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硕 士 学 位 论 文

实证分析中国外汇储备：ARDL 方法

Empirical analysis of China's Foreign Exchange Reserves: ARDL approach

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摘 要

本研究主要通过协整技术来分析中国长期外汇储备需要以及决定因素，用自回归分布滞后模型（ARDL）来分析 1993 年到 2010 年的季度数据。此模型的目的是检验协整性质以及中国外汇储备需要是否稳定。误差修正模型（ECM）用来分析的一个长期关系。并且通过 CUSUM 以及 CUSUMSQ 检验来说明中国外汇储备以及决定因素之间的长期的稳定性。结果表明中国外汇储备需求与这些决定因素变量之间存在协整关系，并且 CUSUM 以及 CUSUMSQ 检验表明次模型估计具有稳定性。但是机会成本与经常账变量统计不显著尽管估计系数的符号与理论上期望的结果是相符的。

关键词：中国外汇储备；误差修正模型；自回归分布滞后模型

Abstract

This study analyzes the long-run China's demand for foreign exchange reserves with its determinants using cointegration technique, autoregressive distributed lag (ARDL) on quarterly data starting from 1993 to 2010. The plan is to examine the cointegrating property and stability of China's demand for foreign exchange reserves. Error correction model (ECM) is employed to analyze the long run relationship. CUSUM and CUSUMSQ test are utilized to check stability of long run relation of China's foreign exchange reserves with its determinants. The results indicate that there is cointegration among variables in China's foreign exchange reserves demand function. CUSUM and CUSUMSQ tests support the stability of estimated model. However, opportunity cost and foreign exchange reserves variability appeared statistically insignificant with coefficients that are consisted with theory's expectation.

Key Words: China's Foreign Exchange Reserves; ECM; ARDL;

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Chapter 1 Introduction

1.1 Background

Post economic reform of 1978, China has been rapidly growing economically under export-led growth. Her openness to outside world with respect to trade has proven to be a great economic success which paved a way to rapid economic growth over almost three decades. Chinese government implemented different strategies in order to attain rapid economic growth, for example, encouraging inflow of foreign direct investment (FDI) and pegged Chinese currency. In times of trade and current account deficit FDI's support is available to keep foreign exchange reserve rising. And hence the economy kept on growing advantageously. In the process, China managed to build a large current and capital account surplus and hence accumulated enormous foreign exchange reserves.

FDI inflows to China and other factors like pegged exchange rate have facilitated a rapid accumulation foreign exchange reserves. A starting point for China's foreign exchange reserves rapid growth can be traced from early 1990s until present. In January 1993 the size China's foreign exchange reserves was about US$ 20.138 bn, this amount gradually increased, by June 2010 the size was about US$2454.275 bn. This is a huge accumulation and probably it will keep on growing larger and larger under the current exchange rate regime. The remaining question is how far the current level of china's foreign exchange reserves is from the one predicted by the standard macroeconomic determinants?

In 2006, China overtook Japan to become the world's largest holder of foreign exchange reserves. Currently, China's foreign exchange reserves are roughly three times as high as the reserves held by Japan, the country with the second largest international reserves holdings. Presently about 70% of China's foreign exchange reserves are held in US Dollars denominated assets, primarily US state bonds. At the end of the fourth quarter of 2009 the reported foreign exchange reserves stood at US$2, 3992 trillion. This growth of foreign exchange reserves portrays strength of

