The Empirical Study of the Impact of Capital inflow on China’s Inflation

Haiyue Liu

Sichuan Normal University, Chengdu, China

This study focuses on the transmission of inflation through capital inflow in China during 1997-2010. Using a three-step statistical techniques: ADF, VEC and Granger Causality, it is determined that: (1) GDP, trade surplus and FDI variables do not individually Granger-cause inflation, however, they do Granger-cause inflation with M2 and DEV variable(DEV depicts foreign indirect capital inflow) jointly; (2) GDP is found as a strongest pass-through to inflation statistically, accounting for approximately 9% of variance in inflation; (3) FDI representing the “real sector” capital inflow and DEV as a substitution variable of foreign indirect capital inflow account for 2% and 0.7% of the variance of inflation respectively.(4) M2 has over 5% contribution to the variance of inflation in the first lag but gradually decreased to about 0.1%, a very limited percentage in explaining variations in the total variance of inflation .(5) Trade surplus statistically has very little contribution to the variance of inflation in percentage of about 0.1%.

It is extremely important for the monetary policy authority to understand how their policies will affect the capital inflows and a consequence to cause the changes in output and domestic price level. There are a lot of channels for the capital inflows to effect on the domestic price level, such as through FDI, investment in securities, capital lending and even trade. Although the channels are well studied worldwide, there is a lot of uncertainty regarding their significance. This is especially true for China owing to serious data problems.

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3 Haiyue Liu is an associate professor in School of Economics and Management, Sichuan Normal University, Chengdu, China. This paper is finished when she is visiting University of Washington, Seattle, USA.
(quality, reliability, length) as well as the frequent institutional and policy changes by the state and innovations that are characteristic in the 1990s and early 2000s.

As capital inflows particularly into financial instruments (e.g. stock market) are ultimately affected by the monetary policy due to their sensitivity to the fluctuations of interest rates and exchange rates, some economists study monetary policy channel by using same variables as they do analysis on capital inflow channel to learn about these variables' contribution to the transmission of inflation in China. (Especially they are using such variables as real exchange rate and interest rate to test the channels) (Chaoyu Zheng 1996).

My study is going to focus on analyzing the effect of capital inflow on China’s inflation (including both FDI capital and foreign indirect investment capital) using monthly data during 1997-2010. My major contribution is the introduction of a new variable DEV (interest rate risk premium) which could reflect the inflow of the foreign indirect capital due to its characteristic, i.e. highly related with risks in interest rate and exchange rate fluctuations.

1. Literature review

The effect of capital inflow on inflation is extensively studied both theoretically and empirically, especially in developed economies. It has also become popular in NICs in recent years.

On the theoretical side, it has been widely recognized that the capital inflow can affect the price level in an economy through many channels among which the most important one is money supply (Krugman, 1991). The effect will vary depending on the type of exchange rate regime and the level of openness of the capital account (Alexander, 1976).
Generally speaking, with fixed exchange rate regime, the money supply in an open economy would be much more affected by the capital inflow caused by the interest rate difference with the rest of the world. The central bank would have to issue domestic currency to purchase foreign exchange so that the fixed exchange rate could be maintained. This process will increase the money supply in the domestic market and further push upward the price level. To contrast with the flexible exchange rate regime, this inflationary effect can be reduced by the automatically adjustment, i.e., depreciation or appreciation of the exchange rate. (Mundell, 1963; Turnovesky and Kaspura,1974; Frisch, 1976; Dornbusch, 1980)

The degree of capital account openness is considered to be another important factor to affect inflation through changes in money supply due to capital inflow. Robert Mundell and J. Marcus Fleming applied the IS-LM model in the open macro-economic framework in 1960s to explain how the difference of capital account openness between countries would affect the capital flows and further affect the money supply. If a country has a full open capital account, the capital flow would be very sensitive to the interest rate difference. The equilibrium will be soon achieved when the interest rates between two countries adjust to the same level. However, in a country which does not have full open capital account, for example due to restrictions on the exchanging and remitting of foreign currency, the equilibrium interest rate level will take longer to be achieved. The delay in reaching the equilibrium interest rate level is what causes the adjustment in the domestic money supply.

