HONG KONG MONETARY AUTHORITY

HOW DOES THE US CREDIT CRISIS AFFECT THE ASIA-PACIFIC ECONOMIES? --- ANALYSIS BASED ON A GENERAL EQUILIBRIUM MODEL

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Abstract

The current financial crisis differs from most post-war recessions in that the balance sheets of both households and banks have been severely damaged, which could lead to structural changes in the behaviour of households. Therefore, it may exert some far-reaching effects on regional economies in the short run as well as in the medium term. This paper studies these effects using a multi-country dynamic structural model. In the short run, the US credit crisis weighs heavily upon the Asia-Pacific economies through financial linkages in addition to the traditional trade channel due to the deepening global financial integration. The relative importance of various financial channels differs notably across economies. While stock market contagion is more important for advanced economies, flight to quality across borders plays a key role in less developed economies. From a medium-term perspective, changes in the US household behavior caused by the credit crisis can help correct global imbalances, but the effectiveness hinges largely upon how long US households can maintain a reasonably higher savings rate. In addition, although the declining American public savings rate may not exert material impacts on the global imbalances, it can darken regional growth prospects due to a potentially higher world real interest rate.

Executive Summary:

- *The current financial crisis differs from most post-war recessions in that the balance sheets of both households and banks have been severely damaged, which could lead to structural changes in the household consumption behavior. Therefore, it may exert some far-reaching impacts on regional economies in the short run as well as in the medium term.*

- *Using a dynamic structural model, this paper first studies how the US credit crisis spreads to the Asia-Pacific region. We find that the US credit crisis weighs heavily upon the Asia-Pacific economy through financial linkages in addition to the trade channel. For some economies the former channel can be much more important than the latter.*

- *In view of the heterogeneity of financial structure across economies, we break down the financial channels into three sub-channels - banking sector infection, flight to quality across borders, and stock market contagion. The relative importance of these three channels differs notably across economies. While stock market contagion proves to be important for advanced economies, flight to quality across borders plays a key role in less developed economies.*

- *From a medium-term perspective, we investigate to what extent the US household de-leveraging can help achieve global balances, and how it may affect regional current accounts. The main message is that, changes in the US household behaviour can be helpful in correcting the global imbalances, but the effectiveness hinges largely upon how long US households can maintain a reasonably higher savings rate. While a persistent higher savings rate can be noticeably conducive to correcting the global imbalances, temporary rises in the savings rate would not be of much help.*

- *We explore the possible impacts of the declining public savings rate in the US. Despite its marginal effects on the US current account and global imbalances, the mounting public debt may contain potential growth in the US and regional economies as concerns over the fiscal sustainability and prospective inflationary pressure in the US will likely drive up the long-term global real interest rate.*

- *We also study how a lower savings rate in China caused by structural reforms launched to promote domestic demand and to rebalance its growth pattern may affect global imbalances. The main finding is that while such reforms can help China correct its own current account imbalances, their effect on regional current account balances is smaller than that of a higher savings rate in the US, as China's share in the world economy is smaller than that of the US, and the renminbi plays a less important role than the US dollar in the international financial market.*

I.   INTRODUCTION

The credit crisis that originated in the US has generated significant ripples and weighed heavily upon real as well as financial activities across the globe. The current crisis differs from most post-war recessions in that the balance sheets of both households and banks in the US have been badly damaged by the collapse in the US housing prices. Asset prices plunged in the US as well as in the rest of the world. As a result, the crisis was transmitted to other regions not only through the traditional trade channel but also through financial linkages due to the increase in global financial integration in the past decade. Yu and Fung (2009), for instance, find that during the recent credit crisis of 2007-2008, the distress in the US dollar market had had a material impact on the interbank markets for the Hong Kong dollar, Japanese Yen, Australian dollar and New Zealand dollar. As stated in a report from the International Monetary Fund (IMF) (2009), although Asian financial institutions have had limited exposure to US sub-prime securities and little involvement in high-risk mortgage lending practices, indirect effects of the global financial turmoil have proved to be extremely strong due to the region's close financial ties with outside markets .

While there are numerous papers and reports discussing how the US slowdown can affect the Asia-Pacific economy through the traditional trade linkage (N'Diaye et al. (2009) and Zhang (2008), for example), there is little research on the spreading of the US crisis to regional economies through the financial channel. Against this backdrop, this paper first studies how the US credit crisis affects eleven East Asian and Pacific economies in the short run.[1] We explore how the crisis propagates to this area through both financial and trade channels, with more emphasis on the former. As economies in this area differ noticeably in both financial structures and the level of financial development, it is necessary to dissect the financial transmission mechanism by distinguishing how the crisis affects EMEAP economies through three channels: banking sector contagion, flight to quality across borders, and stock market infection. Details on these channels are discussed in the following sections.

This financial crisis could have far-reaching effect on global imbalances, an issue intensively debated among economists as well as policymakers (Bernanke 2007, Faruqee et al. (2005), and Obstfeld and Rogoff (2005)). Governments and investors have realised from the crisis that financial markets were under-regulated and financial institutions were over-leveraged. Regulatory reforms could potentially change the rules of the game and lead to more stringent lending practice in the banking industry. Meanwhile, US households

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[1]   These are the members of the Executives' Meeting of East Asian-Pacific Central Banks (EMEAP). Founded in 1991, EMEAP is a cooperative organisation of central banks and monetary authorities in the East Asia and Pacific region. It comprises central banks and monetary authorities of the following eleven economies: Australia, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, and Thailand.

appear to have learnt that over-leveraging cannot be maintained indefinitely and adjustment in behaviour is inevitable at some point. These developments have led to the ascending personal savings rate in the US recently and discussion on the implications for the long-standing global imbalances, which have, to a large extent, been attributed to the over-consumption in the US.[2] To what extent can the de-leveraging in the US household sector help achieve global balances, and how may it affect regional current accounts in the medium term? The US government deficit, which has also been blamed for the global imbalances in recent years, is set to rise further as a big fiscal-stimulus package has been launched to fuel the weakening economy. To what extent will this offset the effects of the rising private savings rate on global imbalances? We try to address these issues in this paper.

Some researchers argue that the current global imbalances are also related to the savings rate in the Mainland household sector. It has been argued that regional financial imperfections and unbalanced growth pattern in emerging market economies and oil exporters, for example, have contributed to low global interest rate, a conducive if not determining factor in the global financial crisis (Bernanke (2007) and Bracke et al. (2008)). Against this background, we also explore how a declining savings rate in China, which has been actively engaged in a series of structural reforms to rebalance its growth pattern and to stimulate domestic demand, may affect regional current accounts in the medium term.

This paper uses an eight-region version of the Global Integrated Monetary and Fiscal (GIMF) model as the main tool of analysis. The GIMF model was first developed by the IMF. It was extended to the eight-region version by the Hong Kong Monetary Authority to capture the heterogeneous economic structure in East Asia. It is well suited for analysing the issues discussed above, given its strength in modelling cross-country linkages and the effects of fiscal policy. We find that the US credit crisis weighs heavily upon the Asia-Pacific economy through financial linkages in addition to the traditional trade channel. For some economies the former can be much more important than the latter due to their close financial ties with the US. The relative importance of the three financial channels (banking sector, flight to quality across borders, and stock markets) differs notably across economies. While stock market contagion proves to be important for advanced economies, flight to quality across borders plays a key role in less developed economies.

From a medium-term perspective, simulations based on the GIMF model show that the changes in the behaviour of US households can be conducive to correcting the global imbalances, but the effectiveness hinges largely upon how long US households can maintain a reasonably higher savings rate. The effect of lower savings rate in China on current accounts in other economies is relatively smaller compared with the effect of savings-rate adjustment in the US.

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[2] While Bracke et al. (2008) define global imbalances in a broad sense considering both current-account imbalances and financial positions, our main focus is on current-account imbalances.