China's economy in aggregate. However, challenges both internally and externally that are brought by this success cannot be overlooked. Internally China is exposed to inflationary pressures while externally the pressure is on appreciation of Chinese currency.
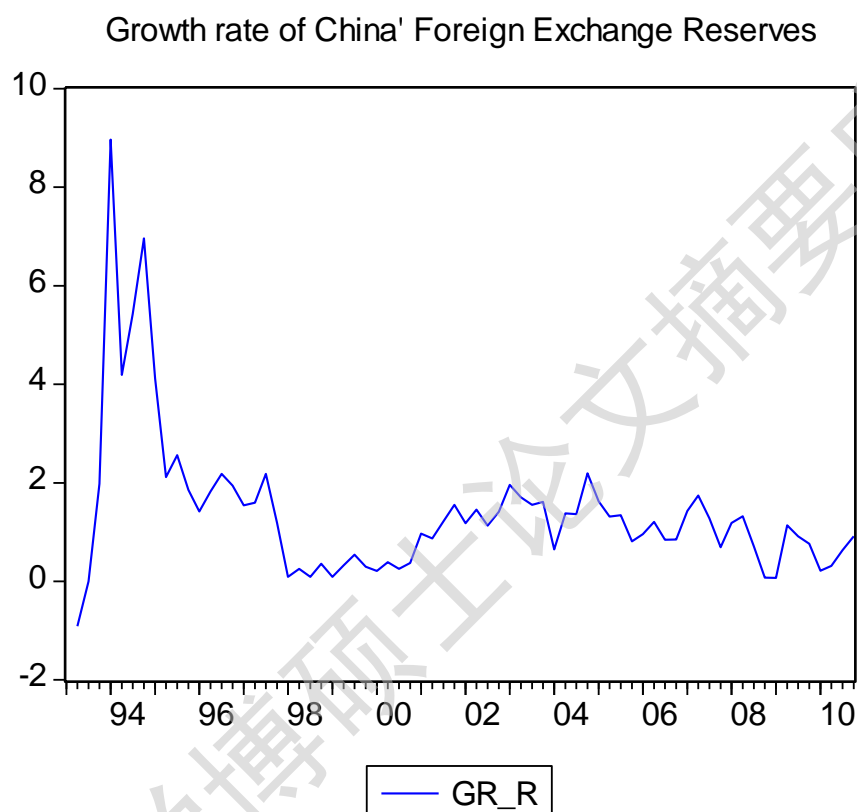
Growth rate of China' Foreign Exchange Reserves

Figure 1: The Growth rate of China's foreign exchange reserves

Central banks accumulate foreign exchange reserves to facilitate international trade and as a means of financing exchange rate interventions in the foreign exchange market. Reserves can therefore be perceived as a buffer stock[1] held for precautionary purposes (Borio et al, (2008) and Aizenman & Marion,(2004)). The threshold of accumulating foreign exchange reserves is not clearly defined though (Park & Estrada, 2009). Nonetheless, (Disyaitat, 2001) attempted to bridge this gap by formulating an optimizing model of currency crisis. Foreign exchange reserves consist of official public sector foreign assets that are readily available to and controlled by monetary authorities. Reserve asset portfolios have special characteristic that distinguish them

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[1] The buffer stock model says that central banks should choose a level of reserves to balance the macroeconomic adjustment costs incurred in the absence of reserves with the opportunity cost of holding reserves.

from other foreign currency assets. Foreign exchange reserve assets consist not only of liquid foreign currency assets, but they need to be held in the form of convertible foreign currency claims as well (Archana, Lai, Jorge, & Alicia, 2004). Henceforth, management of foreign exchange reserves portfolio is a crucial task given that they have potential to exert pressure unto the economy. Management of foreign exchange reserves implies supply meeting demand.

China's currency RMB[2] is pegged to US dollar (and basket of other foreign currencies). Consequently, China is obliged to increase foreign exchange reserves holdings in US dollars dominated assets to maintain the value of RMB (Tatom,(2008) and Dooley et al (2004)). In order to limit RMB movement against the dollar, the PBC[3] purchases and sells foreign exchange reserves on a daily basis. China continues to purchase large amounts of foreign exchange, adding to its reserves while resisting RMB appreciation against US Dollar. If the domestic currency appreciates against all foreign currencies, the value of the government's foreign investments will decline. This may be one reason why the government resists currency appreciation. Generally, accumulating foreign exchange reserves is aimed at overcoming a balance of payments crisis. However, as Yongnian & Jingtao, (2007) noted that huge foreign exchange reserves can cause imbalances in the country's economy.

Sekine, (2009) noted that due to the capital inflows to China brought by its trade surplus, inward foreign direct investment and the fact that only the PBC is allowed to hold foreign exchange and intervenes in the foreign exchange market to sell RMB for foreign currency to ensure that it does not appreciate, China's foreign exchange reserves are set to increase unless there is a sudden capital outflow. In other words, China's accumulation of foreign exchange reserve is closely related to the exchange rate regime. Intuitively, if the exchange rate regime is flexible, the implication is that foreign exchange reserves will reduce. The foreign exchange reserves of a country like China with a managed floating exchange rate regime are mainly used to pay off import bills and foreign debts, to maintain the bands within which the currency floats,

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[2] RMB: renminbi name of China's currency

[3] PBC: Peaple's Bank of China

and to invest in foreign assets.

