

EXCESS LIQUIDITY AND INFLATION IN CHINA: 2001-2010

by

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Abstract

Since the Chinese government administrated the Reform and Opening-up policy designed toward stimulating China's economy in 1979, China stepped into a period of rapid development. Accelerated growth of the trade surplus and foreign capital inflows led to the creation of excess liquidity, which raised inflationary pressures in the economy. In addition to other factors, the persistence of Chinese inflation may be largely attributable to excess liquidity. This hypothesis is examined with the 'price gap measure' in a regression model that includes the Engle-Granger test for conintegration. Estimation is based on available quarterly data for the period from 2001 to 2010.

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Introduction

The objective of this thesis is to analyze the impact of excess liquidity for the 2001-2010 period on Chinese inflation. This thesis is made up of 5 chapters. Chapter 1 deals with the so-called "*twin surplus*" and how it was formed. In Chapter 1 analysis is given to the reasons behind excess liquidity. Estimation methods then follow in Chapter 2. Through its measurement we notice that when "too much money chases too few goods" excess liquidity arises. In Chapter 3, we use Engle-Ganger two-step method to provide evidence that excess liquidity caused inflation. After modeling the relationship between excess liquidity and inflation in China, in Chapter 4 we discuss related issues such as the exchange rate, interest rate, and food supply shortage. In Chapter 5, we draw the conclusion and suggest future research.

CHAPTER 1. Introduction of Twin Surplus in China

The Chinese economy has been growing rapidly since the central government put in place measures towards liberalizing its markets. In 1979, the Chinese government devised the notion of a Special Economic Zone (SEZ) to be established in the coastal cities; its chief aim was to stimulate the coastal areas. Foreign investment in SEZs could enjoy tariff reductions and other preferential policies designed to attract foreign investment.

After the establishment of SEZs, increasing inflows of foreign capital brought along the development of China's economy, especially in the coastal cities. Over the years, foreign trade and foreign direct investment (FDI) in China had been expanding rapidly. Because China typically likes to keep a large foreign exchange reserve, China is facing a *twin surplus* on both current and capital accounts in their balance of payments. The current account surplus was \$12 billion in 1990 and \$249.9 billion in 2006. Since 2004, FDI in China kept increasing annually at a rate of over \$60 billion. China has one of the highest levels of FDI in the world. See Figure 1.

At the beginning of the reformist liberalization policies, Foreign Exchange Reserves (FER) in China were small; it was even negative at -\$1.3 billion in 1980. From 1981 to 1989, China's FER stayed at a low level. The average FER per year in China during this period was only about \$4.8 billion, but it was still enough to cover a small demand for imports.

By the 1990s, FER increased rapidly because of the development of international trade and increased inflows of foreign investment. The average annual growth rate during 1991-1996 was more than 60%. After 2000, because of the acceleration of the trade surplus, FER had been rising for most of the decade.

According to an annual report from the National Bureau of Statistics of China (NBSC), the rapid growth in imports that began in 2001 was largely due to China's joining the World Trade Organization (WTO). During the same period, exports had been expanding at a faster pace than imports. FER had exceeded \$600 billion in 2004. October 2006 was milestone for China when its FER exceeded \$1 trillion.

Finally, after 2006 and until September 2008, foreign exchange reserves in China had reached \$1.9 trillion; in Chinese per capita terms, this is roughly equivalent to \$1,500 when measured against 2008 population levels. By September 2011, FER reached to \$3.2 trillion.

China's balance of payments has shown surpluses in both the current and capital accounts. This has aroused concerns on the part of the Chinese monetary authority about the rise of excess liquidity and its pressures on consumer price inflation in China.

CHAPTER 2. Introduction of Excess Liquidity

Higher exports than imports over years in China make for a trade surplus in the current account. In addition, low domestic consumption weakens the velocity of money. Increased Foreign Direct Investment FDI has accelerated the capital inflow in China.

Zhang (2009) notes that accumulation has built up abundant liquidity for China's domestic market. The Chinese authorities started to express their serious concern that liquidity expansion in China is out of control, especially when considering the potential transmission from excess liquidity into inflation.

Let us first consider the quantity equation of money

$$M \cdot V = P \cdot Y . \quad (1)$$

M denotes stock of money, V denotes the velocity of money, Y represents output, and P is the price level. Equation (1) describes a relationship that simply states that the stock of money multiplied by the number of times a money unit that is used for purchasing goods and services (V) equals real output multiplied by the price level.