The remainder of this paper is organised as follows. The second section gives a brief introduction to the GIMF. Section III studies the spreading of the US credit crisis to regional economies and Section IV discusses the impacts of the crisis in a longer term. The last section concludes the paper.

II.   DESCRIPTION OF THE GIMF MODEL

The GIMF model is a multi-country dynamic stochastic general equilibrium (DSGE) model developed by the IMF and documented in Kumhof and Laxton (2008). It has been widely used by the IMF in its background papers during Article IV consultations, see IMF (2008) and Kumhof and Laxton (2007), for example. The model integrates domestic supply, demand, trade, and international-asset markets in a single theoretical structure, thereby allowing transmission mechanisms to be fully articulated. Compared with conventional macro models, it has the following main features:

1.   It covers ten sectors that allows a more detailed exploration of the interactions between sectors and the transmission of shocks at sectoral levels than can be done with conventional macro models, which usually divide an economy into three sectors (households, intermediate goods and final goods firms, and the government).

2.   There are wide-ranging nominal and real rigidities at the sectoral level generating realistic inertial dynamics for key macroeconomic variables. Moreover, these rigidities facilitate studying, among others, the impacts of structural reforms.

3.   The GIMF model is quite flexible in capturing various forms of monetary policy. It uses an extended Taylor-type rule mainly aimed at stabilising inflation and output. However, various exchange-rate regimes can be considered. One can consider flexible exchange rate, managed floating exchange rate or a fixed exchange rate system.[3]

4.   Unlike conventional DSGE models which are powerful in monetary policy analysis but weak in fiscal policy analysis due to the assumption of Ricardian households, the GIMF model has a few key non-Ricardian features making fiscal policy important in the short and longer terms. For instance, it assumes overlapping generation households which have age-dependent productivity. Therefore, changes in tax rates and government spending will affect households' consumption behaviour.

5.   Last but not least, international trade can be well captured. Bilateral trade is broken down into intermediary goods and final goods, while final goods trade is further broken down into consumption and investment goods. In particular,

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[3]   In the research below, we assume China implements a regime of managed floating exchange rate against the US dollar, and other economies a free floating exchange rate regime. Nevertheless, the exchange rate of renminbi becomes more flexible over time. To be precise, the coefficient of the bilateral exchange rate in the Taylor-type rule is set at 0.6 initially, and declines in the next few years gradually and reaches 0.1 in the tenth year.
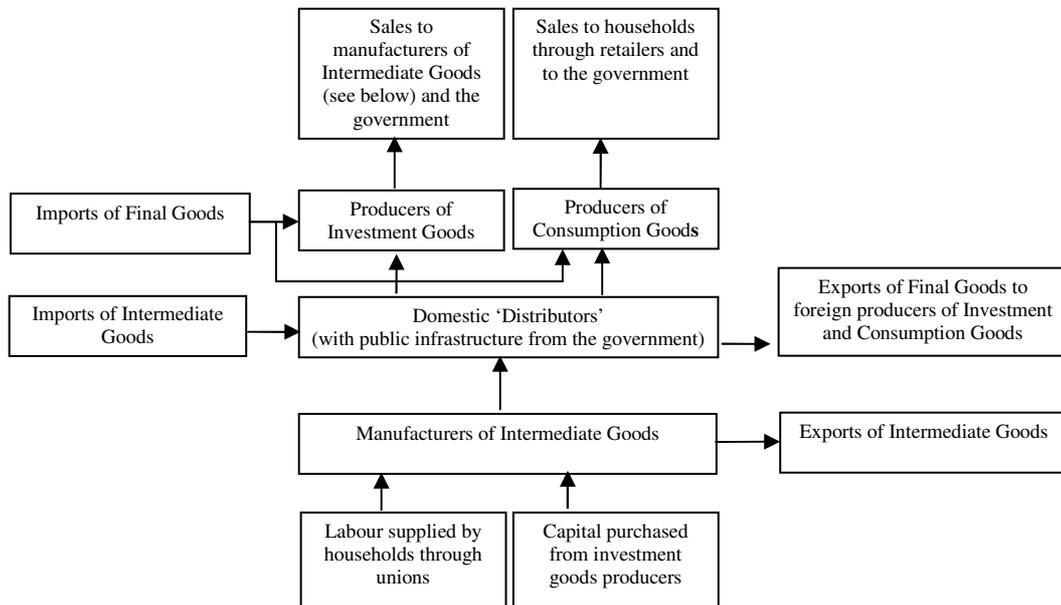
oil, which accounts for a major part of trade for some economies, can be separated from other goods. This setup allows the model to dissect the role played by trade pattern in the development of an economy. Two economies with similar levels of openness but with different trade patterns and trade structures are likely to experience different effects when facing a common external shock.

The linkages between the ten sectors are sketched below. Each economy is populated by two types of households, overlapping generations (OLG) households and liquidity constrained (LIQ) households. The main difference between them is that the latter do not have access to financial markets, and are forced to consume their after-tax income each period. Unions buy labour services from the two types of households and sell them to manufacturers who also purchase investment goods from distributors and use these two factors to produce intermediate tradable and non-tradable goods. The intermediate goods are then sold to domestic distributors and import agents of foreign economies — this is the first layer of trade (intermediary goods trade). Distributors combine domestic and foreign-produced tradable goods with public infrastructure to produce output that will be used as inputs in the production of domestic consumption and investment goods on the one hand and will be exported on the other — this is the second layer of trade (final goods trade). Investment goods producers sell their final output to manufacturers and the government, while consumption goods producers sell their final output to the government and retailers, who in turn sell their output to households. A flowchart of the main sectors is shown in Figure 1.

The extension of the original GIMF model to an eight-region specification has been documented in N'Diaye et al. (2009). The eight blocks are the US, euro area, Japan, China, Korea, EMEAP6 (Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, and Thailand)[4], Australia and New Zealand (AU&NZ, treated as one block because of their large commodity sector), and the rest of the world. It should be noted that economies lumped into one block are by no means homogenous. In fact, these economies differ significantly in monetary, exchange-rate and fiscal policies, not to mention the relatively subtle differences in their economic structures. Theoretically, these economies could be represented individually in the model given the malleability of the GIMF model. However, each block in the model is described with hundreds of parameters and equations, adding an extra block would require an enormous amount of resources for the calibration and simulation. The model is calibrated with actual data of 2006, with the details documented in N'Diaye et al. (2009). Given the said strengths of the GIMF model, particularly its powerfulness in analysing issues in international economics, the research below takes it as the main instrument to study the impacts of the US credit crisis on regional economies in the short run and in the medium to longer term.

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[4] The six economies are grouped together largely because of the similarity in their trade structure and their position in the vertical specialisation of production in the region. Capital goods account for about half of imports and exports of the EMEAP6 economies, while intermediary goods account for one-fifth of their total trade.

Figure 1: Flowchart of the GIMF

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┌──────────────────┐  ┌──────────────────┐
│ Sales to         │  │ Sales to households│
│ manufacturers of │  │ through retailers and│
│ Intermediate Goods│  │ to the government │
│ (see below) and the│  │                  │
│ government       │  │                  │
└──────────────────┘  └──────────────────┘
        ↑                     ↑
┌──────────────────┐  ┌──────────────────┐  ┌──────────────────┐
│ Imports of Final │→ │ Producers of     │  │ Producers of     │
│ Goods            │  │ Investment Goods │  │ Consumption Goods│
└──────────────────┘  └──────────────────┘  └──────────────────┘
                           ↑        ↑    ↑
┌──────────────────┐  ┌──────────────────────────────────┐  ┌──────────────────┐
│ Imports of       │→ │ Domestic 'Distributors'          │→ │ Exports of Final Goods to│
│ Intermediate     │  │ (with public infrastructure from │  │ foreign producers of Investment│
│ Goods            │  │ the government)                  │  │ and Consumption Goods│
└──────────────────┘  └──────────────────────────────────┘  └──────────────────┘
                                 ↑
                      ┌──────────────────────────────┐  ┌──────────────────┐
                      │ Manufacturers of Intermediate │→ │ Exports of Intermediate Goods│
                      │ Goods                         │  │                  │
                      └──────────────────────────────┘  └──────────────────┘
                           ↑            ↑
                 ┌──────────────────┐ ┌──────────────────┐
                 │ Labour supplied by│ │ Capital purchased│
                 │ households through│ │ from investment  │
                 │ unions           │ │ goods producers  │
                 └──────────────────┘ └──────────────────┘
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III. HOW DOES THE US CREDIT CRISIS SPREAD TO OTHER ECONOMIES?

