

**THREE ESSAYS ON MONETARY POLICY, THE FINANCIAL
MARKET, AND ECONOMIC GROWTH IN THE U.S. AND CHINA**

A Dissertation

by

JUAN YANG

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2006

Major Subject: Agricultural Economics

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ABSTRACT

Three Essays on Monetary Policy, the Financial Market, and Economic

Growth in the U.S. and China. (December 2006)

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Does monetary policy affect the real economy? If so, what is the transmission mechanism or channel through which these effects occur? These two questions are among the most important and controversial in macroeconomics. This dissertation presents some new empirical evidence that addresses each question for the U.S. and Chinese economies.

Literature on monetary transmission suggests that the monetary policy can take effect on the real economy through several ways. The most noteworthy one is credit channels, including the bank lending channel and the interest channel.

First, I use a new method to test for structural breaks in the U.S. monetary policy history and present some new empirical evidence to support an operative bank lending channel in the transmission mechanism of monetary policy. Results show that an operative bank lending channel existed in 1955 to 1968, and its impact on the economy has become much smaller since 1981, but it still has a significant buffering effect on output by attenuating the effect of the interest channel.

Second, I adopt the recently developed time series technique to explore the puzzling negative correlation between output and stock returns in China currently, and posit that it is due to a negative link between monetary policy and stock returns when monetary policy increases output. The monetary policy has not been transmitted well in the public sector which is the principal part of Chinese stock market, and increased investment capital from monetary expansion goes to real estate sector instead of the stock market.

Last, I demonstrate how monetary policy has been transmitted into the public and private sectors of China through the credit channel. The fundamental identification problem inherent in using aggregated data that leads to failure in isolating demand shock from supply shock is explicitly solved by introducing control factors. I find that the monetary policy has great impact on private sector rather than public sector through credit channel in China.

These findings have important practical implications for U.S. and China's economic development by improving the efficiency of the monetary policy because a comprehensive understanding of monetary transmission will lead to better policy design.

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CHAPTER I

INTRODUCTION

The relationship between the monetary policy acting through channels and economic growth is still a very open question, and there is not a common agreement. The relationship is crucial because it has significantly different implications for development policy. One could argue that if monetary policy exerts an economically large impact on growth, then policies should aim towards legal, regulatory, and policy reforms designed to promote policy development. However, if economic growth stimulates the monetary policy, then more emphasis should be placed on other growth-enhancing policies. The policy emphasis is to stimulate monetary policy or to stimulate other policies for economic growth, and this is the question solved in this study.

This dissertation aims to explore if monetary policy really effects economy. The transmission mechanism of monetary policy is studied in U.S. and China. The purpose of this dissertation is to provide a more accurate analysis for monetary transmission (channels), and predict the effects a general policy would have if put in force or to predict relevant differences resulting from alternative policies. This information is important for policy design and decision making in promoting national economy.

Specifically, the chapter II tests for structural breaks in the U.S. monetary policy history, and investigates if monetary policy is effective through bank lending channels in U.S. Chapter III investigates why there is puzzling negative relationship between stock returns and real activity in China even though this relationship is contrary to common sense and economic theory. Chapter IV answers two questions: (1) does the credit channel of monetary transmission exist in China, and (2) has monetary policy been transmitted differently to the public and private sectors of China.

CHAPTER II

TRANSMISSION MECHANISM OF U.S. MONETARY POLICY

Introduction

There is no doubt that monetary policy plays an important role in the real macro economy, and it is important to know how monetary policy achieves its goal; therefore the transmission mechanism (channel) is a key component to monetary policy. Recently most economists agree that monetary policy actions transmitted through various interrelated channels have a significant impact on real economic activity, at least in short run, though, monetary policy shocks do not affect output in the current period. However, very little is known about the specifics of the monetary transmission mechanism and the means by which monetary policy affects the economy (i.e. the monetary transmission mechanism). These issues have long been debated. The traditional view of monetary transmission places emphasis on the money, attributing all of the forces of monetary policy to the shift of money supply, which changes the interest rate and spending. That is to say, when policy makers decide to tighten the money, they drain bank reserves. The loss of reserves reduces the supply of deposits that require reserves, which drives up interest rates. The higher cost of capital then reduces investment spending by firms and consumers. The key assumption here is a perfect financial market; the possibility that policy also affects the relative sources of funds that firms use to finance their spending is not considered. All funds are assumed to be perfect substitutes. If information problems

occur, preventing firms from substituting easily among alternate sources of funds, the credit view of monetary policy identifies two possible credit channels: a bank lending channel and a broader balance sheet channel.

These two channels are broadly acknowledged as operative. The balance sheet channel takes effect when an increase in liquidity lowers interest rates and pushes people to transform their excess liquidity into investment and thus provide better returns.

Interest rates are the major policy tool in this channel, thus it can also be called the interest channel. Kashyap and Stein (1994) define the bank lending channel as follows:

“...monetary policy can work not only through its impact on the bond-market rate of interest, but also through its independent impact on the supply of intermediated loans...”

The bank lending channel implies that the Federal Reserve can influence real income by controlling the level of intermediated loans.

Economists often believe that the interest channel is the major channel between monetary policy and the real economy, yet the relative ineffectiveness of falling interest rates to promote economic growth in the 1990s highlighted the importance of exploring additional channels for monetary policies. One of the alternatives worthy of more attention is the bank lending channel.

The bank lending channel was brought to the forefront of economic discussion by Bernanke and Blinder in 1988. They present conditions that must be satisfied for the lending channel to be operative: (1) the supply of bank loans is not fully insulated from changes in reserves induced by the monetary policy, and (2) the demand of bank loans is

not fully insulated from changes in the availability of bank loans. When the first condition holds, a tightening of monetary policy directly causes the contraction of credit issued by banks. The second condition implies that the bank loans are an imperfect substitute for other sources of finance for business. Put together, these two conditions state that bank loans are special, and cannot be substituted with other items on the balance sheets of both banks and non-financial firms.

Several papers have demonstrated the empirical evidence for the existence of a bank lending channel. Gertler and Gilchrist (1994) find that banks lend more to large firms and less to small ones after a tightening of monetary policy. Lang and Nakamura (1995) argue that banks make proportionally more safe loans during a financial crisis. Morgan (1998) uses a contractual difference between loan under commitment and loan without commitment across commercial bank loans to test for credit effects. Perez (1998) found that the bank lending channel did exist in the 1960s but is no longer operative. Kishan and Opiela (2002) provide evidence of a bank lending channel in the United States from 1980 to 1995.

Despite widespread empirical studies on the bank lending channel, the existence of an operative lending channel remains uncertain. The major criticism is that aggregate data used in previous approaches does not control the demand factors (Olinear and Rudebusch 1996). A decline in bank loans during tightening of monetary policy may be caused either by a cutback in lending by banks or by a decline in loan demand brought on by the weakened economy through other channels of monetary policy. Thus many

researchers turn to the bank level and firm level data to study the individual borrower's reactions. This type of approach has two major drawbacks: (1) it fails to directly measure the macroeconomic significance, and (2) it inadequately distinguishes isolated loan demand and supply.

The way to identify loan demand and supply remains unsolved, thus more work is needed on this topic. Peek et al. (2003) propose a creative way try to solve this problem. They use the commercial forecasts of GDP to control demand shocks, use the bank health variable to capture the supply effects, and apply ensuing tests to ensure the identification of loan supply effects. However, they admit the commercial forecasts of GDP fail to account completely for the disturbances of demand shocks in the short-run and so the possibility of errors exists. Moreover, the tests they conducted were insufficient to show the existence of an operative bank lending channel. I will solve this problem by dividing the whole sample into three sub-periods, which is suggested by recently developed test. More discussions are presented in next section.

The Federal Reserve can control bank loans by reducing the quantity of reserves. The reduction in reserves forces a reduction in the level of deposits, and this must be matched by a fall in loans. In other words, the contraction in bank balance sheets reduces the level of loans. The bank lending channel theory posits that during monetary contractions, banks restrict some firms' loans, thus reducing their desired investment independently from interest rates. I start my study by checking whether the bank lending channel did exist in U.S. history. Theory also suggests that one of the

mechanisms through which bank loans affect the real economy is by influencing investment and thus indirectly impacting the real economy. This chapter will test this hypothesis as well. The other general assumption is that the bank lending channel is currently not operative. I also will investigate this assumption.

The chapter proceeds as follows. The next section (section 2) briefly introduces the methodology used, section 3 describes the data set, and section 4 presents the advanced SUP-LM test I apply and propose two sub-samples, then section 5 investigates the causality inference in the two sub-samples. Last, the results are compared in these sub-samples and conclusion is drawn with the policy implications.

Methodology

One of the key questions in studying the effectiveness of monetary policy is the identification problem, that is to say, we need to identify those monetary actions responded to shock of output from those pure actions supposed to be exogenous control to economy. The other important and more interesting question is how change of monetary policy influent on the economy, being so-called transmission channels including the bank lending channel and interest channel. This chapter will bear on each question since they are so important and guidable to the decision makers.

Romer and Romer (1994) addressed these questions by using the historical record to identify times when the Federal Reserve appeared to shift to tighter monetary policy not in response to real economy but just seeking to cut output in order to lower

inflation. They found that “these policy shifts were followed by large and statistically significant declines in real output relative to its usual behavior”, and so they interpreted these results as supporting the view that monetary policy has substantial real effects. Christino, Eichenbaum and Evans (1994) proposed an alternative approach: VAR based approach, and their key point was that by subtracting the monetary actions responded to exogenous output shock from the actually total monetary actions taken they can isolate the pure monetary policy actions and then analyze how these actions influence the output. This type of approach as well as Romer and Romer index might just describe the possible policy shift in the short-run (Christiano, Eichenbaum and Evans, 1994), but not referring to long-run structure, however, the shift of monetary policy takes impact the economy in both long run and short run. The blank is filled by adopting recently developed SUP-LM test to check the long run equilibrium stability in the monetary policy transmission system.

The SUP-LM statistic is a simple function of the data and the restricted MLE, therefore it is computationally easy and fast. The method is based on the weighted power criterion function with respect to the randomized nuisance parameter. It is assumed to know the admissible range of change point, which is a symmetrically set such as $[0.05, 0.95]$, $[0.15, 0.85]$ or $[0.25, 0.75]$ of total observations. When no extra information on the structure change provided, a wider testable range could capture any possible structural changes.

In fact, government interventions and policy changes at designated times can influence economic structure. What we need to know is the way certain monetary policy shift changes the real economy. In a changing economy, the channels of monetary transmission are unlikely to be constant over time, so test will be conducted to check whether the long run equilibrium is stable for bank lending channel and interest channel. The stability of long-run relationships can be statistically assessed by testing structural change of the cointegrating vector among variables in Error Correction Model. By using recently developed SUP-LM test (Byeongseon Seo 1998), we can test for unknown changing points in an fixed interval.

SUP-LM tests offer us the break points in the long run pattern of monetary policy, and combined with famous Romer and Romer date which could be addressed as shifts in short run structure (1991), this study outline all the possible shifts and isolate several sub-samples in which I believe no structure break in error correction model individually. The idea is to isolate episodes in which the change in policy controlled variables such as bank loans, interest rate was both purposeful and large, and to examine the behavior of economy to the shock, thereby this study precisely study the impulse response and other time properties among variables interested and then figure out if certain monetary transmission mechanism such as bank lending channel exist, as said in Bernanke and Blinder (1998) “Impulse response functions for all variables in the system with respect to the policy shock can then be calculated and can be interpreted as the true structural response to policy shocks” .

Since the data are time series data, and observations are probably non-stationary, accordingly, it might well expect to model the U.S. banking and monetary data as an error correction model. Modeling the innovations from such a model will allow us to comment on the causal structure in contemporaneous time and then identify the short run and long run structure of series. Such models were first introduced in Swanson and Granger (1997), and have been developed by others such as Bessler and Yang (2003). In common, the new methods Directed Acyclic Graphs (DAGs) is used to identify the contemporaneous causality in error correction model in these studies. Causal inference on directed graphs (DAGs) has recently been developed by Spirtes, Glymour and Scheines (2000), and Pearl (2000). This method is able to shed light on contemporaneous relationships. The directed graphs literature is an attempt to infer causal relations from observational data. The key idea is to use a statistical measure of independence, commonly a measure of conditional correlation, to systematically check the patterns of conditional independence and dependence and to work backwards to the class of admissible causal structures. (Hoover, 2005) While computers can be used to sort out causal flows from spurious flows and can sometimes distinguish an effect from a cause, human intelligence is helpful to select the set of candidate variables (causal sufficient set) for the computer to study. The causal sufficiency assumption suggests finding a sufficiently rich set of theoretically relevant variables upon which to conduct the analysis, i.e., there is no omitted latent variable that causes two variables included in the study. One of the advantages of using directed graphs is that results based on

properties of the data can be compared to a prior knowledge of a structural model suggested by economic theory or subjective intuition (Awokuse and Bessler, 2003).

Basically, I use the error correction model combined with directed graphs to show the contemporaneous causality structure on innovations. Such structures can be identified through the directed graphs analysis of the correlation (covariance) matrix of observed innovations \hat{e}_t . In this chapter, directed graphs are used to help in providing data-based evidence on causal ordering in contemporaneous time, assuming the information set is causally sufficient. Moreover, the error correction model will allow us to identify the long-run and short-run time structure of the series, thereby I could get clear view on relationship among bank loans, interest rate and real output. In summary, the complete properties of the time series will be studied and a clear acting pattern among loan, interest and output will be proposed, and thus this study provide stronger support for the existence of bank lending channel or interest channel.

Some other frequently used methods to identify the existence of bank lending channel include such as Granger Causality (1969), but this method has obvious drawbacks. For example, variable A Granger causes variable B if knowledge of variable A and its past history help to predict variable B. In essence, variable A Granger causes variable B is a test that variable A precedes variable B in a predictive sense. Nevertheless, as Granger himself notes, Granger causality implies temporal predictability but does not address the issue of control: “If Y [Granger] causes X, it does not necessarily mean that Y can be used to control X.” (Granger, 1980) The difference

is important; because an analysis based on Granger causality can answer the question, “Does knowledge of the level of loans extended help the Federal Reserve predict real income?” However, it cannot answer the question “Will the Federal Reserve’s attempt to restrict the availability of loans reduce real income?” (Perez, 1998)

Another method to determine the causal order is suggested by Hoover (1990). The notion of causal order employed by Hoover is due to Simon (1957); a variable L causes Y if control of L renders Y controllable. This methodology requires examination of the stability of the marginal and conditional distribution of Y and L across interventions in the data generating process. The pattern of structural breaks in the regressions corresponding to the conditional and marginal distributions provides evidence of the underlying causal order. The causal inferences made are based on the structural stability of various conditional and marginal regressions.

Previous evidences of an operative lending channel cited above have been hindered by problems of identification or strict assumption. Their methodologies have problems in either elusive or restrictive argumentation. For example, Perez and others have used the econometric model to derive a clear path of causality, but at the expense of too restrictive assumptions about the intervention in the generating process of bank loans and real income. Such a method is not likely to be applied in cases that are more general. Instead, my method is based on the statistical test and appropriate analysis of error correction model, and thus is more effective and general way to provide convincing empirical evidence of the existence of an operative bank lending channel.

Data

Today it is taken for granted that monetary policy affects aggregate macroeconomic variables. As the economic theory suggests, bank loans, interest rates and real output are indispensable components in the study of the monetary transmission mechanism, thus they are included in my model, and we can compare and contrast the interest channel and bank lending channel simultaneously. The improvement of this study compared to previous empirical studies is that investment is added to my model to better understand how the lending channel takes effect. Traditional macroeconomic theory suggests that the change of money will cause the investment shift and change the equilibrium output. If it can be verified that the change of loans causes the change of investment and thus forces the change of real output, it will be very strong evidence for the existence of an operative lending channel.

In summary, the data in this chapter focuses on quarterly observations of the real gross national product, commercial loans, 3-month T-bill rates and real investments from 1950:1–2003:3. The real measures for GNP and investment are used to counterbalance the impact that other factors—such as inflation—have, and it will allow us to get more accurate estimates. The data is from the website of the Federal Reserve Bank of St. Louis. All variables except three month treasure bill rate (which do not have significant seasonality) are seasonally adjusted and quarterly recorded with total observations of 215 on each series. These variables chosen are popularly used in

previous literature in exploring the bank lending channel, and may facilitate comparison across studies.

The analysis is aggregate and all of the data are in the aggregated level.

Industrial and commercial loans (LOAN) in all commercial banks are grouped to address the lending channel. The 3-month T-bill rate is included to explore the traditional channel of monetary policy via interest rates. This study selected the gross private domestic investment (INVESTMENT) to represent investments and this consists of fixed investment and change in private inventories. Real GNP is used as proxy for real output level.

Test for Long Run Structure Break and Isolate Sub-Samples

As addressed above, this study considers advanced SUP-LM test for structure change of the long run equilibrium in the error correction model I investigated. The test is new and unconventional, which allows us to explore the possible structure breaks in the Error Correction Model without many assumptions. Specifically, this study tests structural change of the bank lending channel and interest rate channel across the whole period I have. This study conducts the error correction model from 1950:Q1 to 2003:Q3, all variables (GNP, LOAN, TBILL, INVEST) are included in level. The stability of long-run relationships can be statistically assessed by testing the stability of the cointegrating vector and the adjustment vector in the error correction model. It is assumed that the change point is known to lie between 1957:Q4 to 1995:Q2. The

asymptotic critical values of adjustment vector (α) has been found by Andrews (1993) and the distribution of cointegrating vector (β) was revised and updated by Seo (1998).

One step Schwarz Loss criterion (It will be explained in details in next section) picked 1 lag and model specification with no intercept or trend in cointegration equation or VAR for my error correction model (see Appendix A), the long-run relationship (cointegrating vector) and adjustment coefficient are estimates as:

$$\begin{aligned}
 (2.1) \quad & \begin{bmatrix} \Delta GNP \\ \Delta LOAN \\ \Delta TBILL \\ \Delta INVEST \end{bmatrix} = \alpha \beta' \begin{bmatrix} GNP(-1) \\ LOAN(-1) \\ TBILL(-1) \\ INVEST(-1) \end{bmatrix} + \dots \\
 & = \begin{bmatrix} 0.004751 \\ (6.7069) \\ -4.99E-05 \\ (-0.2001) \\ -3.04E-05 \\ (-2.5039) \\ -0.00052 \\ (-1.0766) \end{bmatrix} \begin{bmatrix} 1 & -2.4333 & -107.0199 & 6.60917 \\ & (-2.0091) & (-0.8930) & (2.5047) \end{bmatrix} \begin{bmatrix} GNP(-1) \\ LOAN(-1) \\ TBILL(-1) \\ INVEST(-1) \end{bmatrix} + \dots
 \end{aligned}$$

Where t-statistics are in parentheses.

The detailed test hypothesis and procedures refer to Seo (1998). All my tests are done in MATLAB, and they are replicable and available from the corresponding author. My tests reject the stability of the cointegrating vector β and adjustment vector α in two periods at the 10% size. In Figure 2.1, SUP-LM statistics about β have a spike

reaching critical value of 12.98 in 1974, and all above the critical value after the second quarter of 1980. Thus cointegrating vector is not stable in these two points. Figure 2.2 shows that no break point for adjustment vector α , though there are two spikes around 1981:Q4 and 1991: Q3, those statistics are not big enough to over critical value. From Figure 2.3 I could find that the joint SUP-LM statistics share the same spine pattern with $SUP - LM^\beta$. Therefore, the critical values of the SUP-LM tests for joint stability largely depend on those of the stability of β . In summary, SUP-LM tests clearly present two break points in the long run structure of economy: 1974:Q2 and 1980:Q2.

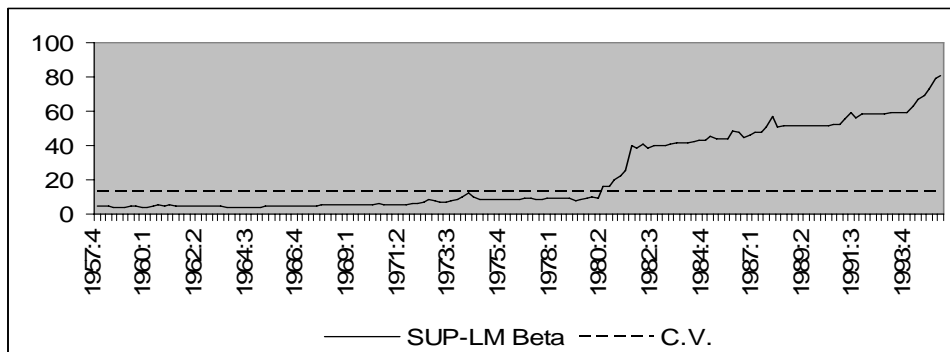


Figure 2.1. $SUP - LM^\beta$

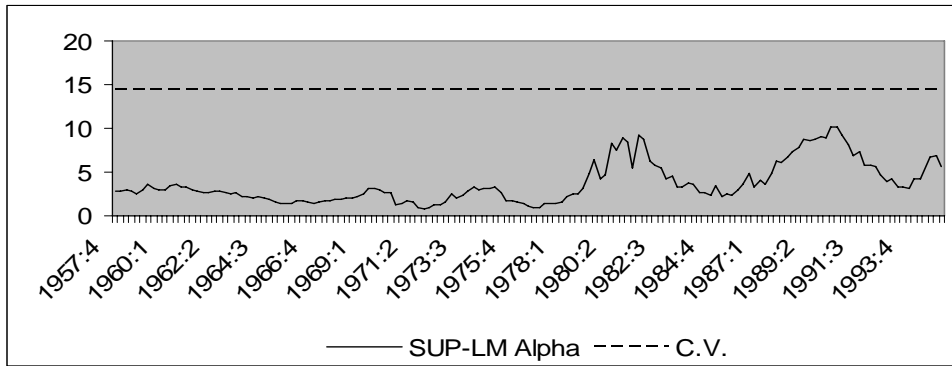


Figure 2.2. $SUP - LM^a$

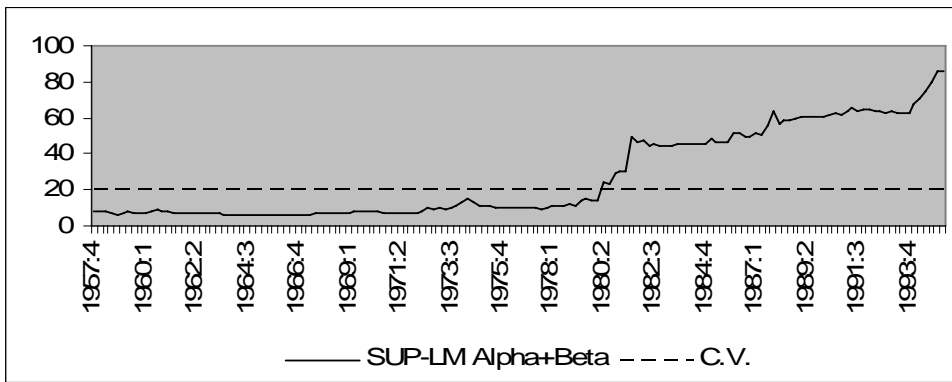


Figure 2.3. $SUP - LM^{ab}$

Consider the famous Romer and Romer date, they proposed six monetary policy shift in postwar period: Oct. 1947, Sep. 1955, Dec. 1968, Apr. 1974, Aug. 1978 and Oct. 1979. Then in their 1994 paper, they added the seventh: Dec. 1988. The break dates are very close to two of them: Apr. 1974 and Oct. 1979, indicating the dramatic changes of economic structure in both long run and short run at these two points. For the sake of

getting more accurate analyses, test results obtained here are combined with results Romer and Romer suggested, so that the stability of both long run and short run structure is guaranteed. In this criterion, such break points are picked up in the data range: 1955:Q4, 1968:Q4, 1974:Q2, 1978:Q2, 1980:Q2, 1988:Q4. Thus this study isolates periods into two big sub-samples for my study: sub-sample I 1955:Q4 – 1968:Q3, sub-sample II 1981:Q4 – 2003:Q3 (too many break points between 1968:Q4 to 1981:Q4 prevent us conducting an error correction model for sub-sample in this period due to the inefficient data). 1981:Q4 is chosen as the start of the second sub-sample instead of 1980:Q2, recall that the famous “Volker Experiment” period lasting from 1979 to the end of 1981, in which the Federal Reserve was experimenting with a nonborrowed reserve operating procedure and there is also a small spike in $SUP - LM^{\alpha}$ around 1981:Q4 suggesting some change of adjustment vector in my error correction model. It won’t hurt that I start prudently and a little bit postpone the start point.