If we want to take a further look into how money supply changes affect the economy's inflation and output, (1) could be rewritten as:

$$\Delta \ln(MV) = \Delta \ln(YP) . \quad (2)$$

Then, we get

$$\Delta m + \Delta v = \Delta y + \Delta p . \quad (3)$$

The small letters denote logarithms, and Δ denotes the first differences. Solving (3) for Δm , we can get

$$\Delta m = \Delta y + \Delta p - \Delta v. \quad (4)$$

According to (4), money supply changes equal the output difference plus the price level difference less the change in the velocity of money.

According to Polleit and Gerdesmeier (2005) for the measurement of excess liquidity, the price gap measurement for excess liquidity is understandable. They reference the work of Hallman, Porter, and Small (1991) who define long-term and short-term price level equations. The long-term price equation as (10) measures the equilibrium price level with the long-run money velocity and output level; likewise, the short-term (or actual) price level as (11) is based on the long-run money velocity trend and the potential output level

$$p_t^* = m_t + v_t^* - y_t^* \quad (\text{long-term}) \quad (5)$$

$$p_t = m_t + v_t - y_t \quad (\text{short-term}). \quad (6)$$

p_t^* denotes long-term equilibrium price level, also called potential price level; p_t is for the short-term price level. The difference between p_t and p_t^* is called the price gap,

$$p_t - p_t^* = (v_t - v_t^*) + (y_t^* - y_t). \quad (7)$$

The price gap ($p_t - p_t^*$) could be decomposed into two parts: $(v_t - v_t^*)$ and $(y_t^* - y_t)$. If $(p_t - p_t^*)$ is negative, it suggests that there will be an upward pressure on inflation in the future. When $p_t < p_t^*$, actual price is lower than potential price, it indicates that there will be inflation later; when $p_t > p_t^*$, actual price is higher than potential price, so that we will expect a decrease pressure on inflation in the future.

According to (5),

$$v_t^* = p_t^* - m_t + y_t^* \quad (8)$$

Substitute v_t^* in (7) with (8)

$$p_t - p_t^* = [v_t - (p_t^* - m_t + y_t^*)] + (y_t^* - y_t) \quad (9)$$

Simplify (9), we get

$$p_t - p_t^* = (m_t + v_t - p_t^*) - y_t. \quad (10)$$

Equation (10) could be rewritten as

$$P/P^* = MV/P^*Y. \quad (11)$$

where $(m_t + v_t - p_t^*)$ denotes the money supply and y_t denotes the real output. According to (10), excess liquidity will only happen when there is too much money in the market and too few goods at the same time. Money is the source of the price gap, and thus the impact on inflation.

MV/P^*Y is the measurement of excess liquidity here.

Excess liquidity is likely to be an important factor behind the swift increase in inflation that China has seen in recent years. In conclusion, excess liquidity occurs when current price level is greater than the potential long-term price level since too much money chases too few goods.

CHAPTER 3. Modeling Inflation as a Function of Excess Liquidity

Ruffer and Stracca (2006) confirm that excess liquidity was a useful indicator of inflationary pressure and suggest that it is useful to compare broad money supply (M2) with nominal GDP (NGDP) to estimate the excess liquidity of a country. They estimate a vector auto-regressive (VAR) model for 15 countries. Yang (2010) investigates the inflation dynamics and effect of excess liquidity in China, and revealed that the quasi-money (M2) is the main force behind China's inflation.

Excess liquidity happens when there is too much money chasing too few goods, which means excess liquidity occurs when the growth of the money supply is faster than that of GDP. Under this assumption, we introduce an index of excess liquidity, the Marshallian K index (MK). MK index is described as the difference of growth of money supply and nominal GDP. We can also use the ratio of them as $(\text{money supply } M2)/(\text{nominal GDP})$ to describe the level of how much money supply may exceed output .

However, according to Yang (2010), the standard MK index is an index of current levels, if we want to explore its long-term effect on inflation, we must do a log-transformation of the MK index so that we can use the difference between money growth rate and nominal GDP growth rate. Then, we can see that the relationship between excess liquidity and inflation depends on the coefficient of the relative change MK index in the model of describing inflation.

The time period of our model is from 2001 to 2010. With reference to the Chinese economy, however, only the data after 1992 could be used. Yang (2009) pointed out that the market dominant price mechanism in China worked since 1992 when price reform had completed.