The propagation of the US credit crisis to other economies goes through both financial channels as well as the conventional trade linkage. Moreover, there has been anecdotal evidence suggesting that for some economies financial channels may play a more important role than trade channels. As shown in a report from the IMF (2009), international bank flows to Asia turned significantly negative in late 2008, while access to external bond financing has become much more difficult in the past two quarters. Net-equity outflows have also surged. Against this background, this section first explores how the US economic downturn impacts on regional economies through trade, and then investigates what roles financial linkages may play in propagating the crisis. In particular, we would like to break down financial channels into banking sector contagion, flight to quality across borders, and stock market infection, as the relative importance of these three sub-channels may differ across economies due to the heterogeneity of financial structures and the degree of financial deepening.

1.   *Real economy contagion*

The real economy contagion stems from a slowdown in the domestic demand in the US of 3.5%, close to the cumulative weakening in its GDP during 2008 Q3 - 2009 Q2.[5] The slowdown occurs in both household consumption and private investment. The spillovers to other economies are shown in Figure 2. Korea suffers the most, with GDP falling by close to 0.8% in the first year, followed by EMEAP6 and China. In contrast, Australia-New Zealand and the euro area see a much lower contraction of less than 0.2%. The degree of losses experienced by different regions reflects mainly the relative importance of the US market to these economies.[6] Part of the reason why China sees a larger loss than other economies in the second year is that it implements a managed floating exchange rate regime against the US dollar, since the Mainland Government is reluctant to let the renminbi depreciate against the US dollar lest it prompts competitive devaluations in the region.

In interpreting the results in Figure 2, one should keep in mind that the simulation represents only the contagion from the US slowdown through trade linkages to other economies and does not fully explain the economic contraction in regional economies in the past few months. As is known, the world economic growth has slid significantly not only due to the US slowdown but also because of individual domestic factors and the worsening global economic conditions. N'Diaye et al. (2009) show that a slowdown in the G3 economies (the US, Japan and the euro area) of 1% may more than double the losses suffered by emerging Asia caused by a slowdown in the US alone of the same size, depending on the policy responses and exchange-rate regimes of the regional economies.

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[5] The quarter-on-quarter growth in the US GDP in 2009 Q2 is projected according to the mean of *Consensus Forecasts* of May 2009.

[6] IMF (2009) further argues that Asia's particular product mix has amplified the impact of the external slowdown. That is, Asia specialises in manufacturing high and medium technological products, whose demands are heavily dependent on credit conditions.

Figure 2: Effects of US Slowdown on Regional Output through Trade Channel
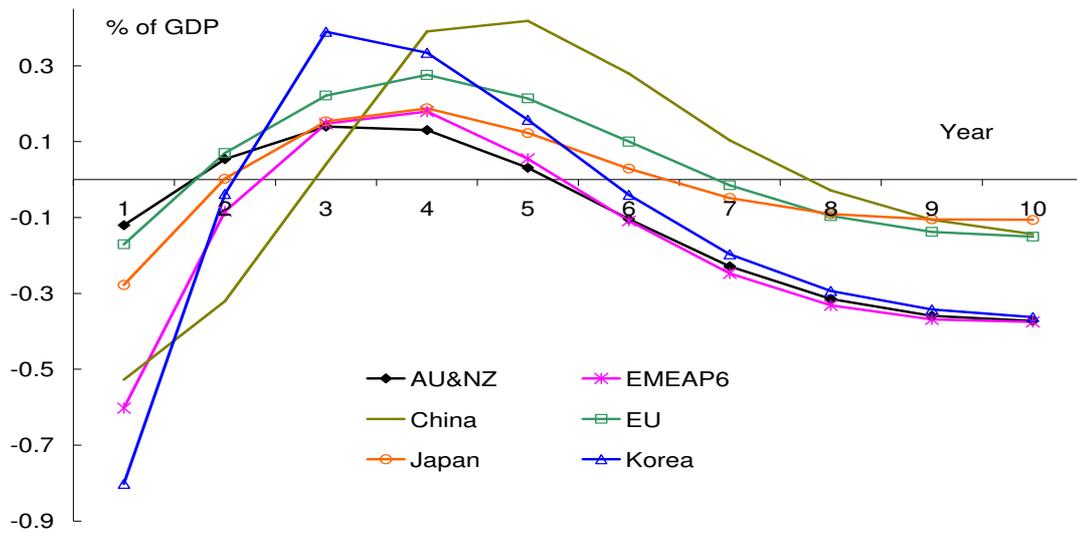
Data source: authors' estimates.

2. *Financial market contagions*

Apart from the negative effects through trade channels, most economies have also been badly hurt on the front of financial sectors. The balance sheets of banks have been damaged, capital outflows have been rampant, and stock markets have plunged. While the transmission mechanisms through trade are straightforward, those through financial channels appear to be more challenging as financial linkages have been more complicated than international trade. Although financial linkages between the EMEAP economies with the US have deepened noticeably in the past decade, there still exists significant heterogeneity in their financial structures and the degree of financial deepening. While equity financing accounts for about one-third of firms' total external financing in Japan, it has been much less important in China. Moreover, economies like Japan and Hong Kong in this area have enjoyed almost perfect capital mobility, whereas capital control is still binding on the Mainland (Ma and McCauley 2008). Therefore, it is necessary to break down the financial channels of propagation in order to fully capture the role they may play in transmitting the infections as the relative importance of various financial channels can differ across economies.

a. Banking sector contagion

As the balance sheets of the banks in the US were damaged by the deepening credit crisis, their counterparts in other economies have also become more risk averse and strived to preserve capital amidst a worsening global economic outlook and tightened their lending standards. Furthermore, as US banks became reluctant to lend US dollar to their counterparts in EMEAP economies, banks in this area have increased their borrowings in currencies other than the US

dollar and actively converted them into the US dollar through foreign-exchange swaps.[7] This may have also contributed to the tightening monetary conditions in the EMEAP economies. Yu and Fung (2009) find evidence of volatility co-movement between the interbank stress indicator of the US dollar and that of the Hong Kong dollar, Japanese Yen, Australian dollar, New Zealand dollar, Korean won and Singapore dollar. As a result, although policy interest rates have been reduced, liquidity conditions have deteriorated, further weighing on the already softening real economic sectors. The corporate risk premium (CRP), measured as the spread between the yield of corporate bond and sovereign bond, has risen noticeably during the past two quarters (Figure 3). While Japan, the US, Australia and Korea have seen a dramatic rise in the CRP in the past few months, China and the euro area appear to have experienced less changes.[8] The CRP is similar to the external finance premium relative to a risk-free rate (policy rate, for example) in the framework of a financial accelerator studied in Bernanke et al. (1996). According to this line of research, external finance premium is inversely related to firms' net worth and can reinforce a slowdown in the real economy as firms face higher funding costs.

