Is the short-term international capital flows a leading indicator? —— Evidence from China

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Abstract

In this paper, we use the improved direct method and improved residual method to re-measure the annual scale and measure the quarterly scale of the short-term international capital flow based on the Chinese BOP table. At the same time we use the residual method to calculate the monthly scale of the short-term international capital flow as well. Then we explain and test these calculated results' rationality. To judge whether the short-term international capital flows is a leading indicator in China, we apply the K-L (Kullback-Leibler) information method and cross correlation analysis method to analyze the lead-lag relationship between the short-term international capital flows and macro-economy by selecting some representative macroeconomic indicators as a reference. Our empirical analysis shows that in China, the short-term international capital flows is a leading indicator to macro-economy, and a coincident indicator to PMI (Purchasing Managers' Index). In the end we give some conclusions and policy proposals.

Key word: short-term capital flow; leading indicator; improved residual method

1. Introduction

International capital flows have always been an important topic in international economics. When we discuss international capital flows, we may have two aspects. One is the net capital flows versus the gross capital flows. Another is the long-term capital flows versus the short-term capital flows. There are many studies on the net capital flows[1] and gross capital flows[2]. Most of these studies measure the capital flows by using the different items of Balance of Payment Table (BOP). But few of them consider the difference between long-term capital flows and short-term capital flows when they measure the capital flows.

Comparing with the long-term international capital flows, the short-term international capital flows are more volatile and easier to reverse flow direction, and thus more strongly influence a country's real economy and financial markets. There are a few studies on measurement of short-term capital flows such as Schneider (2003), Zhang (2011), Yasemin and Talha (2012), and Shi and Lian (2014). But they do not consider and analyze the relationship between shore-term capital flows and macro-economy. In another kind of studies on the leading indicators of crisis, usually called Early Warning Models (EWM) or Early Warning System (EWS)[3], capital flows sometime are used as a leading indicator of the EWS. But in this kind of studies the measurement of capital flows is so simple that FDI is usually looked on as a proxy of it.

[1] See for example, Dornbusch et al. (1995), Kaminsky et al. (1998), Broner and Rigobon (2006), Levchenko and Mauro (2007), Mendoza (2010), Agosin and Huaita (2012), and Zhao et al. (2014).

[2] See for example, Lane and Milesi-Ferretti (2001, 2007), Kraay et al. (2005), Devereux (2007), Gourinchas and Rey (2007a, 2007b), Calvo (2011), Rothenberg and Warnock (2011), Obstfeld (2012), Forbes and Warnock (2012), Calderón and Kubota (2013), Broner et al. (2013), Förster, Jorra and Tillmann (2014), and Cavallo et al. (2015).

[3] See for example, Lainà, Nyholm and Sarlin (2015), Fabio Comelli (2014), Jan Babecký et al. (2014), Candelon, Dumitrescu and Hurlin (2014), Jan Babecký et al. (2013), Jeffrey Frankel and George Saravelos (2012) and etc..

In this paper, we contribute to the literature in terms of both the scope of short-term international capital flows' measurement as well as discerning the lagging-leading relationship between the short-term international capital flows and macro-economy. First, we modify the methods given by Shi and Lian (2014) and Li and Qiu (2012), and use them to calculate the quarterly and monthly data of Chinese short-term capital flows besides the annual data. Second, we use the K-L (Kullback-Leibler) information method and cross correlation analysis method to judge the lagging-leading relationship between the short-term international capital flows and macro-economy by selecting some representative macroeconomic indicators as a reference.

The paper consists of five sections. After the introduction in Section 1, Section 2 is a brief literature reviews on the calculation of short-term international capital flows and the methods of the lead-lag relationship analysis. Section 3 measures the monthly, quarterly and annual scale of short-term capital flows. Section 4 analyzes and tests the estimated results. Section 5 analyzed the lead-lag relationship between the short-term capital flows and macro-economy. Section 6 provides some conclusions and suggestions.