Notice that the date in 1988 are not included as the other break points in my model, though there was a significant change in the goals of policy in late 1988, after that the goal of reducing inflation became an important consideration, and the Fed began to appear willing to accept output losses in order to achieve the disinflation. The reason is that my preliminary analysis on the pseudo sub-samples 1981:Q4 – 1988:Q3 and 1988:Q4 – 2003:Q3 does show similar contemporaneous causal structure as well as the close impulse response pattern in the short run and long run. Moreover, my SUP-LM test does not show significant break in the long run at this episode neither. The possible

explanation is that the monetary policy shift at this time was not likely to cause the structure break in economy, and I believe the way monetary policy affect the economy keep unchanged since 1981. Therefore I do not add this point to isolate the sub-samples.

The study here does make no claim that monetary policy shifts are the only source of structure break in economy here. For example, Hoover and Perez (1994) argued that the oil supply shocks might provide an alternative explanation of the output dynamics. In response, Romer and Romer (1994) showed that the estimated impact of monetary policy shifts remains large and significant when oil shocks are controlled for. The more relevant question I concentrate is that if shifts of monetary policy will and in which way impact the output. Thus the next section will focus on the analysis of error correction models and related impulse responses and seek to find any support to the existence of bank lending channel and/or interest channel.

Error Correction Model and Directed Graph

Preliminary plots of the data and formal tests on unit root in each sub-sample are applied. Briefly, I fail to reject the null hypothesis of a unit root on each series (using the Augmented Dickey Fuller test) in each sub-sample. Since these four series all have a unit root, it is possible that they have cointegration-like behavior.

The common procedure recent studies have used to set up the error correction model (ECM) is to use either a trace test or information criterion to determine the lag order of the unrestricted VAR in the first step, and then use the same criterion to

determine the cointegration rank and appropriate specification for ECM in the second step. This chapter, however, will use a one step Schwartz Loss Criterion (SLC) to determine the lag order and the cointegration vectors in the ECM simultaneously, which has been proven to work at least as well as or even better than the traditional trace test or two steps approach in both efficiency and consistency (Wang and Bessler, 2005). Step by step, I check the Schwartz Loss (SL) for each rank = 1, 2... and each model specification by lags and find the one that yields the lowest SL. Because data set excludes the seasonality (GNP, LOAN and INVEST are seasonally adjusted numbers; I do not believe the three month T-bill rate will include any seasonality), 0 lag does not make sense in my case, and I start search from lag 1 to lag 2, 3...5. (Detailed statistics are listed in Appendix B-C).

Then I can conduct the Error Correction Model based on the test results. It is well recognized that the individual coefficients of the Error Correction Model are difficult to interpret, which in turn make trouble in exploring the short run structure. Instead, innovation accounting may be the best form of studying the dynamic structure over the time. (Sims, 1980; Lutkepohl and Reimers, 1992; Swanson and Granger, 1997). Accordingly, I report the lower triangular elements of the correlation matrix on innovations (errors) from the error correction model (see Tables 2.1 and 2.2 below). It is this matrix that provides the starting point for my analysis of contemporaneous causation using directed graphs. By using TETRAD III, I get the directed graphs in Figures 2.4 and 2.5 below. The directed graphs are then helpful in identifying the contemporaneous

structure. Once I have identified the order of contemporaneous innovations by using the direct graphs¹, the next step is to check the impulse response associated with this error correction model in 32 periods (I believe that 8 year segments will cover both short-run and long-run responses) in Figures 2.6 and 2.7. Below I will explain the models and results in 2 sub-samples individually.

Table 2.1. Correlation Matrix of Innovations (Errors) during Sub-Sample I (1955:Q4 – 1968:Q3)

	ε_{GNP}	ε_{LOAN}	ε_{TBILL}	ε_{INVEST}
ε_{GNP}	1.000000			
ε_{LOAN}	0.336957	1.000000		
ε_{TBILL}	0.322883	0.310929	1.000000	
ε_{INVEST}	0.848506	0.427487	0.232327	1.000000

GNP: gross national output.

LOAN: commercial loan.

TBILL: 3 month T-bill rate.

INVEST: total private investment.

¹ We have unidentified variable in the contemporaneous structure, so we tried all possible orders given the specified structure from the directed graph in the Choleski ordering and obtained robust impulse response indicating that my impulse responses functions are appropriate.

Table 2.2. Correlation Matrix of Innovations (errors) during Sub-Sample II (1981:Q4-2003:Q3)

	ε_{GNP}	ε_{LOAN}	ε_{TBILL}	ε_{INVEST}
ε_{GNP}	1.000000			
ε_{LOAN}	0.161546	1.000000		
ε_{TBILL}	0.166269	0.247677	1.000000	
ε_{INVEST}	0.688622	0.197987	0.257943	1.000000

GNP: gross national output.

LOAN: commercial loan.

TBILL: 3 month T-bill rate.

INVEST: total private investment.

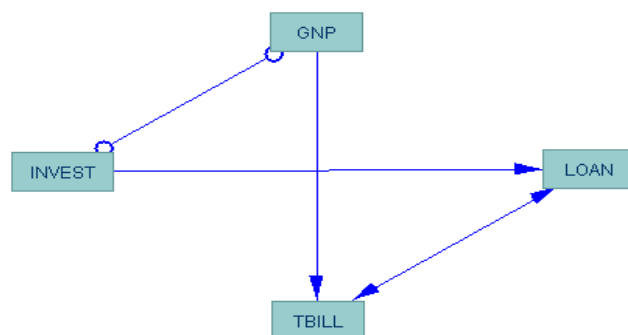


Figure 2.4. Directed graph in sub-sample I (1955:Q4 – 1968:Q3)

GNP: gross national output.

LOAN: commercial loan.

TBILL: 3 month T-bill rate.

INVEST: total private investment.

Note: o-----o indicates unoriented link².

² Here unoriented link in the directed graph may suggest the existence of latent variable which is the common cause of two variables in my system. However, according to theory and literature, we cannot identify such a latent variable, and the currently used 4 variables system is maintained.

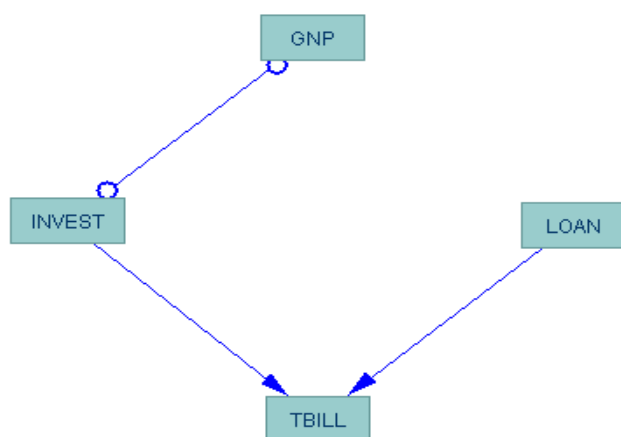


Figure 2.5. Directed graph in sub-sample II (1981:Q4-2003: Q3)

GNP: gross national output.

LOAN: commercial loan.

TBILL: 3 month T-bill rate.

INVEST: total private investment.

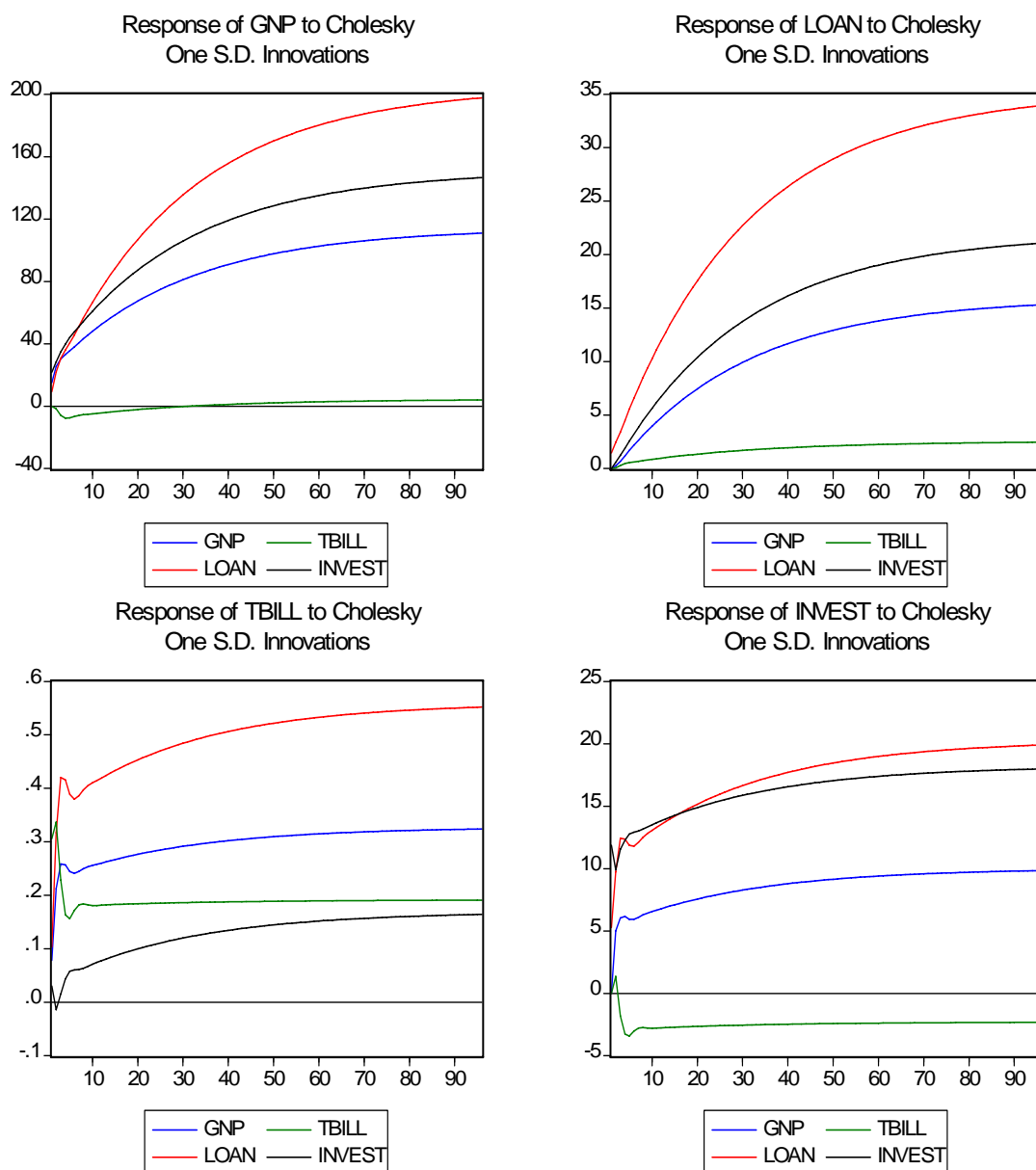


Figure 2.6. Impulse response functions in sub-sample I (1955:Q4 – 1968:Q3)

GNP: gross national output.

LOAN: commercial loan.

TBILL: 3 month T-bill rate.

INVEST: total private investment.

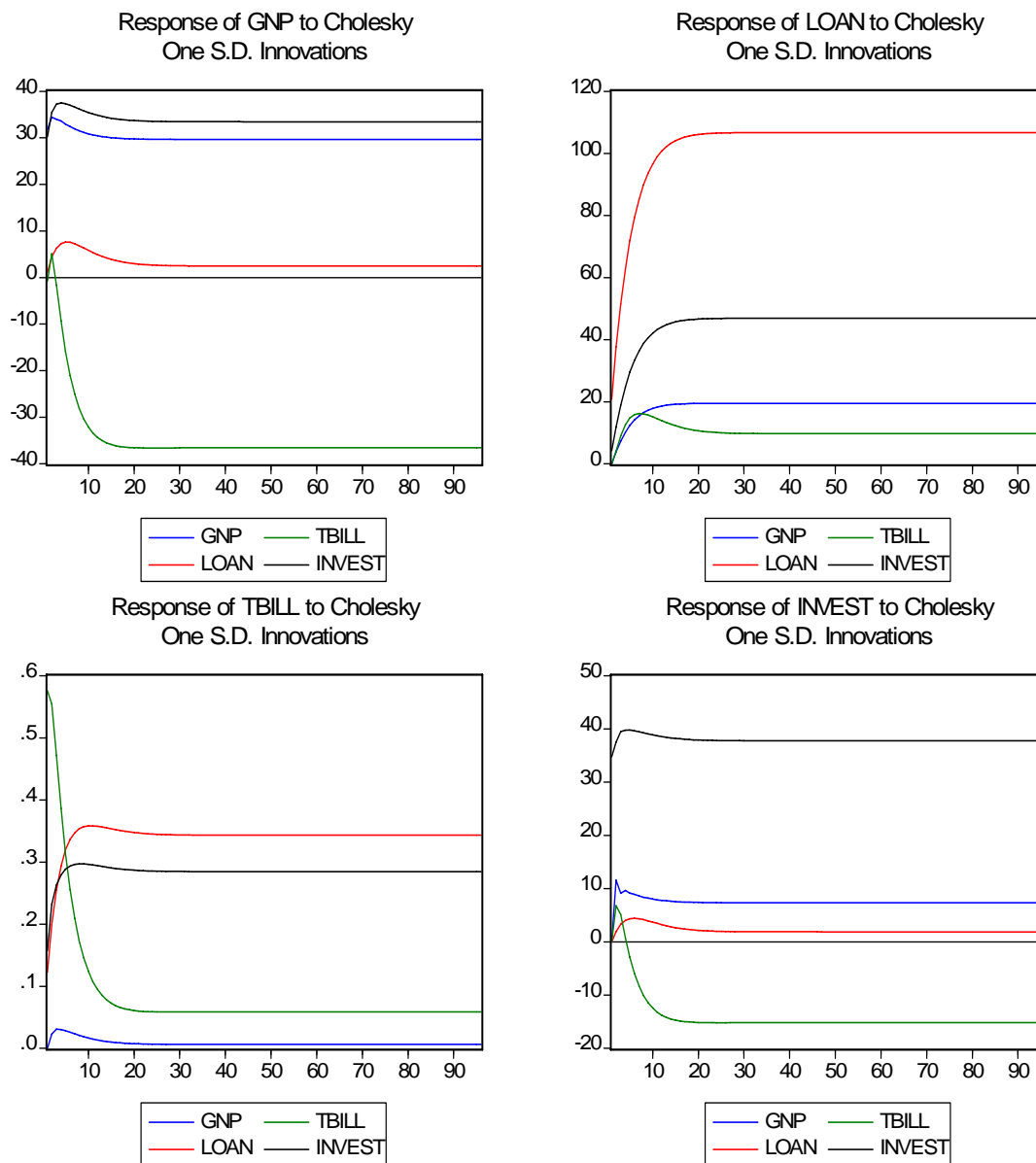


Figure 2.7. Impulse response functions in sub-sample II (1981: Q4—2003: Q3)

GNP: gross national output.

LOAN: commercial loan.

TBILL: 3 month T-bill rate.

INVEST: total private investment.

Sub-sample I (1955:Q4 – 1968:Q3)

The one step Schwarz Criterion indicates that the appropriate specification of the model assumes no deterministic trend in data, and no intercept or trend in the cointegrating equation (CE) or test VAR. With the existence of cointegration, the data generating process of these series can be appropriately modeled in an ECM with 1 lag and 1 cointegration vector.

The correlation matrix of innovations and the DAG results are reported in Table 2.1 and Figure 2.1 individually. From DAG, at a 20% significance level (I choose 20% significance level since the data points is smaller than 100), the innovations in GNP significantly contemporaneously cause innovations in TBILL, innovations in INVEST cause innovations in LOAN, innovations in LOAN and innovations in TBILL are bidirectional, and innovations in GNP has an unspecified link to innovations in INVEST. That is to say, interest rates was pretty sensitive to shocks of GNP and bank loans was pretty sensitive to innovations in INVEST in this period, while both interest rates and bank loans do not affect GNP in the current period, which is consistent with my assumption. I could expect the bank loans or interest rates take the effect on output in a longer time, and the impulse response will check it out. The Choleski-generated impulse responses reported here are based on the contemporaneous causal ordering figured out by DAG, actually the impulse responses are pretty robust to the alternatives which are based on the basic ordering addressed in DAG.

The impulse response next (See Figure 2.4) shows that a positive shock to LOAN yields a steadily increase in output. A positive shock to TBILL rate will make very little effect on output and keep GNP stay at the base level. A positive shock to INVEST will make GNP dramatically increase. The fact that GNP responds more sensitively to the shock of LOAN than TBILL implies that the bank lending channel is the operative and dominant one at this period.

I notice that INVEST acts as an accelerator for both bank lending channel and interest channel. A positive shock to LOAN cause INVEST increase rapidly in the first 3 quarters, and then stay in a slower rise, a positive shock to TBILL results in very little fall in INVEST, while positive innovations will make GNP go up continuously and significantly. In fact, INVEST have bigger response to the shock of LOAN than to the shock of TBILL, and it is consistent with the movement patterns that innovations of LOAN and TBILL on GNP, it might be the evidence to support that investment actually is the intermediary mechanism through which bank lending channel and interest channel affect the economy.

In summary, the impulse response summarized in this period appears to be consistent with a monetarist's view in favor of bank lending channel: GNP show strong response to bank loans and investment in the short term and long term, while almost no response to interest rate. The fact that shocks of bank loans make output go up through both itself and shocks on investment just suggests that the bank lending channel is the

key and operative component of monetary transmission mechanism in this period. It is consistent with Perez's study (1998) that the bank lending channel did exist in 1960s.

Sub-sample II (1981:Q4-2003:Q3)

The one step SLC procedure indicates that the appropriate specification is the model that assumes no linear trend in data, has an intercept (no trend) in CE and VAR. With the existence of cointegration, the data generating process of these series can be appropriately modeled in an ECM with one lag and one cointegration vector.

The correlation matrix of innovations and the DAG results are reported in Table 2.3 and Figure 2.3 individually. From DAG, I see that the shock of INVEST and LOAN both significantly contemporaneously cause the change of TBILL at a 20% significance level. That is to say, interest rates were very sensitive in this period and the extraneous shocks would be reflected in the fluctuation of interest rate firstly. I could expect the interest rates being very active in transmission mechanism, and the impulse response will check it out. The Choleski-generated impulse responses reported here are based on the contemporaneous causal ordering figured out by DAG: innovations in LOAN and INVEST cause innovations in TBILL, and the unspecified link between the innovations of GNP and INVEST. Actually the impulse responses are pretty robust to the alternatives which are based on the basic ordering addressed in DAG.

Figure 2.6 present the impulse response functions for this sub-sample. A positive shock in LOAN results in very little increase in GNP in the first 5 quarters, and then

back to original level and keep unchanged after 20 quarters. Comparing these responses with the response of GNP to innovations in TBILL, I see different patterns, the GNP keep decreased to the positive shock of TBILL until the 20th quarter and then stay in a much lower level, suggesting that the interest channel might be a key component in monetary transmission in this period. To study how INVEST and LOAN take the effects on interest channel, I find that a positive shock to GNP cause an increase in both INVEST and LOAN, then positive shocks to INVEST and LOAN make TBILL increase, finally GNP decline to the positive shock of TBILL. The response pattern here indicate that both INVEST and TBILL attenuate the effect of interest channel in the long run in this period, and it might explain why the response of GNP to positive shocks of TBILL eventually keep stable instead of continuously declining.

Consider what was said by Volcker, the chairman of Fed, “Given that I am in the early stages, if I can put it that way, of any success in the face of very high interest rates despite the distortions in the economy and the very different impacts on different sectors—it seems to me that there is still a considerable danger, and maybe an overriding danger, of underkill rather than overkill...” The U.S. entered a new era with an emphasis on controlling inflation. Interest rates had been controlled and became the government’s strongest policy instrument in this period. It was expected that the interest channel was the dominant monetary channel in this sub-sample, and the bank lending channel is losing its aggregated importance that has also been suggested by some other economist, i.e. Perez (1998). However, I have shown that bank loans together with

investment still take the neutral effect on the economy by attenuating the effect of interest channel. The effect of interest channel was easily overrated in this sense if decision makers could not realize the neutral effect in the long run caused by bank lending and investment and so rely more on interest rate control since the 1990s. I have seen that falling interest rates in the 1990s did not work as well as in the 1980s, and more emphasis should be put on comprehensive understanding of these interactive channels and then make an appropriate design.