Figure 3: Corporate Risk Premium across Economies
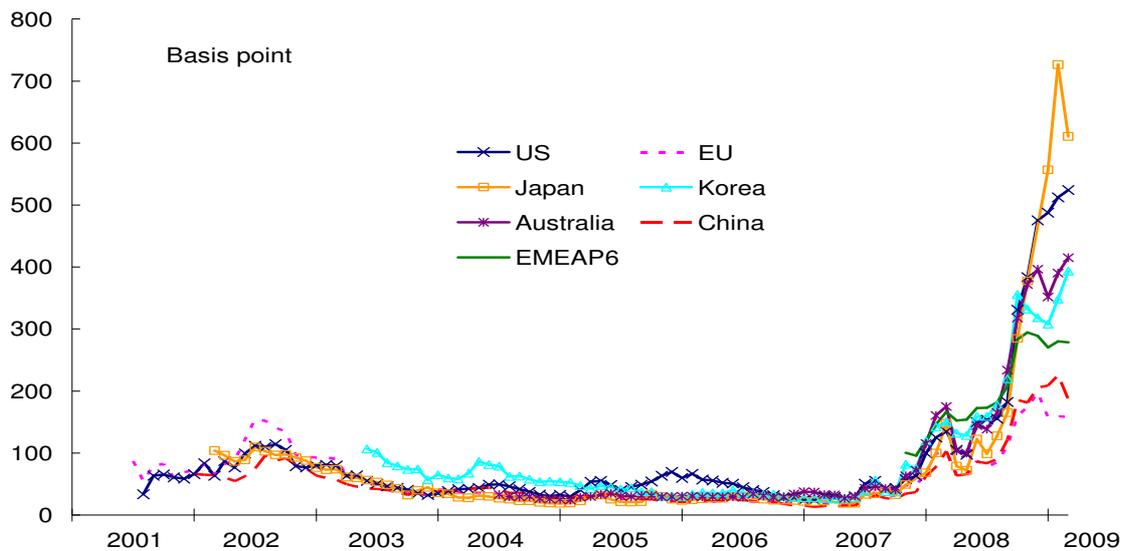
Data sources: Bloomberg and Markit iTraxx Asia/Pacific.

As the current version of the GIMF model does not feature a financial accelerator and private sectors are assumed to determine consumption and investment based on a risk-free rate (policy interest rate), it is necessary to modify the model somewhat to capture the effects of tightened liquidity conditions. We add a risk premium to the interest rate in the first-order conditions for investment, capital stock and consumption, reflecting the fact that private sectors are confronted

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[7] Genberg et al. (2009), analyse the link between the turbulence in money markets and the FX swap markets for the Australian dollar, Japanese yen, Hong Kong dollar, and Singapore dollar.

[8] This figure presents mainly the CRP of large firms. The CRP for small-and medium-sized enterprises (SMEs) was likely to be higher. IMF (2009) shows that the lending to SMEs has declined more and faster than that to large firms in Korea over the past year.

with higher funding costs in the case of a rising risk premium. To be precise, the CRP is specified as a decreasing function of output gap, namely,

$$CRP_t = \alpha \times \exp(-\beta \times y_t) + \varepsilon_t, \quad \alpha, \beta > 0 \tag{1}$$

where y_t denotes output gap and ε_t is a stochastic shock.[9] The CRP declines with a positive output gap and rises with a negative output gap, consistent with the fact that the external finance premium rises when the net worth of firms declines in an economic downturn, and vice versa. The parameters α and β are calibrated using the data of CRPs from Bloomberg in the past few years. The parameter α, which can be interpreted as the long-run CRP, is set at 0.005 for all blocks, suggesting a long-run CRP of 50 basis points.[10] The parameter β is calibrated such that the ratio of the CRP to output gap in a US slowdown scenario simulated using the GIMF is close to the actual ratio of the deviation of the CRP in 2008 from its average value since 2001 to the deviation of the output growth in 2008 from its average value during the same period.[11]

The contagion from the US banking sector to other economies can then be modelled as follows. We first set the stochastic shock ε_t in the US at 450 basis points, close to the difference of the average CRP during 2008 Q4 - 2009 Q1 and that observed before the failure of the Lehrman Brothers. The ε_t in other economies is then set as the product of the US CRP shock (450 basis points) and the correlation coefficient between each block's CRP changes with those of the US in the past few years. The correlation coefficients between the US CRP changes and those of the euro area, Korea, Japan, Australia-New Zealand, EMEAP6 and China are 0.70, 0.67, 0.62, 0.58, 0.54 and 0.11 respectively. The degree of the correlation mainly reflects the linkages between banks in regional economies with those in the US, and is largely consistent with the evidence found in Yu and Fung (2009). It is useful to note that the positive ε_t will not only dampen investment and consumption and hence output directly, but will also affect output indirectly through second-round effects. This is because the declining output caused by the positive shock ε_t will further push the CRP up which is specified as a decreasing function of y_t in equation (1). The two-year cumulative effects of the banking sector contagion on regional economies' output are shown in Figure 4. China sees the lowest loss of 0.2% of GDP due to its limited linkages with the US banking sector. The euro area, in contrast, sees the largest loss of around 0.70%of GDP, followed by Australia-New Zealand, Korea, Japan and EMEAP6.

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[9] We have also tried to define y_t as output growth rather than output gap in the exercises in later sections and did not find substantive changes in the simulation results.

[10] This is close to the world average CRP of 45 basis points since 2001.

[11] The β for Australia-New Zealand, EMEAP6, China, euro area, Japan, Korea, the US and the rest of the world is calibrated at 200, 150, 300, 170, 200, 240, 270 and 300 respectively.

Figure 4: Breakdown of Financial Contagion Effects
(Two-year cumulative effect on GDP)
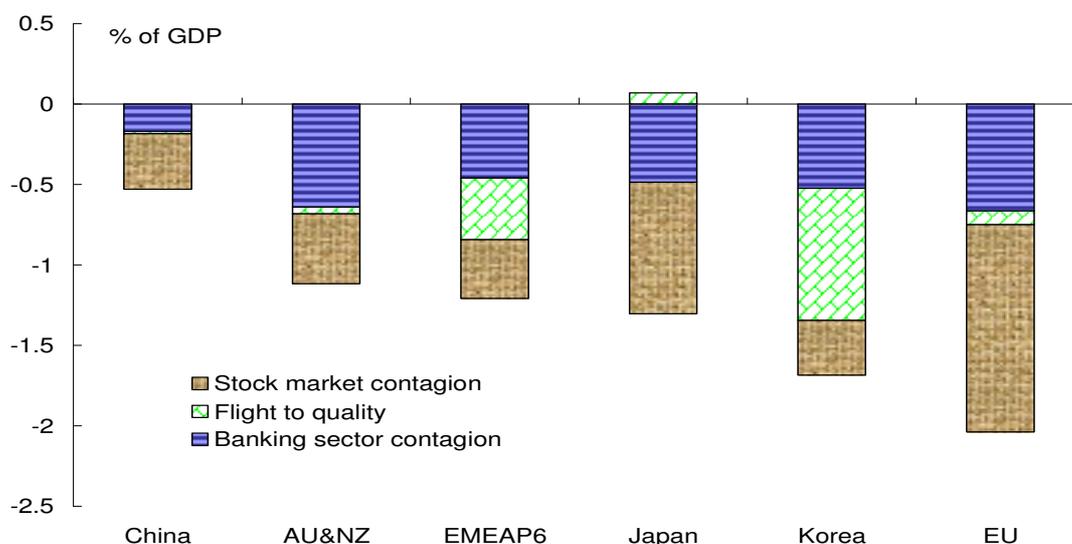
Data source: authors' estimates.

b. Flight to quality across borders

As the credit crisis spread from the US to other regions, downside risks on the economic outlook in these areas intensified, leading to sizable capital outflows to the US treasury bonds as a result of flight to quality. IMF (2009) estimates that net capital inflows into emerging Asia will drop sharply in 2009. Country-risk premium measured as the sovereign spreads relative to the US treasury bonds has risen noticeably in the past few months (Figure 5). Korea and EMEAP6 have experienced the largest increase in country risk premium, whereas Japan has only seen a modest rise. Flight to quality across borders would affect an economy in two opposite directions. On one hand, it would exacerbate the worsening domestic liquidity conditions and dampen economic growth. On the other hand, it would add depreciation pressure to regional currencies against the US dollar and may improve trade balance in these economies. For example, the Korean won and the Indonesian rupiah have depreciated about 20% and 10% respectively in nominal effective terms between September 2008 and March 2009, thereby partly supporting their exports. Furthermore, a depreciation of domestic currency would exert beneficial valuation effects on foreign assets denominated in the US dollar for a creditor economy and negative valuation effects for a debtor economy. The overall effects of flight to quality therefore depend on which effect dominates.

