional OLS estimator and recent dynamic panel GMM estimator of Arellano and Bond (1991) will be biased and inconsistent (see Baltagi, 2001). As a result, an extended GMM estimator based on orthogonal deviations (Arellano and Bover, 1995) is adopted in our estimation, which is consistent in the face of the unit root problem. Since this extended GMM estimator involves orthogonal differencing the variables in levels, therefore it may be subject to a potential misspecification problem if the variables were cointegrated (Engle and Granger, 1987) in our SPVAR model. An error-correction term should be added in to the SPVAR model if the cointegration is found. Otherwise, the specification of our SPVAR would be valid to the extended GMM estimator.

Pedroni (1999) developed a panel cointegration testing procedure based on the original framework of Engle and Granger (1987) two-stage estimation. In the first-stage, a fixed-effect or a random effect static panel model is estimated and the residuals ξ_{it} are obtained:

$$\log(GDP_{i,t})=\alpha_{i0}+\alpha_1\log(GDP_{i,t}/DA_{i,t})+\alpha_2\log(DA_{i,t}/DAs_{i,t})+\alpha_3\log(DAs_{i,t}/C_{i,t})+\xi_{it}.$$

Then, in the second-stage, a panel unit root test such as the IPS test is applied to the residuals ξ_{it}. If unit roots are found in the residuals, then it indicates there is no cointegration among the four variables. The results of the panel cointegration tests are reported in Table 3. It shows that the residuals for all 29 regions contain a unit root and therefore there is no cointegration.

3.4 SPVAR estimation

To estimate the reduced-form of the SPVAR model, the dynamic panel GMM estimator developed by Arellano and Bover (1995) based on orthogonal deviations is applied. The estimation results are presented in Table 4. The lag of the PVAR is chosen as two, which is determined by the Schwarz criterion. A linear trend also is fitted in the model. As a result, the differenced model has a constant without trend. The White (1994) period robust coefficient standard deviation is adopted to compute the t statistics of the coefficients. It is robust to arbitrary serial correlation and time-varying variances in the disturbances. The estimation results of GMM method are quite satisfactory (see Table 4). Most of the explanatory variables are significant with at the 5% level (i.e. probability of the coefficient being zero is less than 0.05).

3.5 Impulse response analysis

Finally, the impulse response of the structural shocks from the residuals of $\log(GDP_{i,t})$ equation will be investigated. Since most of the variables have a unit root, the following first-differenced model of SPVAR is employed to conduct the impulse response analysis:

$$\Delta X_t = \Theta_c^{-1}\, \Theta_0\, \Delta Z_t + \Sigma^{N}_{n=1}\, \Theta_c^{-1}\, \Theta_n \Delta X_{t-n} + \Delta U_t$$

Since the exogenous variable is just a time trend, its first-difference is a unit constant. Hence we can rewrite the reduced-form of the SPVAR for impulse response analysis as follows:

$$\Delta X_t = \Theta_c^{-1}\, \Theta_0 + \Sigma^{N}_{n=1}\, \Theta_c^{-1}\, \Theta_n \Delta X_{t-n} + V_t$$

Table 5 reports the unnormalized impulse responses (in first-difference, i.e. ΔX_t) to one-standard-deviation of income shocks. Standard errors of the impulse responses are computed by Monte Carlo simulations. Given the variance-covariance matrices of the coefficients estimated by the extended GMM approach, 1,000 repetitions are drawn from multivariate normal distribution for the coefficients. Then 1,000 sets of impulse response are computed based on these random coefficients of the SPVAR (Hamilton, 1994). The standard errors are estimated and are reported in parentheses in parentheses in all the tables. Table 6 gives the unnormalized impulse responses in levels, i.e. X_t.

From Tables 5 and 6, it indicates that the responses of Δlog(GDP) to the income shock are weakening very slowly over time. As a result, the level response of log(GDP) takes a long time (around 15 years) to reach its steady-state of 0.359 in Table 6.