Discussion and Policy Implication

Ongoing changes in the banking industry have brought renewed attention to the role banks play in the monetary transmission mechanism. In this chapter I validate the theory that an operative bank lending channel existed in the transmission mechanism of monetary policy in U.S. history. The bank lending channel implies that the Federal Reserve exerts some control over real income by controlling the level of intermediated loans traded in the economy. Independent of movements in interest rates, an increase in loans will raise aggregate output as bank-dependent firms have increased access to working capital.

I find that monetary policy actions transmitted through various interrelated channels have a significant impact on real economic activity, monetary policy does matter. But the bank lending channel appears to no longer be of aggregate importance currently (i.e. the expansion of commercial/industrial loans does not cause aggregate

output growth). My error correction model and causality analysis do not provide evidence supporting the hypothesis that the lending channel is currently aggregately effective, while I do show that that bank loans together with investment still takes the neutral effect on the economy by attenuating the effect of interest channel. .

Some perspectives other than the factors I addressed above can be used to understand why a lending channel functioned outstandingly in the sub-sample I (1955:Q4 – 1968:Q3), but not recently. Recall the two conditions for a bank lending channel to exist that I addressed in the beginning: (1) changes in policy affect the supply of bank loans and (2) some borrowers depend on banks for credit (Bernanke and Blinder 1988). With this in mind, it is easier to understand the shifting role of the bank lending channel. One of the reasons for the existence of a lending channel in the 1960s is that there were a number of firms without alternative sources of investment funds at that time, thus the second condition was satisfied. As Cecchetti pointed out, “...It [the lending channel] arises when there are firms who do not have equivalent alternative sources of investment funds and loans are imperfect substitutes in investors’ portfolios” (1994). The access to capital market, especially in the period marked as “new economy”, turns out to be easier, and more substitutes to traditional bank financing emerged. Hence, I can expect the bank lending channel would not be as strong a policy tool for impacting the real economy as it was in 1960s. Moreover, the first condition for a lending channel—that tight monetary policy reduces the bank loan supply—is more difficult to hold in current days. Banks now have several alternatives to cutting their lending when

reserves decline; they could issue certificates of deposits (CDs) or other liabilities other than those that require reserves (Romer and Romer 1990).

Another possible explanation is that lending has an asymmetric impact on the real economy; that is to say, the tightening of monetary policy will exacerbate the decline of the economy in the recession, although the ease of monetary policy won't accelerate the development in the upswing. If this is true, it can well explain why the lending channel seems less operative recently than in the famous period of "credit crunch" such as in the 1960s. I am fairly confident that the contraction of monetary policy will cause a recession, but not vice versa.

There is no strong evidence to support the existence of a bank lending channel recently. On one hand, this might be due to the emergence of a great deal of financing substitutes. On the other hand, it may be because of the relatively stable stance of monetary policy; the Federal Reserve has not enacted any dramatic tightening policies recently. It will be a good topic for my future research to test whether or not there are asymmetric responses of real economy to positive and negative monetary innovations.

In summary, the Federal Reserve can use explicit action, such as changing the base deposit rate to control loans supply, which will have a differential impact on the real economy that depends on time. Though the bank lending channel seems no longer to be of aggregate importance, it does not imply that the bank lending channel is unimportant. Bank lending channel nowadays still takes the important neutral effect on the economy by attenuating the effects that interest channel may perform. A more

efficient policy design should include the neutral effect of bank lending channel, well recognizing interrelated response among bank loans, interest rate and investment.

Moreover, bank lending still has structural effect on the real growth, because the change of bank loans supplied has differential effects on individual firms that are more or less dependent on bank credits. If some firms cannot access credit market when monetary policy gets more tight, but other firms still have access to the contracted credit market, then some firms win and some firms lose when the stance of monetary policy changes. Therefore, the distribution of bank lending loans will have effects on economic growth, and how to efficiently allocate these bank loans should be my future research topic on the bank lending channel.

CHAPTER III

STOCK RETURNS, MACRO POLICIES

AND REAL ACTIVITY IN CHINA

Introduction

There is a common positive association between real activity and stock returns in both economic theory and, for most countries, this is also true in empirical situations. However, this relationship can be ambiguous, particularly in emerging market such as in China. Recently China has boasted the world's fastest growth rate in GDP, a stark contrast to the Chinese stock market that has been sluggish for several years. I expect fluctuations in the stock market to be reflective of the macro economy. The stock market is supposed to positively predict capital accumulation and real growth (Lee 1992, Levine and Zervos 1998). In this sense, the stock market acts as an indicator for the economy as a whole. Yet this relationship appears not to hold in modern China. Starting in 1996, the stock market cycle in China has shown an obvious deviation from the real business cycle. When the real economy became sluggish, the stock market turned into a bull market, and when the economy started growing quickly after 2000, the Chinese stock market plunged into a bear market. It is important to understand what is happening in the Chinese stock market that causes such a puzzling negative relationship

between the stock market and real GDP growth in China. Moreover, it is important to consider what effect it will have on the future economy.

This chapter attempts to explain this anomalous stock return/real activity correlation by considering associated macro policies currently employed in China. I believe that negative stock return/real activity correlation is not a causal relationship, but is instead induced by the relationship between stock returns and macro policies. These, in turn, are explained by factual implementation of macro policies in China and investors' preferences.

An outline of the remainder of this chapter is as follows. Section 2 briefly introduces the Chinese stock market development. Section 3 summarizes the previous literature on the Chinese stock markets. In section 4 we provide the methodology and data details. Section 5 provides results and discussion. Finally, section 6 concludes and proposes future research.

Chinese Stock Market Development

China's stock market is a relatively new—but increasingly important—part of the Chinese financial system, which is undergoing a structural shift from a heavily-regulated and almost exclusively bank-based system to one with much greater diversity of institutions, including a vigorous and increasingly sophisticated stock market (Groenewold et al. 2003). In 1991, the Shanghai stock exchange officially opened their

exchange to the public, and shortly thereafter the Shenzhen stock exchange began trading publicly.

The Chinese stock markets primarily have two classes of shares: A shares and B shares. A-shares were initially designated exclusively for domestic investors, while B-shares were initially designated exclusively for foreign investors; these are also traded on the exchange board. Both the Shanghai and Shenzhen stock exchange trade both A and B shares, only difference is that B Shares listed in Shanghai Stock Exchange are listed in US dollars, while B Shares listed in Shenzhen Stock Exchange are listed in Hong Kong dollars. Additional classes of shares, namely “H” shares, are mainland company lists in Hong Kong and foreign markets.

Since they began operation in the early 1990s, the two official stock markets in China have expanded dramatically and have become one of the leading equity markets. As of August 2005, 1380 firms (most of them being state-owned ones) had been listed with a market capitalization of about \$420 billion (US dollars), among this around \$409 billion is listed in A shares, and \$11 billion is listed in B shares (the numbers come from Shanghai and Shenzhen Stock Exchange Fact Book). It is the second largest stock market in Asia right now—second only to Japan. It is speculated that within the coming decades China’s securities market has the potential to rank among the top four or five in the world (Ma and Folkerts-Landau, 2001), yet little is known about this relatively new market.

Despite its tremendous growth, the Chinese stock market may not be characterized by the depth and maturity of a stock exchange observed in a developed country. Evidence of this is that in 2001 China's market capitalization as a proportion of GDP was about 45%, while the corresponding figure for the US was over 300% (Demirer & Kutan, 2006). Since 1996, the stock market has played an important role in China's national economy; it was defined as a major source of refinancing in the state-owned enterprises (SOEs) sector. However, about two-thirds of outstanding shares are not publicly tradable which are exclusively A shares. Currently, companies traded on Chinese exchanges still answer to large, powerful, public or semi-public organizations that have invested in them and private investors are likely to gain fewer rights than in Western nations. Karmel (1994) writes: "This combination of public, semi-public and private management, with decentralized distribution of responsibilities, profits and rewards, is the defining characteristic of an emerging 'capitalism with Chinese characteristics' that sits above and complements the smallest private business." One of the biggest problems facing China's stock market is a lack of transparency. Reporting requirements for listed companies in China are not yet well developed and are significantly less comprehensive than those in the stock markets of industrial countries (Demirer & Kutan, 2006).

The Shanghai and Shenzhen stock markets have collapsed since early summer 2001, dropped by 40% with Shanghai Stock Exchange Composite Index running from the record high 2245 points to currently 1346 points, at the same time China's economy

experienced a golden period with high GDP growth around 8% per year. Such puzzling association attracts much attention, and three questions rose immediately:

- 1) Is the stock market really a signal of China's economy?
- 2) Is there any causality between stock returns and the real economy?
- 3) How do we explain such a counter-theory phenomenon?

This chapter uses a newly developed time series technique to apply quantitative analysis to these two questions and bears new evidence on the strange dilemma of China's high economic growth rate accompanying a dismal stock market.

Literature Review

Existing empirical work on the Chinese stock market has focused on the studies under these categories: if it is an efficient market (Groenewold, Tang and Wu 2003, Seddighi and Nian 2004), if sub-markets (Shanghai, Shenzhen, and Hong Kong) and different types of shares(A, B, and H shares) are co-integrated (Zhu, Lu and Wang 2004), identifying stock market regime shifts (Girardin and Liu 2003), modeling day-of-the-week and holiday effects (Tsui and Yu 1999, Chen et al 2001), or explaining the large price difference between A and B shares in the Chinese stock market (Chung and Wei 2005).

China displays an important counterexample to the existing economic dogma that stock market should signal the real economy: the financial system, including the stock market, is very underdeveloped in efficiency and contribution (Allen et al. 2005), but

China has one of the largest and fastest growing economies in the world. Little has been done to study this obvious contradiction to the conventional wisdom about the relationship between stock returns and real activity. Only one recent paper has touched on this question: Allen et al. (2005) points out that the law-finance-growth nexus applied to the State Sector and the List Sector with poor performance corresponds to the largely undeveloped law and financial system³. They assert that the private sector grows much faster than the other sectors because it is driven by other mechanisms (such as reputation, relationship, competition, etc.) and provides most of the economy's growth. But they do not adequately explain why in recent years stock returns plunged even with the growth of the State Sector and List Sector although such growth is relatively low compared to private sector growth; moreover, their conclusion is based more on qualitative analysis, not quantitative modeling.

I cannot locate the real reason by just observing the stock market cycles and real economy cycles; I believe it is reasonable to combine these two with respect to macro policies, particularly monetary policy and fiscal policy implemented during this period, to explain why such contradictory relationships appear.

³ State Sector refers to all companies such that the government has ultimate control (state-owned enterprises); List Sector refers to all firms that are listed on an exchange and are publicly traded, which include both state sector and private sector.

Tobin's well known general equilibrium theory of the financial sector (1969) suggests that both money growth and budget deficits may have significant impacts upon stock markets. James, Koreisha, and Partch (1985) posit that stock returns signal both changes in real activity and changes in the monetary base. Of course, whether or not fiscal and monetary policies do exert the theoretically postulated effects on stock market can only be resolved empirically.

In this study I will contribute to the existing literature and practices in these three aspects: first, I will analyze and forecast the interactions among selected macro variables; second, I will propose the reason for the puzzling relationship between stock returns and real activity and clarify its impact on China's economic future; third, advise decision makers on future policies and practices in coordinating the stock market and real economy. In the long run, the development of financial system including stock market liquidity should work along with real activity and provide better service for economic growth (Levin and Zervos 1998, Allen et al. 2005).

Data and Methodology

According to previous studies (Darrat 1988, Lee 1992, Ali and Hasan 1993, Dropsy and Nazarian-Ibrahimi 1994, Thorbecke 1997, Allen et al. 2005), my study should include the following variables covering various aspects of the economy: stock

returns, monetary policy variable, fiscal policy variable, exchange rate policy variable, GDP or other production measurement, inflation index and interest rates⁴.

I will use the consumer price index (CPI) as the proxy for inflation measure $INF = (CPI_t - CPI_{t-1}) / CPI_{t-1}$. I will use the Shanghai Stock Exchange Composite Index (COM) as a proxy for stock returns, since it is well recognized that the Shenzheng Stock Exchange moves in the same direction as the Shanghai Stock Exchange (Zhu et al. 2003). Moreover, the Shanghai Stock Exchange is dominant over the Shenzheng Stock Exchange in all aspects including capitalization, shares issued and capital raised. I calculate the growth rate of stock returns, which is frequently used to measure the performance of the current Chinese stock market (Girardin and Liu 2003, Groenewold et al. 2003, Zhu et al. 2004, Demierer and Kutan 2006). The formula is as follows: the stock return growth rate (SRG) = $(COM_t - COM_{t-1}) / COM_{t-1}$. The Shanghai Stock Exchange Composite Index takes December 19, 1990 as base day and the total market capitalization of all listed shares (including both A and B shares) on that day as base period. The base period index is set as 100 points and has been officially published since July 15, 1991.

⁴ Unemployment rate is not included due to the data availability.

I select the nominal narrow money supply (M1) growth as a proxy for monetary policy, and let $MSG = (M1_t - M1_{t-1}) / M1_{t-1}$. I choose monetary base growth rate instead of interest rates because the central bank of China (People's Bank of China) generally exerts influence on real activity by controlling money supply but not interest rates. Interest rates have been stable over time. In current China, interest rates are not completely marketable and efficient (Groenewold et al. 2003, Seddighi and Nian 2004, Qin et al. 2005). I don't include a particular exchange rate policy proxy in my study, because the exchange rate policy is clearly targeted in monetary policy operations in China⁵ and was pegged to the US dollars until July 2005. Such a unique monetary policy target also determined that the money supply, not the interest rates, was the most important intermediate target of policy committee to keep the stability of Renminbi (Chinese currency). The growth rates of the national government budget deficit (BDG) are used as a proxy for fiscal policy, and computed by $BDG = (BD_t - BD_{t-1}) / BD_{t-1}$, here BD is the monthly budget deficit series.

Growth of value added of industry (VAG) is used as a proxy for the GDP growth due to both theoretical and data availability reasons⁶. It is computed by monthly value added of industry (VAI) by $VAG = (VAI_t - VAI_{t-1}) / VAI_{t-1}$. Value added of industry is

⁵ The Ultimate objective of monetary policy is to maintain the stability of the Renminbi and thereby promote economic growth. – Cite from the Peoples' Bank of China website.

⁶ Generally we should use GDP to measure the real output, but only the quarterly GDP data for China are available, while value added of industry has a very high correlation with GDP, my preliminary correlation test shows value added of industry is highly correlated with detrend GDP.

the difference between the total output value of production and the value of consumption and transfer of material products and service during production.

I conduct study from 1996 to the current period in China. This choice follows two considerations. First, a famous counter stock market cycle against real economic cycle has occurred since 1996, and I am more interested in the combined analysis of stock market and real economy during this period. Second, before 1996, trading was not very active and information disclosure requirements were rather poor. Since 1996, the Chinese stock market has been more formal.

Note that the period from April to December 1996 was characterized by intense speculative pressure; over-speculation started to prevail and became increasingly rampant. This led the government to take measures to calm down the stock market. December 16, 1996 became well known as the ‘Black Monday’ of China’s stock market because the Shanghai stock exchange reacted with sharp drops in prices : 10% on December 16th, nearly 8% on the 17th, and 10% on the 18th of December (Giradin and Liu 2003). I will skip this period to avoid possible structural changes, and choose the period from Jan. 1997 to Aug. 2005 as my study sample.

In summary, five variables which will be included in my study are: the growth rate of stock returns (SRG), the growth rate of money supply (MSG), the growth rate of government budget deficit (BDG), the inflation index (INF), and the growth rate of value added of Industry (VAG). I will use nominal monthly data running from Jan. 1997 to Aug. 2005. Monthly data is preferred to quarterly data, particularly when analyzing

the stock market in which prices are determined on a daily basis⁷. With monthly date, I get plenty of observations and avoid degrees of freedom problems. All of my data come from the data company CEIC. These are nominal and unadjusted series. The variables SRG, MSG, INF and BDG will be seasonally adjusted. The adjusted series are plotted in Figure 3.1 to help have a preliminary view of series trend particularly the correlations among stock returns, value added in industry and macro policies.

Previous studies (Darrat 1988, Ali and Hasan 1993, Chatrath et al. 1996, Thorbecke 1997, and Allen et al. 2005) employ one-step or two-step regression methods to explore the interactions among stock returns, macro policies, and output. As pointed out by Darrat that: "...the measurement errors, model misspecifications, or any other estimation problems are responsible for the inefficiency evidence... the reason for the inefficiency may lie instead in some inadequacy of the model...".

⁷ Daily data on certain macro series like GDP, value added of industry, money supply or budget deficit are not available.

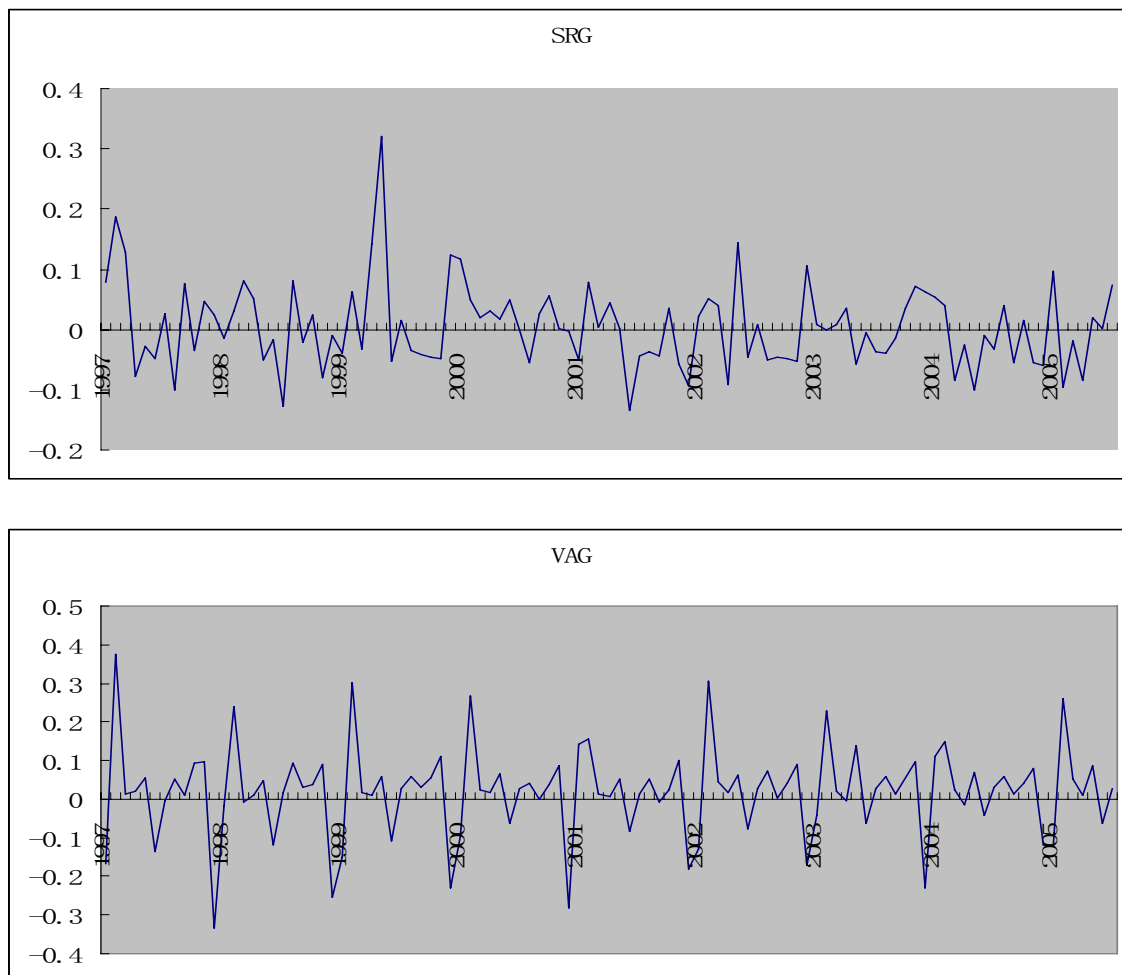


Figure 3.1. Data plot for SRG, VAG, MSG, INF and BDG after seasonal adjustment

Vertical axis for each series except BDG is measured with % index.

Horizontal axis is measured with time.

SRG: the growth rate of stock returns.

VAG: the growth rate of value added in industry.

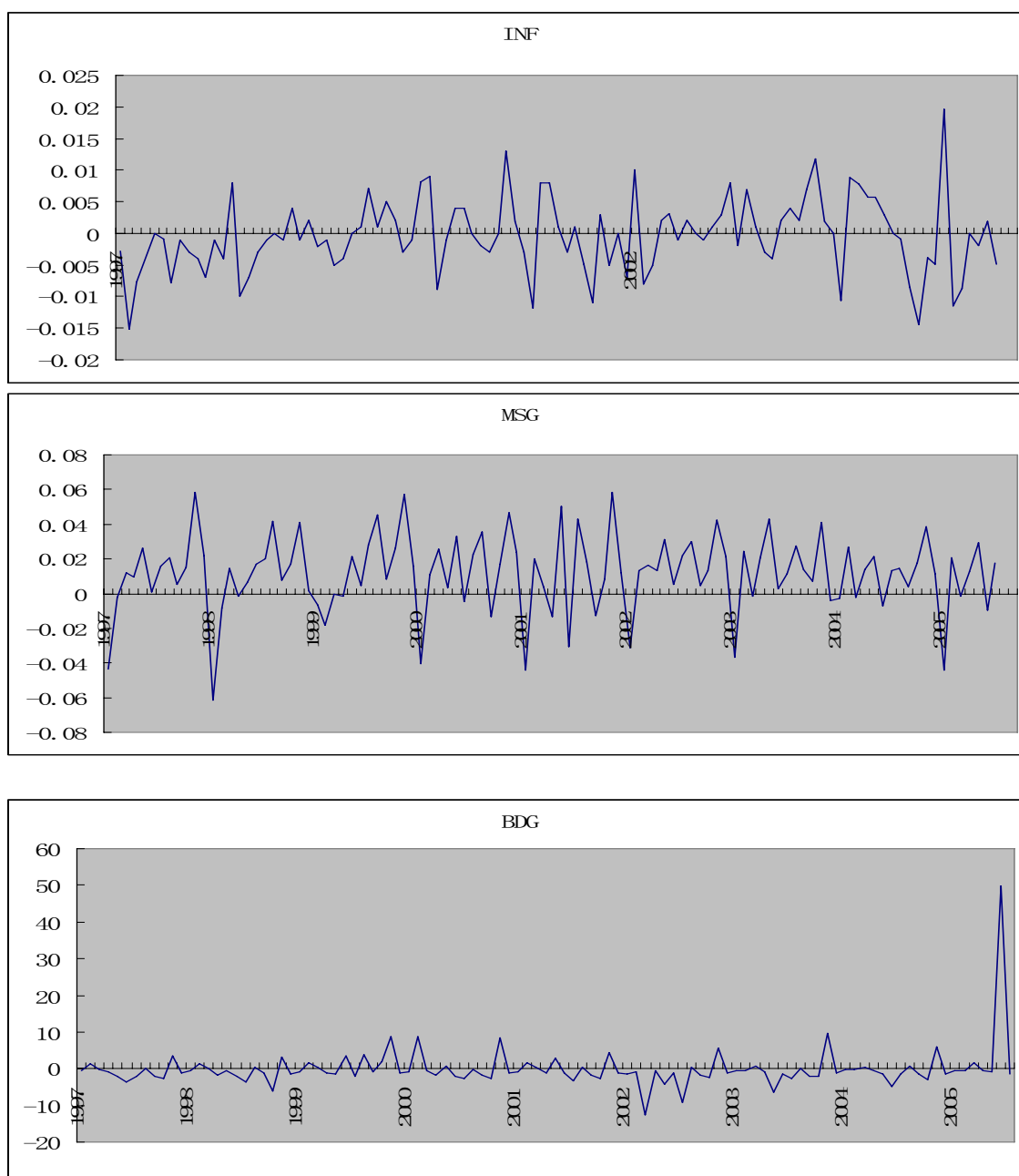


Figure 3.1. Continued

ING: the growth rate of inflation.

