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Identifying the bank lending channel in a small open economy

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Abstract

This paper attempts to provide an alternative method of identifying the bank lending channel in a small open economy at the aggregate level, with emphasis on the degree of the asset substitutability. By testing the long-run relationships underlying a general equilibrium model, our results show that, in the Canadian economy, the bank lending channel plays a role during the financial regulatory period (1970:Q3-1988:Q1) but becomes ineffective during the deregulated period (1988:Q2-2006:Q2). Our findings confirm the prediction of the theory that change in Canadian financial structure matters for change in its transmission of monetary policy.

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1. Introduction

The topic of monetary policy and how it affects aggregate economic activity are always popular and often controversial. There is considerable uncertainty and disagreement regarding the precise mechanism by which monetary policy affects economic activities, and policy may work through several channels (Mishkin, 1995).

Since 1992 oil price and real estate price shocks lead to the 'credit crunch' in the United States and other countries, a large body of literature has put much attention to the credit channel of monetary transmission. Comparing to the traditional interest rate channel (or called money view), the credit channel emphasizes the role of the financial market imperfections and informational asymmetries between borrowers and lenders in monetary transmission mechanism (Bernanke and Gertler, 1995). Two possible sub-channels have been explored. One is the bank lending channel (or lending view) which refers to how a change in monetary policy influences banks' willingness to provide loans. The other is the bank balance sheet channel (or net worth channel) which focuses on the potential impact of monetary policy on banks' (firms') balance sheets and their abilities to lend (borrow).

Disentangling shifts in credit supply from credit demand has been one of the most controversial areas in debates about the bank lending channel because similar outcomes can be observed even when the money view solely operates. Suppose that a monetary contraction decreases aggregate demand through the traditional interest rate channel, and consequently the demand for loans. While the lending view implies that banks cut back on lending simply because they have less money to lend in the wake of monetary contraction. As such, the cutback of bank loans does not provide direct evidence on the shift in loan supply, rather than the shift in demand. This identification problem is referred to as the supply-versus-demand puzzle by Bernanke (1993).

This paper aims to provide one method of identifying the bank lending channel in a small open economy at the aggregate level, with emphasis on the degree of the asset substitutability. A number of primarily US-oriented studies over the last decade have tested the bank lending channel by examining timing relationship between quantity/price variable and monetary policy variable. According to the first alternative, Bernanke and Blinder (1992) apply a VAR analysis to examine the impulse responses to a positive innovation in the US Federal funds rate. They find that an immediate decrease in securities and deposits and a delayed decline in bank loans, and that both a rebuilding of bank securities holdings and a further decline in loans over a somewhat longer time period essentially match the reduction of deposits. Their results however fail to isolate the bank lending channel from the interest rate channel, since loans respond with the same lag as unemployment to a policy shock.

In an attempt to solve for the identification problem, Kashyap et al. (1993) examine the movements in the mix between bank loans and commercial paper following monetary policy changes. They define the 'mix' variable as the ratio of bank loans to the sum of bank loans and commercial paper, and argue that the supply-based contraction of bank loans forces borrowers to substitute away from bank loans into commercial paper, thereby causing the 'mix' variable to drop. The fall of the 'mix' variable does not necessarily imply a leftward shift of loan supply curve; however, it is possible that the demand for commercial paper substantially increases relative to the demand for bank loans. If there are certain sorts of heterogeneities in credit demand, Kashyap et al. (1993)

may be subject to the same identification problem.

Besides, Suzuki (2004) suggests that observing the price of loans will help solve the supply-versus-demand puzzle behind the change in the quantity of loans. Thus, a negative correlation in movements between the price and the quantity identifies a shift of the supply schedule; whereas a positive correlation in movements between the price and the quantity identifies a shift of the demand schedule. He also adopts an alternative measure of loan prices but ignores some properties of time series, such as non-stationarity.

Overall, a common shortcoming of the above-mentioned studies for identifying a bank lending channel using aggregate data is that they focus on short-run responses, which may not be very informative when they ignore the long-run relationship. Some researchers instead focus on cross-section data to explore some of the distributional effects of the lending view, namely that the responses of banks to changes in monetary policy may differ from their characteristics, such as asset sizes, liquidity strength and capitalization (Kashyap and Stein, 1995, 2000; Ehrmann et al., 2001). These studies capture asymmetries in loan supply behavior by examining reduced form equations on the basis of bank level data. However, the implicit assumption is that loan supply shifts can be identified when asymmetries are present. Due to data limitations, the observed asymmetries cannot be directly linked to the output responses of firms that borrow from a particular size category of banks; therefore, their implications for aggregate economic activity and the transmission mechanism are not clearly visible. Thus, empirical research based on aggregate data still yields valuable insights.