On the empirical side, economists tend to use VAR model to estimate the effect of capital inflow on the economy in general, i.e., its output and price level. The majority of the empirical studies are focused on the US transmission mechanism (Leeper et al.1998, Chirstiano et al. 1999, Jeong and Lee.2001,
Kuttner and Mosser 2002). For the EU, summarized findings of the empirical studies can be found in Angeloni et al. (2003). Cheng and Yuan (2002) studied the transmission mechanism from US to HK and Singapore as two cases of small open economy. They established that the sensitivity of the transmission channel lies in the exchange rate regime.

Many of the findings of these studies support some of the theoretical arguments. For China this is true as well, including the work by Wanjie Sun and Xuheng Zhang (1995) who studied the data in 1993-1994 to drew a conclusion that foreign capital inflow pushed the inflation directly and the “absorption ability” to the foreign capital which means the allocation of the domestic resources is the key factor on how much the capital inflow can influence the inflation. According to the estimation of Wanjie Sun and Xuheng Zang (1995), for every one dollar FDI increase, the domestic fixed investment would increase 13.6 RMB Yuan, which is 1.8 dollars, while the domestic floating investment would increase 4.5 RMB Yuan, which is 0.6 dollars during 1990s in China. Chaoyu Zheng (1996) set up a structural model to analyze the transmission mechanism of balance of payment and foreign capital to further explain the macroeconomic situation in 1994. Xiandong Yan and Keran Feng (1997) found out that capital inflow and price level are positively correlated.

All these empirical studies are useful and mainly focus on the foreign direct investment. With China’s increasing openness in capital account, the foreign indirect investment should be also considered when we are going to discuss the capital inflow effect on inflation. In this study, DEV as a variable to depict the foreign indirect investment is introduced in the model.

2. The historical background: China’s policies on capital flows
   2.1 The Gradual opening of China’s capital account
Since 1993, China pursued a policy of gradual opening of its capital account. On January 1st, 1994, China eliminated the original dual exchange rate and unified the official exchange rate and foreign exchange swap market rate.

In 1996, China achieved the current account convertibility which was four year earlier than it was planned. With the entry into WTO in 2001, China has been actively fulfilling the commitment to open the financial market gradually.

In November 2002, China allowed a trial implementation of QFII (Qualified Foreign Institutional Investor) by opening the domestic capital market so that foreign investment institutions have a channel to invest in China’s “A-share stock market”, its domestic securities market, as well as allowing foreign currency prepayment as a method for debtors to pay back their creditor loans.

In 2003, China eased the restrictions on investments in foreign capital markets and permitted Chinese citizens to make investments abroad by purchasing foreign currency. In the same year, foreign merger and acquisitions were permitted. Restrictions on foreign capital flows were removed from certain industries.

In 2004, China permitted the Chinese Multi-national corporations to grant loans to their foreign subsidiaries, eased the restriction of transferring personal assets to foreign countries, and allowed the Chinese citizens who are immigrating to remit their assets with permission of foreign exchange authority.

In 2005, China permitted private foreign investors to invest in listed companies whose stock is entirely listed publically (the companies that has accomplished the reform of non-tradable shares), as well as A-shared listed companies in the medium or long term under the provision that the shares could not be negotiable for three years after the initial purchase.

In 2006, China released the document titled “Merger and Acquisition of a Domestic Enterprise by Foreign Investors” which provided regulations for
Chinese enterprises to get indirectly listed internationally, while also creating a channel for foreign enterprises to get into China’s capital market indirectly.

In June 2007, China executed a trial implementation of QDII (Qualified Domestic Institutional Investor) which allowed the financial institutions to invest a certain amount into foreign capital market. In August 2007, investments from private individuals in the Hong Kong Stock exchange were permitted for the first time.

In general, while China’s capital account is not fully open due to the large number of remaining restrictions on free capital flows, the state has indicated it will continue creating reforms so that China’s capital account will become increasingly open. In reality, regardless of all these government restrictions, capital flow cannot be completely restricted. It can flow due to imperfections of the system whether it is a channel like commodity trade, foreign direct investment, underground illegal bank, individual foreign exchange account settlement, domestic enterprise and financial institution’s foreign investment, or domestic financial institution’s foreign debts. There are some areas which are fully open already, like direct investment flow for non-citizens is free from which the returns can be freely remitted abroad. Moreover, non-citizens can invest in China’s B-share companies from which the returns can be freely remitted abroad. Finally, Chinese citizens can hold foreign currency deposit and foreign assets (B-share) within China. As long as the restrictions of capital account transactions are mainly subject to the approval from authorities, they are not fully prohibited.