MSG: the growth rate of money supply.

BDG: the budget deficit, measured with unit million Renminbi (Chinese Currency).

Faced with these inefficiencies and the absence of the knowledge about the “true” model, the vector autoregression (VAR) technique appears appropriate in this context to empirically study the stock market with respect to other macro series. VAR methodology has proven useful for investigating the relationship between stock returns and other macro variables (Lee 1992; Ali and Hasan 1993).

Formal tests on the unit root to each series are applied. Briefly, I reject the null hypothesis of a unit root on SRG, INF, BDG, and fail to reject the null hypothesis on VAG and MSG (using the Augmented Dickey Fuller test). Since there are two series with unit root, it is possible that they are cointegrated, thus I conduct an error correction model in this study.

I use recently proposed development of VAR - error correction model (ECM) combined with directed graphs (Swanson and Granger 1997, Spirtes et al. 2000, Pearl 2000, Bessler and Yang 2003) to study the negative relationship between stock returns and value of added in industry with controlling the impact that macro policies have on this relationship. ECM is a reduced form method that doesn't require any priori restrictions on the model. Directed graphs will allow us to identify the contemporaneous order of variables and thus provide more accurate impulse response analysis. These modeling procedures enable us to obtain deeper insights into the dynamic interactions of these series.

Basically, I use the error correction model combined with directed graphs to show the contemporaneous causality structure on innovations and analyze the short-run

and long-run interactions and causalities among variables based on an impulse response function. In this chapter, directed graphs are used to help in providing data-based evidence on causal ordering in contemporaneous time, assuming the information set is causally sufficient⁸. Causal inference on directed graphs (DAGs) has recently been developed by Spirtes, Glymour and Scheines (2000), and Pearl (2000). This method is able to shed light on contemporaneous relationships. The directed graphs literature is an attempt to infer causal relationships from observational data. The key idea is to use a statistical measure of independence, commonly a measure of conditional correlation, to systematically check the patterns of conditional independence and dependence and to work backwards to the class of admissible causal structures (Hoover, 2005). Results indicate that achieving model identification through the use of direct acyclic graphs can yield plausible and theoretically consistent impulse response functions that can be used in policy analysis (Awokuse and Bessler 2003).

Moreover, the error correction model will allow us to identify the long-run and short-run time structure of the series, thereby clearly showing the relationship among stock returns, macro policies, and real activity.

⁸ Causally sufficiency means there is no latent variable that causes two included variables in the study, see Spirtes et al. 1993.

Results and Discussion

Before discussing the Error Correction model analysis, I briefly summarize empirical contemporaneous cross correlations among variables (Table 3.1) for the period of January 1997 to the period of August 2005, and I find:

Table 3.1. Cross Correlations among Variables SRG, VAG, INF, MSG, BDG

	SRG	VAG	INF	MSG	BDG
SRG	1				
VAG	-0.08631	1			
INF	0.09964	-0.3834	1		
MSG	0.06403	-0.0129	-0.0491	1	
BDG	-0.02423	-0.0217	0.02179	-0.0565	1

SRG: the growth rate of stock returns.

VAG: the growth rate of value added in industry.

INF: the inflation rate.

MSG: the growth rate of money supply.

BDG: the budget deficit.

1. Stock returns are negatively correlated with VAG growth, contrary to the general assumption that the stock market rationally signals changes in real activity.
2. Contrary to the common negative association between stock return and inflation in developed countries like the US (Fama 1981, Stulz 1986) during the post-war period, stock returns and inflation are weakly positively correlated in China, which is consistent with theoretical assumptions that common stock should be a hedge against inflation.
3. Inflation is negatively associated with nominal GDP growth, which is consistent with most other empirical relationships in developed countries.
4. Change in money supply and budget deficit are correlated with stock returns, real activity and inflation in expected direction.

This chapter will focus more on the correlation of stock market return versus economic activities. Preliminary plots of the data and formal tests on the unit root are applied to each variable. Briefly, I fail to reject the null hypothesis of a unit root on VAG and MSG (using the Augmented Dickey Fuller test). It is possible that they are co-integrated, and so I can model it with error correction model.

The common procedure in previous studies to set up the error correction model (ECM) is to use either a trace test or information criterion to determine the lag order of the unrestricted VAR in the first step, and then use the same criterion to determine the co-integration rank and appropriate specification for ECM in the second step. In this chapter, however, I will use a one step Schwartz Loss Criterion (SLC) to determine the

lag order and the co-integration vectors in the ECM simultaneously, which has been proven to work at least as well as or better in both efficiency and consistency than both the traditional trace test and the two-step approach (Wang and Bessler, 2004).

Step by step, I check the Schwartz Loss (SL) for each rank = 1, 2... and each model specification by lags and find the one that yields the lowest SL. Because my data set has been adjusted for seasonality, 0 lag is not appropriate, and I start search from lag 1 and continue to lag 12 (Detailed statistics are listed in Appendix D). I then apply a one-step Schwarz Loss criterion that identifies 1 lags, two cointegrating vectors, and model specifications with no deterministic trend in data, intercept (no trend) in CE, but no intercept in VAR. I report both parameter estimates and associated t-statistics in the Appendix E.

In terms of the long-run relations (the parameter matrix associated with levels lagged one period), the matrix of parameter can be written as $\pi = \alpha\beta'$ where α is a 5×2 matrix and β' is a 2×5 matrix, since I have two cointegrating vectors. The long-run component of the error correction representation is given as β' , the speed adjustment of each series to perturbations in the long-run component (β') is given by the α matrix.

I further conduct some exploratory tests on the long-run structure of interdependence among variables. One hypothesis which I am extremely interested is whether one of cointegrating vector (β') could explain the puzzling relationship

between stock returns and real economy when considering associated macro policies.

Thus I consider over-identified restrictions on each vector of β' . Suppose β' is the matrix represented as:

$$(3.1) \quad \beta = \begin{bmatrix} \beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15} \\ \beta_{21}, \beta_{22}, \beta_{23}, \beta_{24}, \beta_{25} \end{bmatrix},$$

and I have:

$$(3.2) \quad \begin{bmatrix} \beta_{11} \\ \beta_{12} \\ \beta_{13} \\ \beta_{14} \\ \beta_{15} \end{bmatrix} = \begin{bmatrix} \phi_1 \\ 0 \\ \phi_2 \\ \phi_3 \\ 1 \end{bmatrix},$$

and

$$(3.3) \quad \begin{bmatrix} \beta_{21} \\ \beta_{22} \\ \beta_{23} \\ \beta_{24} \\ \beta_{25} \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ \phi_5 \\ \phi_6 \\ 0 \end{bmatrix}^9,$$

where ϕ is unknown coefficients. Under the null hypothesis that these restrictions are “true”, I apply the LR tests for binding restrictions, and have p -value 0.4418, suggesting that I should accept the null hypothesis and these restrictions are consistent with the data.

One of my identified β matrixes is listed as the following:

⁹ We test other forms of the design of β , in particular a restriction between stock return and monetary policy in the form of $\beta_{21}=0$, $\beta_{22}=1$, $\beta_{23}=0$, and we reject those restrictions at a p -value of .05.

$$(3.4) \beta = \begin{bmatrix} -1245.60 & 0 & -197.38 & 2252.68 & 1 \\ 0 & 1 & -41.57 & 36.00 & 0 \end{bmatrix}$$

The second row shows stock return is negatively related to money supply, and positively related to inflation. The negative sign is opposite to the common sense that expansionary monetary policy should drive up the stock market. The effect of real output and fiscal policy on stock return in the long run could be dismissed. The first row reflects that the value added of industry (VAG) is positively related to money supply and budget deficit and negatively related to inflation.

In the next step, I explore the possibility that some series do not respond to perturbations in the cointegration vector. Here I am interested in the weak exogeneity of each series, relatively to the long-run equilibrium (see Ericsson, Hendry, and Mizon (1998) for a formal discussion on weak exogeneity). The null hypothesis is that each variable does not make adjustment toward the estimated long run relation. From the test statistics reported in Table 3.2 below, I find that I cannot reject the null hypothesis for stock return (SRG) and fiscal policy (BDG), indicating that both stock return and fiscal policy do not respond to perturbations in two long run relations. The weakly exogeneity of SRG points out that the correlation between stock returns and real economy at least is not a causality relation and it must be induced by other relevant relations.

Table 3.2. Test of Weak Exogeneity of Each Series (Given Two Cointegration Vectors)

Series	chi-square	<i>p</i> -value	Decision
VAG	34.4116	0.0000	R
SRG	2.987	0.3936	F
INF	22.5023	0.0000	R
MSG	24.3257	0.0000	R
BDG	2.3189	0.5089	F

Note: Imposing simultaneous over identifying restrictions on β at the same time.

Thus far I discussed on tests revealed long-run relationships, next I turn to contemporaneous relationships and short-run as well as long-run relationships obtained from impulse response. It is well recognized that the individual coefficients of the error correction model are difficult to interpret, which in turn makes it difficult to explain the short-run and long-run structure. Instead, innovation accounting may be the best form of studying the dynamic structure over the time (Sims, 1980; Swanson and Granger, 1997).

Before reporting the impulse response function, I explain precisely it means. As discussed in Hamilton (1994), a common, but technically unsound, interpretation of an impulse-response function is the effect of a primitive impulse on variable $Y_{j,t+k}$. A more technically accurate interpretation of an impulse-response function is the revision in the conditional forecast of some variable $Y_{j,t+k}$ given a past shock to some other variables $Y_{i,t}$. Sims (1980) and others have noted that when there is contemporaneous correlation among variables, the choice of ordering in the Choleski decomposition, which is the base of an impulse response derivation, may make a significant difference for

interpretation of impulse responses. I use directed graphs as an alternative to the widely used Choleski factorization of contemporaneous correlation to determine the Choleski ordering required in the impulse response; such applications of directed graphs in finance and economic studies are now common (Awokuse and Bessler 2003, Bessler and Yang 2003, Kalai 2003, Yang et al. 2006)

I report the lower triangular elements of the correlation matrix on innovations (errors) from the error correction model in Table 3.3. This matrix provides the starting point for my analysis of contemporaneous causation using directed graphs. By using TETRAD III, I get the directed graphs in Figure 3.2. Using DAG at a 10%¹⁰ significance level, I find the innovations in MSG (growth of money supply) significantly contemporaneously cause innovations in VAG (growth of value added of industry), and then innovations in VAG cause innovations in INF (growth of inflation) contemporaneously. I also find that the innovations in SRG (growth of stock returns) contemporaneously cause innovations in INF. This makes sense because monetary policy can be more effective in the short-run according to classical theory, and inflation is sensitive to fluctuations of real output and stock returns which I also expect according to general money demand and supply theory. After identifying the order of

¹⁰ A 10% significance level is chosen since my data is not large between 100 and 200.

contemporaneous innovations;¹¹ I check the impulse response of variables in 40 periods segments to cover both short-run and long-run interactions.

Table 3.3. Correlation Matrix of Innovations (Errors) on SRG, VAG, INF, MSG, BDG

	SRG	VAG	INF	MSG	BDG
SRG	1				
VAG	-0.07478	1			
INF	0.224476	-0.23012	1		
MSG	-0.09513	0.184795	-0.041	1	
BDG	-0.01553	-0.00983	-0.02132	-0.11886	1

SRG: the growth rate of stock returns.

VAG: the growth rate of value added in industry.

INF: the inflation rate.

MSG: the growth rate of money supply.

BDG: the budget deficit.

¹¹ BDG (growth of budget deficit) has not entered my identified contemporaneous structure, so I tried all possible orders for BDG in the Choleski ordering and obtained quite robust impulse response indicating that the order of BDG in the Choleski ordering does not matter.

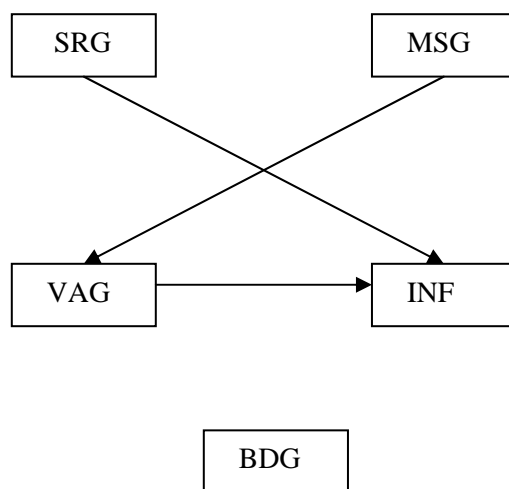


Figure 3.2. Directed graph on SRG, VAG, INF, MSG, BDG

SRG: the growth rate of stock returns.

VAG: the growth rate of value added in industry.

INF: the inflation rate.

MSG: the growth rate of money supply.

BDG: the budget deficit.

To investigate the puzzling relationship between SRG and VAG, I first check there impulse response to all unanticipated shocks of the other variables (Figures 3.3 and 3.4). As shown in Figure 3.3, positive output innovations have an almost immediate, but slight effect on stock returns in the first 5 periods, and then quickly return to unchanged in the remaining periods. Stock returns respond positively and consistently to shocks of inflation, and swing in a narrowband to shocks of budget deficit in the first 30 periods and thereafter return to normal levels. Unanticipated expansionary fiscal policy do not exhibit a consistent influence on stock markets, which is consistent with a previous

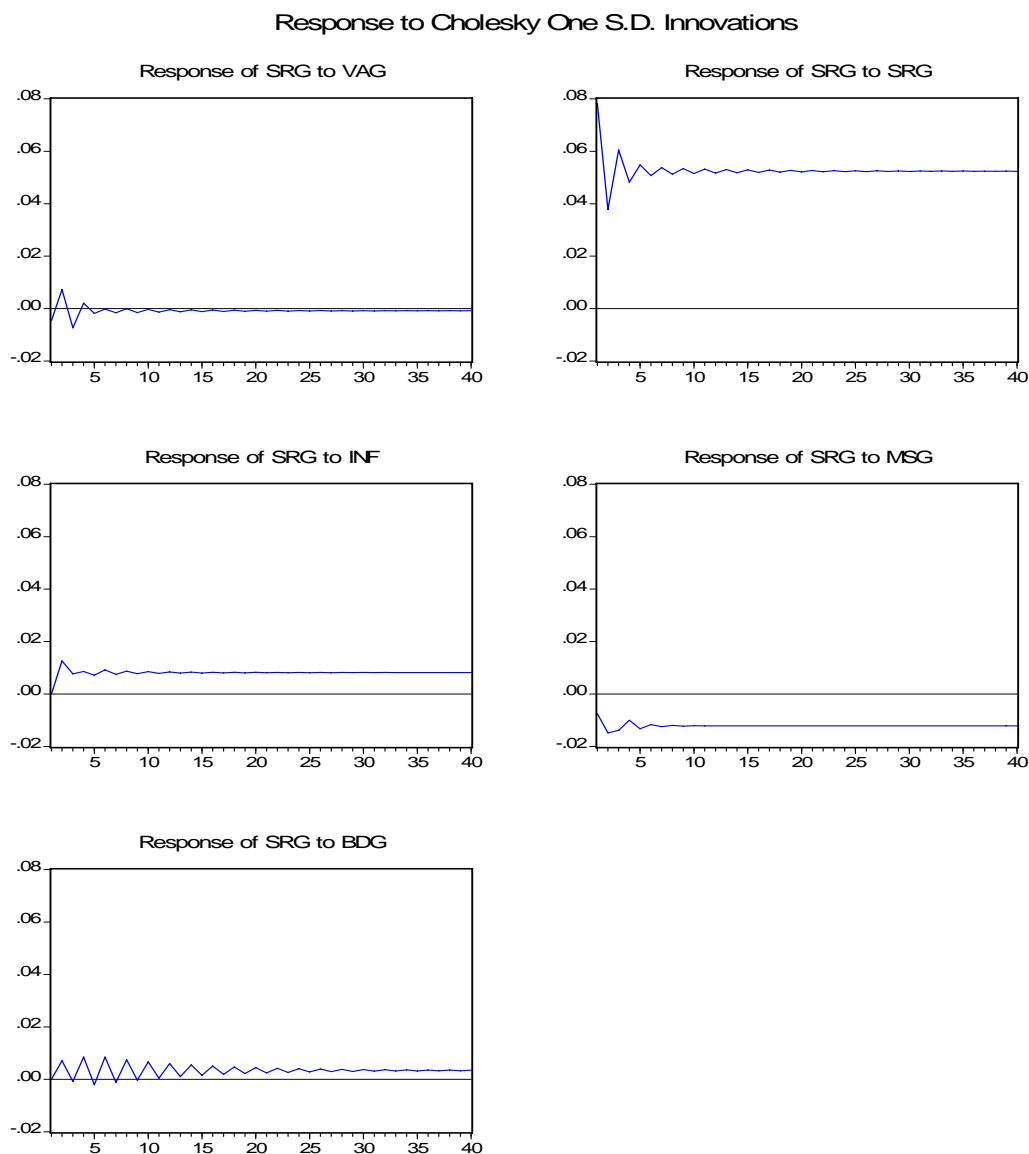


Figure 3.3. Impulse response of SRG to shocks of all other variables in 40 periods¹²

SRG: the growth rate of stock returns.

VAG: the growth rate of value added in industry.

INF: the inflation rate.

MSG: the growth rate of money supply.

BDG: the budget deficit.

¹² The vertical axis in all of impulse responses in this chapter are measured with % growth rate.

study on 11 industrialized countries conducted by Dropsy and Nazarian-Ibrahimi (1994). However, stock returns respond negatively and significantly to shocks of money supply.

As shown by Figure 3.4, output has little response or even negative response to stock returns innovations, and had positive response to money shocks. Inflation results in an initial positive response by output in less than 1 year and then sustains that level. It is easy to understand that expansion of monetary policy will stimulate the real economy, at least in the short-run. Moderate inflation boosting the economy can also be explained since the Chinese are likely to consume and invest more to hedge against inflation expectations and thus provide stimulus for the economy. Output responds inversely to positive shocks of fiscal policy in the first 30 periods, and then stays at that positive level indicating that fiscal policy does not effective the current economy in China. Continuous budget deficit expansion might hurt the Chinese economy in the long run.

We see that a positive shock to monetary supply will cause an increase in output but a decrease in stock returns. In order to check if monetary supply has a strong and persistent impact on stock returns and output, I need to explore how money supply responds to shocks of stock returns and output (see Figure 3.5). In Figure 3.4, innovations in stock returns have no effect on the money supply, and innovations in output have little positive effect on the money supply. This indicates a money-output bi-directional association. Considering that money supply has no response to stock returns,

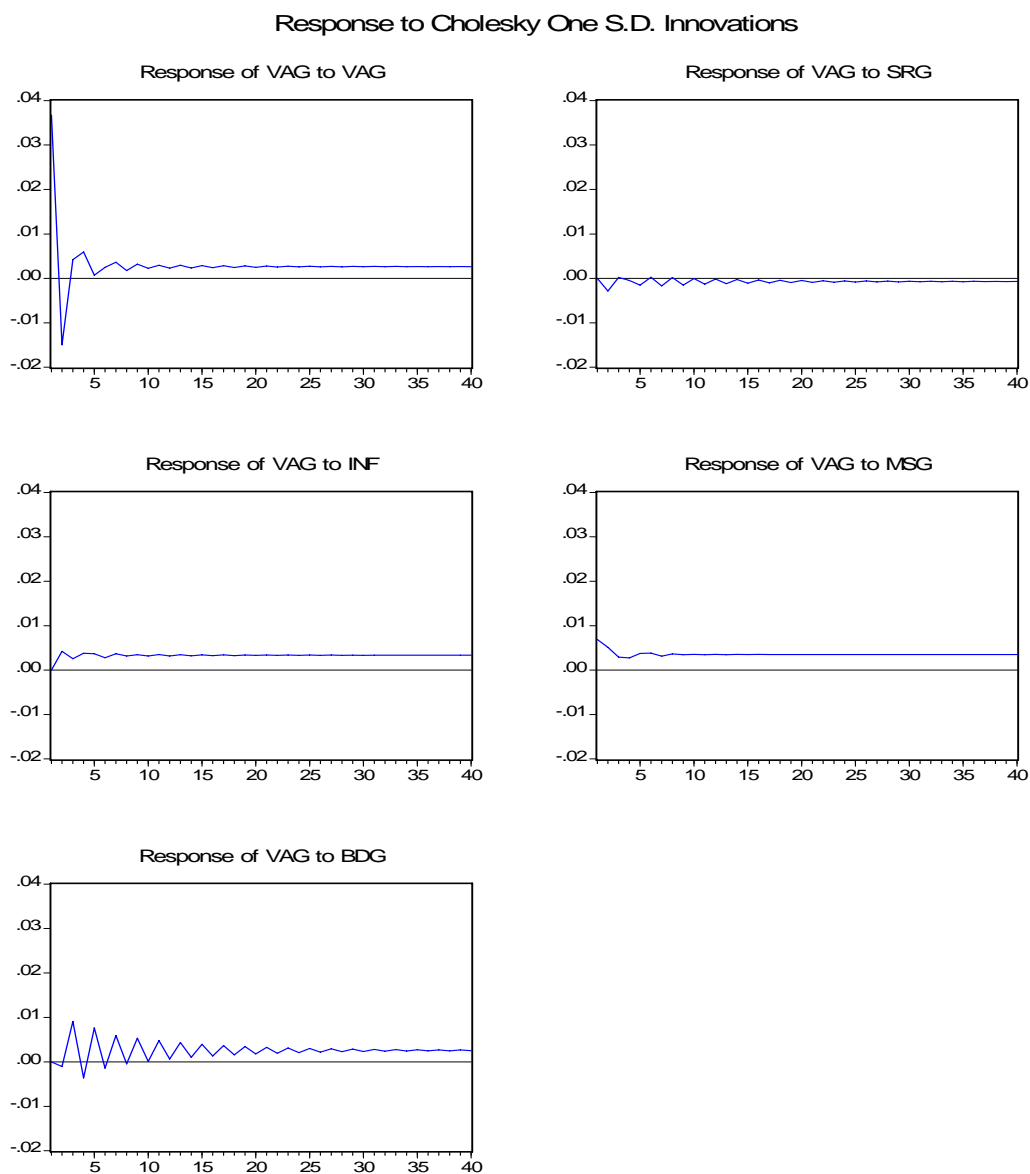


Figure 3.4. Impulse response of VAG to shocks of all other variables in 40 periods

SRG: the growth rate of stock returns.