To reach our goal, we first modifies Chang's (2008) framework to develop a general equilibrium model of a small open economy, incorporating bank lending channel, then derive the long-run relationships underlying the theory, and thereby form our testable hypotheses. Empirically, we use Canadian data over the period from 1970:Q3 to 2006:Q2 and adopt a multivariate cointegration method (Johansen and Juselius, 1990, 1994) to examine the existence of the bank lending channel. Our results show that the bank lending channel plays a role during the financial regulatory period (1970:Q3-1988:Q1) but becomes ineffective during the deregulated period (1988:Q2-2006:Q2). This confirms the prediction of the theory that change in financial structure matters for variation in transmission of monetary policy. Finally, this research lessons may benefit policy makers in countries where the banking system plays a more important role in credit allocations.

The remainder of this paper proceeds as follows. Section 2 lays out the econometric specification, describes the data and carries out the empirical analyses. Last section draws our conclusions.

2. The Empirical Analysis

2.1 Econometric Specification

To deal with the above-mentioned identification problem, we provide an alternative theoretical basis of exploring the long-run relationship for assessing the importance of the bank lending channel by discriminating the loan supply specification from other equilibrium conditions and by directly examining the substitutability in portfolios. The two long-run equilibrium conditions are written in the following quasi-reduced form:[1]

[1] The details for theoretical model are upon the request.

$$\hat{y}^d = f_\ell \hat{\ell}^d + f_d \hat{d}^s + f_\varepsilon(\hat{e} - \hat{p}), \quad (1)$$

$$\hat{\ell}^s = \hat{d}^d + \gamma_\ell \hat{i}^\ell - \gamma_b \hat{i}, \quad (2)$$

where a variable with ^ denotes the log-linearized deviation around its steady state while all parameters are positive and stand for the elasticity.

Equation (1) reveals that the demand for output $\hat{y}^d$ is positively related to the firm's demand for real loans $\hat{\ell}^d$, real deposit (money) supply $\hat{d}^s$ and real exchange rate $(\hat{e} - \hat{p})$. This relationship comes from the equilibrium conditions in commodity and deposit (money) markets, balance of payments, and loan demand function. Equation (2) depicts a loan supply function, representing that the real bank loan supply $\hat{\ell}^s$ is determined by the bank's demand for real deposits $\hat{d}^d$, loan rate $\hat{i}^\ell$ and bond rate $\hat{i}$.

As mentioned in Bernanke and Blinder (1988) and Bernanke and Gertler (1995), the bank lending channel is operative when bank loans and government bonds are imperfect substitutes, leading both the loan rate and bond rate to be unequal. In one extreme case of both loan and bond rates equal to infinity (such as, $\gamma_\ell = \gamma_b = \infty$), neither the loan demand function nor loan supply function can be separately defined, meaningless to address the bank lending channel. Another extreme case of both loan and bond rates equal to zero implies that the demand for bank loans do not affect the demand for output, violating the viewpoint of the bank lending channel. Thus, the system of Equations (1) and (2) allows us to construct the theoretical basis for a direct test of the bank lending channel. One is to verify that the parameter on the demand for real loans f_ℓ is significantly different from zero in Equation (1); the other is to identify that the structural parameters are the same as shown in Equation (2). In this context, testing for the existence of a bank lending channel implies to test for restrictions on estimated cointegrating vectors using multivariate cointegration techniques (Johansen and Juselius, 1990, 1994).

2.2 Data and Estimation Results

This empirical analysis focuses on the characteristics of the Canadian monetary transmission mechanism over the last three decades by means of a vector error-correction model. Canada is used as an interesting case study in the current paper because the Canadian economy has a relatively small size and high degree of openness to international financial market, especially to the US. Since shocks from Canada probably affect its own economy but little influence on other countries, by construction. Parallel to other industrial countries, on the other hand, the Canadian financial system has experienced some marked changes over the last two decades as a result of financial deregulation, innovation and disintermediation (Freedman and Engert, 2003; Calmes, 2004). For example, the Canadian financial system has become more market-based, as corporations have increased the use of direct (or market) financing compared to indirect (or intermediated) financing. Alternatively, there has been an increase in household's access to credit, reflected in a rise in consumer and mortgage credit. This transformation has likely affected the transmission of monetary policy. Our analysis with a richer financial sector can significantly contribute to the discussion on policy issues in a small open economy such as Canada.