To give these impulse responses a better interpretation, we divide all the numbers in Tables 5 and 6 by the steady-state income level 0.359 in Table 6. Therefore, the long run response of income level is 100%. The normalized percentage impulse responses of each risk-sharing channel are reported in Table 7 (first-difference) and Table 8 (levels).

Table 8 indicates that 13.7% out of 100% of (cumulative) total income risk is posed at the initial period 0. Among the 13.7% of the initial risk, 4% is immediately shared by the fixed investment channel, and 1.2% is shared by the international trade channel. As time goes by, the fixed investment risk-sharing channel continues to dominate the international trade and inventory investment channels, although the trend is declining. As a matter of fact, the fixed investment shares only 5.4% of the risk accumulatively in the long run steady-state (cf. Table 8).

Similar to the results of Asdrubali and Kim (2004b), we found that the inventory investment and the international trade both exhibit a high volatility (cf. Table 8). The response of the international trade swings between positive and negative magnitudes and shares 8.5% of total risk in the long run. Initially, the responses of the inventory investment to income shocks are negative (-1.5%) with a weakening trend. Eventually it turns into a positive and increasing trend. It shares +10.9% of total risk in the long run, which is a bigger share than that of either fixed investment or trade channel.

Finally, Table 9 summarizes the degree of risk-sharing in the short-run and long-run. Table 9 shows that, in the short run, 72.8% of the income shocks are *un*insured for the final consumption. In other words, only 27.2% of shocks to regional GDP are insured between China and HKSAR. To compare with other countries, it is reported that the percentages of shocks that are insured are 83.7% among the US states, 51% within EU 15 members, and 51.1% among OECD 22 countries (Asdrubali and Kim, 2004a). That is, the degree of short run risk-sharing in the Chinese regions is only one-third as large as that in the US states, and about half as big as those of EU and OECD economies.

In the long run, 75.2% of the shocks are *un*insured between China and HKSAR. That is, 24.8% of shocks to regional GDP are insured between China and HKSAR, whilst the percentages of shocks that are insured are 64.2% among the US states, but only 21% within EU 15 members, and 21.3% among OECD 22 countries (Asdrubali and Kim, 2004a).

These results imply that the degree of short-run risk-sharing between Mainland 28 regions and HKSAR through the investment and trade channels is much lower than that within the US states, as well as that among EU 15 and OECD 22 countries through the financial market and fiscal transfer channels. However, in the long run, the degree of risk-sharing between China and HKSAR is slightly higher than that among EU 15 and OECD 22 countries, although it is not as high as that within the US states. Furthermore, it takes much longer time to reach the long run steady-state risk-sharing level for Chinese regions through investment and trade channels than the US, EU and OECD economies to reach long run level via the financial market risk-sharing mechanisms.

4. Conclusion

Although the risk-sharing mechanisms through the financial market and fiscal transfer are limited between Mainland China and Hong Kong Special Administrative Region

(HKSAR), the two-way cross-boarder trade and direct investment flows have been booming between the two economies. This study therefore investigated the degree of risk-sharing through trade and investment between Mainland China and HKSAR. We found that the degree of risk-sharing between Mainland 28 regions and HKSAR is much lower in the short-run than that in the long-run. In the short-run the degree of risk-sharing between China and HKSAR is also much lower than that within the US states, as well as that among EU 15 and OECD 22 countries. Nevertheless, in the long run, the degree of risk-sharing between China and HKSAR is much higher than that among EU 15 and OECD 22 countries, although it is not as high as that within the US states. This interesting finding suggests that a monetary union between Mainland China and Hong Kong may be formed in the long run, instead of in the short run.

Indeed, there are quite a number of potential real obstacles in the short run to form a monetary union among the Mainland China and the HKSAR. The main difficulties for Mainland China include the capital control, a hugh bad debt of the banking sector, the incomplete reform of the state-owned enterprises, the current corruption situation and the related capital flight problem.