2.2 The transmission channel through capital inflow to inflation in China

The widely recognized channel through which the inflation is transmitted would be capital inflow leads to an increase in foreign reserve, and then an increase in central bank money base, further an increase in domestic money supply, finally causes an increase in domestic price level. In order to decrease
the effect of the RMB Yuan funds outstanding for foreign reserve, China executed the exchange restrictions for foreign direct investment which is named ‘foreign exchange examine and approval system’. ²This system simply means that no matter whether you are going to buy or sell foreign currency, you will have to accept the examination and get approval from the foreign exchange bureau under China central bank.

Taking foreign capital inflow as an example, only under the following conditions, can the related party apply to the foreign exchange bureau for approval of exchange settlement: 1) Foreign government loans or international financial institution loans are involved; 2) Foreign company’s capital fund is for the spending on invested project; 3) The purpose of the long term or middle term loans that are granted to the foreign company is only for purchasing materials or equipment within China, not including the capital in RMB Yuan that is defined in the project contract; 4) The flow capital or the short-term international commercial loans that are granted to the foreign company is only for trade purpose with the total amount not exceeding 30% of the monthly average amount of the flow capital last year. 5) The foreign exchange come from the stocks income issued abroad by a domestic institution. 6) Other priced securities issued abroad by foreign company have to be used only within China.³

With the above policies, related party can settle the exchange (when meet the requirements of the approval system) or just open a foreign exchange deposit account which very much rely on the willingness for the related party whether to hold the foreign exchange or not. If they have strong willingness to hold the foreign currency, then the impact of the foreign capital inflow to the

³ The related policies and regulations are from the National Administration of Foreign Reserve. (http://www.safegov.cn)
monetary base would be very small.

The FDI capital inflow can also affect monetary base through the domestic supporting fund in China. This is also called ‘indirect effect’. To efficiently use the foreign direct investment will result in the increase in the domestic fixed capital investment such as infrastructure investment as well as domestic floating capital investment such as floating money for employee’s salary or raw material purchasing.

3. The empirical study
3.1 Model specification and data

To test the effect of capital inflow to China’s inflation this study employs a three-step procedure. These procedures are unit root test, vector autoregressive (VAR) co-Integration test, Granger causality test. Basically, the analysis starts from the reduced form of an unrestricted VAR model with k lags that can be written down as

\[ Z_t = a_0 D_t + \sum_{i=1}^{k} A_i Z_{t-i} + u_t \]  

where \( D_t \) is a \((n \times 1)\) vector of all deterministic variables such as intercepts, trends, dummies etc., \( A_1, \ldots, A_k \) are \((n \times n)\) matrix of coefficients, \( Z_t = (Z_{1t}, Z_{2t}, \ldots, Z_{nt})' \) is a vector of \( n \) variables, \( u_t \) is a \((n \times 1)\) column vector of innovations, that is, serially uncorrelated disturbances that have zero mean and a variance-covariance matrix \( E(u_1, u'_1) = \Sigma u, \) i.e. \( u_t \sim N(0, \Sigma) \).

The estimation of \( a, A_1, \ldots, A_k \) are obtained by applying ordinary least squares (OLS) to each part of Equation (1) separately, and the estimate of \( \Sigma u \) is given by the sample covariance matrix of the OLS residuals.

If co-integration between the variables is present, the VAR model can be
rewritten in a vector error correction (VEC) model as

\[ \Delta Z_t = a_0 D_t + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-k} + u_t \]  

where \( \Delta \) is a difference operator, \( \Pi \) is a \((n \times n)\) matrix of long-run multipliers and \( \Gamma_i \) is a \((n \times n)\) matrix of coefficients that contain the short-run responses among variables.

In this study, \( Z_t = (\text{CPI, } M2, \text{TDspls, } lGDP, lFDI, DEV)' \), a \((6 \times 1)\) vector of I(1) variables are considered as endogenous in the model, and \( D_t \) is an \((n \times 1)\) vector of deterministic matrix that also contains three dummy variables.