To simulate the impacts of flight to quality across borders, we shock the country risk premium of all economies except the US by the average of sovereign spreads in each block during 2008 Q4 - 2009 Q1. In parallel, we also increase the CRP in these economies in line with the

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correlation between the changes in country risk premium and the changes in CRP in the past few years to reflect the effects of capital outflows on domestic lending rates. In other words, if the country risk premium of an economy rises by *x,* the CRP will go up by ω*x* given a correlation coefficient of ω between the two variables. The monthly average of the country risk premium during 2008Q4 - 2009Q1 across economies and the correlation coefficients between the two variables are given in Table 1. Korea features the highest rise in the country risk premium with a significant correlation coefficient between the two variables of 0.90, suggesting that capital outflows may have generated a material impact on domestic liquidity conditions. In contrast, China, EMEAP6 and Australia-New Zealand have a relatively low correlation coefficient. As demonstrated in Figure 4, the flight to quality across borders may exert significant effects in Korea, leading to a GDP loss of over 0.8%, followed by EMEAP6 of close to 0.4%. In contrast, other economies experience relatively low losses. Japan sees a slight cumulative gain instead of a loss because its loss in the first year is outweighed by a gain in the second year. The story behind reads as follows. An initial rise in the country risk premium leads to a depreciation in the domestic currency against the US dollar. As the uncovered interest parity condition holds in the GIMF model, the weakening domestic currency leads to a rising domestic interest rate, which will in turn induce an appreciation in the domestic currency in the next period. As Japan has experienced a smaller rise in its country-risk premium than other economies, it will also see a smaller appreciation in its currency against the US dollar in the second year, suggesting a depreciation of its currency in effective terms in the second year which may support its exports. As the positive effect in the second year overshadows the loss caused by the adverse impacts of flight to quality on domestic liquidity conditions, there is a net gain over two years.[12]

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[12] The Japanese yen has appreciated about 25% in nominal effective terms between September 2008 and March 2009. As this paper focuses on the direct contagion effect from the US, we will not simulate such a shock.

Figure 5: Country Risk Premium
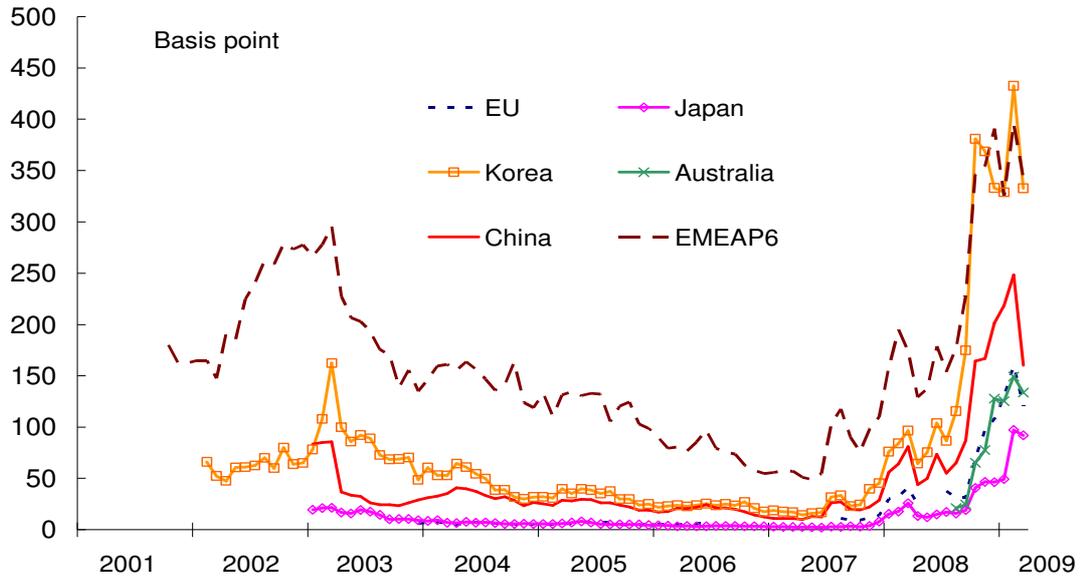
Data source: Bloomberg.

Table 1: Flight to Quality Shocks

Economy	Country risk premium shock (basis point)	Correlation coefficient	CRP Shock (basis point)
Korea	360	0.91	330
EMEAP6	350	0.25	88
China	200	0.20	40
EU	110	0.42	46
AU&NZ	110	0.20	22
Japan	60	0.89	53

Data sources: Bloomberg and authors' estimates.

c.   Stock market infection

The third financial channel through which the US credit crisis spreads to other economies is stock market. The drops in the US stock prices affect the stock markets in other regions through both confidence effects as well as wealth effects. Moreover, as global institutional investors and hedge funds tried to reduce exposure to emerging markets in general, net equity outflows have hit many regional markets. For example, IMF (2009) estimates that the amount managed by Asia-based hedge funds at end-2008 was a third less than that at the end of 2007 in terms of the US dollar. As stock markets are not explicitly modelled in the GIMF, we capture the

contagion mainly by shocking the Tobin's Q (the ratio of the market value of installed capital to replacement costs of capital stock) since the Tobin's Q is proportional to stock prices in theory. As Tobin's Q declines, firms reduce their investment and hence dampen consumption, which leads to slower economic growth. As equity markets play a more important role in firms' fund-raising in some economies than in others, it is necessary to consider the relative importance of stock markets in firms' financing in each economy.

The shock to the Tobin's Q in the US is specified as the product of the year-on-year changes in the US S&P 500 index during 2008 Q4 - 2009 Q1 (around -30%) and the relative importance of equity financing in total external financing of firms (60%).[13] The sizes of shocks to Tobin's Q in other economies are determined by two factors: (a) the correlation between their stock price changes and those of the US in the past ten years or so, and (b) the relative importance of equity financing in total external financing for firms in these economies. The stock market shocks are specified in Table 2. Equity financing is the most important in the US, followed by the euro area and Japan. It accounts for only 15% of total external financing for firms in China. Moreover, while the stock markets in advanced economies are closely related to their counterpart in the US, emerging market economies have been more isolated.

Table 2: Stock Market Infection Shocks

| Economy	Correlation coefficient with US stock market	Relative importance of equity financing (%)	Shock to Tobin's Q
US	---	60	-0.18
EU	0.80	44	-0.11
Japan	0.80	30	-0.07
AU&NZ	0.60	18	-0.03
Korea	0.35	20	-0.02
EMEAP6	0.30	20	-0.02
China	0.10	15	-0.005

Data sources: CEIC, Davis and Stone (2004), European Commission (2008), Li (2007), Reserve Bank of Australia (2006) and authors' estimates.