A strict capital control by Mainland China makes the financial market operates less efficiently across boarders. Furthermore, given the current corruption situation, the capital flight problem is very difficult to control. For example, Mainland China has 23 extradition pacts signed with foreign governments (see Appendix). Except the recent one with Spanish government, none of them is between US, EU, Japan, due to the different legal and political systems. This situation has enabled hundreds of corrupt bank and government officials and other suspected of embezzling public funds to remain beyond the reach of Chinese courts. Hence the capital account deregulation is unlikely to be implemented in the short run. Therefore it almost completely blocks the risk-sharing channel between the Mainland and HKSAR through the financial market. Parenthetically, Hong Kong had more than 90 extradition agreements with foreign governments before 1997. Although the number of such agreements has been reduced to 13, they are mainly the agreements between US, and EU countries (see Appendix). That provides the legal insurance for the capital account liberalization against corruptions and criminal activities.

Another obstacle for Mainland China to open up the capital account is the large bad debt of the Chinese banking sector. It is related to the incomplete reform of the state-owned enterprises (SOEs) and the state-owned banks (SOBs). Until there are more progress in reforms of the SOEs and SOBs, the bad debt problem may not be resolved, rather it may get deteriorated. That will make the risk-sharing difficult through the credit market channel.

Finally, the Basic Law, which is the mini-constitution of HKSAR, stipulates that there is no fiscal transfer between the central government in Beijing and the SAR government. This implies that the fiscal transfer channel for the risk-sharing will be ineffective in the foreseeable future.

From the empirical finding of this study, the trade and investment channels are not effective in the short run. Furthermore, the bilateral trade and investment between the Mainland and HKSAR are both experiencing a declining share to the total trade volume and total FDI inflow to the Mainland, the risk-sharing through these two channels in the long run is also uncertain. A monetary union between the two economies seems to be remote.

Appendix. Extradition pacts signed by the governments of Mainland China and Hong Kong

Mainland China has extradition treaties with 23 countries, according to the Ministry of Foreign Affairs: Belarus, Brazil, Bulgaria, Cambodia, Kazakhstan, Kyrgyzstan, Laos, Lesotho, Lithuania, Mongolia, Pakistan, Peru, Romania, Russia, South Africa, South Korea, Spain, Philippines, Tunisia, Ukraine, United Arab Emirates, Uzbekistan, and Thailand.

According to the Department of Justice of HKSAR Government, there are 13 countries signed the 'Surrender of Fugitive Offenders Agreements' with Hong Kong up to 2005: Australia, Canada, India, Indonesia, Malaysia, Netherlands, New Zealand, Philippines, Portugal, Singapore, Sri Lanka, the UK, and USA.

Table 1. GDP of 29 Regions in 2004

Region	GDP (bil. RMB)	GDP growth (%)	GDP per capita (RMB)
Municipalities			
Beijing	428	13.2	37,058
Tianjin	293	15.7	31,550
Autonomous regions			
Inner Mongolia	271	19.4	11,305
Guangxi	332	11.8	7,196
Xinjiang	220	11.1	11,199
Provinces			
Anhui	481	12.5	7,768
Fujian	605	12.1	17,218
Gansu	156	10.9	5,970
Guangdong	1,604	14.2	19,707
Guizhou	159	11.4	4,215
Hainan	77	10.4	9,450
Hebei	877	12.5	12,918
Heilongjiang	530	11.7	13,897
Henan	882	13.7	9,470
Hubei	631	11.3	10,500
Hunan	561	12	9,117
Jiangsu	1,540	14.9	20,705
Jiangxi	350	13.2	8,189
Jilin	296	12.2	10,932
Liaoning	687	12.8	16,297
Qinghai	47	12.3	8,606
Shaanxi	288	12.9	7,757
Shandong	1,549	15.3	16,925
Shanghai	745	13.6	55,307
Shanxi	304	14.1	9,150
Sichuan	656	12.7	8,113
Yunnan	296	11.5	6,733
Zhejiang	1,124	14.3	23,942
Special Administrative Region			
Hong Kong	1,372	4.7	199,310

Source: Statistical Yearbook of China, 2005, p.58.