The data employed for the study are monthly series from 1997:M01 to 2010:M12. The reason to choose this data period is that China opened the current account in December 1996 which indicates the opportunity or ease of foreign capital to enter China through trade has been increased.

The variables used are as follows:

1. Consumer price index (CPI, as the usual proxy to measure the inflation rate);
2. M2 money supply (M2, in 100 million RMB Yuan);
3. Gross Domestic Product (GDP, we can only get quarterly GDP data from the official statistics in China, so we take the average number for each month which comes from the quarterly GDP data to test, in 100 million RMB Yuan);
4. Trade surplus (TDspls, we will use the export minus import to represent the trade surplus which is a large origin of foreign reserve, in 100 million RMB Yuan);
5. Foreign direct investment (FDI, representing the volume of physical

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\footnote{CPI data, GDP data, trade surplus data are from CEIC database; M2 data are from People’s Bank of China database. FDI data are from National Administration of Foreign Reserve database. DEV data are based on CEIC database and calculated by author.}
capital flowing into China); (6) Interest rate risk premium (DEV\(^5\) is taken as a variable that can reflect the risks that the short term foreign capital takes when it invests in China. In this study it is used as a substitution and a major indicator to reflect the variability of indirect foreign investment.

All the original data of CPI, M2, FDI, GDP are seasonally adjusted. Except DEV, all the data are taken natural logarithm to remove the heteroscedasticity. We will use Eviews 7.0 to analyzing data.

3.2 Empirical results
3.2.1 ADF unit root test result

To determine the appropriate specification for the VAR estimate, the variables must be tested for the stationary process. The presence of non-stationary behavior in the autoregressive representation of the variable, i.e. the order of integration for each variable is determined using the Augmented Dickey-Fuller (ADF) Unit root test. The null hypothesis is that there is a unit root. The results of the ADF tests for six variables as presented in Table 1 reveal that \(CPI, TDSPLS\) and \(FDI\) are stationary at level\((I(1))\) process), while \(GDP, M2\) and \(DEV\) are first difference stationary\((I(2))\) process). So in the further tests, \(GDP, M2\), and \(DEV\) will be differentiated to become \(I(2)\).

Engle and Granger(1987) stress that there is the possibility that the variables share a long-run equilibrium relationship if they are integrated of the same order. Specifically, and important property of \(I(1)\) variables is that there can be linear combinations of these variables which calls for a co-integration Test.

\(^5\) \(DEV_t = r_t - r^*_t - (e_t - e_{t-1})\), \(r\) represents the one-year time deposit interest rate in China. \(r^*_t\) is the federal fund rate(USA). \(e_t\) is the logarithm of exchange rate between RMB and US dollar.
### Table 1 ADF unit root test results

<table>
<thead>
<tr>
<th>Variables</th>
<th>t-value(constant and trend)</th>
<th>P-value(constant and trend)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( L\text{CPI} )</td>
<td>-3.243684**</td>
<td>0.0796</td>
</tr>
<tr>
<td>( L\text{GDP} )</td>
<td>-1.563289</td>
<td>0.8033</td>
</tr>
<tr>
<td>( L\text{TDSPLS} )</td>
<td>-4.953607*</td>
<td>0.0004</td>
</tr>
<tr>
<td>( L\text{FDI} )</td>
<td>-6.184623*</td>
<td>0.0000</td>
</tr>
<tr>
<td>( L\text{M2} )</td>
<td>-0.375727</td>
<td>0.9877</td>
</tr>
<tr>
<td>( \text{DEV} )</td>
<td>-2.049725</td>
<td>0.5692</td>
</tr>
<tr>
<td><strong>1st difference</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( L\text{M2} )</td>
<td>-15.94437*</td>
<td>0.0000</td>
</tr>
<tr>
<td>( L\text{GDP} )</td>
<td>-15.39158*</td>
<td>0.0000</td>
</tr>
<tr>
<td>( \text{DEV} )</td>
<td>-4.147913*</td>
<td>0.0067</td>
</tr>
</tbody>
</table>

Notes: *denotes the rejection of the null hypothesis (a variable has a unit root) at 1% significance level,
**at 5% significance level. Critical values are from MacKinnon (1996). Lag length selection is automatically based on Schwarz info Criterion (SIC), maxlag=13.