As shown in Figure 4, the euro area suffers the most significant losses through stock market contagion among the six economies, followed by Japan and Australia-New Zealand. EMEAP6, Korea and China, however, are less severely infected. Despite a much smaller shock of -0.005 than other economies, China sees a loss of a size close to that of Korea and EMEAP6 due to the large share of investment in its GDP of around 40%, compared

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[13] The reason why we use year-on-year changes in stock prices is that the current version of the GIMF model is an annual one.

with about 25% in Korea and 20% in Japan. While Figure 4 presents the breakdown of the financial contagion effects through the channels of banking contagion, flight to quality across borders and stock markets, Figure 6 shows the aggregate effects over ten periods. The euro area seems to be the most severely affected through financial channels, followed by Korea mainly due to flight to quality effects. China appears to be the least affected, while the damage to other economies ranks in between.[14]

Figure 6: Overall Effects of Financial Contagions
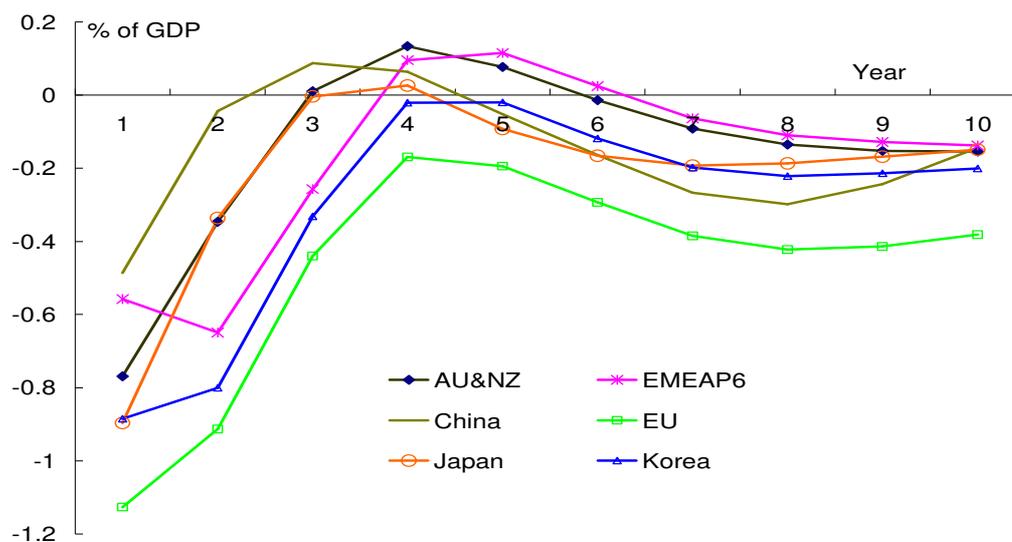
Data source: authors' estimates.

The above analysis indicates that financial channels played a more significant role in spreading the credit crisis from the US to developed economies, whereas their effect on China is relatively small. Moreover, the adverse impacts of financial contagion seem to last longer than those of trade in most cases, as it usually takes a longer time for these economies to recover in Figure 6 than in Figure 2. Overall, economies with stronger financial linkages with US may suffer more losses through financial channels. In particular, while developed economies have been less subject to capital outflows caused by flight to quality and more affected by stock markets, the reverse holds for emerging market economies.

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[14] The reason why EMEAP6 sees a smaller loss in the first period than in the second period is that in the first year the beneficial effects of exchange-rate depreciation on exports overweigh the adverse impacts of a rising CRP brought about by a higher country-risk premium.

IV. HOW WILL THE US CREDIT CRISIS IMPACT UPON REGIONAL ECONOMIES IN THE MEDIUM TERM?

Compared with most post-war crises, the current recession differs in that the balance sheets of both households and banks have been severely damaged. Net worth of US households, for instance, fell by about 20% between mid-2007 and end-2008. As a result, households have to change their consumption behaviour by cutting discretionary spending to repair their balance sheets. Indeed, according to the estimate of Bureau of Economic Analysis, household savings rate in the US has risen from 1.8% in 2008 Q4 to 5.7% in April 2009. The over-leveraging in the US household sector has raised concerns among economists as well as policymakers over the long-term growth prospects for the US and has long been blamed for the global imbalances (Garner 2006 and Bernanke 2007). As the current episode of global imbalances can be attributed to both structural factors as well as cyclical elements, it requires some structural changes to get the problem solved. What happened in the past few months indicates that such structural changes may have started. Households might stay thrifty for a considerable period of time, banks might have learnt to be more cautious in lending, and the government has pledged to strengthen supervision on financial institutions in the future. If these developments are translated into persistent structural changes, the credit crisis may exert some far-reaching impacts on regional economies in the medium to longer term.

This section focuses on how the possible reversal of the US household savings behaviour may help solve the problem of global imbalances. In addition, a higher savings rate in the US may bring some beneficial effects to regional economic growth as world interest rate may be lower given its large share in the world GDP. In the base scenario, we assume the private savings rate measured by the ratio of private savings to GDP in the US rises gradually by about six percentage points to its historical average level of about 10% in about four years and stays there beyond the fourth year.[15] This is undoubtedly a sanguine view as in reality the rise in the savings rate may be short-lived and comes down when financing constraint in the US is relaxed, an alternative scenario that we will explore later. The rising savings rate in our simulation is assumed to be brought about by changes in behaviour embodied by a rise in the discount factor and other factors such as negative wealth effects.[16] More stringent regulations on financial institutions may also prevent households from over-consuming. Our simulations show that the adjustment in the US savings rate exerts a noticeable impact on its own current account balance and those of other economies in the medium term

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[15] In this simulation we assume corporate savings rate remains largely stable. As the personal savings rate in the US has reached around 4% in the first quarter of 2009, a further increase of about six percentage points would make the households savings rate reach its historical level of about 10% in the 1970s and 1980s.

[16] A higher discount factor in the objective function implies that households become more patient and would save more for future consumption. As discussed in Bracke et al. (2008), housing market seems to have a significant wealth effect in the US.

(Figure 7). The ratio of the US current account to its GDP improves by close to 3.5 percentage points in the fifth year while the US dollar may depreciate by close to 20% in nominal effective terms in the medium term. The current-account balances in Australia-New Zealand, Korea, EMEAP6, China, Japan and the euro area deteriorate by 1.9%, 1.7%, 1.4%, 1.4%, 0.9% and 0.8% of GDP respectively in the same year.

The effects of the ascending US savings rate on other economies' current accounts work through both trade channel and valuation effect of net foreign assets (NFA). Devereux and Genberg (2007) provides a theoretical analysis of these two channels. Higher savings in the US dampen its trading partners' exports and as a result, trade balances in these economies may deteriorate. On the other hand, the valuation effect depends on a number of factors: (i) the NFA position of an economy, (ii) the exchange rate movement of a block's currency against the US dollar, and (iii) the changes in the US interest rate. A higher savings rate leads to a lower interest rate in the US, and an economy experiences positive valuation effects if (i) it has a positive NFA status (a creditor) and its domestic currency depreciates against the US dollar, or (ii) it has a negative NFA status (a debtor) and its currency appreciates against the US dollar.[17] While China, Japan and EAMEAP6 are calibrated as creditors in the GIMF, Australia-New Zealand, Korea and the euro area are debtors.[18] Australia-New Zealand sees the largest deterioration in current account in terms of the percentage of GDP, followed by Korea, EMEAP6 and China, while Japan and the euro area experience a deterioration of less than one percent of GDP. The changes in the current accounts of these economies can mainly be attributed to the worsening in their trade balance, but the valuation effects and interest earnings on NFA have also played a non-negligible role. While large creditors like Japan and China experience double blows on NFA positions owing to their stronger currencies against the US dollar and the lower interest rate on the US dollar denominated assets, debtors like Australia-New Zealand see some positive valuation effect.

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[17] A caveat is that the valuation effect in the GIMF model is relatively simple, as all NFA positions are assumed to be in assets denominated in the US dollar.

[18] The steady-state NFA-to-GDP ratio in these economies is 20%, 41%, 48%, -68%, -22% and -14% respectively.