Table 2. IPS panel unit root test with individual effects and individual trends (sample: 1978 to 2004)

	Level				First difference				
Variable	Statistic	Prob.	No. of regions	No. of obs.	Statistic	Prob.	No. of regions	No. of obs.	Conclusion
LogGDP	2.9141	0.9982	29	726	-12.3191	0.0000	29	706	I(1)
Log(DAs/C)	-0.6896	0.2452	29	748	-26.3952	0.0000	29	718	I(1)
Log(GDP/DA) (a)	-0.7717	0.2201	24	606	-19.3788	0.0000	24	588	I(1)
Log(GDP/DA) (b)	-5.9851	0.0000	5	122					I(0)
Log(DA/DAs) (c)	-0.0754	0.4699	24	599	-13.2009	0.0000	24	586	I(1)
Log(DA/DAs) (d)	-4.8423	0.0000	5	122					I(0)

Note: Automatic selection of lags based on Schwarz criterion. The 29 regions are listed in Table 1.
(a), (b): Five regions of Beijing, Jiangsu, Jilin, Shandong, Yunnan have log(DA/DAs) as I(0).
(c), (d): Five regions of Anhui, Fujian, Guangdong, Guangxi, Shaanxi have log(GDP/DA) as I(0).

Table 3. Panel cointegration test based IPS statistics (sample: 1978 to 2004)

Variable	Statistic	Prob.	No. of regions	No. of obs.
Fixed effect	-0.9308	0.1759	29	667
Random effect	-0.9425	0.1729	29	667

Note: Automatic selection of lags based on Schwarz criterion.

Table 4. Results of dynamic panel GMM with orthogonal deviations transformation: 1981 to 2004 (29 regions)

Total panel (balanced) observations: 696								
Dependent Variable:	$\log(GDP_{i,t})$				$\log(DA_{i,t}/DAs_{i,t})$			
Explanatory variable	Coeff.	Std. Error	t-value	Prob.	Coeff.	Std. Error	t-value	Prob.
Time trend	0.01	0.00	5.36	0.000	0.01	0.00	4.81	0.000
$\log(GDP_{i,t-1})$	1.08	0.02	45.60	0.000	0.14	0.05	3.09	0.002
$\log(GDP_{i,t-2})$	-0.18	0.03	-6.10	0.000	-0.17	0.04	-4.33	0.000
$\log(DA_{i,t-1}/DAs_{i,t-1})$	0.00	0.05	0.07	0.942	0.88	0.08	10.58	0.000
$\log(DA_{i,t-2}/DAs_{i,t-2})$	-0.10	0.04	-2.34	0.020	-0.15	0.07	-2.29	0.022
$\log(DAs_{i,t-1}/C_{i,t-1})$	-0.25	0.05	-4.83	0.000	0.09	0.05	1.83	0.067
$\log(DAs_{i,t-2}/C_{i,t-2})$	-0.02	0.04	-0.67	0.505	-0.08	0.05	-1.70	0.090
$\log(GDP_{i,t-1}/DA_{i,t-1})$	-0.12	0.05	-2.13	0.033	-0.09	0.05	-1.83	0.068
$\log(GDP_{i,t-2}/DA_{i,t-2})$	0.09	0.03	2.52	0.012	0.13	0.04	3.02	0.003
St. Err. of regression	0.05				0.04			
Sum squared residual	1.89				1.26			
Dependent Variable:	$\log(DAs_{i,t}/C_{i,t})$				$\log(GDP_{i,t}/DA_{i,t})$			
Time trend	0.00	0.00	-3.25	0.001	0.00	0.00	-0.13	0.895
$\log(GDP_{i,t-1})$	0.00	0.04	-0.05	0.957	-0.13	0.03	-3.98	0.000
$\log(GDP_{i,t-2})$	0.04	0.04	1.04	0.300	0.12	0.04	3.21	0.001
$\log(DA_{i,t-1}/DAs_{i,t-1})$	0.17	0.06	2.65	0.008	0.05	0.07	0.76	0.450
$\log(DA_{i,t-2}/DAs_{i,t-2})$	-0.17	0.07	-2.42	0.016	0.02	0.07	0.27	0.790
$\log(DAs_{i,t-1}/C_{i,t-1})$	0.79	0.09	8.88	0.000	0.05	0.08	0.67	0.500
$\log(DAs_{i,t-2}/C_{i,t-2})$	-0.04	0.06	-0.69	0.491	0.03	0.06	0.51	0.612
$\log(GDP_{i,t-1}/DA_{i,t-1})$	0.23	0.08	2.97	0.003	0.77	0.06	12.49	0.000
$\log(GDP_{i,t-2}/DA_{i,t-2})$	-0.19	0.08	-2.40	0.017	0.03	0.06	0.51	0.612
St. Err. of regression	0.05				0.04			
Sum squared residual	1.82				1.16			