### 3.2.2 Co-integration test

Co-integration captures the presence of a long-run relationship between two or more variables. We run the Johansen co-integration test in Eviews 7, using the variable \( \text{LCPI}, \text{DlGDP}, \text{LTdspls}, \text{LFDI}, \text{DlM2} \) and \( \text{DDEV} \). The result is briefly summarized and used as the basis for the rest of the analysis.

### Table 2 Result of Johansen co-integration test

Sample (adjusted): 1997M06 2010M12
Trend assumption: Linear deterministic trend
Series: LTDSPLS LCPI LFDI LDM2 DLGDP DDEV
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)
Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

<table>
<thead>
<tr>
<th>Hypothesized</th>
<th>Trace</th>
<th>0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of CE(s)</td>
<td>Eigenvalue</td>
<td>Statistic</td>
</tr>
<tr>
<td>None *</td>
<td>0.451105</td>
<td>223.8030</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.339965</td>
<td>138.0247</td>
</tr>
<tr>
<td>At most 2 *</td>
<td>0.271207</td>
<td>78.61358</td>
</tr>
<tr>
<td>At most 3 *</td>
<td>0.130079</td>
<td>33.37329</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.086614</td>
<td>13.44583</td>
</tr>
<tr>
<td>At most 5</td>
<td>0.003424</td>
<td>0.490428</td>
</tr>
</tbody>
</table>

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

<table>
<thead>
<tr>
<th>Hypothesized</th>
<th>Max-Eigen</th>
<th>0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of CE(s)</td>
<td>Eigenvalue</td>
<td>Statistic</td>
</tr>
<tr>
<td>None *</td>
<td>0.451105</td>
<td>85.77829</td>
</tr>
<tr>
<td>At most 1 *</td>
<td>0.339965</td>
<td>59.41111</td>
</tr>
<tr>
<td>At most 2 *</td>
<td>0.271207</td>
<td>45.24029</td>
</tr>
<tr>
<td>At most 3</td>
<td>0.130079</td>
<td>19.92746</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.086614</td>
<td>12.95540</td>
</tr>
<tr>
<td>At most 5</td>
<td>0.003424</td>
<td>0.490428</td>
</tr>
</tbody>
</table>

Table above shows that after running the unrestricted co-integration test with three lags (lag length is suggested as the optimal length according to AIC), all the variables concerned are co-integrated. Trace test indicates four co-integrating equations at the 0.05 level. Max-eigenvalue test indicates three co-integrating equations at the 0.05 level. This result indicates that these variables share a long run relationship.

3.2.3 VEC model set-up and Granger-causality test

Considering this study is to analyze the pass-through of the variables related to capital inflows to the domestic price level variable, all these
macro-economic variables might share a same long-run trend and affect each other in a certain way, or while they exhibit short run fluctuations around a long run equilibrium. Hence we implement \( \Delta CPI, \Delta GDP, \Delta FDI, \Delta TDSPLS, \Delta M2, \Delta DEV \) in Eviews7.0 to establish VEC model. The result shows that all the inverse roots are less than one, i.e. all the model roots are located in a unit circle, and the optimal lag period is three according to AIC. The model is stable so that we can complete other statistic analysis.