**Figure 7: Effects of Permanently Higher US Savings Rate
on Regional Current Accounts in the Medium Term**
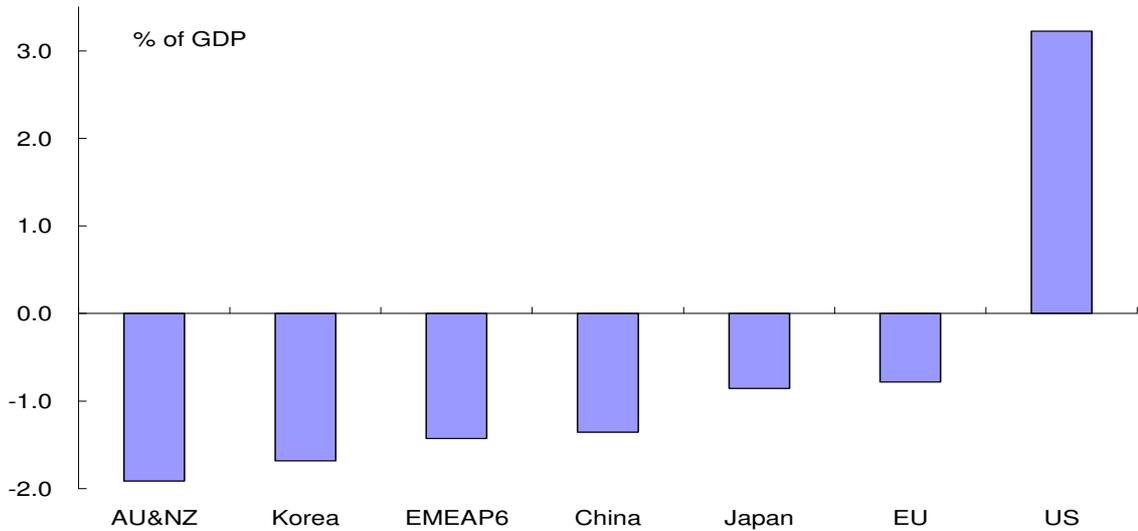
Data source: authors' estimates.

The above analysis is based on the assumption that the US household savings rate will return to its historical level and stay there permanently. As this may not be true in practice, we have also considered an alternative scenario by assuming that the private savings rate returns gradually back in the medium term to close to the starting level after rising by six percentage points. We find that the US current-account-to-GDP ratio will improve by less than two percentage points in the medium term, while regional current accounts will accordingly deteriorate less (Figure 8). This suggests that in order to have a significant correction to the global imbalances, it is necessary for US households to maintain a reasonable savings rate for a considerable period of time, rather than just temporarily.

**Figure 8: Effects of Temporarily Higher US Savings Rate
on Regional Current Accounts in the Medium Term**
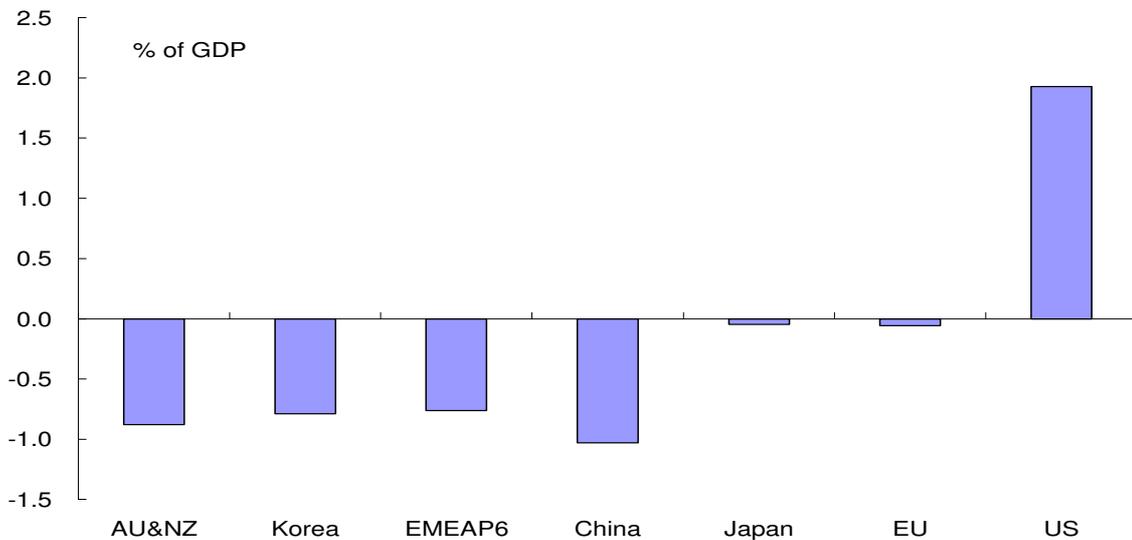
Data source: authors' estimates.

In contrast to the household de-leveraging, the US public sector is set to reduce its savings rate further as a big fiscal stimulus package of close to US$800 billion (about 5.5% of the 2008 GDP) has been unfolded to fuel domestic demand. To what extent will the declining public savings rate offset the effects of the rising household savings rate on the global imbalances? In order to quantify the impact of this fiscal impulse package, we simulate a government spending shock for the US of 5.5% of GDP. As the fiscal stimulus is expected to be conducted over two years with possible frontloading effects, we assume government spending increases by 3% of GDP in the first year and by 2.5% in the second year.[19]   The effects of the permanently higher US household savings rate on its current account with and without fiscal stimulus are shown in Figure 9.

Figure 9: Impacts of Household Savings Rate Changes on the US Current Account with and without Fiscal Stimulus
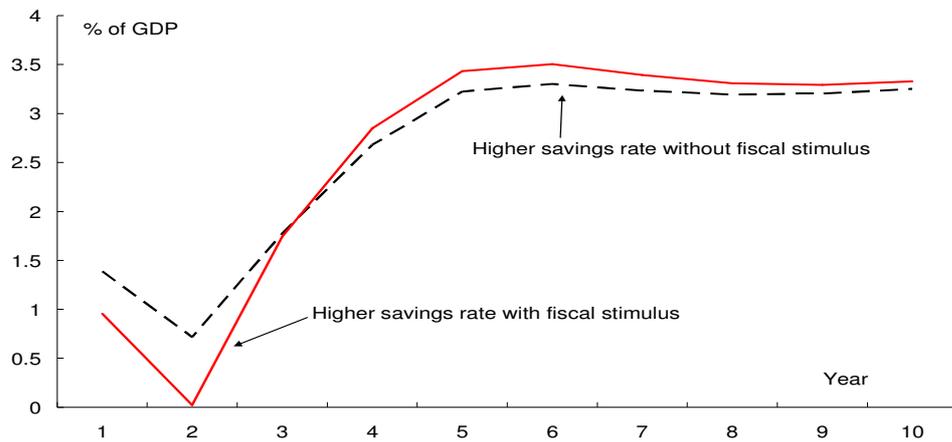
Data source: authors' estimates.

It is clear that the US fiscal stimulus worsens the US current account in the short term by less than 1% of GDP, and its impact in the medium term is limited. The fiscal stimulus does not have a significant impact on the current account mainly for two reasons. First, leakage effects of a fiscal stimulus in the US are likely to be moderate as the ratio of imports to GDP in the US has been relatively low compared with other blocks in the model. While the imports-to-GDP ratio in EMEAP6, Korea and China was 75%, 42% and 33% respectively in 2006, it was only 17% in the US. Second, we find that a declining public savings rate leads to a higher household savings rate in the simulation. This is because the private sector is reasonably forward looking given a planning horizon of 20 years.[20]

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[19] We allocate 75% of the government spending to investment and the remaining 25% to government consumption, following Goldman Sachs (2009). Government investment is calibrated to be more productive than government consumption in the GIMF model.

[20] The panning horizon for households is calibrated according to the level of financial market development and the situation of social welfare. A planning horizon of 20 years corresponds to a myopia parameter of 0.95 in the model.

Households increase their savings in anticipation of higher public debt and higher tax rates in the future. The net effect of the stimulus package on the US dollar exchange rate is that it may depreciate 5% more in the medium term in nominal effective terms than when no fiscal stimulus is launched.

Despite its marginal effects on current accounts, the mounting public debt has raised concerns over the growth prospects in the US and regional economies. Reflecting the worries about the fiscal sustainability and inflationary pressure, the 10-year US Treasury bond yields have risen by over 100 basis points in the past three months.[21] In order to explore the effects of the potentially higher real interest rate on regional output, we have simulated a scenario by assuming that the equilibrium real interest rate in the US will rise by 200 to 250 basis points during 2009-2014.[22] Our simulation shows that the output in the US, Korea, China, EMEAP6 and Japan may decline by about 1%, 0.5%, 0.3%, 0.15% and 0.15% respectively in the short run, and by around 0.8%, 0.4%, 0.5%, 0.3% and 0.2% respectively in the medium term.[23] Australia-New Zealand sees only a slight drop in the short run and a 0.13% fall in the medium term.