The limitation here for using quarterly data is that there may be seasonality. We therefore need to do make both inflation indicator (CPI) and excess liquidity indicator ($\ln[(M2)/(GDP)]$) de-seasoned and stationary. Before we set up the completed model, consider the explanation of some important variables in this model.

The excess liquidity indicator, a log-transformation MK index should be expressed as

$$EL = \ln \text{ MK index} = \ln \frac{M2}{NGDP} . \quad (12)$$

A main measurement of price is the consumer price index (CPI) that describes the growth rate of price level as inflation rate. Here, we use the CPI for multiple items for inflation indicators because we would like to discuss the impact of excess liquidity on general inflation.

We set up a regression model here to test the relationship between inflation and excess liquidity in China from 2001 to 2010. From Figure 1 we can see the change of inflation based on consumer price index along with excess liquidity in China from 2001 to 2010 (un-seasoned quarterly data).

Figure 1 suggests the excess liquidity may systematically affect the consumer price inflation in China over the most recent decade. A linear regression model will test for the relationship between excess liquidity and inflation in China. Before that, we apply X12-ARIMA (run by E-views 7) method to remove the seasonality from both the original CPI and EL data; and then, we will test for the stationary of these primary variable series.

We use Augmented Dickey–Fuller test (ADF) test. ADF test is testing for whether there has a unit root. If there is a unit root, we accept the null hypothesis that the series is non-stationary, otherwise we reject the null hypothesis. For CPI, we have its AR(1) process

$$cpi_t = a_0 + a_1 cpi_{t-1} + e_t . \quad (13)$$

We express the first difference of CPI for ADF test as

$$\Delta cpi_t = a_0 + a_1 cpi_{t-1} + \sum_{j=1}^p \beta_j \Delta cpi_{t-j} + \varepsilon_t. \quad (14)$$

Implying the ADF test for cpi_t and Δcpi_t respectively, according to the estimation in Table 2: cpi_t is not stationary; Δcpi_t is stationary. Also, the residual term is WN since the ARCH(1) test in Table 2 is less than 1.6 and Durbin-h is between -1.96 and 1.96.

For EL, we have its AR(1) process

$$el_t = a_0 + a_1 el_{t-1} + e_t. \quad (15)$$

Also, we express the 1st difference of EL for the ADF test

$$\Delta el_t = a_0 + a_1 el_{t-1} + \sum_{j=1}^p \beta_j \Delta el_{t-j} + \varepsilon_t. \quad (16)$$

Implying the ADF test for equation (15) and (16) respectively, according to the estimation in Table 2, Δel_t is stationary. Also, the residual term here is WN.

Since both Δcpi_t and Δel_t are stationary, we set up a simple regression model as inflation is regressed on excess liquidity

$$\pi_t = a_0 + a_1 \Delta el_t + e_t. \quad (17)$$

π_t is measured by Δcpi_t , Δel_t denotes growth rate of excess liquidity. According to the OLS estimation (see Table 3), the estimate of (17) is

$$\pi_t = 0.60 + 2.60 \Delta el_t. \quad (18)$$

(0.17) (0.54)

The Engle and Granger's two-step method generates a regression model based on a long-term relationship of inflation and excess liquidity.

A simple regression equation based on non-stationary and de-seasoned variables is

$$cpi_t = a_0 + a_1 el_t + \varepsilon_t . \quad (19)$$

Even if the variables are non-stationary, the linear combination of these two variables may be stationary, i.e. $cpi_t - a_1 el_t \sim I(0)$, and a_1 here is unique. If the linear combination here between cpi and el is stationary, cpi_t and el_t are cointegrated. Table 4 is the OLS estimation for (19).

The error correction model (ECM) introduces information from (19) into (17). The error correction regression requires the residual term in (19) is stationary. Check the residual term ε_t in (19) with DF test with no constant term in the Engle-Granger regression

$$\Delta \varepsilon_t = \alpha_1 \varepsilon_{t-1} + e_t . \quad (20)$$

See Table 5, the EG test (t-stat) is significant since $t < \tau_T = -2.67$, and $\alpha_1 < 0$, so that ε_t is stationary. There is a presumption that if $\alpha_1 < 0$, the $\varepsilon_t^s = (1 + \alpha_1)\varepsilon_{t-1} + e_t$ is AR(1) stationary. The residual term in (20) is WN. So that cpi_t and el_t in equation (19) are cointegrated.