2. Brief literature review

2.1 Review of the measurement of short-term international capital flows

The main measurement methods of short-term capital flows are usually grouped into two types. One is the direct method first proposed by Cuddington (1986). Another is the residual method (usually called the indirect method) first proffered by the World Bank (1985). And Shi and Lian (2014) give a very extensive and detailed review of short-term capital flows' measurement methods. But in their review literature, most studies only calculate the annual data of the short-term capital flows and few of them calculate the monthly data of the short-term capital flows. In the following paragraph we give a brief review of the measurement of the short-term capital flows' monthly scale.

The measurement of the short-term capital flows' monthly scale is generally on the base of the residual method. Its calculation formulas and corresponding studies are shown in Table 1. From Table 1 we can see that the measurement formulas of monthly scale are mainly on the basis of three indicators which are FDI, increment of foreign exchange reserves and trade surplus. The big problem of the monthly scale measurement is that most of the relevant monthly indicators are unavailable, which will induce to overestimate the monthly scale of short-term capital flows by using the current measuring formulas.

2.2 Review of methods of the lead-lag relationship analysis

Mitchell and Burns (1938), working for the National Bureau of Economic Researchers, coined the term "leading indicators" to identify sectors that moved in and out of recession before the rest of the economy (cited by Hamilton & Perez-Quiros, 1996). When we analyze whether an economic indicator is a leading indicator, we firstly need to find out a reference series which may reflect the economy situation. Studies on economic lead-lag analysis, such as composite leading indicators study, usually prefer Industrial Production over GDP as a reference series, because it is available on a monthly basis (whereas GDP data are only available on a quarterly basis) and, as documented by previous OECD studies (for example, Nilsson and Guidetti, 2007; Fulop and Gyomai, 2012), the cyclical profiles of the industrial production index and GDP are very closely

related. And industrial production has become a common benchmark series in this kind of academic literature (Fichtner, Ruffer and Schnatz, 2011).

In general, there are three methods used to analyze the lead-lag relationship between two variables. The first is the cross correlation analysis method which is traditionally and popularly used by many researchers such as Gallegati(2014), He et al. (2013), Fichtner, Ruffer and Schnatz (2011), and Rua and Nunes (2005) because it is simple and its lag or lead is integer. The second is the K-L (Kullback-Leibler) information method (the KL information defined by Kullback and Leibler (1951)). The drawback of this method is that all the sample data values are needed to be positive, but in the lead-lag relationship analysis the negative value usually happens when we use the data of economic time series growth rates (Dong et al., 1998)). The third is the frequency domain analysis method which is used to characterize the comovement between the variables frequency by frequency. The drawbacks of this method are that on one hand its application raises issues related with spectrum and cross-spectrum estimation, on the other hand its lag or lead is noninteger (Rua and Nunes, 2005).

In conclusion, the first method is simple and popular. And the second method is also a good alternative if the negative problem can be solved. The third method can offers additional precision in terms of lead/lag determination, but it is complex and its lag or lead is noninteger. So in this paper, we select the first and second methods, i.e. the cross correlation analysis method and the K-L (Kullback-Leibler) information method which will be modified in order to solve the negative problem in the following application, to analyze the lead-lag relationship between the short-term capital flows and other representative macroeconomic indicators.

3. Measurement of Chinese short-term international capital flows' scale

3.1 Annual scale measurement

We use the improved direct method and the improved indirect method given by Shi and Lian (2014) to estimate the annual scale of Chinese short-term international capital flows. And the annual data comes from websites of State Administration of Foreign Exchange of China and National Bureau of Statistics of China. By comparing the calculated results, we find out a little mistake in Shi and Lian's calculation, which falsely calculates the term "inflows of speculative capital in the trade account" by adding 3% that should be subtracting 3%. After correcting this mistake, we get the annual scale estimates of Chinese short-term international capital flows, as shown in Table 2 where SCF1 denotes the results calculated by the improved direct method and SCF2 denotes the results calculated by the improved indirect method. The line chart of SCF1 and SCF2 is presented in Figure 1.

3.2 Quarterly scale measurement

For quarterly scale estimates of Chinese short-term capital flows, we use the same methods that applied in the annual scale estimates. The quarterly data (from Q1 1998 to Q3 2014) also comes from websites of State Administration of Foreign Exchange of China and National Bureau of Statistics of China. The results of the quarterly scale estimates are given in Table 3 where QSCF1 stands for the results calculated by the improved direct method and QSCF2 denotes the results calculated by the improved indirect method. The line chart of QSCF1 and QSCF2 is presented in Figure 2.