VAG: the growth rate of value added in industry.

INF: the inflation rate.

MSG: the growth rate of money supply.

BDG: the budget deficit.

Response to Cholesky One S.D. Innovations

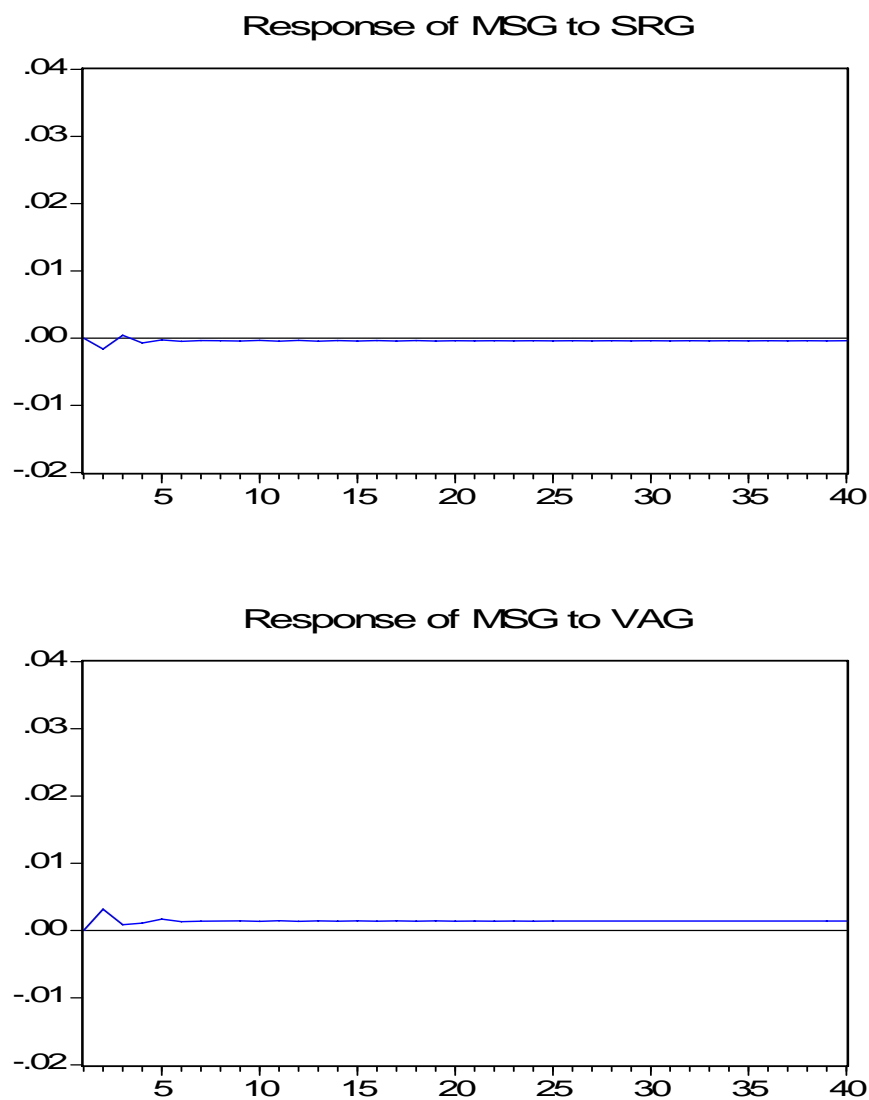


Figure 3.5. Impulse response of MSG to shocks of SRG and VAG in 40 periods

SRG: the growth rate of stock returns.

VAG: the growth rate of value added in industry.

INF: the inflation rate.

MSG: the growth rate of money supply.

BDG: the budget deficit.

while stock returns negatively respond to the positive shock of money supply, and stock returns and output have no direct response to each other, I conclude that in the Chinese stock market money supply expansion causes a decrease in the stock return in the short and long run. The puzzling negative relationship between stock returns and real activity in China is a proxy for the negative link between monetary policy and stock returns when expansion of monetary policy causes an increase in real output.

I propose that one of the reasons that the expansion of monetary policy adversely affects the stock market is that the real estate market absorbed more capital than that of stock market during the period of loose monetary policy. When the money supply increases, the available total investment capital rises. I could clearly divide such investment into two categories: tangible investment such as in real estate market, equipment, etc., and equity investment such as in stocks, bonds, and the futures market. In the current Chinese capital market, investors obviously have fewer alternatives than in industrial countries. Of the limited options available, investing in real estate is a good choice, particularly since it has been such a hot market. Recognizing these key factors, it makes sense that when monetary policy expands and increases available credit from banks, loans become more readily available for all sectors, including the real estate industry. Investment in real estate is heavily dependent on bank lending since other external financing is thus far significantly underdeveloped in China. Consequently, large sums of funds were transferred from the stock market into the real estate market, as see in Figure 3.6.

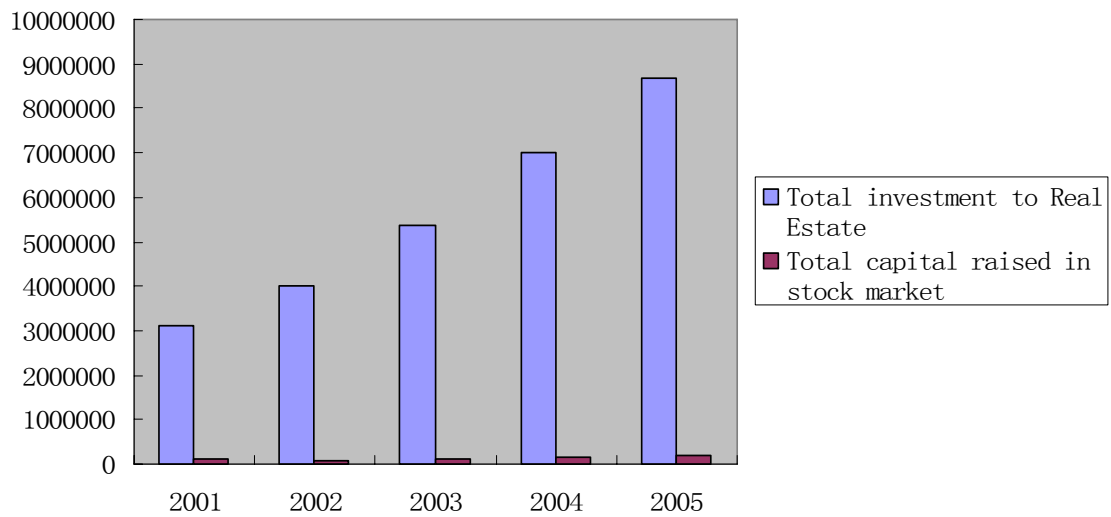


Figure 3.6. The comparison of total investment to real estate sector and stock market in China.

Unit: Million Renminbi (Chinese currency)

Data source: China National Bureau of Statistics, Shenzhen Stock Exchange Fact Book and Shanghai Stock Exchange Fact Book.

The growth rate of real estate loans has been far above the average growth rate of total domestic loans since June 2001 (China Real Estate Financial Report 2004), and China's vigorous housing market has absorbed a large percentage of available investment capital. Thus, money pulled out of stocks is finding its way into real estate.

Another important reason might be that the expansion of monetary policy is not easily transmitted to corporate firms. For most of the State Owned Enterprises (SOEs) in China, they are still greatly dependent on state owned banks for external financing. Such loan contracts are often set up for long time periods and cannot be adjusted sensitively and efficiently to changes in the money base. The corporate earnings for those SOEs have been unstable for a long time and not prompted by monetary policy change. As pointed out in the 2002 monetary report by the state development research center "...for SOEs, their contribution to GDP growth rate is around 30%, to economic development is less than 20%...Instead, the non state owned economy has accounted for 70% of total GDP, and 100% of growth in employment." (Resource: <http://www.drcnet.com.cn>) Considering the possibility of overestimation for public number (Fang 2000), the actual contribution ratio of SOEs to growth would be even less.

Summary and Conclusion

In this chapter, I have examined the contradictory relationship between stock returns and real activity in China by using impulse response analysis based on directed graphs and an error correction model. I conclude that the contradiction is not because of a causal relationship between stock returns and real activity, but because of the negative relationship between stock returns and monetary policy. The expansion of money supply causes an increase in output but a decrease in stock returns. The impact of monetary policy on output and stock returns induces the puzzling relationship between stock returns and real activity. I suppose that the negative relationship between monetary expansion and stock returns is due to the overheating real estate market attracting intensive capital investment and the fact that the expansion of monetary policy has not be transmitted efficiently to state-owned enterprises which are the predominantly listed companies in the Chinese stock market. This is in my future research agenda and I expect to find out more evidence to support it.

In some sense, the stock returns signal one of the important indicators of economic activity in China: the unemployment rate. Though it is not an officially public number, it is widely speculated that the unemployment rate has kept rising in the years accompanied with the sluggish stock market. The most unemployment in China comes from the state-owned sector which is also the principal part of stock market, thus there is a strong link between stock market and unemployment rate. According to Professor and economist Xiao Zuoji's opinion, the actual unemployment rate for urban population is

about 15% - 20%, which does not include the possible billion unemployed laborers in rural areas. Not surprisingly, China might have the world's highest unemployment rate. (2003 United Morning Daily, Beijing). The other abnormal phenomenon in China economy is that the coexistence of high growth rate of GDP and unemployment, which is the other interesting topic. The puzzling relationship I study in this chapter is highly correlated to such phenomenon. I have to recognize that currently the rising unemployment rate is concomitant with fast GDP growth in China, and it is not good for development in the long run. The high unemployment rate primarily in urban areas is due to poor performance of state-owned sector, therefore the slumped stock market is a constant reminder of the importance for China's government to face and solve the problem of high unemployment even during periods of fast GDP growth.

In terms of the relationship between stock returns and fiscal policy, both my long-run tests and impulse response show that the stock returns have very little response to changes in fiscal policy. The similar result could be found in the literature, i.e., Ali and Hasan's study (1993) in Canada.

My analysis confirms that the Chinese stock market has a restricted effect on the whole economy, because the stock returns are proxy for only a fraction of the whole economy—state owned enterprises, in particular. The effect is more on downside. As pointed out by Green and Ho in 2004 “The lack of a real threat of de-listing still undermines corporate governance on China's exchanges.” In essence, the inefficiencies in the Chinese stock markets could be attributed to poor and ineffective regulation. To

change the negative relationship between stock returns and real activity, the Chinese government should adjust the institution and allow more private firms to be listed as well as allowing more SOE shares to be traded on the board. By doing so, the Chinese stock market could be expected to be more efficient and competitive compared to other capital markets and become a real indicator of the economy as a whole.

Because Chinese currency, Renminbi, was firmly pegged to the US dollar in the study sample, one may expect that the change in US dollar value would exert some impact on the Chinese money market; future research may analyze how stock returns fluctuate with respect to changes in the US dollar exchange rate. In addition, the impact of the real estate market volatility requires further scrutiny. Another interesting phenomenon worthy of attention in China is the positive relationship between inflation and stock returns, which requires more explanation and analysis in future research.

CHAPTER IV

CREDIT CHANNEL AND EFFICIENCY IN THE PUBLIC AND PRIVATE SECTORS OF CHINA

Introduction

The role monetary policy has on the real economy, and the means by which monetary policy affects the economy, remains an open question in macroeconomics for decades. Economic theory suggests several possible channels through which monetary policy can affect the real economy, for example, money channel and credit channel. Traditional money channel places emphasis on the money, attributing all of the forces of monetary policy to the shift of money supply, which changes the interest rate and spending. The key assumption here is a perfect financial market; all funds are assumed perfect substitutes. If information problems occur, preventing firms from substituting easily among alternate sources of funds; two other possible channels take effect: credit channel and exchange rate channel.

While the traditional money channel works in a perfect economic environment assuming a closed economy, the credit channel hinges on the assumption of an imperfect financial market. The credit channel has gained great interest within the last decade (Bernanke and Blinder 1992, Kashyap and Stein. 1994, Romer and Romer 1994, Kierzenkowski 2005). Given market imperfection, monetary policy has the potential to

affect not only credit demand by affecting the willingness to consume or invest, but also credit supply by changing the supply of bank loans as well as other external finance.

In an open economy, exchange rate channel posits that monetary policy affects net export through the impact of the interest rate on the exchange rate. Higher interest rates mean stronger currency, and strong currency leads to a decline in net export demand and output (Leitemo et al 2002).

There are two sub-channels of credit channel generally discussed in literature: bank lending channel and balance sheet channel. Kashyap and Stein (1994) define the bank lending channel as follows: "...monetary policy can work not only through its impact on the bond-market rate of interest, but also through its independent impact on the supply of intermediated loans..." The bank lending channel implies that the central bank can influence real income by controlling the level of intermediated loans. The balance sheet channel takes effect from either the demand or supply side. An increase in liquidity lowers interest rates and pushes people to transform their excess liquidity into investment or consumption, and thus provides better returns. On the other hand, when interest rate increases lead to a reduction in the value of different assets that could be used as collateral by borrowers, the borrower's balance sheet becomes worse. Then a restrictive monetary policy has the potential to lower the available credit due to lower quality loan collateral (Hulsewig et al 2004). Interest rates are the major policy tool in the balance sheet channel, thus it can also be called the interest channel.

The existence and efficiency of credit channel have important policy implications. Many studies have searched for empirical evidence of credit channels (Bernake and Blinder 1992, Gertler and Gilchrist 1994, Kashyap and Stein 1994, 2000, Oliner and Rudebusch 1996, Perez 1998). However, most recent studies focus on developed countries such as in the U.S., and have no reference to China. Since the late 90s, especially accompanied with financial crisis in south-eastern Asia, China consecutively executed the stable monetary policy in order to prevent a crisis. Such policy was expected to loose money and stimulate the economy, though its effect is not clear. Under this background, the efficiency of monetary policy in China as well as the transmission mechanism becomes the more important question and is getting more attention.

Besides these two generally acknowledged credit channels, the exchange rate channel as one of credit channels was also proposed recently. The exchange rate channel states that in an open economy monetary policy affects net export through the impact of the interest rate on the exchange rate. Higher interest rate mean stronger currency and stronger currency leads to a decline in net export demand and output. The empirical evidence on the effects of monetary policy on exchange rates is still very mixed because the response of exchange rates to monetary policy is notoriously hard to predict (Anegelsoni et al. 2003). In China, the exchange rate channel is not considered operative. China economy is still not an absolutely open economy, and the fixed exchange rates are still under the strict control of the People's Bank of China (PBC), the

central bank. Adjustments to these rates occur very infrequently as shown in Figure 4.1. Beginning July 2005, PBC announced they would scrap the yuan's decade-old peg to the U.S. dollar, and phase in a managed floating exchange rate system. A long time fixed exchange rate regime in China limits the effects of the exchange rate channel of monetary transmission, which is consistent with basic open economy assumption, and it has been in agenda to set up a more flexible exchange rate policy in the long run.

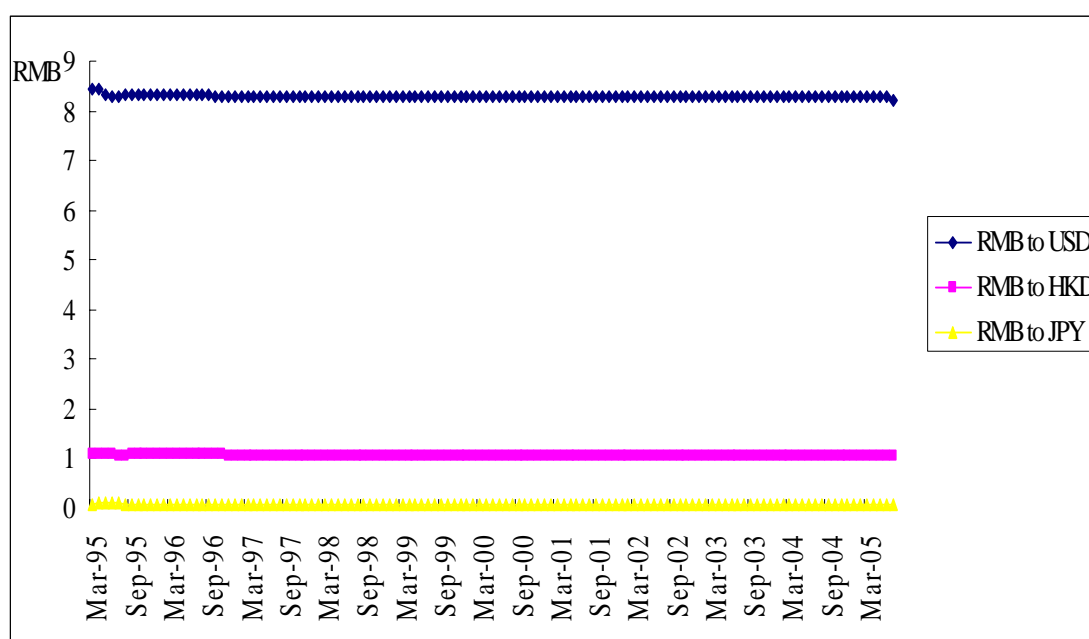


Figure 4.1. China foreign exchange trade system (CFETS) spot exchange rate

Monthly Average Mar. 1995 – Jul. 2005

Vertical Axis Unit: Renminbi.

RMB: Chinese currency.

USD: United States currency dollar.

HKD: Hong Kong currency dollar.

JPY: Japanese currency yen.

Source: CEIC China Database.

The monetary transmission channels addressed above can be illustrated as Figure 4.2:

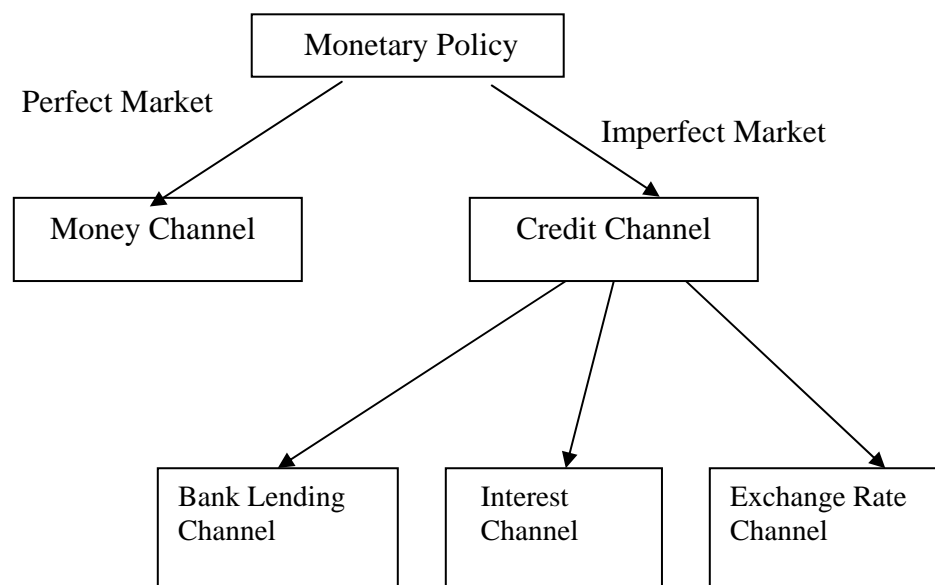


Figure 4.2. Monetary transmission channels

There possible exist some other sub-channels of credit channel in the monetary transmission that may be important to China. For example, Yuan and Zimmermann (1999) proposed the importance of firm heterogeneity as a channel of transmission for monetary policy. They believe the capital structure of firms changes endogenously over time as a result of their financial decisions as well as self regulation of banks in determining the allocation of money from deposits to selected types of loans. Such

heterogeneity may significantly amplify both real and nominal shocks to the economy. They also report that monetary policy can do little to ease a credit crunch that arises because of increasing loan risk. However, more flexible loan regulations, in particular, rules that allow the banks to take more risks that are compensated by higher loan rates, is very effective.

This study will focus on the roles of two major credit channels including both bank lending channel and interest channel (balance sheet channel), in the monetary transmission of China. Generally, we expect that industries that use external finance will grow relatively faster during the period of monetary expansion (Rajan and Aingales 1998). It is widely acknowledged that in China, during the last decade, the private sector being more dependent on external finance than public sector has been the most dynamic component in the Chinese economy, and it has become a powerful engine for China's economy growth (Guillaumont Jeanneney, et al 2006). The Chapter III about stock market and monetary policy in China argues that the monetary policy may have been transmitted less efficiently to the public sector than to the private sector, and I will investigate this assumption in this study.

The purpose of this chapter is therefore, (1) to test for the existence of credit channel in China monetary transmission, and (2) to examine if monetary policy has been transmitted with the same efficiency to the different sectors of China.

The rest of chapter proceeds as follows: Section 2 addresses the methodology adopted. Section 3 briefly describes the data. Section 4 presents the ECM and the

estimated long-term cointegration relationships that allow for a loan demand and supply interpretation. Section 5 addresses the directed graph and impulse response that identify the contemporaneous and short-run dynamics. Section 6 discusses the results of the above sections and concludes the chapter.

Methodology

Most empirical studies about credit channel concentrate on bank lending channel by using aggregate time series data (Bernanke and Blinder 1992, Perez 1998, Hulsewig et al 2004). Many studies established that bank loans and economic activity fall significantly after a monetary contraction, which is consistent with the credit channel. However, a severe identification problem occurs because it is very hard to reveal whether the cut off in bank loans is driven by loan supply or by loan demand “It is not possible using reduced-form estimates based on aggregate data alone, to identify whether bank balance sheet contractions are caused by shifts in loan supply or loan demand” (Cecchetti 1995). Thus, many researchers turn to the bank level and firm level data to study the individual borrower’s reactions. Gertler and Gilchrist (1994), Kashyap and Stein (1994, 2000), and Olinear and Rudebusch (1995) use large numbers of disaggregated panel data to identify loan supply effects. However, using micro data has its own problems. One of the most serious problems is that it does not indicate how important this channel is on a macroeconomic scale.

