Optimal Capital Account Openness in China

Wenyun Zhou

1 Zhejiang Financial College, Hangzhou, China

Correspondence: Wenyun Zhou, Zhejiang Financial College, Hangzhou, China. E-mail: wenyun@wustl.edu

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1. Introduction

The degree of capital account openness plays a positive role in the development of economy. Fry (1988) studied the data of 14 Asian countries and found that there was a positive correlation between the amount of deposits and the interest rate in these countries. Therefore, if the interest rate increased under the condition of capital account openness, it could be proved that there was an increase in deposits during this period. Okpara (2010), in studying the impact of financial openness on macroeconomic factors, concluded that financial openness has a positive effect on economic growth. In the investigation of financial openness in Nigeria, Fasanya (2020) through marginal test and cointegration test, argued that financial openness has a great impact on economic growth in theory, whether it is the development of new industries, the capital circulating in the financial system or international trade, is greatly affected by the financial system openness. In theory, the realization of full capital account convertibility as soon as possible will help China improve its economic strength and the development of various domestic industries.

However, although the predictions of theoretical models point out that capital account liberalization can promote economic development by increasing personal savings, investment and capital output, in reality, there are many cases that capital account liberalization will cause serious fluctuations in international financial system or lead to the outbreak of the world financial crisis, and these situations occur not only in developing countries. This has also occurred in developed countries. Philip and Panicos (2004) argued that capital account openness has a precondition for promoting economic development, that is, the society must have perfect competition and perfect information equivalence. Moreover, this theory of openness does not pay much attention to the study of the stock market, which is extremely unstable. Conclusions based on such unrealistic premises and incomplete research are obviously one-sided. This is why many countries that actively participated in full capital account liberalization during this period experienced financial crises of varying degrees. Yin (2021) conclude that the capital account and economic development are inverted U-shaped. Specifically, when a country is in the early stage of development, the level of capital opening is relatively backward, then the national economy can achieve significant development when policies are adopted to promote capital opening to the outside world. When these developing countries reach a certain level, if they further expand the opening of capital account to the outside world, the economic benefits of these developing countries will begin to languish or even decline. Gu Shugui...
(2020) pointed out that in order to maximize benefit, investment in developed countries is often accompanied by a large outflow of short-term funds, which promotes the migration of low-level labor skills and talents to developed countries. Economic and social development is a process from balance to imbalance and then back to balance. For developed countries, it is a process of constantly breaking the low-level uniformity. This also shows that as long as the growing market economies face the pressure of short-term working capital, it is easy to use the cross transformation of short-term capital and long-term investment to use short-term capital as long-term assets, increase investment, and lengthen the long-term products with the highest yield, which leads to the national economic structure of their own more disordered, and finally leads to the economic crisis of local overproduction.

Due to the impact of the continuous epidemic in recent years, China’s economic growth has slowed down, and the real estate industry, as the pillar of the economy, has also appeared the risk of rupture. In the current economic environment, if the full opening of the capital account is rashly carried out, it may cause market turbulence and even trigger an economic crisis. On the other hand, under the current economic dilemma, it is of great significance to study whether China is eligible to apply the theory of openness and whether opening of capital account can become a breakthrough point of economic development.

Although there is no practical example to prove that capital account openness can significantly promote economic development, opening is indeed a way to the development of financial and economic system. There are many studies on the relationship between capital account openness and economic growth, as well as the impact of capital account on financial stability. However, few scholars have proposed specific suggestions on how far capital account openness of China should be based on the impact of capital account openness on economic development and financial stability. This paper chooses machine learning method to predict the performance of economic and financial stability under different openness conditions through the simulation of SVR, so as to obtain the quantitative conclusion of this topic. The concepts of the degree of capital account openness and the level of financial stability are difficult to derive through theoretical or event analysis, and unlike the degree of economic development which can be measured by the available statistical indicator of GDP, there is no single available datum that can measure these two indicators. Therefore, before constructing an analytical model, it is imperative to establish indicators for capital account openness and financial stability.

2. Kalman Filter of Capital Account Openness

There are two main methods to measure capital openness: one is to measure the nominal capital account openness index, and the other is to measure the real capital account openness index. Compared with the nominal measurement, the real capital account openness index is more practical, more flexible, and more suitable for observing the direct or indirect effects of capital account. Based on the theory of interest rate parity proposed by Edwards and Khan (1985) and extended by Haque and Montiel (1989), this paper estimates China’s capital account openness by constructing a state-space model with time-varying parameters and using the Kalman filter method.