A VEC model can be used to test the Granger causality among variables of the model, i.e. to ascertain the direction of causality. Granger’s definition of causality is a widely used concept of causality (Granger 1969). In order to analyze the causal relationships between \( \Delta CPI \) and the other variable, a Granger causality test within a VEC framework is used. The test estimates the Chi-square value of the coefficient on the lagged endogenous variables. The null hypothesis is that the lagged explanatory variables of the model and also their joint significance do not Granger-cause the dependent variable. Table 3 reports p-values for F-statistics at lag three for the VEC Granger causality test results. The lag three was chosen since at that lag the estimated VEC model was stable with well-behaved residuals in terms of autocorrelation and heteroschedasticity.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>( \Delta CPI )</th>
<th>( \Delta GDP )</th>
<th>( \Delta FDI )</th>
<th>( \Delta TDSPLS )</th>
<th>( \Delta M2 )</th>
<th>( \Delta DEV )</th>
<th>Block exogeneity(df=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta CPI )</td>
<td>0.0007*</td>
<td>0.003*</td>
<td>0.4050</td>
<td>0.9703</td>
<td>0.7242</td>
<td>0.0012*</td>
<td></td>
</tr>
<tr>
<td>( \Delta GDP )</td>
<td>0.5379</td>
<td>0.7749</td>
<td>0.0098*</td>
<td>0.1588</td>
<td>0.7955</td>
<td>0.0815***</td>
<td></td>
</tr>
<tr>
<td>( \Delta FDI )</td>
<td>0.1439</td>
<td>0.1256</td>
<td>0.5793</td>
<td>0.1726</td>
<td>0.0485**</td>
<td>0.1107</td>
<td></td>
</tr>
<tr>
<td>( \Delta TDSPLS )</td>
<td>0.4477</td>
<td>0.4579</td>
<td>0.1606</td>
<td>0.8001</td>
<td>0.0718***</td>
<td>0.2086</td>
<td></td>
</tr>
<tr>
<td>( \Delta M2 )</td>
<td>0.1042</td>
<td>0.4296</td>
<td>0.8312</td>
<td>0.7372</td>
<td>0.3103</td>
<td>0.5341</td>
<td></td>
</tr>
</tbody>
</table>
The results presented in Table 3 indicate that the lags of variables $\text{dd}M2$, $\text{dd}DEV$, $\text{dl}TDSPLS$ are not statistically significant. They do not “cause” $\text{dl}CPI$ individually; While $\text{dd}GDP$ and $\text{dl}FDI$ show a strong significance to “cause” $\text{dl}CPI$ which can be explained as that economic growth and foreign direct capital inflow do have a sizable effect on the price level in China. These five variables influence $\text{dl}CPI$ jointly. Furthermore, Table3 shows strong causalities from $\text{ddDEV}$ to $\text{dl}LFDI$ and $\text{dl}TDSPLS$ which inclined that indirect foreign investment might flow into the Chinese capital market through the channel of real/physical economy which has become the major task for Chinese central bank to calculate and supervise the volume of the virtual capital inflow.

3.2.3 The dynamic behavior of the VEC model

The dynamic behavior of the VEC model is analyzed using the impulse response function and variance decomposition.

1. Impulse response functions

The impulse response function (IRF) traces the effect of a one-standard-deviation shock in a variable on current and future values of others in the system. It indicates the size and characteristics of the effects. As discussed in Mitchell (2000), an impulse response function should be generated by an error correction model if unit roots and /or co-integration exist in the system.

It is well known that the results of the IRF and variance decomposition based on Cholesky’s decomposition are sensitive to the order of the variables.
and the lag length. The latter cannot be determined with statistical methods but has to be specified by the analyst (Lutkepohl 2006). Following common practice which is from outside to inside, from real economy to virtual economy, we take the Cholesky order as $lTDSPLS$, $lFDI$, $dDEV$, $dGDP$, $dM2$, $lCPI$. The results of the Granger causality tests helped in the ordering as well.

IRF for $lCPI$, based on VEC models with three lags, was specified for 12 months in advance. Figure 1 depicts this IRF examines the effects of a shock in all variables on $lCPI$. The vertical axis shows the deviation from the baseline level of the $lCPI$ in response to a change in the shock variable of one standard deviation. The horizontal axis shows the number of months passed after the shock. Although a shock in one variable affects all endogenous variables in the system, we focused on the effect on our target variable, $lCPI$.

Figure 1 shows that a shock on $lCPI$ itself has the biggest positive effect. Then a shock on $dGDP$ has the second biggest positive effect on $lCPI$ (reaches the highest point after four months at about 0.3%) and the effect is quite stable as well. $lFDI$ also has immediate response which is quite sensitive after three months (about 0.16%). The effect of one shock on $lTDSPLS$ to $lCPI$ reaches a high point at the second month (about 0.09%) and then fades out after about three to four month. $dDEV$ has positive effect which is relatively low and stable (reaches the highest point after four month at about 0.08%), not showing sharp changes compared with other variables. $dM2$ has immediate and positive effect on $lCPI$ (about 0.17%) after one month and the effect decrease quickly to a low point (at 0.01%) in the second month. Generally speaking, the pass-through effects of shocks of one standard deviation in all variables to $lCPI$ fade out relatively quickly, as do the $lCPI$ responses, at levels that are higher than the baseline after approximately six to seven months. Such permanent effects are not strange according to Lutkepohl(2006). The most significant effect on $lCPI$ is from a shock in $dGDP$. 
2. Variance decomposition

Variance decomposition measures the percentage of the forecast variance in inflation that can be attributed to shocks or innovations to each explanatory variable over a series of time horizons. Hence, it also shows how this proportion changes over time. The variance decomposition in \( d\text{CPI} \) of the VEC model by using the Cholesky decomposition method is reported in Table (the Cholesky order has been discussed earlier).