All series in this work are seasonally adjusted data for Canada over the period from

1970:Q3, the beginning of the floating exchange rate period, to 2006:Q2, the time period before stepping into the subprime crisis, and have been collected from the *International Financial Statistics* CD-ROM database. According to our theoretic framework, the series include the real gross domestic product (*lrgdp*), the real demand deposits (*lrde*), the real claims on private sector (*lrln*), the real exchange rate (*lrxr*), the consumer price index (*cpi*), the rate on prime loans (*loanr*), the over-10-year government bond yield (*br*), and the US 10-year government bond yield (*fbr*). The first four variables are constructed from their nominal variables deflated by the consumer price index (*cpi*) and transformed in logarithms. And interest variables are represented in a percentage point. The nominal exchange rate is Canadian dollars measured in US dollars. Hence, an increase in the exchange rate means an appreciation of the Canadian currency against the US currency. The exchange rate is an important variable for modeling the transmission of monetary policy, especially for a small open economy, because it accounts for the openness of the Canadian economy and captures interaction with the rest of the world. While the US 10-year bond yield (*fbr*) is the only oversea variable here, serving as a proxy for the international linkage. This simplified setting of foreign variable allows us to focus on the identification of monetary transmission in a small open economy. The details for data description are placed in Table 1.

Table 1. Data Description

Notation	Variable	Descriptor	Code
gdp	Nominal gross domestic product	Seasonally adjusted	15699B.CZF...
cpi	Consumer price index	All cities population over 30,000	15664...ZF...
m3	M3	Seasonally adjusted	15659MCFZF...
cu	Currency	Currency outside banks	15614A..ZF...
nlq	Loans	Claims on private sector	15622D..ZF...
loanr	Lending rate	CHTD BKs' rate on prime loans	15660P..ZF...
br	Bond rate	Over 10 years	15661...ZF...
fbr	US bond rate	10 years	11161..ZF
nxr	Nominal effective exchange rate	Unit-labor-cost-based index	156..NEUZF…

Notes: The Canadian data comes from the International Financial Statistics (IFS) CD-ROM and covers the period from 1970:Q3 to 2006:Q2. The data is further transformed as: *lrgdp* = log(*gdp*/*cpi*), *lrde* = log((*m3*-*cu*)/*cpi*), *lrln* = log(*nlq*/*cpi*), and *lrxr* = log(*nxr*/*cpi*).

The data above are first analyzed to determine the best statistical approximation for the time series process of their long-run components; i.e., the integration properties of the time series. We apply two types of unit root tests to justify these series: the augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test. All specifications include a constant term, either without or with a trend, and up to twelve lags. The lag length for the ADF test is chosen on the basis of the AIC to purge serial correlation to the extent

possible; the Newey-West bandwidth for PP test is based on Bartlett kernel method. From both the results of ADF and PP tests, all series in levels cannot reject the null hypothesis of unit roots at the 5% significant level, while their first-differenced series reject the null. In other words, the series are all integrated of order one; that is, I(1).

The next step in the analysis is to determine whether these variables share any common stochastic trends. We conduct the analysis using Johansen procedure on the system of seven variables. To do so, we set up an initial VAR and include a constant. We use an AIC and a likelihood ratio test to choose the optimal lag length of the VAR process. The results suggest one lag as our optimal length of a first-differenced VAR system. We then use the Johansen cointegration test to determine the number of cointegration relations among the variables in levels. This procedure provides two separate test statistics: the trace statistic and the maximum eigenvalue statistic. At the 5% significance level, both tests indicate the existence of either two or three vectors in all cases of data trend. Recursive estimation of the trace statistic shows that in several cases there are changes in the number of estimated vectors. This reflects the possibility of structural changes and enforces us to test for structural stability of the cointegrating vectors estimated after imposing just-identifying restrictions. The recursively estimated tests for the stability of the parameters of the cointegrating vectors as well as the recursive one-step and break-point Chow tests for each equation and the system as a whole indicate the possibility of a structural break.[2]

The test results indicate a sample break in 1988:Q1. As noticed by Calmes (2004), the 1987 amendments to the Bank Act allow banks to conduct brokerage activates and to make substantial investments in the securities business between 1987 and 1989. Nonetheless, banks continue to be the main providers of loans to the medium-and-small enterprise sector. Besides, Calmes (2004) finds that the Canadian banking system has continued to grow despite their decreasing share of the lending business-especially when off-balance sheet activities are included. This change can be seen as an indication of a transition to a new regime of increased asset substitutability and a loss of the bank lending channel's potency.