3.3 Monthly scale measurement

For monthly scale estimates of Chinese short-term capital flows, on the basis of Li and Qiu (2012) and Shi and Lian (2014), we can define the measurement formula of the monthly scale as the following:

MSCF= Monthly increment of the RMB counterpart of foreign exchange reserves－Monthly actual used FDI×0.7 －Monthly actual trade surplus

Here, MSCF is used to denote the monthly scale of the short-term capital flows. And monthly actual trade surplus is equal to monthly trade surplus minus the monthly short-term capital flows in the trade account. We assume that the monthly short-term capital flows in the trade account = monthly total trade volume of foreign-invested enterprises × (monthly trade surplus of foreign-invested enterprises / monthly total trade volume of foreign-invested enterprises) according to Shi and Lian (2014). By using the above formula of MSCF, we calculate the monthly scale of Chinese short-term capital flows from January 1999 to November 2014. The results of the monthly scale estimates are given in Table 4. The line chart of MSCF is presented in Figure 3.

4. Test and analysis of the measured results

Shi and Lian (2014) put forward two kinds of methods to test the measured results of short-term capital flows. One is the "real event" test method, and the other is the "consistency of measurement results" test method. The core idea of their test is that the measured results from the improved direct method and the improved indirect method should be able to explain the economic realities and to maintain consistency between them. According to this idea, we test and analyze the above measured results from the following three aspects. The first is that testing the annual and quarterly results by aggregating quarterly results and monthly results separately. The second is that analyzing the consistency between results from the improved direct method and from the improved indirect method. The third is that explaining these results by the real event analysis and their trends analysis.

4.1 Testing the annual and quarterly results by aggregating their sub-frequency results

In order to test and verify the consistency among the annual data, quarterly data and monthly data of short-term capital flows, we aggregate the quarterly scale series QSCF1 and QSCF2 into the annual scale series TQSCF1 and TQSCF2, and the monthly scale series MSCF into quarterly scale series TMSCF. Then we compare the TQSCF1 with SCF1 as shown in Figure4, TQSCF2 with SCF2 as shown in Figure 5, TMSCF with QSCF2 as shown in Figure6. From these figures, we can see that the aggregating results basically keep consistent with the non-aggregating results. And the average relative deviation values separately between the series TQSCF1 and SCF1, TQSCF2 and SCF2, TMSCF and QSCF2 are 11.3%, 18.2% and 45.5%. The average relative deviation value between the TMSCF and QSCF2 is much larger than the former two values, because the monthly scale measurement is limited to the unavailability of some relative monthly indicators.

4.2 Consistency analysis of the two methods' results

Because some monthly indicator can not be available, the monthly scale of short-term capital flows is estimated just by indirect method. So here we mainly analyze the consistency between QSCF1 estimated by the improved direct method and QSCF2 estimated by the improved indirect

method, and SCF1 estimated by the improved direct method and SCF2 estimated by the improved indirect method. By comparing the values of SCF1 and SCF2, we can see that signs of these two estimates of the short-term capital flows are consistent. And magnitudes of these two estimates are basically consistent from 1995 to 2013 except for 2006 and 2008. For QSCF1 and QSCF2, signs and magnitudes of their values also basically keep consistent. The relatively large gaps between QSCF1 and QSCF2 exist in some points such as Q4 2000, Q4 2003, Q4 2004, Q4 2006, Q2 2007, Q3 2007, Q4 2007, Q2 2008, Q3 2008, Q1 2011, Q4 2011, Q1 2013 and Q3 2013.

The reason of the relatively large gaps between the two methods' measurement in the above time points is that when we apply the improved indirect method, we adopt the indicator Increment of the RMB Counterpart of Foreign Exchange Reserves (denoted as S) as the proxy of Reserve Assets Increment (denoted as B). The line charts of the annual and quarterly data of B and S are separately shown in Figure 7 and Figure 8. By comparing the annual data and quarterly data of B with S, we find that the above relatively large gaps' points are almost the points where the relatively large gaps between B and S exist.