The residual in equation (19) is not WN but stationary, suggesting that residuals in (19) are related to each other. Since $\alpha_1 < 0$ in (20) by the EG test, we could derive a error correction model (EMC)

$$\Delta cpi_t = \pi_t = a_0 + a_1 \Delta el_t + a_2 \varepsilon_{t-1} + \mu_t . \quad (21)$$

Referring to Table 6, the OLS estimation shows the representation of (21) is

$$\Delta cpi_t = \pi_t = 0.62 + 1.03 \Delta el_t - 0.28 \varepsilon_{t-1} . \quad (22)$$

(0.28) (0.61) (0.03)

As to the residual term μ_t , since DW is approaching to 2 and it passed the ARCH test, it is WN.

Since π_t and Δel_t are cointegrated in this error correction regression as (22), the change of CPI in (21) not only depends on the difference of EL, but also on the long-run dynamic equilibrium CPI. The residual term ε_{t-1} brings the relationship among levels into the error correction regression (21).

The long-term impact from excess liquidity on inflation could be measured by the sum of error correction adjustment and transitory. The error correction adjustment is denoted by the negative product of coefficient of error correction coefficient in (22) and the coefficient of Δe_l in (18). It is the adjustment in Δe_l towards to the dynamic equilibrium.

$$\text{Error correction} = \frac{-(-0.28)}{(0.03)} \times \frac{2.60}{(0.54)} = \frac{0.73}{(0.02)} . \quad (23)$$

The transitory term is expressed by the coefficient of Δe_l in (22), so that

$$\text{Transitory} = \frac{1.03}{(0.61)} . \quad (24)$$

Then, the long-term impact is derived as:

$$\begin{aligned} \text{Long-term impact} &= \text{error correction} + \text{transitory} \\ &= \frac{0.73}{(0.02)} + \frac{1.03}{(0.61)} = \frac{1.76}{(0.61)} \end{aligned} \quad (25)$$

According to equation (25), the long-term impact from excess liquidity on inflation will be 1.76, explained as 1 percent increase in the growth rate of excess liquidity may cause 1.76 percent increase in inflation as a long-term impact. The standard error for the long-term impact derived with the rule of error propagation $\gamma = \alpha \pm \beta \Rightarrow \sigma_\gamma = (\sigma_\alpha^2 + \sigma_\beta^2)^{.5}$.

CHAPTER 4. Other Reasons for Inflation in China

Economists have been studying the RMB's under-valuation problem as one of the principal reasons behind increased inflationary pressures in China.

In theory, when there is inflation, central banks could control the money supply by applying tightening monetary policy. The standard policy is to raise the benchmark interest rate in order to absorb excess money in circulation or sell bonds. Prices will thereby decrease and currency will appreciate.

Figure 1 shows the inflation change in China in 2001-2010. We notice that in the years 2006 and 2007, China's CPI kept increasing steadily, until it reached a peak of 113.16 in the 2nd quarter of year 2008. During this period, the steep rise in oil prices in 2007 had been driving up very large bills needed in China (China is one of the world's largest oil-consuming countries). Also, food prices in China were increasing rapidly because the global agricultural commodities' prices were increasing at a steep pace since 2003 for structural and cyclical reasons. In particular, prices of meat and pork stayed in a high level, because Chinese people have pork very often in their diet and it would take time to adjust to other types of meat. Moreover, the Sichuan Earthquake and an unexpected winter storm in 2008 created a huge impact on transportation and power supply in China, thus driving up the prices of so many food items, for example, pork, poultry, eggs, vegetable oil and dairy products.

CHAPTER 5. Conclusion

Inflation in China has been a constant macroeconomic problem since the time the reformist liberalization policy was put into practice by the Chinese government in 1979. With the rapid increase of foreign exchange reserves and foreign direct investment inflows, including a tightly controlled exchange rate, excess liquidity has been a problem.

A *twin surplus* has shown up in China's national accounts and has remained over recent decades due to a constant international trade surplus and strong rates of inflow of investment. Even though the Chinese Central Bank tried to raise the benchmark rate 5 times in 2011, it does not seem to have the desired effect on sterilizing the excess liquidity because it has attracted more foreign investors to buy bonds in China.