China's foreign exchange reserves have created conflicting views concerning their magnitude. Some people assert that China's foreign exchange reserves are excessive, while some people view them otherwise. For instance, Li (2006) maintains that China's foreign exchange reserves are not excessive. He argues China needs ample reserves to maintain the stability of the RMB and to maintain the confidence of international investors. He also argues that China's foreign exchange reserves have been rewarded by sufficient returns. Frankel (2005) emphasized the opportunity cost of huge foreign exchange reserves and argued that China is presumably paying foreign investors on their inward investment a higher return than she is earning from investment in foreign exchange reserves. Xia (2006) estimated that approximately 22 percent of foreign exchange reserves accumulated in 2005 was induced by expectations of the Chinese currency's appreciation, mostly in terms of short-term capital inflows. He maintained that US$700bn in foreign exchange reserves should be sufficient. But the actual accumulation of reserves in 2005 was about US$819bn[4]. Liu (2007) upholds that China's holding of foreign exchange reserves exceeds the estimated adequate level.

Given the rapid accumulation of China' foreign exchange reserves over the past 20 years and the trend of continuing growth in the foreseeable future, it is imperative for Chinese authorities to have an idea of how far is the current level of foreign exchange reserves from the level estimated[5] by standard macroeconomic determinants. The concern is that, as much as foreign exchange reserves supports country's financial system in times of economic shocks, they can as well invite pressure unto the country's financial system. Sekine, (2007) pointed out that huge foreign exchange reserves of China have created excess liquidity in the country, which in turn creates the risk of high inflation and investment overheating. Yongnian & Jingtao, (2007)

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[4] See SAFE monthly Forex reserves

http://www.safe.gov.cn/model_safe_en/tjsj_en/tjsj_detail_en.jsp?ID=30303000000000000,13&id=4

[5] A common strategy is to assume actual reserve holdings are proportional to optimal reserves up to an error which is white noise

asked whether Chinese foreign exchange reserves are excessive. With consideration that accumulation of foreign exchange reserves earns credibility and maintains stability of the currency. On the other hand, excessive accumulation of foreign exchange reserves creates pressure for the currency to appreciate, and the appreciation would result in financial losses and instability of the currency. Nonetheless, China manages its foreign exchange reserves in a stable manner and this is not going to change swiftly in the long run[6].

To analyze the long run behavior of macroeconomic variables cointegration techniques were proposed in the literature. Engle & Granger, (1987) introduces error correction model (ECM) where the main condition is cointegration variables. That is, a vector of time series macroeconomic variables that are individually nonstationary must have stationary linear combination. In this case the non-stationary time series variables form cointegrating vector. Statistical inference on the parameters of the cointegrating vector is facilitated by the fact that the t- statistics of the estimated coefficients have an asymptotic normal distribution, even with endogenous regressors (Stock and Watson, 1993). The stationary linear combination is called the cointegrating equation and it is interpreted as a long-run equilibrium relationship among the variables.

Under conditions outlined by Engel and Granger (1987), Stock & Watson, (1993) point out that the remaining problem is to estimate parameters of cointegrating vector. Stock and Watson (1993) proposes dynamic ordinary least square (DOSL) as a computationally simple estimators of cointegrating vectors where the underlying condition is; all time series variables must be integrated of order one (i.e. I(1)) and residuals are integrated of order zero otherwise the results are spurious. But Pesaran, et al (2001) developed autoregressive distributed lag (ARDL) bounds testing approach to the problem of testing the existence of a level relationship between a dependent variable and a set of regressors inconsiderate of stationarity structure of the explanatory variables. Pesaran et al (2001) propose tests based on standard F- and

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[6] Governor of People's Bank of China Zhou Xiaochuan made a comment during Financial Stability Board meeting in Basel on 28 June 2009

t-statistics used to test the significance of the lagged levels of the variables in a univariate equilibrium correction mechanism. Both DOLS and ARDL procedure provides unbiased and asymptotically efficient estimates of the long-run relation, even in the presence of endogenous regressors. Thus, the endogeneity of any of the regressors has no effect, asymptotically, on the robustness of the estimates, even in relatively small sample.

1.2 Literature Review

Foreign exchange reserves in a strict sense are only the foreign currency deposits and bonds held by central banks and monetary authorities. The quantity of foreign exchange reserves can change as a central bank implements monetary policy. A central bank that implements a fixed exchange rate policy may face a situation where supply and demand would tend to push the value of the currency lower or higher. In a flexible exchange rate system foreign exchange reserves assets allow central banks to purchase the domestic currency which is considered a liability for the central bank. This action can stabilize the value of the domestic currency. Central banks throughout the world have sometimes cooperated in buying and selling foreign exchange reserves to attempt to influence exchange rates.