This study uses macro-aggregated data and complements the existing empirical literature. The time series analysis of China macro data is analyzed using an error correction model (ECM) and directed graph suggested by Swanson and Granger (1997), and Bessler and Yang (2003). The ECM approach does not require a specific functional form or assumed knowledge about the variables, and is better in dealing with macro variables when the true relations among these variables are extremely hard to know. Thereby the ECM is of great importance and particular advantage in policy analysis, especially for developing countries such as China. My time series model includes control factors for both loan demand and loan supply, and allows the identification of long-run integration relationships that can be interpreted as loan supply and loan demand equations. In this way, the fundamental identification problem inherent in a reduced form approach based on aggregate data is explicitly solved, and the importance of credit channel of monetary transmission is quantitatively measured in macro level.

The contemporaneous causality among the macro series is checked by a directed graph. Then the short-run dynamics of the interested series can be appropriately investigated by impulse response analysis, incorporating the causality information. This analysis helps to clarify the loan demand and loan supply puzzle.

Three novel contributions of this study are made to the literature and empirical practice. First, a large developing economy is studied for the first time within a time series framework (extant literature concerns mainly on developed countries for monetary transmission study). Second, the fundamental identification problem inherent in using

macro-aggregated data is explicitly solved by the error correction model with controlled factors. Third, the newly developed time series technique – error correction model combined with a directed graph – is adopted to help explore the complicated monetary transmission in China.

My data are time series data, and observations are probably non-stationary. Accordingly, I model the China banking and monetary data as an error correction model. Modeling the innovations from such a model allows us to investigate the causal structure in contemporaneous time and identify the short run and long run structure of series. Such models were first introduced in Swanson and Granger (1997), and have been developed by others such as Bessler and Yang (2003).

The new method, called Directed Acyclic Graphs (DAGs), is used to identify the contemporaneous causality in error correction model in these studies. Causal inference on directed graphs (DAGs) has recently been developed by Spirtes, Glymour, Scheines (2000), and Pearl (2000). This method is able to shed light on contemporaneous relationships.

The directed graphs literature attempts to infer causal relations from observational data. The key idea is to use a statistical measure of independence, commonly a measure of conditional correlation, to systematically check the patterns of conditional independence and dependence and to work backwards to the class of admissible causal structures (Hoover, 2005). While computers can be used to sort out causal flows from spurious flows and can sometimes distinguish an effect from a cause,

human intelligence is helpful to select the set of candidate variables (causal sufficient set) for the computer to study. The causal sufficiency assumption suggests finding a sufficiently rich set of theoretically relevant variables to conduct the analysis, i.e., there is no omitted latent variable that causes two variables included in the study. One of the advantages of using directed graphs is that results based on properties of the data can be compared to a prior knowledge of a structural model suggested by economic theory or subjective intuition (Awokuse and Bessler, 2003).

Basically, I use the error correction model combined with directed graphs to show the contemporaneous causality structure on innovations. Such structures can be identified through the directed graphs analysis of the correlation (covariance) matrix of observed innovations \hat{e}_t . In this chapter, directed graphs are used to help in providing data-based evidence on causal ordering in contemporaneous time, assuming the information set is causally sufficient. Moreover, the error correction model will allow us to identify the long-run and short-run time structure of the series, which enables us to get a clearer view on the relationship among bank loans, interest rates and real output. In summary, I will study the complete properties of the time series that I am interested in and propose a clear acting pattern among loans, interest and output, and thus providing stronger support for the existence of bank lending channel or interest channel.

Data

The monetary reform in China lagged behind real sector reforms for more than a decade. Although the PBC was established as a separate central bank as early as 1983, the role of the PBC as the central bank was not legally reinforced until 1995, when the Central Bank Law was enacted. The Commercial Bank Law was also enacted at the time as the Central Bank Law. The enactment of these two major laws marked the beginning of the banking sector and monetary reforms. In 1996, the interbank market in China was unified via a computer network system. The 1997 Asian financial crisis made the Chinese government feel an urgency to accelerate the monetary reforms (Shi 2001, Qin et al 2005).

The following time series analysis of the monetary transmission in China is based on quarterly data taken from the People's Bank of China and the National Bureau of Statistics. The time period under consideration starts with the first quarter of 1997 to the first quarter of 2006.

Within the data sample, the execution of monetary policy in China causes changes in real output. Expansions and contractions of credit affect both aggregate demand and aggregate supply, thus influencing aggregate activities.

My time series analysis includes bank loans and interest rates. With an immature equity and bond capital market, the financial system in China primarily depends on the banking sector; hence the aggregated bank loan data are important. According to China's constitution, the state-owned sector is in a dominant position in the economy, and it co-

exists with other ownership systems such as collective, township enterprises, self-employed, private and individual firms, joint venture, etc. They can be categorized into two big sectors: public and private. Therefore, the bank loans will be separated into two terms: loans to the public sector and loans to the private sector.

Since this study focuses on the effect of monetary transmission on the different economy sectors, I employ a five-variable ECM system – gross domestic product (GDP), interest rates (IR), loans to public sector (PB), loans to private sector (PR), and total Credit Funds available for lending (CF). Similar variables have been used in previous studies (Lee 1992, Ali and Hasan 1993, Thorbecke 1997, Hulsewig et al. 2004, Allen et al. 2005).

GDP is added as a measure of the general economic activity. According to previous study, the GDP could be considered as a proxy for loan demand factors. Of course, GDP may also have effect on loan supply, and I assume that this effect is relatively small compared with its impact on demand (Bondt 1999, Kakes 2000).

Because banks may relate their loan supply decision to the amount of disposable capital, I can use CF as an approximate for disposable capital to control loan supply side. The total credit fund of banks include deposits, financial bonds, currency in circulation, and liabilities to IMF, and it is an important factor that attributes to loan supply rather than to loan demand. I also include benchmark interest rate (IR) in my system as the control factor to both loan supply and demand. The benchmark interest rates refer to the interest rates set up by PBC to influence markets, which is a fixed rate for financial

institutions to borrow from the PBC. Interest rates are still under the strict control of the PBC. Recently, the PBC slowly started liberalization of interest rates by allowing for a floating band of commercial lending rates with a centrally controlled benchmark rate. Thus, the benchmark interest rate has an impact on both loan supply and loan demand. The interest rates are also useful for exploring the interest channel, which has the effect on demand side as well. Studying such a system will identify the dynamics among all these variables, specifically what factors drive the change of bank loans and GDP. The unique monetary policy design in China provides us a great chance to conduct the study for credit channel with fundamental identification problems explicitly solved.

All series are quarterly and nominal with seasonal adjustment. The use of nominal value is also supported by related studies, e.g. James, Koreisha and Partch (1985). The details of data are listed below in Table 4.1.

Table 4.1. Time Series Aggregated Data Sources and Variable Definitions

Variable	Definition	Unit	Data Source
GDP	Gross Domestic Product	1 billion Renminbi	National Bureau of Statistics
PB	Short term loans ¹³ to the public sector	1 million Renminbi	The People's Bank of China Quarterly Statistical Bulletin
PR	Short term loans to the private sector	1 million Renminbi	The People's Bank of China Quarterly Statistical Bulletin
IR	Benchmark interest rate: 6 months or less	%	The People's Bank of China Quarterly Statistical Bulletin
CF	Bank credit funds	1 million Renminbi	The People's Bank of China Quarterly Statistical Bulletin

¹³ As addressed in many monetary studies, the monetary policy may influence real economy through short-run instruments which cannot be fully adjusted to policy change. The short term loans here refer to the loans with duration less than 1 year.

Results of ECM Analysis for Long Run Relationships

Formal tests on the unit root to each series are applied to test for stationarity. Briefly, I accept the null hypothesis of a unit root on all series except IR by using the Augmented Dickey Fuller test, it is reasonable since adjustments to these interest rates are infrequent. Because all variables except IR have a unit root, it is possible they are cointegrated, thus I conduct an error correction model in this study.

The common procedure in previous studies to set up the error correction model (ECM) was to use either a trace test or information criterion to determine the lag order of the unrestricted VAR in the first step, and then use the same criterion to determine the cointegration rank and appropriate specification for ECM in the second step. In this chapter, however, I will use a one step Schwartz Loss Criterion (SLC) to determine the lag order and the cointegration vectors in the ECM simultaneously, which has been proven to work at least as well as or better in both efficiency and consistency than both the traditional trace test and the two-step approach (Wang and Bessler, 2004).

Step by step, I check the Schwartz Loss (SL) for each rank = 1, 2...n and each model specification by lags to find the lag that yields the lowest SL. Because my data set has been adjusted for seasonality, 0 lag is not appropriate in this case, so I start search from lag 1 and continue to lag 12. (Detailed statistics are listed in Appendix F). I then apply a one-step Schwarz Loss criterion that identifies 3 lags and model specifications with quadratic deterministic trend in data, and assume intercept and trend in CE and linear trend in VAR for my error correction model. Based on this criterion, I

adopt a rank $r = 2$, which means that I have two independent long-term relationships among variables to identify cointegration space and demand-supply relationship. Table 4.2 reports multiple test statistics; I cannot reject the null hypothesis of no autocorrelation and normality at 5% significance level, which shows that the model is statistically well-specified.

Table 4.2. Test for Misspecification

	Test	P-Value
Autocorrelation	LM(1)	0.3735
	LM(4)	0.2140
Normality	Jarque-Bera Test	0.5218

Notes:

1. The test on autocorrelation is based on LM test with the null hypothesis that there is no serial correlation. LM (1) is the test of first order autocorrelation on the residuals from the error correction model, and LM (4) is the test of fourth order autocorrelation on the residuals.
2. The Jarque-Bera statistic is used for normality test, which has a χ^2 distribution with two degrees of freedom under the null hypothesis of normally distributed errors.

Let X_t denote a vector of selected variables. The data generating process of X_t could be appropriately modeled in such an error correction model:

$$(4.1) \quad \Delta X_t = \pi X_{t-1} + \sum_{i=1} \Gamma_i \Delta X_{t-1} + \mu + e_t,$$

where $\pi = \alpha\beta'$ where β is the cointegration vectors, α is the adjustment vectors. The long-run structure can be identified through cointegration vector β , and the short-run structure can be identified by testing hypotheses on adjustment vector α and Γ (Johansen and Juselius, 1994; Juselius, 1995; Johansen, 1995).

The credit channel implies that the bank's loan supply should depend positively on total credit fund CF, and negatively on the benchmark interest rate IR, while loan demand may depend positively on GDP. I could also expect the total credit fund to increase with the level of economic activity. I also want to know if the bank loans to the private or public sector will have a different impact on GDP. In order to check these and identify the system, I normalized the first cointegration vector with respect to GDP, and the second cointegration vector with respect to IR. The results are reported in Table 4.3 below.

Table 4.3. Estimated Cointegration Vectors (β') with Normalization in GDP, IR

GDP	CF	IR	PB	PR
1	-2.0783	- ¹⁴	0.0055	-39.3439
-	0.007762	1	-0.00002	0.2343

GDP: national domestic product.

CF: total credit fund available.

IR: benchmark interest rates.

PB: bank loans to public sector.

PR: bank loans to private sector.

The first row in Table 4.3 indicates the following relationship can be interpreted as a long term economy equation:

$$(4.2) \quad \text{GDP} = 2.0783 \times \text{CF} - 0.0055 \times \text{PB} + 39.3439 \times \text{PR}^{15}$$

which relates positive GDP growth to increase the total credit fund and credit to the private sector. We see the negative sign associated with PB indicating that the expansion

¹⁴ We set the long coefficient in β' associate with IR to zero in the first vector, and coefficient in β' associate with GDP to zero in the second vector, so we have two restrictions for each vector, which will exactly identify cointegration space (β').

¹⁵ ECM assumes the error correction process ΔX_t is stationary, X_t is not stationary, but $\beta' X_t$ is stationary (Johansen 1991), thus we can interpret the relations $\beta' X_t$ as stationary relations (long-run equilibrium) among nonstationary variables.

of credits to the public sector hurts the economy instead, suggesting that the monetary transmission is not efficient in the public sector. The positive sign associated with CF means that the growth of total credit fund would stimulate the economy in the positive direction, indicating that the monetary policy through credit channel is effective in China.

The second row describes a long-run relationship for interest rate,

$$(4.3) \quad IR = -0.007762 \times CF + 0.00002 \times PB - 0.2343 \times PR,$$

which could be explained as a policy rule for a central bank to set up the benchmark interest rates. The equilibrium state is what economy wants, thereby with increase of total credit fund and credit to the private sector, the benchmark interest rate should be adjusted downward, while with increase of credit fund to public sector, the benchmark rate should be tuned up. This also suggests that the benchmark interest rate in current China should be adjusted to prevent redundant capital from flowing into the public sector to maintain continuous economic growth in China.

For the sake of identifying demand and supply equation in the long run individually, I normalize the two cointegration vectors with respect to both PB and PR and impose overidentifying restrictions¹⁶ on cointegrating vector β , where

$$(4.4) \quad \beta = \begin{bmatrix} \beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15} \\ \beta_{21}, \beta_{22}, \beta_{23}, \beta_{24}, \beta_{25} \end{bmatrix} \text{ representing the two long-run equations associate with}$$

GDP, CF, IR, PR, PR. I have restrictions:

¹⁶ We have 6 restrictions for two cointegration vectors, so it is overidentifying restrictions.

$$(4.5) \quad \begin{bmatrix} \beta_{11} \\ \beta_{12} \\ \beta_{13} \\ \beta_{14} \\ \beta_{15} \end{bmatrix} = \begin{bmatrix} 0 \\ \phi_1 \\ \phi_2 \\ 1 \\ 1 \end{bmatrix}, \text{ and}$$

$$(4.6) \quad \begin{bmatrix} \beta_{21} \\ \beta_{22} \\ \beta_{23} \\ \beta_{24} \\ \beta_{25} \end{bmatrix} = \begin{bmatrix} \phi_3 \\ 0 \\ \phi_4 \\ 1 \\ 1 \end{bmatrix}^{17},$$

where ϕ is unknown coefficients. Under the null hypothesis that these restrictions are “true”, I apply the LR tests for binding restrictions, and have p -value 0.32, suggesting that I should accept the null hypothesis and these restrictions are consistent with the data.

My overidentified β matrix is listed in the Table 4.4:

¹⁷ We test for restrictions that impose no demand factor in the first equation, and no supply factor in the second equation. Both coefficients associate with PB and PR are set to 1 so PB+PR could represent total bank loan supply or demand.

Table 4.4. Estimated Cointegration Vectors with Over Identifying Restrictions Imposed.

GDP	CF	IR	PB	PR
0	-252.82	9106512	1	1
-955.5709	0	26390353	1	1

GDP: national domestic product.

CF: total credit fund available.

IR: benchmark interest rates.

PB: bank loans to public sector.

PR: bank loans to private sector.

Therefore I have these two long run equations for loan demand and loan supply respectively:

$$(4.7) \quad PB + PR = 252.82 \times CF - 9106512 \times IR$$

$$(4.8) \quad PB + PR = 955.5709 \times GDP - 26390353 \times IR$$

The first equation can be explained as loan supply equation where loan supply is negatively related to the benchmark interest rate, and positively related to total credit fund. This is expected if the credit channel is active. The large coefficients suggest that loan supply is sensitive to shifts in credit availability and benchmark interest rates. This is what bank lending channel implies that tightened monetary policy will cause bank loans supplied to decrease if the bank lending channel is operative. This is necessary condition for the bank lending channel to be operative and the results support this.

The second equation could be interpreted as loan demand equation. I see that the positive GDP shocks drive up the demand to bank loans, and the positive shocks of IR will reduce the demand to bank loans. This supports the existence of interest channel that the increasing interest rates will raise the cost of money and cut the demand for bank loans.

For a deeper insight in the error correction process, I performed LR tests on restrictions on the adjustment vector α to see whether there is any evidence that some variables may be weakly exogenous (see Ericsson, Hendry, and Mizon (1998) for a formal discussion on weak exogeneity). A variable can be treated as weakly exogenous

if its coefficients of all error correction terms in α are zero, implying that the respective equation in the first difference does not contain information about the long-run parameters β . The LR test statistics on joint zero restrictions for each variable are documented in Table 4.5 and have been carried out without imposing restrictions on β . The test results show that the null hypothesis of weak exogeneity cannot be rejected for GDP and CF, indicating it is appropriate to choose these two as control factors in my loan demand and supply identification.

Table 4.5. Test of Weak Exogeneity of GDP, CF, IR, PB, PR

Series	chi-square	<i>p</i> -value	Decision
GDP	1.0567	0.5896	F
CF	4.5606	0.1022	F
IR	5.3292	0.0696	R
PB	14.6827	0.0006	R
PR	31.3824	0.0000	R

GDP: national domestic product.

CF: total credit fund available.

IR: benchmark interest rates.

PB: bank loans to public sector.

PR: bank loans to private sector.

In short, the long-run equilibrium analysis solve the inherent identification problem in loan supply and demand explicitly, and supports my hypothesis that the credit channel is effective in the long run which is reflected on the efficiency of monetary transmission in the private sector.

Directed Graphs and Impulse Response for Contemporaneous and Short-Run Dynamics

It is well recognized that the individual coefficients of the error correction model are difficult to interpret, which in turn makes it difficult to explain the short-run structure. Instead, innovative accounting may be the best form of studying the dynamic structure over the time (Sims, 1980; Swanson and Granger, 1997). Based on recently developed directed graph technique, I can identify the contemporaneous causality among the series and provide the correct ordering for impulse response. Accordingly, I skip the detailed estimates of ECM and report the directed graph and the impulse response only.

The contemporaneous structure on innovations can be identified through a priori structural modeling of observed innovations or through the directed graph analysis of the correlation (covariance) matrix of \hat{e}_t (Pearl 1995, Swanson and Granger, 1997). I report the lower triangular elements of the correlation matrix on innovations (errors) from the error correction model in Table 4.6 below. It is this matrix that provides the starting point for my analysis of contemporaneous causation using directed graphs. By using TETRAD III, I get the directed graphs in Figure 4.3. Using DAG at a 10% significance level¹⁸ (I choose a 10% significance level because the data points are less than 100, see Bessler and Lee 2002, Bessler and Yang 2003), I find the innovations in GDP

¹⁸ We use both PC Algorithm and GES Algorithm and obtain the same directed graph.

significantly contemporaneously cause innovations in both PB (bank loans to public sector) and CF (total credit funds available), and a causality running from innovations in IR (benchmark interest rate) to innovations in CF and then to innovations in PB contemporaneously. This is expected since both demand and supply shocks exist in contemporaneous time taking the effect on CF, and thus cause the change of PB in current time. Two points are worthy of further consideration. One is that there is no edge pointed to GDP, indicating neither bank loans nor interest rates has effect on real economy in contemporaneous time. It is not true that monetary policy takes effect immediately, since borrowers and lenders always adjust to the change of monetary policy over time. Second, PR is not entering any contemporaneous causality; there is no edge between PR and any other variable. However, PB is very responsive to the shocks from other variables except PR. Current policy changes such as adjustment of benchmark interest rates cause the change of total credit funds available, and thus change the bank loan supplied to the public sector, but bank loans supplied to the private sector seems unaffected. It is consistent with the current situation of Chinese financial market in which the public sector raises the most capital. The private sector obtains less share of total capital and it has become a severe problem for the development of the private sector in China.

Table 4.6. Correlation Matrix of Innovations (Errors) on GDP, CF, IR, PB, PR

	GDP	CF	IR	PB	PR
GDP	1				
CF	-0.31437	1			
IR	-0.09527	-0.57319	1		
PB	-0.67777	0.77956	-0.33647	1	
PR	-0.21739	-0.03542	0.01969	-0.04745	1

GDP: Measure of general economic activity.

CF: Total available credit fund for banks

IR: Central bank benchmark interest rate.

PB: Bank loans to the public sector.

PR: Bank loans to the private sector.

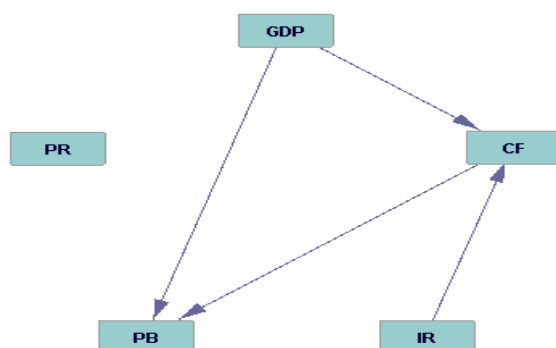


Figure 4.3. Directed graph on GDP, CF, IR, PB, PR

GDP: Measure of general economic activity.

CF: Total available credit fund for banks

IR: Central bank benchmark interest rate.

PB: Bank loans to the public sector.

PR: Bank loans to the private sector.

Since I identified the order of contemporaneous innovations¹⁹, I then check the impulse response of variables in 5-year (20 periods) segments to cover both short-run and long-run structure.

As discussed in Hamilton (1994), a common, but technically unsound interpretation of an impulse-response function is the effect of a primitive impulse on variable $Y_{j,t+k}$. A more technically accurate interpretation of an impulse response function is the revision in the conditional forecast of some variable $Y_{j,t+k}$ given a past shock to some other variables $Y_{i,t}$. Sims (1980) and others have noted that when there is contemporaneous correlation among variables, the choice of ordering in the Choleski decomposition, which is the base of an impulse response derivation, may make a significant difference for interpretation of impulse responses. I use directed graphs as an alternative to the widely used Choleski factorization of contemporaneous correlation to determine the Choleski ordering required in the impulse response. Such applications of directed graphs in finance and economic studies are now commonplace (Awokuse and Bessler 2003, Bessler and Yang 2003, Kalai 2003, Yang et al. 2006).

¹⁹ PR (bank loans to private sector) has not entered my identified contemporaneous structure, so we tried all possible orders for PR in the Choleski ordering and obtained quite robust impulse responses indicating that the order of PR in the Choleski ordering does not matter.

Figure 4.4 below plots the impulse response of each variable to one positive shock of IR, which could be interpreted as their reaction to an unexpected monetary tightening. The simulation covers a period of 20 quarters.