In sum, the above analysis shows that a rise in the US household savings rate to its historical average level will notably help correct the global imbalances. The effectiveness, however, depends largely upon how long the higher savings rate can be maintained, and the global imbalances may not be well corrected if the changes in household behaviors are short-lived. The fiscal stimulus unfolded recently may to some extent worsen the US current account in the short run, but will not show significant impacts in the longer term due to its limited leakage effects. Nevertheless, the surging public debt may exert non-neglectable adverse impacts on regional output as a result of potentially higher real interest rate worldwide.

The Central Government in China has engaged in initiatives to rebalance its growth pattern and promote domestic consumption. The reforms include levelling the playing field between tradable and non-tradable sectors, developing and opening domestic financial markets, and expanding contributions to health care and education to reduce precautionary savings. These reforms are expected to yield broad-based productivity gains, particularly in the non-tradable sector and to prompt domestic consumption. N'Diaye et al. (2009) find that these reforms will generate non-negligible beneficial effects on regional economies. Below we will simulate a scenario for China on top of the above scenarios assuming that China's private savings rate declines by about ten percentage points gradually over the next ten years along with a productivity improvement in both

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[21] The effect of deteriorating public finance on interest rates is discussed in Cheung, Tam, and Szeto (2009).

[22] This implies a rise of 50 to 70 basis points in the GDP-weighted world equilibrium real interest rate.

[23] The reason why China may see a larger drop than other Asian economies in the medium term is that although China is expected to conduct a more flexible exchange rate regime over time, it may not let its currency depreciate much in the face of a strengthening US dollar to prevent a competitive depreciation among regional currencies.

tradable and non-tradable sectors.[24] The reason why we assume a slower pace for changes in China's household savings behaviour than for the US is that China is not in the centre of a major crisis and, as a result, household behaviours will adjust gradually with the deepening of the market economy reforms and the development of financial markets. The simulation results are shown in Figure 10. Obviously, China sees a drop in the current-account-to-GDP ratio of about five percentage points in the medium term (fifth year), while other economies only see marginal improvement in their current accounts.

Figure 10: Effects of Descending China's Savings Rate on Regional Current Accounts in the Medium Term
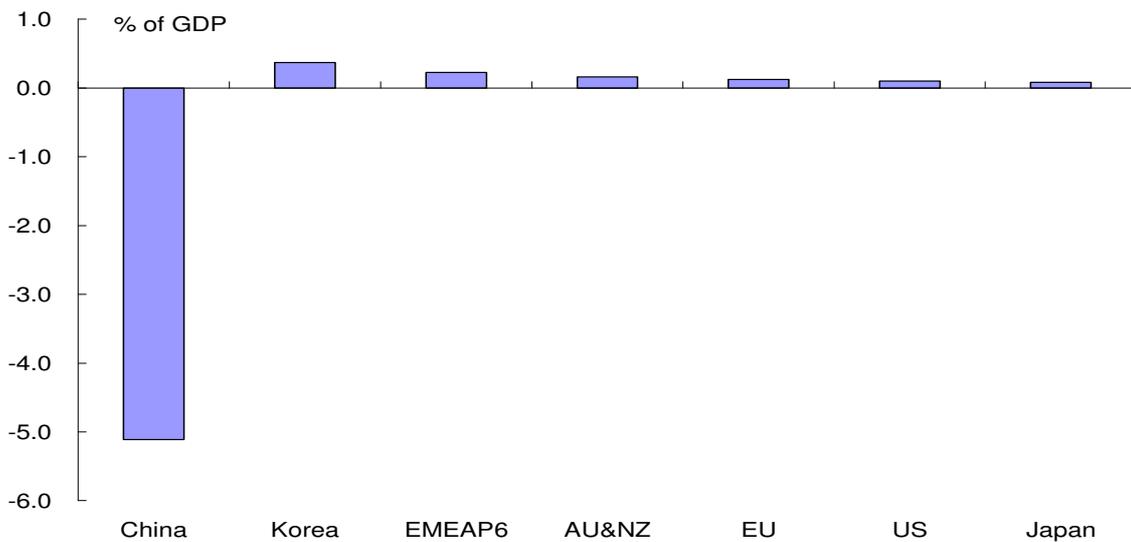
Data source: authors' estimates.

Compared with the US, changes in China's household savings rate seem to have a much smaller impact on regional current accounts. The main reasons for this difference are summarized as follows: (i) although the ratio of imports to GDP in China is almost double that of the US, the value of China's imports has been much smaller than that of the US. Therefore, given a change in the savings rate of a similar size in the two economies, their impacts on international trade are not comparable; (ii) as productivity in the non-tradable sector improves relative to the tradable sector with the deepening structural reforms, China's households may consume more domestic products, particularly non-tradable products. This will partly limit its effects on exports of other economies; and (iii) while changes in the US private savings rate can impact upon regional NFA positions directly and hence their current accounts through the changes in the US-dollar exchange rate and the US interest rate, the changes in China's savings rate can only affect regional NFA positions marginally because

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[24] Following N'Diaye, Zhang and Zhang (2009) we assume the non-tradable sectors sees a larger productivity gain than tradable sector. This is also consistent with Blanchard and Giavazzi (2005) who claim that one approach for China to rebalance its growth pattern is to reallocate investment from tradable sector to the non-tradable sector to increase the productivity of the latter.

China's currency is not yet an international reserve currency.

Regional economies including China, Japan, Australia and Korea have also introduced fiscal stimuli to mitigate the adverse impacts of the external slowdown. One may wonder what effects these measures can exert on the Asia-Pacific economy. Our simulations indicate that China's fiscal stimulus package launched last November may worsen its current account by 1.2% and 0.3% of GDP over the next two years respectively, and can improve the current accounts of Korea and EMEAP6 by about 0.5% of GDP the next year, but may not generate significant effects on the current accounts of other economies.[25]

V.   CONCLUDING REMARKS

Using the EMEAP version of the GIMF model, this paper investigates how the US credit crisis affects the Asia-Pacific economies in the short run as well as in the longer term. From the short-term perspective, the crisis can weigh heavily upon regional economies through financial channels in additional to the traditional trade channel. For some economies, the financial linkages seem to be more important in spreading the crisis than the trade channel. Furthermore, the relative importance of the three financial channels (banking sector, flight to quality across borders, and stock markets) differs noticeably across economies depending on their financial structures and the level of financial development. While advanced economies can be less subject to capital outflows caused by flight to quality and more affected by equity market shocks, the reverse holds for emerging market economies.

In addition to the short-run ripple effects, the credit crisis may also show some far-reaching impacts on regional economies in the medium to longer term as some structural changes in household behaviors in the US could take place. Our simulations show that higher savings rate in the US will help correct the global imbalances, but the effectiveness largely depends upon how long US households can maintain their savings rate at a reasonably higher level. While a persistently higher savings rate can be noticeably conducive to correcting the global imbalances, temporary rises in the savings rate would not be of much help. In addition, we find that although the mounting public debt in the US may not exert material impacts on the global imbalances, it may darken regional growth prospects due to a potentially higher real interest rate worldwide. Our study also shows that while a lower savings rate in China can help restore its own current-account balance, it may not exert significant effects on regional current accounts due to its limited size in the world economy and the relatively weak status of its currency in international financial markets.

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[25] He et al. (2009) show that China's fiscal stimulus may boost the GDP growth of EMEAP6, Korea, Australia-New Zealand and Japan by about 0.40, 0.35, 0.10 and 0.09 percentage points respectively in the first year. We have also tried to simulate the effects of Japan's fiscal stimulus package released of late and find that it has only marginal effects on regional economies' current accounts and growth.

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