Given this sample break, tests for determining the cointegration rank are carried out for each sub-sample by means of Johansen and Juselius (1990) and the results are displayed in Table 2. Having determined the number of cointegrating relations in each sub-period, it is important to consider what these relationships can tell us about the operation of the bank lending channel as outlined above. Therefore, it is necessary to impose and test for over-identifying restrictions in order to assess the degree of asset substitutability. The assumptions underlying Equations (1) and (2) provide the necessary restrictions to identify unique cointegrating vectors. These over-identifying restrictions on each of the cointegrating relations are tested against the exactly identified model using the likelihood ratio test of Johansen and Juselius (1994).

[2] We choose to localize the break point (1988:Q1, 1991:Q1 and 1993:Q2, as suggested by Calmes, 2004) on the basis of the Chow test so that parameter estimates within each of the two sub-periods are relatively constant. It must be noted that localizing a point in time which indicates a structural break over-simplifies a significantly more complex process of structural change that takes place gradually.

Table 2. Estimates and Tests of Cointegrating Vectors

Sample period	1970:Q3-1988:Q1		1988:Q2-2006:Q2
A. Number of cointegrating vectors[a]	2		1
Trace test	112.958 (103.847)		125.615 (122.233)
Max-eigenvalue test	40.957 (40.162)		39.439 (46.231)
B. Coefficients on cointegrating vector variables[b]	vector 1	vector 2	vector 1
lrgdp	1	0	1
lrde	- 0.313 (0.142)	-1	-0.783 (0.373)
lrnl	- 0.192 (0.064)	1	0
lrxr	-0.039 (0.020)	0	0.112 (0.056)
loanr	0	-3.571 (1.190)	0
br	0	2.130 (0.533)	0

Notes: a. Numbers in parenthesis are critical values at the 5% significance level. b. Numbers in parenthesis are asymptotic standard errors.

As stated early, Equation (1) results from the equilibrium conditions in the commodity, deposit and foreign exchange markets and the loan demand function, and should be one of the cointegrating vectors of the model in the presence of a bank lending channel. Under imperfect asset substitutability, the model should give rise to another cointegrating vector representing a loan supply specification as Equation (2). The possibility to find a statistically significant coefficient on the loan variable in the first cointegrating vector and to identify the second cointegrating vector as a loan supply function would imply that the bank lending channel is operative. Table 2 also reports the maximum likelihood estimates for the equilibrium over-identified model.

The result appears that the bank lending channel played an important role in monetary policy transmission through the late 1980s when we are able to identify two cointegrating vectors that correspond to Equations (1) and (2). All the parameters of these two vectors are significant and correctly signed. A zero restriction on the coefficient of the loan variable in the first equilibrium relationship, Equation (1), is easily rejected at the 5% significance level. In the second sub-period (1988:Q2-2006:Q2) there is a unique cointegrating vector identified as Equation (1), while it is not possible to identify a loan supply function as Equation (2). Moreover, non-rejection of a zero over-identifying restriction on the coefficient of the loan variable in Equation (1) indicates a switch to a perfect substitutability regime in the second sub-sample period. Calmes (2004) observes a declining share of bank loans in external financing during the 1990s, attributing this to the ongoing securitization and, to some extent, to disintermediation.

3. Conclusions

Comparing to the conventional interest rate channel, the bank lending channel provides important implications for the amplified effects of monetary policy on economic activity. Previous empirical work on the bank lending channel using aggregate data concentrated on the examination of timing relationship between quantity/price variable and monetary policy. Unfortunately, much of this evidence admits other interpretations due mainly to the difficulties in distinguishing shifts in loan supply from shifts in loan demand.

Based on the general equilibrium of a small open economy, this paper provides a directly testable hypothesis related to the degree of financial asset substitutability and, consequently, to the effectiveness of the bank lending channel at the aggregate level. These hypotheses are tested in the context of a vector error-correction model which is applied to a case study of Canadian data over the period from 1970:Q3 to 2006:Q2. In view of the substantial changes that took place in financial markets during the above period, we would expect the degree of asset substitutability to have increased over time, thus weakening the potency of the bank lending channel. This issue is investigated by looking for evidence of structural change in the empirically identified long-run equilibrium relationships derived from the model. Our findings suggest that the bank lending channel plays a role in the Canadian economy and that change in Canadian financial structure matters for its change in monetary transmission.

Finally, this research lessons may be relevant to policy makers in countries where the banking system plays a more important role in credit allocation. It highlights why the International Monetary Fund and the central banks around the world have recently emphasized the importance of maintaining a healthy banking system.

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