The variance decomposition results support the empirical findings from the impulse response functions. CPI itself contributed 88% of its variability. Then GDP can explain almost 9% of the CPI's variance which is the highest among all these explainable variables. Trade surplus can explain 1% of the CPI's variance in the second month which is supported by the IRF test as well,
but it faded after a year to about 0.1%. Interest risk premium (DEV) can explain 0.7% of CPI’s variance and the percentage is increasing gradually which shows that although foreign indirect capital inflow has very limited effect on domestic price level, while it will become an active factor with China’s gradual opening its capital market. FDI has a significant contribution to CPI’s variance in the first t month at about 4% and keeps a percentage of 2% after 12 month. M2 has immediate influence in the first month, about 6%, while the influence is decreasing month by month to only 0.1% at the end.

Table 3 Variance decomposition for ICPI (%)

<table>
<thead>
<tr>
<th>Period</th>
<th>S.E.</th>
<th>LTDSPLS</th>
<th>LCPI</th>
<th>LFDI</th>
<th>DLM2</th>
<th>DLGDP</th>
<th>DDEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.666519</td>
<td>0.055116</td>
<td>85.30204</td>
<td>3.821396</td>
<td>5.690267</td>
<td>4.839592</td>
<td>0.291586</td>
</tr>
<tr>
<td>2</td>
<td>0.737820</td>
<td>0.820564</td>
<td>88.46738</td>
<td>1.905825</td>
<td>2.850140</td>
<td>5.746374</td>
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</tr>
<tr>
<td>3</td>
<td>0.824591</td>
<td>0.559779</td>
<td>88.18722</td>
<td>2.556646</td>
<td>1.706849</td>
<td>6.768422</td>
<td>0.221088</td>
</tr>
<tr>
<td>4</td>
<td>0.893837</td>
<td>0.385719</td>
<td>88.24110</td>
<td>2.241433</td>
<td>1.126591</td>
<td>7.605697</td>
<td>0.399460</td>
</tr>
<tr>
<td>5</td>
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<td>0.316647</td>
<td>88.06357</td>
<td>2.421923</td>
<td>0.826855</td>
<td>7.839289</td>
<td>0.531715</td>
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<tr>
<td>6</td>
<td>1.034397</td>
<td>0.251008</td>
<td>88.08571</td>
<td>2.337669</td>
<td>0.648358</td>
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<td>0.603767</td>
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<tr>
<td>7</td>
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<tr>
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<tr>
<td>9</td>
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<td>0.382932</td>
<td>8.502807</td>
<td>0.682144</td>
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<tr>
<td>10</td>
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<td>87.92307</td>
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<td>0.335987</td>
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<tr>
<td>11</td>
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<td>8.690687</td>
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</tr>
</tbody>
</table>

Cholesky Ordering: LTDSURPLUS LFDI DDEV LGDP DLM2 LCPI2

4. Further discussion

Through the empirical study, it is clear that the transmission channel by “Foreign capital inflow → Money supply → Domestic price level” has been proved limited effective in China. While the foreign direct investment, transnationally securities investment that flows into China do contributed to an increase in China’s foreign reserve. The central bank has to buy the extra foreign exchange in the market to keep the exchange rate relatively stable
which leads to an increased amount of RMB that eventually puts a pressure on
the domestic price level. Although the central bank does have sterilization
policy to reduce the direct money supply, the policy in China is incomplete and
less than fully effective. Figure 2 reports the figures of FDI, foreign reserve,
RMB funds outstanding for foreign exchange, M2, net inflow in securities
investment from 1997 to 2010. It shows that since 2000, FDI jumped from
38.39 billion US dollars to 124.1 billion US dollars, almost three times, in 2010,
FDP kept increasing to 185.1 billion US dollars. The net inflows in securities
investment experienced a downturn in 2001 and 2002, after China
implemented QFII in 2003, and implemented QDII in 2007, we can see a
drastic increase in the net inflow of securities investment respectively. The
upturns of capital inflows are very much in accordance with the inflation in
China during 2004-2007 which further indicates that capital inflow does have
effect on the money supply and contribute to the inflation in China.