Assume that the market clearing rate of a country with an open capital account is composed of the weighting of the international market interest rate and the national market interest rate in the closed state:

\[ i = \lambda i_0 + (1 - \lambda) i_1 \]  

(1)

Where, \( i \) is the market clearing rate, \( i_0 \) and \( i_1 \) are the international market interest rate and the market interest rate in the closed state, respectively, \( \lambda \) represents the capital account openness, and \( \lambda \in [0, 1] \). When \( \lambda = 0 \), means that capital is completely immobile; Back then \( \lambda = 1 \), means full capital mobility. Then, incorporate money demand function into the system of equations. When the market clears, the money demand function is expressed as:

\[ \ln(M_t/P_t) = a_0 + a_1 i_1 + a_2 \ln(Y_t/P_t) + a_3 \ln(M_t/P_t)_{-1} + \varepsilon_t \]  

(2)

After transform, we get:

\[ \ln(M_t/P_t) = a_0(1 - \lambda) + a_1 i_1 + (1 - \lambda) \ln(M_t/P_t) + a_2 \lambda \ln(Y_t/P_t) + a_3 \ln(M_t/P_t)_{-1} + \varepsilon_t \]  

(3)

Thus, the equation can be used as measurement equation for estimation.

And the state equation can be written as: \( \lambda_t = \gamma \lambda_{t-1} + \varepsilon_t \)

2.1 Selection of Data

In order to solve the formula, this paper chooses quarterly data of M1, the Federal Funds Rate and GDP as data group. The money supply is replaced by M1, M1= cash + demand deposits. Demand deposit here can reflect real purchasing power in the economy, represent the change of the financial tightness of residents and enterprises,
and is a leading indicator of the fluctuation of the business cycle. Compared with M0, which is an indicator of money in circulation, M1 contains a more representative factor that affects the interest rate in the economy, namely, demand deposits. Compared with M2, which includes long-term deposits, M1 reflects the impact of short-term interest rates on interest rates.

The no-covering parity theory points out that under the condition of sufficient international liquidity of capital, investors’ arbitrage behavior makes the return of similar assets denominated in different currencies tend to be the same in the international financial market. In other words, the cross-border flow of arbitrage capital ensures that the law of one price applies to the international financial market. In current international market, the US market has the highest degree of openness and is the most suitable to represent i0, so Federal Funds Rate is used to represent i0. y for the actual output, and use the actual quarterly data of GDP to represent.

2.2 Measurement

Since Kalman filter significantly eliminates the interference of the uncertain state, this paper uses this method to estimate the value of $\lambda$, in order to eliminate the influence of other factors except the above variables on the results to the greatest extent.

The least square method is used for regression estimation of Equation (3) to obtain the initial data of Kalman filter, and the estimated results are shown in Table 1.

From the empirical results, the degree of fitting is quite good, and the regression equation is significantly valid. Therefore, using the $\lambda$ estimated from the fitted regression as the initial value, we obtain the $\lambda$ value that varies over time. the state equation is $\lambda_t = \gamma \lambda_{t-1} + \varepsilon_t$, and the measurement equation is Equation (3).

Table 1. Least squares estimation results

<table>
<thead>
<tr>
<th>Estimated values</th>
<th>Standard deviation</th>
<th>t</th>
<th>P-value</th>
<th>0.025</th>
<th>0.975</th>
</tr>
</thead>
<tbody>
<tr>
<td>a0</td>
<td>-0.1058</td>
<td>0.029</td>
<td>2.576</td>
<td>0.012</td>
<td>0.017</td>
</tr>
<tr>
<td>a1</td>
<td>-0.0154</td>
<td>0.001</td>
<td>-3.727</td>
<td>&lt;0.001</td>
<td>-0.007</td>
</tr>
<tr>
<td>a2</td>
<td>0.1036</td>
<td>0.022</td>
<td>1.452</td>
<td>0.15</td>
<td>-0.012</td>
</tr>
<tr>
<td>a3</td>
<td>0.8738</td>
<td>0.040</td>
<td>6.631</td>
<td>&lt;0.001</td>
<td>0.187</td>
</tr>
</tbody>
</table>

Figure 1. Trend chart of capital account openness $\lambda$

China’s capital account openness fluctuates from low to high and then to low. We can generally divide the changes of China’s actual capital account openness from 1998 to 2020 into the following stages.