Ford & Huang, (1994) considers whether China's long-run demand for reserves and the dynamic adjustment of reserve holdings can be explained by means of the now standard macroeconomic variables; and whether the monetary disequilibrium, reflecting short-run disequilibrium in the Chinese economy, has implications for the adjustment in reserve. Monetary disequilibrium is estimated by estimating error correction mechanism (ECM) model for China's demand for money. The estimated monetary disequilibrium is incorporated in the estimation of ECM model for the demand for international reserves then recursive regression method is employed in the test for stability of the dynamic demand for reserves. Their finding prompt two conclusions; reserve holdings in China have maintained a long-run relationship and a stable dynamic relationship with several determinants since the 1950s, confirming

China's prudential foreign reserve policy; and monetary disequilibrium has significant short-run effects on reserve holdings, reflecting the authorities' 'general balancing' policy in their annual planning.

Following Elbadawi, (1990), Ford & Huang, (1994) and Huang, (1995), Badinger, (2004) uses a vector error correction approach to estimate Austria's demand for international reserve and tests for short-run effects of monetary disequilibrium on the national monetary market. The results indicate that Austria's long-run reserves demand can be described as function of imports uncertainty and the opportunity cost of holding reserves with strong economies of scale. CUSUM and CUSUMSQ comfirms stability of dynamic reserve demand eqution.

Craigwell, Downes, & Geenidge, (2006) empirically investigates the factors influencing the demand for the net international reserves in Barbados over the past three decades, using the dynamic OLS (DOLS) method developed by Saikkonen (1991) and generalised by Stock and Watson (1993). This estimation technique is appropriate for small samples and allows for the explicit account of endogenity. The results indicate that long-run reserve policy is primarily determined by real income, the propensity to import and capital account liberalization. In the short-run, reserve movements were also found to be driven by these three variables. He, (2009) employed quarterly data from the period of 2001 through 2008, to test the effect of four determinants on China's demand for international reserves, namely international reserves variability, GDP, average propensity to import and interest rate spread. Empirical results demonstrate China's holding of international reserves experiences economies of scale.

Pesaran M. H., (1997) advocates for the use of autoregressive distributed lag (ARDL) model in the analysis of long-run relationship. The argument is that not only does ARDL model time siries long-run relation based on cointegration, it provides an explicit account of the underlying type of equilibrium theory. Pesaran, et al (2001) introduced ARDL bounds testing approach to test for the existence of cointegration relationship between the time series variable and its determinants. Nor, et al (2008) analyzes both the short-run and long-run demand for international reserves, Prabheesh,

et al (2009) empirically investigates the importance of precautionary and mercantilist approaches to international reserves. In both studies ARDL approach to cointegration is used to estimate the long-run relationship between reserves and its determinants. The results suggest that the considered determinants are statistically significant in the long run. Nor, et al (2008) used the ARDL bounds testing approach to cointegration to estimate the reserve demand.

1.3 Overview of this Thesis

This study analyzes the long-run China's demand for foreign exchange reserves with its determinants using cointegration technique, autoregressive distributed lag (ARDL) approach on quarterly data starting from 1993 to 2010. The plan is to examine the cointegrating property and stability of China's demand for foreign exchange reserves. Error correction model (ECM) is employed to analyze the long run relationship. CUSUM and CUSUMSQ test are utilized to check stability of long run relation of China's foreign exchange reserves demand function.

Most of the studies in the demand for foreign exchange reserves area of research have given much attention to Ordinary Least Square (OLS) and the cointegration techniques developed by Engle and Granger (1987), Johansen (1988) and Stock & Watson, (1993). On contrary, in this area of research little attention has been given to ARDL introduced by Pesaran., (1997) and Pesaran, at al (2001). Both techniques have their statistical advantages and limitations; they can be applied in studies with small sample sizes and regressors' endogeneity is not a problem. DOLS can be applied only when time series variables are individually integrated of order one and their linear combination is integrated of order zero. On contrary, ARDL approach to cointegration can be applied regardless of whether the regressors are I(0) or I(1).

Moreover, few studies have been conducted on China's demand for foreign exchange reserves and its determinant ((Ford & Huang, 1994), (Huang, 1995) and (He, 2009). As such this study intends to add to this literature by applying ARDL approaches to cointegration with emphasis not only on the statistical properties of the underlying economic time series, but also theoretical insights and economic

interpretation.

This study is divided into chapters: 1 introduces the study; 2 mentions theoretical and empirical analysis; 3 gives Empirical evidence; 4 provides conclusion.