Figure 2 Capital inflow, foreign reserve and money supply (1997-2010)

Source: Foreign reserve, M2 and RMB fund outstanding for foreign exchange (RMB-EXC) data are from
database of Bank of China; FDI, Net inflow in securities investment data are from database of State
Furthermore, the foreign direct investment can effect not only the real investment but also on consumption; the foreign indirect investment (mainly securities investment) can affect people’s judgment on the capital market value in addition to affect people’s investment behavior. Hence we should understand the complicated mechanism through capital inflows to the real economy to possibly cause the inflation in China.

(1) capital inflow and the reprising of land, real estate and stock value

The capital inflow especially FDI is highly synchronized with the repricing procedure in China in the area of land, real estate and stock value which shows that foreign capital inflow played an important role in the process of reprising the assets. In 2007, the land price, house price and FDI inflows reached the highest point at the same time, Real estate industry becomes the second largest industry that most attracts FDI. Shanghai composite index started to increase in the second half year of 2006 as well. (See figure 3 and figure 4)As said, after China implements QFII, foreign capital can invest in A-shares without any restrictions. The listed company’s value was reevaluated. Foreign capital can acquire fixed assets of SOEs such as land, factories, and facilities then resell them at much higher price which greatly increased the asset value under the background of China’s exchange rate regime reform in 2005.
Figure 3 FDI, real estate sales price index and land transaction price index

Source: FDI data are from National Administration of Foreign Reserve database; Real estate sales price index and residential land transaction price index data are from National Statistics Bureau of China database, adjusted from the quarterly bases.

Figure 4 FDI and Shanghai composite index

Source: FDI data are from National Administration of Foreign Reserve database; Shanghai composite index data are from CEIC database.

(2) Capital inflow and the cost-push transmission

The increase in the price of land, real estate and stocks provided a
reference to prices of other resources and assets. Such as Water, energy resources cost and environmental cost, they become much more expensive in China compared in the period before 2004. National Statistics Bureau calculated the raw material purchasing price index which includes the prices of a basket of factors, i.e., steel, lumber, cement, chemicals, unit labor, other equipment. It shows that the index fluctuation is synchronized with the FDI inflows since 2004. (See figure 5)

Figure 5 FDI and raw material purchasing price index

Source: FDI data are from National Administration of Foreign Reserve. Raw material purchasing price index data are from National Bureau of Statistics of China.

(3) Capital inflow and consumer’s behavior

The repricing process triggered by the foreign capital inflow also informed consumer’s investment behavior. This is also called “Herding Behavior” in the capital market. When consumer faced a limited investment options, excess liquidity and high inflation expectation, it is rational for them to transfer their savings to investment in real estate and stocks. Not only individuals but also enterprises are enthusiastic about investment in houses and stocks. This overheating can be seen in the drastic increase in Shanghai composite index
and hyper housing price in 2007. The considerable profit that the investment brings adds up to the speculative behavior of consumers.

**Conclusions:** there is a need to further emphasize the background of China’s capital account framework which is that it operates in a big, open and transitional economy, with high foreign reserve, at the same time China is the largest creditor of foreign government bonds, with a fragile and less-developed financial system, undeveloped and limited-open capital market as well as managed float exchange rate regime. These features impede and impose tough challenges to the monetary policy authority and leave risks in transmitting shocks into domestic economy. It is imperative for the related authorities to understand that although inflation is transmitted mainly through the real economic sector such as trade, the empirical test also shows that foreign capital inflow (both FDI and foreign indirect investment) has certain influence to CPI. Also the capital inflow is quite sensitive related to the policy changes. The effect from capital inflow to China’s inflation has become more and more obvious for policy-makers to put into consideration as long as we are gradually liberating the capital account.

References:
    Gaussian vector autoregressive models. Econometrica, 59 (6), 1551–1580.
    in VAR models. NIESR discussion papers, no. 172. National Institute of Economic and Social
    Research.
    Verlag.
countries- based on China’s capital account openness. Shanghai: Shanghai Fareast
    Publication House, 204-216.
15. PBC Working Group, 2009. The transmission mechanism of inflation in China- an