1998-2000: During this period, current account of RMB has been fully convertible, which created convenient conditions for the transactions under the capital account to be mixed into the current account transactions to realize cross-border flows. At the same time, the Asian financial crisis also greatly affected residents’ confidence in the RMB exchange rate. At this time, the capital openness was very low.

2001-2006: During this period, in order to meet the needs of accession to the WTO, China has gradually relaxed the control of some capital transactions. Therefore, during this period, China’s capital account openness also increased constantly and remained at a relatively high level. Although in some years, especially after the reform of RMB exchange rate system in July 2005, the capital mobility has been reduced.

2009-2015: In this period, after the financial crisis period, China officially launched the cross-border RMB trade settlement in 2009, which was suspended due to the financial crisis. Before that, in China’s import and export
trade, the main settlement currencies were the US dollar and the euro. At this point, the relevant trade parts of RMB cross-border settlement business have been lifted from restrictions on the geographical scope of trade and the scope of business.

2015 to now: Up to now, the central bank has gradually reduced its influence on the foreign exchange market, so that the foreign exchange market runs smoothly and the two-way fluctuation of RMB exchange rate has become normal. The openness of the capital market has also gradually become stable.

3. Principal Component Analysis of Financial Stability

3.1 Selection of Variables

Financial stability refers to the degree of financial market stability, which indicates the ability of financial market to resist financial risks in the economy. The financial system is built up of subsystems, so the stability of the financial system depends on the stability of subsystems to a large extent.

In order to construct financial stability indicators, this paper divides the performance indicators of financial stability into four categories: financial institutions, financial markets, macro economy and local finance, and divides the four categories of indicators into 17 secondary indicators.

3.2 Principal Component Analysis

The comprehensive score of the FSI from the second quarter of 1998 to the third quarter of 2022 was calculated (Table 2).

Table 2. Comprehensive score table of principal component analysis

<table>
<thead>
<tr>
<th>Components</th>
<th>Initial eigenvalue</th>
<th>Extract the sum of squared loads</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Percent variance</td>
</tr>
<tr>
<td>1</td>
<td>9.884</td>
<td>58.140</td>
</tr>
<tr>
<td>2</td>
<td>2.202</td>
<td>12.951</td>
</tr>
<tr>
<td>3</td>
<td>1.368</td>
<td>8.045</td>
</tr>
</tbody>
</table>

According to the results of variance contribution rate and cumulative contribution rate of each component in Table 2, it can be found that the variance contribution rate of the first principal component is 58.14%, more than half of the variance of all principal components, and the first three components have accounted for 79.136% of the cumulative contribution rate, which indicates that these three components can describe the level of financial stability.

By multiplying the components of each basic index in the component matrix with the standardized data of each basic index, the expressions of principal components F1, F2 and F3 can be obtained. The expressions of principal components are further multiplied with the variance contribution rate and finally added to obtain the regional financial stability index, namely

\[ F1 = 0.977X1 + 0.965X2 + 0.963X3 - 0.759X4 + 0.96X5 + 0.963X6 + 0.916X7 + 0.247X8 + 0.824X9 - 0.543X10 - 0.703X11 - 0.595X12 + 0.19X13 - 0.677X14 - 0.792X15 - 0.888X16 + 0.945X17 \]

\[ F2 = -0.032X1 + 0.06X2 + 0.052X3 - 0.411X4 + 0.249X5 + 0.385X6 - 0.145X7 + 0.031X8 + 0.045X9 + 0.587X10 + 0.542X11 + 0.672X12 + 0.769X13 + 0.254X14 - 0.19X15 + 0.098X16 + 0.031X17 \]

\[ F3 = -0.093X1 - 0.139X2 - 0.153X3 - 0.17X4 + 0.174X5 - 0.337X6 - 0.214X7 + 0.913X8 + 0.399X9 + 0.073X10 + 0.101X11 - 0.092X12 - 0.138X13 + 0.051X14 + 0.197X15 + 0.127X16 + 0.058X17 \]

Figure 2. Financial stability index F1 trend chart
The above results are based on the financial stability FCI index constructed from 17 data that are highly correlated with financial stability.

According to the results of Figure 2, the analysis and evaluation of the FCI from 1998 to 2022 show that the overall FCI score shows a fluctuating upward trend.

4. TVAR Model

In order to further qualitatively analyze the impact of capital account openness on economic development and financial market stability, we use TVAR model to understand the dynamic relationship between capital account openness and economic development and financial stability.