4.3 Trend analysis and explanation of these results

For the annual scale of Chinese short-term capital flows shown in Figure 1, it is easy to be divided into the following three stages from 1995 to 2013. The first stage which is mainly earmarked for short-term capital outflows covers 1995 to 2001. The second stage which is mainly earmarked for short-term capital inflows covers 2002 to 2011. The third stage begins from 2012, and its characteristic that is earmarked for short-term capital outflows will be more clearly shown by the trend analysis of quarterly and monthly scale of Chinese short-term capital flows.

For quarterly scale and monthly scale series of short-term capital flows of China, we apply the X-12-ARIMA method to do the seasonal adjustment and get the trend and cycle series of MSFC (denoted as TC-MSFC), the trend and cycle series of QSCF1 (denoted as TC-QSCF1), and the trend and cycle series of QSCF2 (denoted as TC-QSCF2). And we use the HP filter method to produce the trend series of MSFC (denoted as T-MSFC), the trend series of QSCF1 (denoted as T-QSCF1), and the trend series of QSCF2 (denoted as T-QSCF2). The line chart of T-QSCF1 and TC-QSCF1 are shown in Figure 9, T-QSCF2 and TC-QSCF2 are shown in Figure 10, and T-MSFC and TC- MSFC are shown in Figure 11. From Figure 9 and Figure 10, we can see that the second stage of Chinese short-term capital flows covers Q2 2002 to Q2 2012. From Figure 11, we can see that the second stage of Chinese short-term capital flows covers March 2002 to February 2012. From the above trend analysis, we can see that the stages of Chinese short-term capital flows divided from quarterly and monthly scale data is almost the same with the annual scale data.

The best aspect to explain the above three stages of Chinese short-term capital flows may be the political cycle. In China, the ruling period of the president of PRC is often ten years from the beginning of 1993. And from 1993 to 2002, it is the period of president Jiang; from 2003 to 2012, it is the period of president Hu; and from 2013 till now, it is the period of president Xi. The three stages of Chinese short-term capital flows basically keep consistent with these three political periods. More specifically, before 2003, the main characteristic of Chinese short-term capital flows is outflow; from 2003 to 2012, it is inflow and to flood in largely in the last five years of this period; from 2013 till now, it is outflow and to fluctuate largely.

5. The lead-lag relationship analysis

As introduced in the literature reviews, we select the cross correlation analysis method and the K-L (Kullback-Leibler) information method to analyze the lead-lag relationship between Chinese short-term capital flows and some reference economic indicators such as Electricity Generation (denoted as EG), Value-added of Industry (denoted as VI) and Total Retail Sales of Consumer Goods (denoted as TRS) which are usually looked on as coincident indicators. In order to ensure these three reference indicators to be coincident, we apply the cross correlation analysis and K-L method to analyze their lead-lag relationship. Then we use the same methods to analyze the lead-lag relationship between MSCF and those three indicators separately. Furth more, we select PMI which is usually taken as a leading indicator in the world wide to be a counterpart of MSCF, and use the same methods to analyze their lead-lag relationship. All these analysis results are shown in Table 5.

Table 5: The results of lead-lag relationship analysis

Indicator	Lag	Cross correlation Coefficient	K-L information
VI EG	0 (-3)	0.9953	11
TRS EG	0 (-2)	0.9754	21
VI TRS	0 (-1)	0.99	7
MSCF EG	-6 (-12)	0.41	35
MSCF VI	-12 (-12)	0.38	1269*
MSCF TRS	-12 (-12)	0.34	1059*
MSCF PMI	-3 (+2)	0.63	23

From Table 5, we can see that MSCF is a leading indicator by comparing with VI, TRS and EG. And it leads these three indicators about six to twelve months. At the same time, MSCF is a coincident indicator of PMI which is usually a leading indicator. So, it can be concluded that the monthly short-term capital flows of China (MSCF) is a leading indicator in China and it usually leads macro-economy about six to twelve months.

6. Conclusion and suggestion

From above measurement and analysis, we can draw the following two conclusions. One is that the short-term capital flows of China has the characteristic of political cycle. The other is that the short-term capital flows is a leading indicator of economy in China. And we give a suggestion here that the government should strengthen short-term capital flows' monitor and supervision.

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