Within the impulse response as plotted in Figure 4.4, the monetary policy shocks of the benchmark interest rate bring in the dramatic decrease of GDP in the first year. The GDP then follows a mean reverting process and returns to a level slightly below the base level. The CF decreases for about 12 quarters, then slightly increases, then levels out. This is consistent with a monetarist view that the tightened bank lending will drive down the real output, and the total available credits for lending is also cut back. It's worth noting that the moving pattern of GDP to shocks of IR follows the same pattern as that of PR albeit at 2 or 3 lag level. Such adjustment of GDP suggests that the bank loans to the private sector (PR) have certain effect on GDP in the short run. Following the rise or decline in PR, the GDP consequently begin to rise or fall in the subsequent periods.

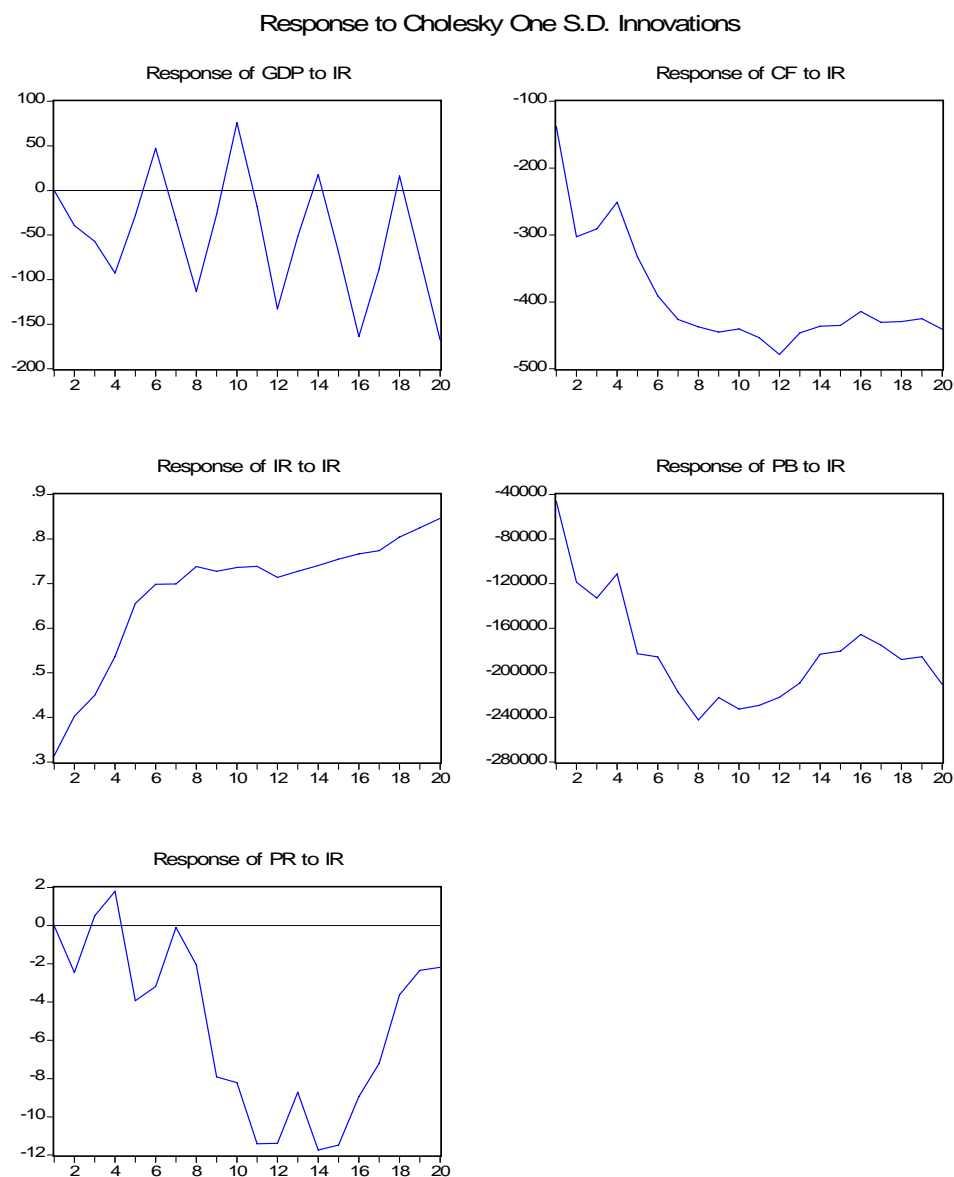


Figure 4.4. Impulse response of all variables to shocks of IR in 20 periods

Vertical Unit: Million Renminbi (Chinese currency).

GDP: national domestic product.

CF: total credit fund available.

IR: benchmark interest rates.

PB: bank loans to public sector.

PR: bank loans to private sector.

According to the bank lending channel, the fall of total bank funds will worsen the lending situation, and banks would thus decrease the lending size. On the other hand, the increase of total bank funds will large the lending size and benefit the economy. This is represented by Figure 4.5. With a positive response to total bank funds (CF), the bank loans to the public sector (PB) show an immediate and significant increase in the first 2 quarters followed by a sharp decrease in the third quarter, then swing in such a band upward after that. The swing process of bank loans to the private sector (PR) is in a much smaller range compared to that of public sector, contrary to the response of public sector, PR goes down in the first 2 quarters and jumps in the next 3 quarters, then swing in a tighter band. Such different response patterns reveal the fact that the lending inclination is still to favor the public sector but not private sector in current China, the increase of total credit funds will greatly benefit the public sector first. What is more, I also see that the supply shocks from credit fund has a great impact to the public sector than that to the private sector, implying that public sector adjusts to the exogenous shocks very sensitively, however, the private sector has much smaller responses to such shocks. Of course, the public sector has the dominant advantage in financial market presently; it is much easier for public sector than private to obtain bank loans when total lending is increasing, and substitute bank loans from other financial finds when lending is cut back.

Response to Cholesky One S.D. Innovations

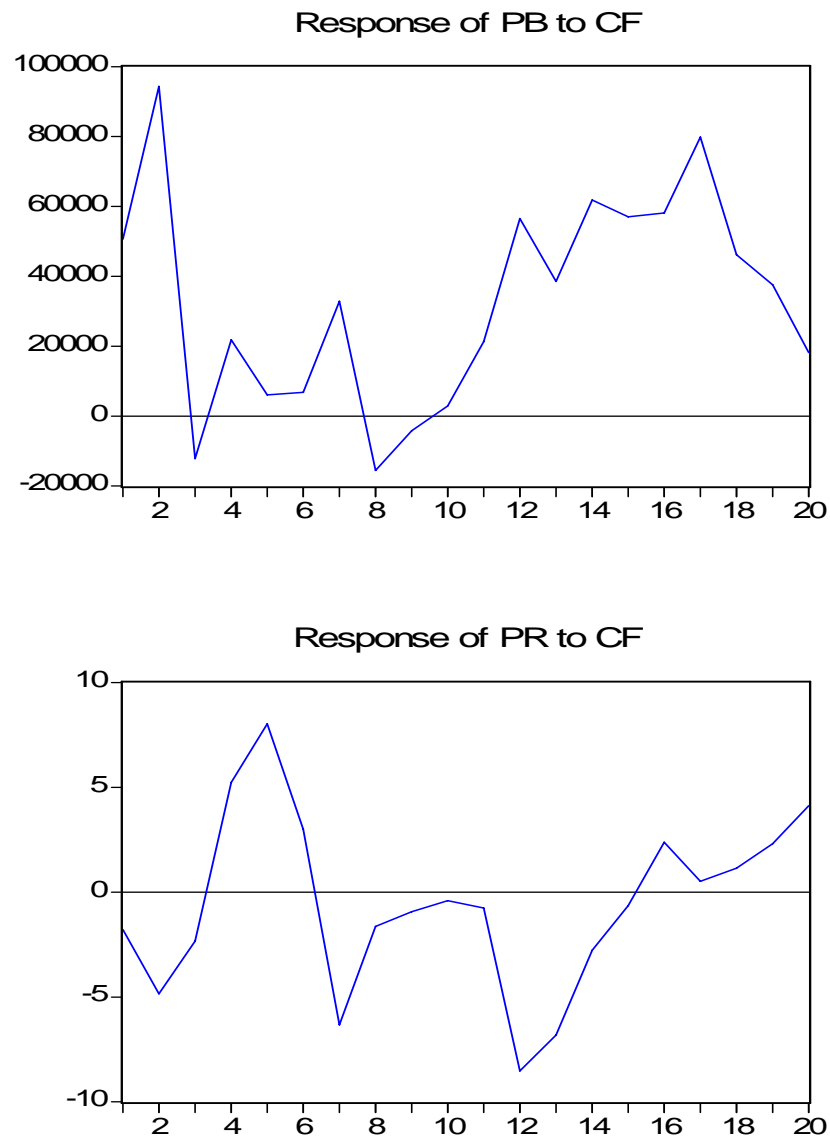


Figure 4.5. Impulse response of PB, PR to shocks of CF in 20 periods

Vertical Unit: Million Renminbi (Chinese currency).

CF: total credit fund available.

PB: bank loans to public sector.

PR: bank loans to private sector.

Moreover, I want to check if PB and PR have different effect on GDP, thus I run the impulse of GDP to the shock of PB and PR (see Figure 4.6), and compare the responses. I find that innovations of PR (credit to the private sector) have always had a stronger effect on GDP than that of PB (credit to the public sector) in most periods.

Generally I conclude this section that the credit channel (both bank lending channel and interest channel) appears to be operative in China in the short run. My impulse response results suggest that loan supply effect in addition to loan demand effect contribute to the propagation of a monetary policy tool (IR). It is also worth noting that the effect of the credit to private sector on real output (GDP) appears much stronger than that of the public sector, suggesting that monetary transmission has been more efficient in private sector than public sector.

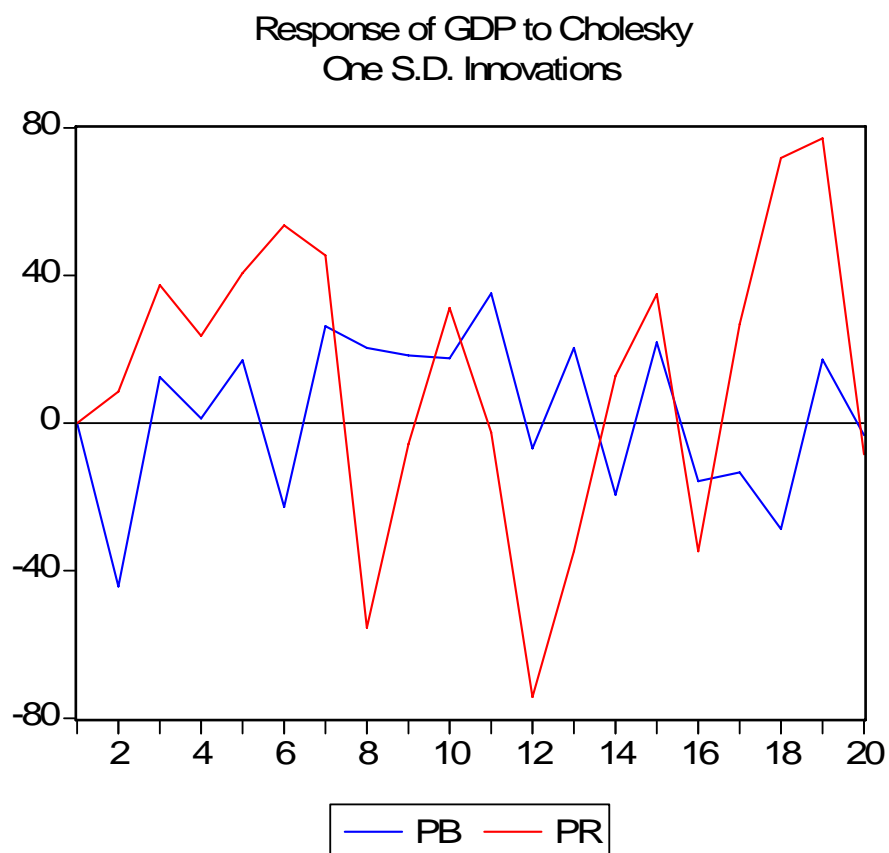


Figure 4.6. Impulse response of GDP to shocks of PB, PR in 20 periods

Vertical Unit: Million Renminbi (Chinese currency).

GDP: national domestic product.

PB: bank loans to public sector.

PR: bank loans to private sector.

Conclusion

Theoretical literature on monetary transmission suggests that the monetary policy can take effect on the real economy through several ways. The most noteworthy one is credit channels, including the bank lending channel and the interest channel (balance sheet channel).

In this study, I attempt to apply these theoretical insights to the case of China. Motivated by recent debate in identifying the credit channel, I first use the error correction model to check the long-run equilibrium, which could be interpreted as loan demand and loan supply equation by including separate controlling factors for loan demand and loan supply respectively as I address in section 4. Thereby the inherent identification problem in loan supply and demand has been solved explicitly. My long-run equilibrium results support the hypothesis that the credit channel is effective in the long run which work through the monetary transmission to the private sector. The credit channel interest channel and including bank lending channel is proved to function operatively in current China, indicating that central bank of China could take the effect on real economy by influencing the interest rates and bank loan supplied.

Moreover, I adopt the directed graph and impulse response analysis to investigate the contemporaneous and short-run dynamics among variables. My directed graph shows that both demand and supply shocks exist in contemporaneous time, and affect CF causing a change in PB in current time. Two points are worthy of further consideration. First, there are no innovations of any variable to cause a change in GDP,

indicating that it takes time for monetary policy to impact the real economy through credit channels. Second, the causality between PR and other variables cannot be identified in contemporaneous time. Current policy changes such as adjustment of the benchmark interest rate negatively cause change of total credit funds available, and thus change the bank loan supplied to the public sector, but bank loans supplied to the private sector seems unaffected. It is consistent with current situation of Chinese financial market in which the public sector raises the most capital. On the other side, the private sector obtains a much smaller share of total capital and it has become a severe problem for the development of the private sector in China.

My impulse response analysis supports a monetarist view that tightened bank lending will drive down the real output in the short run. I also find that innovations of PR (credit to private sector) have always had a stronger effect on GDP than PB (credit to the public sector) in most periods.

In summary, in both the short run and long run my results indicate that monetary policy has real effects through credit channel, and such effects are quantitatively important. I show that credit channels including both bank lending channel and interest channel are still operative and play a very important role in monetary transmission in the Chinese economy. I find that the credit channel might be sufficient to explain monetary transmission in China. This study provides useful guidance about the next step in studying the monetary transmission in China. With financial markets continuously developing, the credit channel still should be the reliable channel in the long run.

My empirical results also imply that there exists a great difference in the efficiency between monetary transmission to the private sector and the public sector in China. The credits allocated to the private sector contribute more significantly to the Chinese economy. Comparison of the different efficiency of the two sectors can provide policy makers with very useful information as to what sector is the main priority for credit distribution in the long run.

These findings have important policy implications to China's future development, given that high economic growth in China is always in doubt for its sustainability. As shown in this study, appropriate monetary policy through credit channel can play an important role in the economy in the short and long run. Moreover, to improve China's efficiency, further policy measures must be advanced to stimulate the development of the private sector, and provide greater lending support to both the private and public sector. I believe the development of monetary policy, through its credit channel to the private sector, can provide strong support to the growth of this emerging sector, which will in turn continuously foster China's economic development.

I realize that the rather short duration of these series may limit potential for achieving conclusive statistical results. I precede time series analysis mindfully that any results may have been improved had longer series of data been available.

An interesting question I might study in the future is if credit crunch is generated by greatly reducing deposits, should the monetary authority increase rather than decrease

the deposit rate during a credit crunch. This is the other debated question worthy of attention in the monetary transmission in China.

CHAPTER V

CONCLUSION

Based on the recent empirical studies addressing the essential question of effect of monetary policy on macro economy, it is likely that monetary policy has a substantial positive impact on economic growth. It has two important policy implications, especially for developing countries such as China.

1. To gain sustainable economic growth, it is desirable to further undertake monetary policy reforms
2. To take advantage of the positive interaction between monetary and economic development, government should develop the economy while reform the financial system. In other words, not only should it be addressed for developing monetary policy, policies that promote development in the real economy should also be emphasized.

This study finds that monetary policy actions transmitted through various interrelated channels have a significant impact on real economic activity, which means monetary policy does matter. But the bank lending channel currently appears to no longer be of aggregate importance in U.S. (i.e. the expansion of commercial/industrial loans does not result in aggregate output growth). The error correction model and causality analysis do not provide evidence supporting the hypothesis that the lending channel is currently aggregately effective, while we do show that that bank loans

together with investment still takes the neutral effect on the economy by attenuating the effect of interest channel in U.S.

In the case of China, our results indicate that monetary policy has real effects through credit channel including bank lending channel and interest channel, and such effects are quantitatively important. We show that credit channels are still operative and play a very important role in monetary transmission and China economy. We find that the credit channel might be sufficient to explain monetary transmission in China, and some other channels might not be operative at this time. The results provide useful guidance about the next step in studying the monetary transmission in China. With financial market continuously developing, the credit channel still should be the reliable channel in the long run.

Our empirical results also imply that there exists a great difference in the efficiency between monetary transmission to private sector and that to public sector in China: the credits allocated to the private sector contribute more significantly to China economy. Comparison of the different efficiency of two sectors can provide policy makers with very useful information as to what sector is the in priority for credit distribution in the long run.

REFERENCES

- Ali, S.M., and M.A. Hasan. "Is the Canadian Stock Market Efficient with Respect to Fiscal Policy? Some Vector Autoregression Results." *Journal of Economics and Business* 45(1993): 49-59.
- Allen, F., J. Qian, and M. Qian. "Law, Finance, and Economic Growth in China." *Journal of Financial Economics* 77 (2005): 57-116.
- Andrews, D.W. "Tests for Parameter Instability and Structural Change with Unknown Change Point." *Econometrica* 61(1993): 821-856.
- Andrews, D.W., and W. Ploberger. "Optimal Tests When a Nuisance Parameter Is Present Only Under the Alternative." *Econometrica* 62(1994): 1383-1414.
- Arestis, P., P.O. Demetriades, and K.B. Luintel. "Financial Development and Economic Growth: The Role of Stock Markets." *Journal of Money, Credit, and Banking* 33(2001): 16-41.
- Awokuse, T.O., and D.A. Bessler. "Vector Autoregressions, Policy Analysis, and Directed Acyclic Graphs: An Application to the U.S. Economy." *Journal of Applied Economics* VI(2003): 1-24.
- Beck, T., R. Levine, and N. Loayza. "Finance and the Sources of Growth." *Journal of Financial Economics* 58(2000): 261-310.
- Bernanke, B.S., and A. S. Blinder. "Credit, Money, and Aggregate Demand." *The American Economic Review* 78(1988): 435-439.

- Bernanke, B.S., and A.S. Blinder. "The Federal Funds Rate and the Channels of Monetary Transmission." *The American Economic Review* 82(1992): 901-921.
- Bernanke, B.S., and A.S. Blinder. "Measuring Monetary Policy." *The Quarterly Journal of Economics* 113(1998) 869-902.
- Bessler, D., and S. Lee. "Money and Prices: U.S. Data 1869-1914 (A Study with Directed Graphs)." *Empirical Economics* 27(2002): 427-446.
- Bessler, D., and J. Yang. "The Structure of Interdependence in International Stock Markets." *Journal of International Money and Finance* 22(2003): 261-287.
- Boschen, J., M. Richardson, and R.F. Whitelaw. "Industry Returns and the Fisher Effect." *The Journal of Finance* 49(1998): 1595-1616.
- Cecchetti, S.G. "Distinguish Theories of the Monetary Transmission Mechanism." *Federal Reserve Bank of St. Louis Review* 77(1995): 83-97.
- Chatrath, A., S. Ramchander, and F. Song. "Stock Prices, Inflation and Output: Evidence from India." *Journal of Asian Economics* 7(1996): 237-245.
- Chen, G., C.C.Y. Kwok, and O.M. Rui. "The Day-of-the-Week Regularity in the Stock Markets of China." *Journal of Mathematical Financial Management* 11(2001): 139-163.
- Chick, V. *Macroeconomics after Keynes: A Reconsideration of the General Theory*. Oxford, UK: Philip Allan, 1983.

- Christiano, L. J., M. Eichenbaum, and C.L. Evans. "Identification and the Effects of Monetary Policy Shocks." Federal Reserve Bank of Chicago Working Paper Series, Macroeconomic Issues with number 94-7, 1994.
- Chung, S., and P. Wei. "The Relationship between Bid-ask Spreads and Holding Periods: The Case of Chinese A and B Shares." *Global Finance Journal* 15(2005): 239-249.
- Darrat, A.F. "On Fiscal Policy and the Stock Market." *Journal of Money, Credit and Banking* 20(1988): 353-363.
- De Bondt, G.J. "Credit Channels in Europe: A Cross-Country Investigation." *Banca Nazionale Del Lavoro Quarterly Review* 210(1999): 295-326.
- Demirer, R., and A.M. Kutan. "Does Herding Behavior Exist in Chinese Stock Markets?" *Journal of International Financial Markets, Institution and Money* 16(2006): 123-142.
- Dropsy, V. and F. Nazarian-Ibrahimi. "Macroeconomic Policies, Exchange Rate Regimes and National Stock Markets." *International Review of Economics and Finance* 3(1994): 195-220.
- Ericsson, N.R., D.F., Hendry, and G.E., Mizon. "Exogeneity, cointegration, and Economic Policy Analysis." *Journal of Business and Economic Statistics* 16(1998): 370-387.
- Fama, E.F. "Stock Returns, Real Activity, Inflation and Money." *American Economic Review* 71(1981): 545-565.

- Fang, G. "Dynamic Interaction of Institution Transformation." Title Translated from Chinese, *Economic Study*, 1(2000): 1-19.
- Favero, C.A., and R. Rovelli. "Macroeconomic Stability and the Preferences of the Fed: A Formal Analysis, 1961-1998." *Journal of Money, Credit, and Banking* 35 (2003): 545-555.
- Gertler, M. and S. Gilchrist. "Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms." *Quarterly Journal of Economics* 109(1994): 309-340.
- Geske, R., and R. Roll. "The Monetary and Fiscal Linkage Between Stock Returns and Inflation." *Journal of Finance* 38(1983): 1-33.
- Girardin, E., and Z. Liu. "The Chinese Stock Market: A Casino with 'Buffer Zones'?" *Journal of Chinese Economic and Business Studies* 1(2003): 57-70.
- Glymour, C. "A Review of Recent Work on the Foundations of Causal Inference." In Vaughn McKim and Stephen Turner, eds. *Causality in Crisis*. The University of Notre Dame Press, 1997, pp. 201-248.
- Glymour, C., and G. F. Cooper. *Computation, Causation, & Discovery*. Menlo Park, CA: AAAI Press/The MIT Press, 1999.
- Granger, C.W.J. "Testing for Causality: A Personal Viewpoint." *Journal of Economic Dynamics and Control* 2(1980): 329-352.