TVP-VAR model can well reflect the dynamic relationship between capital account openness and economic development, financial stability. For example, we can incorporate capital account openness as a variable into the TVP-VAR model and consider its interactions with other economic variables, thereby studying the impact of capital account openness on economic development and financial stability. Through the estimation and prediction of model parameters, we can better understand the dynamic relationship between these variables.

4.1 Data Processing

Before the cointegration test, integration test should be carried out first. If a set of data is integration of zero order, that is, the stationary series, then the cointegration test will not be meaningful, and the cointegration test can only be carried out for the series of the same order.

Table 3. ADF test results

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF statistic</th>
<th>Critical value at 5% level of significance</th>
<th>Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>-2.66</td>
<td>-3.45</td>
<td>Unsteady</td>
</tr>
<tr>
<td>lambda</td>
<td>-3.65</td>
<td>-3.45</td>
<td>Unsteady</td>
</tr>
<tr>
<td>Financial indices</td>
<td>-2.87</td>
<td>-3.45</td>
<td>Unsteady</td>
</tr>
</tbody>
</table>

As can be seen from the above table, the ADF test values of the three groups of data selected in this paper all accept the null hypothesis at the significance level of 5%, that is, there is a unit root and the data is not stationary.

Table 4. ADF first-order difference results

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF statistic</th>
<th>Critical value at 5% level of significance</th>
<th>Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>-11.36</td>
<td>-3.45</td>
<td>steady</td>
</tr>
<tr>
<td>lambda</td>
<td>-6.42</td>
<td>-3.45</td>
<td>steady</td>
</tr>
<tr>
<td>Financial indices</td>
<td>-8.8</td>
<td>-3.45</td>
<td>steady</td>
</tr>
</tbody>
</table>

First difference was performed on the data, and then ADF unit root test was performed, and the results are shown in Table 4. After the first-order difference, the ADF test values are all less than the critical value at the 5% significance level, which rejects the null hypothesis, that is, the data are all first-order stationary.

After proving that the two sets of data selected are first-order single integration, this paper can start to carry out VAR modeling.

4.2 Impulse Response Analysis

Impulse response graphs are shown in Figures 3 and 4:

The result in Figure 3 is an impulse response analysis of the effect of capital account openness on GDP, that is, economic development. These figures can be used for qualitative analysis of the impact of capital account openness on economic growth. From Figure 3, it can be analyzed that capital account openness has a certain sustained impact on economic development. There are four peaks in the impulse graph, which are in period 5, period 10, period 26 and period 30 respectively. In the early stage of capital account opening, especially from period 3 to period 4, it will have a certain negative effect on the economy. After the peak values, there is also a rebound, especially in period 13 to 22, there is a considerable period of economic regression, and there is a declining peak in period 12, but the overall degree of regression is not high, significantly lower than the degree of economic growth. One possible reason for the slow economic growth could be the insufficient openness of the capital account, especially as the international economic environment changes, China faces huge capital outflow pressures, which is an unfavorable signal for foreign exchange equilibrium and economic development. Therefore, at this stage, it is necessary to increase the openness of the capital account and keep it within a reasonable range, while prudently monitoring capital flows to avoid the loss of foreign exchange reserves, in
hopes of bringing a positive impact on economic growth.

Figure 4 shows the impulse response of the impact of capital account openness on financial stability. Analysis of Figure 4 reveals that the shocks of capital account openness have a negative impact on financial stability in the first three periods. Although in the fourth period, it caused a positive impact on financial stability, reaching a peak at an extremely high level, this impact turned negative again in the fifth period. After the sixth period, the impact of capital account openness on financial stability gradually diminishes, and the impact slowly shifts from negative to positive.

It can be seen from the above analysis that the capital account openness shock under one standard deviation does have a long-term impact on the economy, it also has a negative impact on financial stability, but this negative impact will gradually decrease over time. This result proves the theoretical analysis above and reflects the two sides effect of capital account openness.

5. Support Vector Regression

Based on the above qualitative research, we can draw a general conclusion that China’s capital account openness can promote economic development but has a negative impact on financial stability under the current situation. There are few quantitative studies on this topic, this paper tries to use machine learning method to carry out regression and prediction, in order to obtain ideal qualitative results. I use SVR model for regression. Given the vast data structure of this study, choosing Support Vector Regression (SVR) for regression modeling is appropriate. SVR is particularly suitable for datasets that are large. It performs well in high-dimensional spaces and is capable of handling nonlinear relationships through the use of different kernel functions. When faced with a large dataset with numerous features, SVR can often discern patterns within complex data, making it well-suited for regression problems with extensive data structures. Additionally, SVR includes regularization parameters, which help prevent overfitting, a crucial aspect when working with large datasets.