According to the present results there is a significant impact from excess liquidity on inflation. This positive effect between excess liquidity and inflation is statistically sound and economically meaningful. Macroeconomic theory suggests inflation is related to money supply and the capacity of potential output. Results suggest that the price gap as the measurement of excess liquidity is viable.

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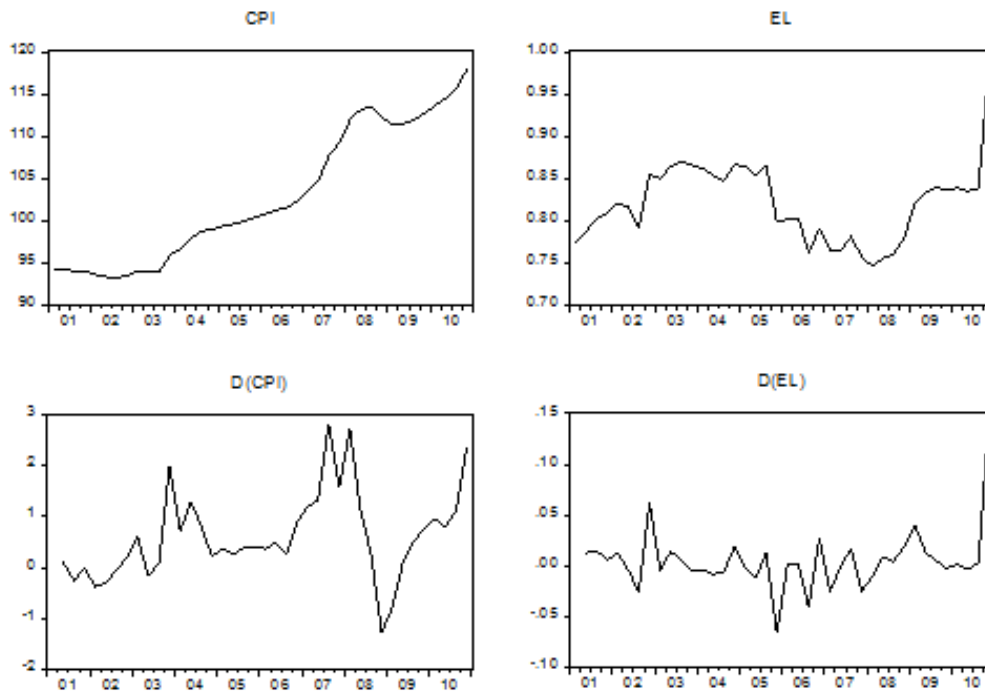
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APPENDIX:

FIG.1: CPI and EL in China: 2001-2010



* Source: IFS, OECD, Economics Forum of Renmin University (Database), Economics Statistics Database service provided by Economy Watch.com, Author's calculation.

TABLE 1: ADF test for CPI and EL

t-stat	ADF_{c+t}	Residual Term	
		ARCH(1)	Durbin-h
Δcpi_t	-3.90**	-0.78	0.61
Δel_t	-4.78***	-0.55	1.56
cpi_t	-3.06	0.93	3.67
el_t	1.40	-0.53	0.45

Note: "****", "***" and "**" denote significant at 1%, 5% and 10% significant levels respectively. Automatic-based on AIC, maxlags=9.

TABLE 2: OLS estimation for (20)

	a_0	Δel_t	
π_t	0.60 (0.15)	2.60 (1.51)	R ² .27 ARCH(1) .13 DW1.08

TABLE 3: Newey-West Standard Errors adjustment for (20)

	a_0	Δel_t	
π_t	0.60 (0.17)	2.60 (0.54)	R ² .27 ARCH(1) .8 DW 1.92

TABLE 4: OLS estimation for (22)

	a_0	el_t	
cpi_t	-12.42 (16.57)	95.84 (13.73)	R ² .56 ARCH(1) 3.81 DW.33

TABLE 5: EG Test (25)

	ε_{t-1}	
$\Delta \varepsilon_t$	-0.34** (0.11)	R ² .18 DW 2.02 ARCH(1) -0.55 F-stat .33 EG -3.05

*Note: $\tau_t = -2.67$, for 50 observations at 90% confident level. EG test used t-stat of coefficient of ε_{t-1} .

TABLE 6: OLS estimation for ECM (26)

	a_0	Δel_t	ε_{t-1}	
π_t	0.62 (0.28)	1.03 (0.61)	-0.30 (0.04)	R ² .42 DW 2.06 ARCH(1) 1.01