Note: 2SLS weighting matrix includes instruments of $\log(GDP_{i,t})$, $\log(GDP_{i,t}/DA_{i,t})$, $\log(DA_{i,t}/DAs_{i,t})$, $\log(DAs_{i,t}/C_{i,t})$ with lags from 2 to 5, plus the time trend. White period standard errors and covariance (d.f. corrected) is adopted to calculate the t-values.

Table 5. Unnormalized impulse response to income shocks (first-difference)

	Δlog(GDP)	Δlog(DA/DAs)	Δlog(DAs/C)	Δlog(GDP/DA)	Δlog(C)
Step	Income	Fixed investment	Inventory investment	International trade	Uninsured component
0	0.069(0.004)	0.020(0.004)	-0.007(0.006)	0.006(0.005)	0.051(0.009)
1	0.076(0.006)	0.026(0.005)	-0.001(0.006)	-0.004(0.005)	0.055(0.013)
2	0.069(0.009)	0.021(0.005)	0.001(0.006)	-0.003(0.005)	0.051(0.016)
3	0.058(0.011)	0.011(0.005)	0.003(0.006)	0.000(0.006)	0.045(0.019)
4	0.048(0.013)	0.002(0.005)	0.004(0.007)	0.002(0.006)	0.040(0.022)
5	0.039(0.014)	-0.003(0.004)	0.004(0.006)	0.003(0.006)	0.034(0.023)
10	0.015(0.016)	-0.005(0.003)	0.004(0.004)	0.002(0.005)	0.013(0.024)
∞	0.000(0.021)	0.000(0.004)	0.000(0.002)	0.000(0.003)	0.000(0.027)

Note: Standard errors are in parentheses.

Table 6. Unnormalized impulse response to income shocks (levels)

	log(GDP)	log(DA/DAs)	log(DAs/C)	log(GDP/DA)	log(C)
Step	Income	Fixed investment	Inventory investment	International trade	Uninsured component
0	0.069(0.004)	0.020(0.004)	-0.007(0.006)	0.006(0.005)	0.051(0.009)
1	0.146(0.009)	0.047(0.009)	-0.009(0.011)	0.002(0.010)	0.105(0.021)
2	0.215(0.018)	0.067(0.014)	-0.008(0.016)	0.000(0.014)	0.156(0.037)
3	0.273(0.029)	0.078(0.019)	-0.005(0.022)	-0.001(0.019)	0.201(0.055)
4	0.321(0.041)	0.080(0.024)	-0.001(0.028)	0.001(0.025)	0.241(0.076)
5	0.359(0.054)	0.077(0.028)	0.003(0.033)	0.004(0.030)	0.275(0.098)
10	0.471(0.127)	0.049(0.041)	0.026(0.055)	0.019(0.056)	0.378(0.212)
∞	0.506	0.027	0.055	0.043	0.380

Note: Standard errors are in parentheses. The long run standard error is infinite due to the existence of unit roots.