5.1 Selection of Data

This paper selects 17 sets of data that have an impact on GDP from the second quarter of 1998 to the third quarter of 2022, including consumer price index, fixed asset investment, per capita income, national power generation, etc., plus the capital account openness obtained by Kalman filter method above, a total of 18 characteristics to train and forecast the impact of capital account openness on financial stability.
This paper selects 10 sets of data on the impact of capital account opening on financial stability from the second quarter of 1998 to the third quarter of 2022. These 10 sets of data are different from those used for principal component analysis, including consumer expectation index, RMB/USD exchange rate, Shanghai Composite index, and liabilities of depository companies. These 10 sets of data are selected to conduct training and prediction of the impact of capital account openness on financial stability.

This paper uses 10-fold Cross Validation method to process the training set. In this training, data set is randomly divided into 10 different subsets. Each time, 9 subsets are used as the training set, and the remaining 1 subset is used for validation. Finally, the average test results of the 10 subsets are returned. The different R2 levels under the cross-validation method were compared, and the parameters with the largest R2, C and γ, were selected.

5.2 Support Vector Machine Regression Model (SVR)

Divide the dataset into training, validation, and prediction sets. Randomly assign the data from the second quarter of 1998 to the second quarter of 2022 to the training and test sets, and use the third quarter of 2022 as the prediction set.

On the basis of this model, the upper and lower bounds are standardized to obtain the new upper and lower bounds after standardization. 40 values are taken within the bounds, and the other 17 eigenvalues in the third quarter of 2022 are combined to obtain the data matrix of 18*40, so as to obtain GDP forecast value under the model, as shown:

![Figure 5. Trend chart of GDP forecast results](image)

Treat financial stability in the same manner, standardize the upper and lower bounds of λ, and obtain standardized bounds. Within these bounds, select 40 values and combine them with the other 10 related feature values within the third quarter of 2022 to obtain an 11*40 data matrix. Use this to derive the predicted values of financial stability under the model.

![Figure 6. Trend chart of financial stability index FI](image)

Actual capital openness λ is 0.4, GDP is 304, and the predicted value of the model is 302, which are very close. From Figure 5, it can be analyzed that capital account openness has a significant promotional effect on economic
development in the initial stage, but this promotional effect is marginally diminishing, and the growth effect decreases over time. Based on the basic situation of China in the third quarter of 2022, when the value of $\lambda$ is 0.79, the utility of capital account openness for economic growth reaches its peak. The results of SVR simulation show that according to the current domestic economic structure and economic status, the optimal value of capital account openness is 0.8.

The trend of Figure 6 indicates that an increase in the degree of capital account openness causes a continuous decline in financial stability, but the overall degree of decline is not high. Within the entire validation range, the financial stability index drops from 15.4 when $\lambda$ is 0 to 15.1 when $\lambda$ is 0.9, with a decrease of only 0.3. Compared with the significant change of financial stability index from 1.6 to 17.5 since 1998, The decrease of 0.3 will not have a great impact on the financial system.

Based on the above machine learning output results, the conclusion of this paper is that given the current financial system and economic structure in the country, an increase in the degree of capital account openness will improve the domestic economic development level and have a small impact on financial stability.

6. Conclusions

First, capital account liberalization has both advantages and disadvantages for China’s economy, but based on the current situation, the advantages outweigh the disadvantages. The positive impact of capital account openness will promote economic development, and have a minor negative impact on financial stability, but the effect on economic development is more enduring compared to the impact on financial stability. Second, based on the fundamental situation of China’s conditions, the optimal capital account openness $\lambda$ is 0.8. Since the current $\lambda$ level is around 0.4, there is considerable room to increase the degree of capital account openness. Under the present circumstances, increasing the degree of capital account openness can promote economic development, with minimal impact on financial stability.

7. Deficiencies and Prospects

When using machine learning to conduct quantitative analysis, the results show that the impact of capital account openness on economic development and financial stability is not very significant, which may be related to the selection of other variables. Moreover, this paper estimates the degree of capital account openness based on the theory of interest rate parity, but does not quantitatively study the impact of interest rate theory and interest rate policy on the degree of capital account openness. We may try other simulation methods to get better forecasting.

References


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