Green. S., and J. Ho. "Old Stocks, New Owners: Two Cases of Ownership Change in China's Stock Market." *Journal of Chinese Economic and Business Studies* 2(2004): 267-280.

Groenewold. N. "The Efficiency of the Chinese Stock Market and the Role of the Banks." *The Journal of Asian Economics* 14(2003): 593-609.

Guillaumont Jeanneney, S., P. Hua, and Z., Liang. "Financial Development, Economic Efficiency, and Productivity Growth: Evidence from China." *The Developing Economics* XLIV-1 (2006): 27-52.

Guiso, L., P. Sapienza, and L. Zingales. "Does Local Financial Development Matter?" National Bureau of Economic Research, working Paper No. 8923, 2002.

Hamilton, N.D. *Time Series Econometrics*. Princeton, NJ: Princeton University Press, 1994.

Hancock. D.G. "Fiscal Policy, Monetary Policy and the Efficiency of the Stock Market." *Economics Letter* 31(1989): 65-69.

Hicks, J. *A Theory of Economic History*. Oxford, UK: Clarendon Press, 1969.

Hoover, K.D. "The Logic of Causal Inference, Econometrics and the Conditional Analysis of Causation." *Economics and Philosophy* 6(1990): 207-231.

Hoover, K.D. "The Causal Direction between Money and Prices." *Journal of Monetary Economics* 27(1991): 381-423.

- Hoover, K.D., and S.J. Perez. "Post Hoc Ergo Propter Hoc Once More: An Evaluation of 'Does Monetary Policy Matter?' in the Spirit of James Tobin." *Journal of Monetary Economics* 34(1994): 47-74.
- Hoover, K.D. "Automatic Inference of the Contemporaneous Causal Order of a System of Equations." *Econometric Theory* 21(2005):69-77.
- Ireland, P.N. "Interest Rates, Inflation, and Federal Reserve Policy since 1980." *Journal of Money, Credit and Banking* 32(2000): 417-434.
- James, C., S. Koreisha, and M. Partch. "A VARMA Analysis of the Causal Relations among Stock Returns, Real Output, and Nominal Interest Rates." *Journal of Finance* 40(1985): 1375-1384.
- Johansen, S. "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models." *Econometrica* 59(1991): 1551-1580.
- Johansen, S., and K. Juselius. "Identification of the Long-Run and Short-Run structure: An Application to the ISLM Model." *Journal of Econometrics* 63(1994): 7-36.
- Johansen, S. "Identifying Restrictions of Linear Equations with Applications to Simultaneous equations and cointegration." *Journal of Econometrics* 69(1995):111-132.
- Jorge, A., C. Lau, and Z. Chen. "Financial Crisis and Credit Crunch as a Result of Inefficient Financial Intermediation – with Reference to the Asian Financial Crisis." IMF Working Paper, 1998.

- Juselius, K. "Do Purchasing Power Parity and Uncovered Interest Rate Parity Hold in the Long Run? An Example of Likelihood Inference in a Multivariate Time-Series Model." *Journal of Econometrics* 69(1995): 211-240.
- Kakes, J.I. *Monetary Transmission in Europe*. Centenham: Edward Elgar, 2000.
- Kalai, G. "Learnability and Rationality of Choice." *Journal of Economic Theory*, 113(2003), Pages 104-117.
- Karmel, S.M. "Emerging Securities Markets in China: Capitalism with Chinese Characteristics" *The China Quarterly* 140 (1994): 1105-1120
- Kashyap, A.K., and J.C. Stein. "Monetary Policy and Bank Lending." In N. Gregory Mankiw, eds. *Monetary Policy*. The University of Chicago Press, 1994, pp. 221-256.
- Kashyap, A.K., and J.C. Stein. "What Do A Million Observations on Banks Say About the Transmission of Monetary Policy?" *American Economic Review* 90(2000): 407-428.
- Kierzenkowski, R. "The Multi-Regime Bank Lending Channel and the Effectiveness of the Polish Monetary Policy Transmission During Transition." *Journal of Comparative Economics* 33(2005): 1-24.
- Kim, E. H., and V. Singal. "Stock Market Opening: Experience of Emerging Economics." *The Journal of Business* 73(2000): 25-66.
- Kishan, R.P., and T.P. Opiela. "Bank Size, Bank Capital and the Bank Lending Channel." *Journal of Money, Credit and Banking* 32(2000): 121-141.

- Laitner, J., and D. Stolyarov. "Technological Change and the Stock Market." *The American Economic Review* 93(2003): 1240-1267.
- Lang, W.W., and L. Nakamura. "'Flight to Quality' in Bank Lending and Economic Activity." *Journal of Monetary Economics* 36 (1995): 145-164.
- Layaratne, J., and P.E. Strahan. "The Finance-Growth Nexus: Evidence from Bank Branch Deregulation." *Quarterly Journal of Economics* 111(1996): 639-670.
- Lee, B.S. "Causal Relations among Stock Returns, Interest Rates, Real Activity, and Inflation." *The Journal of Finance* 47(1992), 1591-1603.
- Leitemo, K., O. Roisland, and R. Torvik. "Time Inconsistency and the Exchange Rate Channel of Monetary Policy." *The Scandinavian Journal of Economics* 104 (2002): 391-398.
- Levine, R., and S. Zervos. "Stock Markets, Banks, and Economic Growth." *The American Economic Review* 88(1998): 537-558.
- Lucas, R.E. "On the Mechanics of Economic Development." *Journal of Monetary Economics* 22(1988): 3-42.
- Lutkepohl, H., and H. Reimers. "Impulse Response and Forecast Analysis of Cointegrated Systems." *Journal of Economic Dynamics and Control* 16(1992): 53-78.

- Ma, J., and D. Folkerts-Landau. “China’s Financial Liberalization Agenda.” Research Report May 2001, Global Markets Research, Deutsche Bank, Hong Kong.
- MoKinnon, R.I. *Money and Capital in Economic Development*. Washington, DC: Brookings Institution, 1973.
- Morgan, D.P. “The Credit Effects of Monetary Policy: Evidence Using Loan Commitments.” *Journal of Money, Credit and Banking* 30(1998): 102-118.
- Morris, C.S., and H.S. Gordon. “Bank Lending and Monetary Policy: Evidence on a Credit Channel.” *Federal Reserve Bank of Kansas City Economic Review* 80(1995): 59-74.
- Narayan, P. K. “The Saving and Investment Nexus for China: Evidence from Cointegration Tests.” *Applied Economics* 37(2005): 1979-1990.
- Oliner, S.D., and G.D. Rudebusch. “Monetary Policy and Credit Contractions: Evidence from the Composition of External Finance: Comment” *American Economic Review* 8(1996): 300-309.
- Pearl, J. “Causal Diagrams for Empirical Research.” *Biometrika* 82 (1995): 669-710.
- Pearl, J. “Graphs, Structural Models, and Causality.” *Computation, Causation, & Discovery*. AAAI Press/The MIT Press, 1999.
- Pearl, J. *Causality*, Cambridge, MA: Cambridge University Press, 2000.
- Peek, J., E. S. Rosengren, and G. M. B. Tootell. “Identifying the Macroeconomic Effect of Loan Supply Shock.” *Journal of Money, Credit, and Banking* 35(2003): 931-946.

- Perez, S. J. "Causal Ordering and the Bank Lending Channel." *Journal of Applied Econometrics* 13(1998): 613-626.
- Qin, D., P. Quising, X. He, and S. Liu. "Modeling Monetary Transimssion and Policy in China." *Journal of Policy Modeling* 27(2005): 157-175.
- Rajan, R.G., and L. Zingales. "Financial Dependence and Growth." *American Economic Review* 88(1998): 559-586.
- Real Estate Financial Analysis Group in Peoples Bank of China (PBC). "China Real Estate Financial Report 2004" In Chinese from PBC website 2006.
- Robinson, J. "The Generalization of the General Theory." In *The Rate of Interest, and Other Essays*, London, UK: Macmillan, 1952, pp. 67-142.
- Romer, C. D., and D. H. Romer. "New Evidence on the Monetary Transmission Mechanism." *Brookings Papers on Economic Activity*, 1990, pp. 149-214.
- Romer, C. D., and D. H. Romer. "Monetary Policy Matters." *Journal of Monetary Economics* 34 (1994): 75-88.
- Rousseau, P.L., and P. Wachtel. "Financial Intermediation and Economic Performance: Historical Evidence from Five Industrial countries." *Journal of Money, Credit, and Banking* 30(1998): 657-678.
- Seddighi, H.R., and W. Nian. "The Chinese Stock Exchange Market: Operations and Efficiency." *Applied Financial Economics* 14(2004): 785-797.

- Seo, B. "Tests for Structural Change in Cointegrated Systems." *Econometric Theory* 14(1998): 222-259.
- Shi, J.H. "Financial Innovations in China." Working Paper E20001006 at China Center for Economic Research, 2001.
- Simon, H.A. Causal Ordering and Identifiability. Reprinted in *Models of Man*. New York, NY: Wiley, 1957.
- Sims, C. "Macroeconomics and Reality." *Econometrica* 48(1980): 1-48.
- Sprites, P., C. Glymour, and R. Scheines. *Causation, Prediction, and Search*. Cambridge, MA: The MIT Press, 2000.
- Stulz, R.M. "Asset Pricing and Expected Inflation." *Journal of Finance* 41 (1986): 209-223.
- Swanson, N.R., and C.W.J. Granger. "Impulse Response Functions Based on a Causal Approach to Residual Orthogonalization in Vector Autoregression." *Journal of the American Statistical Association* 92(1997): 357-367.
- Tevlin, S., and K. Whelan. "Explaining the Investment Boom of the 1990s." *Journal of Money, Credit and Banking* 35(2003): 1-22.
- Thorbecke, W., and L. Coppock. "Monetary Policy, Stock Returns, and the Role of Credit in the Transmission of Monetary Policy" Working Paper No.133, 1999.
- Thorbecke, W. "On Stock Market Returns and Monetary Policy" *The Journal of Finance* 52(1997): 635-654.

- Tobin, J. "A General Equilibrium Approach to Monetary Theory." *Journal of Money, Credit, and Banking* 1(1969): 15-29.
- Tsui, A.K., and Q. Yu. "Constant Conditional Correlation in a Bivariate GARCH Model: Evidence from the Stock Markets of China." *Mathematics and Computers in Simulation* 48(1999): 503-509.
- Wang, Z., and D.A. Bessler. "A Monte Carlo Study on the Selection of Cointegrating Rank Using Information Criteria." *Econometric Theory* 21(2005):593-620.
- Weise, C.L. "The Asymmetric Effects of Monetary Policy: A Nonlinear Vector Autoregression Approach." *Journal of Money, Credit and Banking* 31(2004): 85-108.
- Woo, W.T. "The Real Reasons for China's Growth." *The China Journal* 41 (1999): 115-137.
- Yang, J., H. Guo, and Z. Wang. "International Transmission of Inflation among G-7 Countries: A Data-determined VAR Analysis." *Journal of Banking & Finance* 30(2006): 2681-2700.
- Yuan, M.W., and C. Zimmermann. "Credit Crunch, Bank Lending, and Monetary Policy: A Model of Financial Intermediation with Heterogeneous Projects." CREFE—Working Paper No. 89, 1999.
- Zhu, H., Z. Lu, S. Wang, and A. Soofi. "Causal Linkages among Shanghai, Shenzhen, and Hong Kong Stock Markets." *International Journal of Theoretical and Applied Finance* 7(2004): 135-149.

APPENDIX A

One step Schwartz Loss Criteria (SLC) by Lags on the Number of cointegrating vectors (r) and model specifications fit over the whole period 1950:Q1-2003:Q3

Rank	Models				
	No intercept No trend ¹	Intercept No trend I ²	Intercept No trend II ³	Intercept Trend I ⁴	Intercept Trend II ⁵
-----Lag 1-----					
1	29.88382	29.87862*	29.96190	29.87913	29.93264
2	29.95153	29.95474	30.01312	29.94704	30.00344
3	31.12462	31.14790	30.19161	30.14141	30.17754
-----Lag 2-----					
1	30.08731	30.06951	30.13975	30.04477	30.13178
2	30.22458	30.22498	30.27049	30.19175	30.25736
3	30.38920	30.40432	30.44763	30.39070	30.43155
-----Lag 3-----					
1	30.22887	30.23516	30.30838	30.26469	30.33248
2	30.37361	30.38810	30.44020	30.40986	30.45712
3	30.54799	30.58555	30.61368	30.60836	30.65041
-----Lag 4-----					
1	30.63633	30.64632	30.71251	30.68558	30.75451
2	30.79797	30.81156	30.85645	30.84877	30.89249
3	30.98229	31.01693	31.04558	31.05162	31.08907
-----Lag 5-----					
1	30.86568	30.87335	30.94412	30.94810	30.99850
2	31.02109	31.04419	31.09529	31.10505	31.13466
3	31.21649	31.24201	31.27546	31.30959	31.33342

Note that one step Schwartz Loss criterion picked model specification 2, while SUP-LM test about this specification is not available, so I chose the closest specification 1.

- ¹ Test assumes no deterministic trend in data, and no intercept or trend in cointegrating equation (CE) or test VAR;
- ² Test assumes no deterministic trend in data, have intercept (no trend) in CE, but no intercept in VAR;
- ³ Test allows for linear deterministic trend in data, and assume intercept (no trend) in CE and test VAR;
- ⁴ Test allows for linear deterministic trend in data, and assume intercept and trend in CE, but no trend in VAR;
- ⁵ Test allows for quadratic deterministic trend in data, and assume intercept and trend in CE and linear trend in VAR.

APPENDIX B

One step Schwartz Loss Criteria (SLC) by Lags on the number of cointegrating vectors (r) and model specifications fit over the period 1955:Q4 – 1968:Q3

Rank	Models				
	No intercept No trend ¹	Intercept No trend I ²	Intercept No trend I ³	Intercept Trend I ⁴	Intercept Trend II ⁵
-----Lag 1-----					
1	22.06027*	22.13062	22.29849	22.37199	22.46612
2	22.35688	22.50316	22.63935	22.77578	22.79814
3	22.83218	22.98631	23.11242	23.21865	23.22390
-----Lag 2-----					
1	23.07550	23.10828	23.32026	23.36563	23.42762
2	23.41031	23.51810	23.72920	23.81777	23.82641
3	23.91123	24.03153	24.17947	24.30509	24.30071
-----Lag 3-----					
1	24.33124	24.35453	24.56916	24.60901	24.69353
2	24.75197	24.75579	24.93359	25.01029	25.10581
3	25.21949	25.28070	25.41471	25.56382	25.66258
-----Lag 4-----					
1	25.65205	25.52628	25.77665	25.82283	25.79758
2	25.89343	25.78933	25.98415	26.08525	26.14566
3	26.34611	26.26985	26.45418	26.60680	26.64658
-----Lag 5-----					
1	26.66565	26.20318	26.48966	26.53115	26.53142
2	26.89677	26.47735	26.72361	26.81841	26.95869
3	27.38849	27.02698	27.21410	27.35936	27.45560

Note: For models specification, check Appendix A.

APPENDIX C

One step Schwartz Loss Criteria (SLC) by Lags on the number of cointegrating vectors (r) and model specifications fit over the period 1981:Q4-2003:Q3

Rank	Models				
	No intercept No trend ¹	Intercept No trend I ²	Intercept No trend rr ³	Intercept Trend I ⁴	Intercept Trend II ⁵
-----Lag 1-----					
1	31.84932	31.78269	31.76133*	31.79802	31.96197
2	32.05032	31.90609	31.99899	32.04449	32.16116
3	32.35547	32.25855	32.31217	32.34221	32.43077
-----Lag 2-----					
1	32.27828	32.24965	32.35850	32.31626	32.46702
2	32.51003	32.43031	32.53818	32.49394	32.62524
3	32.88717	32.84172	32.91099	32.84673	32.93352
-----Lag 3-----					
1	32.84437	32.86444	33.01398	33.01755	33.16729
2	33.17256	33.12262	33.22219	33.26832	33.38508
3	33.52241	33.52314	33.60062	33.66738	33.73475
-----Lag 4-----					
1	33.66371	33.70071	33.85043	33.86292	34.01807
2	33.96099	34.00988	34.11109	34.16440	34.28825
3	34.32409	34.37852	34.45355	34.55657	34.63190
-----Lag 5-----					
1	34.23890	34.28624	34.43404	34.46466	34.57964
2	34.56255	34.60067	34.72762	34.80872	34.88625
3	34.92804	34.98264	35.07308	35.20499	35.24226

Note: For models specification, check Appendix A.

APPENDIX D

One step Schwarz Loss Criteria (SLC) by Lags on the number of cointegrating vectors I and model specifications fit over the whole period Jan. 1997 - Aug. 2005

Rank	Models				
	No intercept No trend ¹	Intercept No trend I ²	Intercept No trend II ³	Intercept Trend I ⁴	Intercept Trend II ⁵
-----Lag 1-----					
1	-11.76184	-11.72006	-11.54451	-11.66872	-11.50748
2	-11.82075	-11.92959*	-11.79949	-11.87840	-11.76138
3	-11.78021	-11.91783	-11.83297	-11.91374	-11.84150
4	-11.45165	-11.69805	-11.65878	-11.70610	-11.67952
5	-11.02761	-11.27578	-11.27578	-11.31116	-11.31116
-----Lag 2-----					
1	-11.43870	-11.41660	-11.24124	-11.31957	-11.16679
2	-11.42304	-11.39402	-11.2647	-11.36917	-11.26171
3	-11.22015	-11.32106	-11.23765	-11.32802	-11.26642
4	-10.80262	-10.98676	-10.9494	-11.03024	-11.01325
5	-10.34572	-10.49390	-10.4939	-10.55792	-10.55792
-----Lag 3-----					
1	-10.93764	-10.89142	-10.7163	-10.82193	-10.67744
2	-10.74202	-10.80924	-10.68027	-10.74515	-10.64684
3	-10.47747	-10.54284	-10.45965	-10.64959	-10.59758
4	-10.03311	-10.14942	-10.11164	-10.28738	-10.27499
5	-9.56915	-9.64815	-9.64815	-9.81195	-9.81195
-----Lag 4-----					
1	-10.42730	-10.38079	-10.20645	-10.18759	-10.03216
2	-10.11136	-10.20318	-10.07559	-10.13242	-10.02245
3	-9.77295	-9.83412	-9.75247	-9.93494	-9.86913
4	-9.32429	-9.39813	-9.36320	-9.50030	-9.48067
5	-8.86064	-8.89708	-8.89708	-9.01298	-9.01298

	-----Lag 5-----				
1	-9.62344	-9.58922	-9.41301	-9.39167	-9.24818
2	-9.29745	-9.36447	-9.23528	-9.22550	-9.12657
3	-8.91970	-8.95229	-8.86779	-9.00020	-8.94733
4	-8.46216	-8.51218	-8.47453	-8.56994	-8.56421
5	-7.99054	-8.00329	-8.00329	-8.09478	-8.09478

Note: For models specification, check Appendix A.

APPENDIX E

Estimates of ECM during the Period Jan. 1997 – Aug. 2005

Note: T-statistics are included in parenthesis.

$$\begin{bmatrix} \Delta VAG \\ \Delta SRG \\ \Delta INF \\ \Delta MSG \\ \Delta BDG \end{bmatrix} = \begin{bmatrix} -1.510 & -0.034 \\ (-9.156) & (-2.954) \\ 0.175 & -0.442 \\ (0.505) & (-1.820) \\ 0.105 & 0.012 \\ (4.282) & (4.086) \\ 0.184 & -0.018 \\ (4.086) & (-5.840) \\ 33.136 & 0.470 \\ (1.328) & (0.269) \end{bmatrix} \begin{bmatrix} 1 & 0.000 & 0.139 & -1.794 & -0.001 & 0.002 \\ & & (0.296) & (-5.467) & (-0.735) & (0.475) \\ 0.000 & 1 & -45.742 & 41.156 & -0.014 & -0.521 \\ & & (-5.928) & (7.696) & (-0.853) & (-7.098) \\ & & & & & 1 \end{bmatrix} \begin{bmatrix} VAG(-1) \\ SRG(-1) \\ INF(-1) \\ MSG(-1) \\ BDG(-1) \\ 1 \end{bmatrix} \\
 + \begin{bmatrix} 0.125 & -0.014 & -0.552 & -0.571 & -0.002 \\ (1.169) & (-0.350) & (-0.929) & (-1.620) & (-2.542) \\ 0.158 & -0.505 & 0.330 & 0.924 & 0.001 \\ (0.670) & (-5.815) & (0.264) & (1.247) & (0.554) \\ -0.032 & -0.004 & -0.155 & -0.192 & 0.0002 \\ (-1.981) & (-0.657) & (-1.745) & (-3.650) & (1.773) \\ -0.094 & -0.006 & -0.672 & -0.095 & -0.0003 \\ (-3.201) & (-0.505) & (-4.142) & (-0.985) & (-1.318) \\ -19.696 & 7.960 & -3.654 & 11.661 & -0.832 \\ (-1.213) & (1.275) & (-0.041) & (0.219) & (-7.841) \end{bmatrix} \begin{bmatrix} \Delta VAG(-1) \\ \Delta SRG(-1) \\ \Delta INF(-1) \\ \Delta MSG(-1) \\ \Delta BDG(-1) \\ 1 \end{bmatrix}$$

APPENDIX F

One step Schwarz Loss Criteria (SLC) by Lags on the number of cointegrating vectors I and model specifications fit over the whole period 1997:Q1-2006:Q1

Rank	Models				
	No intercept No trend ¹	Intercept No trend I ²	Intercept No trend II ³	Intercept Trend I ⁴	Intercept Trend II ⁵
-----Lag 1-----					
1	71.57951	71.66871	71.68147	71.77866	71.33064
2	71.62170	71.78709	71.70304	71.89666	71.72248
3	71.98073	72.22853	72.38925	72.46353	72.35970
-----Lag 2-----					
1	71.06130	68.40003	68.45861	68.47091	68.04470
2	70.85077	68.28022	68.33159	68.41677	68.18655
3	71.07874	68.60925	68.63042	68.81386	68.52695
-----Lag 3-----					
1	68.40656	68.37601	68.69303	68.64215	68.07586
2	68.72368	68.21298	68.42580	68.31941	67.69355*
3	69.16640	68.63666	68.74473	68.21674	67.97580

Note: For models specification, check Appendix A.

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