Table 7. Normalized impulse response to income shocks (first-difference, %)

	Δlog(GDP)	Δlog(DA/DAs)	Δlog(DAs/C)	Δlog(GDP/DA)	Δlog(C)
Step	Income	Fixed investment	Inventory investment	International trade	Uninsured component
0	13.7(0.7)	4.0(0.9)	-1.5(1.1)	1.2(1.0)	10.0(1.8)
1	15.1(1.2)	5.2(1.0)	-0.2(1.1)	-0.8(0.9)	10.9(2.5)
2	13.7(1.7)	4.1(1.1)	0.2(1.2)	-0.5(1.0)	10.0(3.1)
3	11.5(2.2)	2.1(1.1)	0.6(1.3)	0.0(1.1)	8.9(3.8)
4	9.4(2.6)	0.5(1.0)	0.7(1.3)	0.4(1.2)	7.8(4.3)
5	7.6(2.8)	-0.6(0.9)	0.8(1.2)	0.6(1.2)	6.8(4.6)
10	2.9(3.1)	-1.0(0.6)	0.9(0.8)	0.5(1.0)	2.5(4.7)
∞	0.0(4.2)	0.0(0.8)	0.0(0.5)	0.0(0.6)	0.0(5.3)

Note: This table is derived from the first-difference of Table 8. Standard errors are in parentheses.

Table 8. Normalized impulse response to income shocks (levels, %)

	log(GDP)	log(DA/DAs)	log(DAs/C)	log(GDP/DA)	log(C)
Step	Income	Fixed investment	Inventory investment	International trade	Uninsured component
0	13.7(0.7)	4.0(0.9)	-1.5(1.1)	1.2(1.0)	10.0(1.8)
1	28.8(1.9)	9.2(1.8)	-1.7(2.1)	0.4(1.9)	20.9(4.2)
2	42.5(3.5)	13.3(2.8)	-1.5(3.2)	-0.1(2.8)	30.9(7.2)
3	54.1(5.6)	15.4(3.8)	-1.0(4.3)	-0.1(3.8)	39.8(10.9)
4	63.5(8.1)	15.9(4.8)	-0.2(5.5)	0.2(4.9)	47.6(14.9)
5	71.1(10.8)	15.3(5.6)	0.6(6.6)	0.8(6.0)	54.4(19.3)
10	93.2(25.2)	9.6(8.2)	5.1(10.9)	3.7(11.0)	74.7(42.0)
∞	100.0	5.4	10.9	8.5	75.2

Note: This table is derived from Table 6 and all numbers are normalized to the steady-state of income level. Standard errors are in parentheses. The long run standard error is infinite due to the existence of unit roots.

Table 9. Normalized impulse response to income shocks (levels, %)

	log(GDP)	log(DA/DAs)	log(Das/C)	log(GDP/DA)	logC
Step	Income	Fixed investment	Inventory investment	International trade	Uninsured component
0	100	29.2(6.4)	-10.7(8.0)	8.7(7.5)	72.8(13.5)
1	100	32.0(6.3)	-5.9(7.4)	1.5(6.5)	72.4(14.7)
2	100	31.3(6.7)	-3.6(7.5)	-0.2(6.6)	72.6(17.0)
3	100	28.5(7.1)	-1.8(8.0)	-0.3(7.1)	73.6(20.1)
4	100	25.0(7.5)	-0.4(8.6)	0.3(7.8)	75.0(23.5)
5	100	21.5(7.9)	0.8(9.3)	1.1(8.5)	76.5(27.2)
10	100	10.4(8.8)	5.5(11.7)	4.0(11.8)	80.2(45.1)
∞	100	5.4	10.9	8.5	75.2

Note: This table is derived from Table 6 and all numbers are normalized to income levels. Standard errors are in parentheses. The long run standard error is infinite due to the existence of unit roots.

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