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IDENTIFYING BANK LENDING CHANNEL IN INDONESIA: A VECTOR ERROR CORRECTION APPROACH WITH STRUCTURAL BREAK

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***Abstract**: There was a question whether monetary policy works through bank lending channel required a monetary-induced change in bank loans originates from the supply side. Most empirical studies that employed vector autoregressive (VAR) models failed to fulfill this requirement. Aiming to offer a solution to this identification problem, this paper developed a five-variable vector error correction (VEC) model of two separate bank credit markets in Indonesia. Departing from previous studies, the model of each market took account of one structural break endogenously determined by implementing a unit root test. A cointegration test that took account of one structural break suggested two cointegrating vectors identified as bank lending supply and demand relations. The estimated VEC system for both markets suggested that bank loans adjusted more strongly in the direction of the supply equation.*

***Key words**: bank lending channel, unit root hypothesis, structural breaks, vector error correction, bank credit market and Indonesia.*

The literature has identified various transmission channels through which monetary policy decisions are transmitted to real GDP and inflation. They include interest rate, asset price, exchange rate and credit channels (Miskhin, 1995, 2001). Formalized by Bernanke and Gertler (1989) and Bernanke and Blinder (1988), the credit channel relies on the existence of asymmetric information and costly enforcement of contract in financial markets that give rise to an external financial premium charged on top of the market interest rates. Since bank loans are considered to carry the least external premium, a large number of firms, mostly small and medium firms, which cannot afford to raise funds from bonds and capital markets, are mainly dependent on bank credits for external funding.

Bank lending channel arises from two basic assumptions (Brooks, 2007). *First*, the central bank, through a change in monetary policy, is able to constrain the supply of bank loans. For example, a monetary contraction will reduce bank reserve money and in turn the supply of bank loans. *Second*, bank loans and other non-bank assets such as commercial papers are imperfect substitutes,

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due to imperfect information in credit markets. Some firms, mainly small ones, become dependent on bank loans because they find it too expensive to obtain funds through other means, such as issuing securities or bonds, due to high screening and monitoring costs. Accordingly, if banks reduce their loans, there will be a fall in spending by bank-dependent customers and, therefore, aggregate demand. Taken together, these two assumptions imply that a monetary policy contraction will reduce the supply of bank loans and in turn depress the level of economic activity.

Empirical studies on bank lending channel are voluminous (Ashcraft, 2006; Bernanke and Blinder, 1988; Bernanke and Blinder, 1992; Bernanke and Gertler, 1995; Kashyap, Stein and Wilcox (1993), Ramey (1993), and Olliner and Rudebnusch (1996). Most of these studies employ vector autoregression (VAR) models with either aggregate or disagregated data. However, they largely provide ambiguous results. While the bank lending hypothesis requires that a monetary-policy-induced change in bank loans originates from the supply side, the results fail to meet this requirement. In general the results reveal that bank loans respond with a lag and decline almost contemporaneously with the aggregate output following a tight monetary policy. Thus, a monetary-induced decline in bank loans does not necessarily originate from the supply side. It may instead originate from the demand side, thereby supporting the interest rate channel view. That is, a tight monetary policy reduces money supply and raises interest rates, thereby depressing economic activities and in turn reducing the demand for credit. Therefore, there is an identification problem: a monetary-policy-induced movement in the bank loans is not identified as to whether it originates from the demand side or the supply side.

One approach to solving this identification problem is proposed by Kakes (2000). He employed a five-variable vector error correction (VEC) model of bank credit market to identify bank lending channel in the Netherlands. While the supply of bank lending is a function of the spread between bank lending rate and the interest rates on bonds, the demand for bank lending is determined by the lending rate and the real activity. He assumed three cointegrating vectors identified as bank lending demand relation, bank lending supply relation and banks' bond holding relation. He argues that the identification of the first two cointegrating vectors as bank lending demand and supply relations can help solve the identification problem. That is, whether the credit market originates from the supply or demand sides depends on the short-run adjustment toward the equilibrium in the bank credit market in the VEC model. The short-run adjustment toward the credit market equilibrium is said to be dominated by the supply of credit if the short-run adjustment coefficient on the error correction term corresponding to the long-run supply relation is greater in magnitude or statistically more significant than that on the error correction term corresponding to the long-run demand relation.

A similar approach was utilized by Agung *et al*. (2002) to identify bank lending channel in Indonesia. They develop a four-variable VECM that assumes two cointegrating vectors identified as demand for and supply of bank credit relations. While the demand for credit relation is of the same specification as the one specified by Kakes (2000), the supply of bank lending is positively related to the level of economic activity and the interest rate differential, which they assume to be the spread between the banks' lending rate and banks' funding costs proxied by deposit rate. Both studies successfully identify the cointegrating vectors but offer different conclusions regarding bank lending channel. While the former concluded that the credit market in the Netherlands is demand-determined, the latter found that the credit market in Indonesia is supply-induced.

However, Kakes (2000) and Agung *et al*. (2002) ignored structural breaks that likely be experienced by the Indonesian macroeconomic series in their realization process. One possible source of such breaks is the 1998 financial crisis, which was largely responsible for the credit crunch in the aftermath of the crisis. The existence of credit crunch might have reinforced the decline in the supply of bank loans following a monetary tightening. Therefore, the 1998 financial crisis needs to be taken into account. The credit crunch is said to be present only if the decline in the bank loans following the crisis is supply side phenomenon. This may be identified by including a shift dummy in the supply of credit relation only and expecting its coefficient to be negatively signed and significant. Alternatively, the shift dummy may enter both supply and demand relations and its estimated coefficient in the former is greater in magnitude or more significant than in the latter relation.

Another drawback of those studies is that their results at most only provide a test of the first part of the hypothesis and remain silent on the second part of the hypothesis. They only tackle the question as to whether the short-run adjustment in the credit market is supply or demand-determined. But whether this short-run adjustment feeds into the level of economic activity they provide no answer.

This study is an attempt to mitigate these drawbacks in identifying bank lending channel of monetary policy transmission in Indonesia. In so doing, it devices a five-variable VEC model of the Indonesian bank credit market that takes account of one structural break that arises from the 1998 financial crisis. The exact date of the crisis will be endogenously determined through an estimation process and serve as the basis for constructing a shift dummy. Since the shift dummy will be present in the cointegrating vectors, a new cointegration test procedure that takes account of one structural break is implemented. Based on this test, the system assumes two cointegrating vectors identified as demand for and supply of bank credit relations.

The remainder of this paper is organized as follows. Section 2 provides data description and the construction of a five-variable VEC model of the Indonesian bank credit markets. Section 3 presents the results of unit root and cointegration tests that take account of one structural break. Section 4 is divided into two subsections. While the first discusses the estimated long-run bank lending supply and demand relations and their respective short-run adjustment mechanisms, the second presents the impulse response analysis of whether bank lending channel of monetary policy transmission is identified in Indonesia. Section 5 concludes.

RESEARCH METHOD

Data and Empirical Framework

This study assumes that the endogenous variables of the Indonesian bank credit market follow an error correction process where the intercept and shift dummy are restricted and time trend is absent. The model is a vector error correction (VEC) and of the following form:

$$\Gamma_0 \Delta y_t = \alpha\beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_n \Delta y_{t-n} + \mu_t \quad \text{........ (1)}$$

where the vector y_t contains the endogenous variables of the Indonesian bank credit market, Δ is the differencing operator so that $\Delta y_t = y_t - y_{t-1}$, and μ_t is the error vector which is assumed to be white noise; that is, μ_t is supposed to be serially uncorrelated with zero mean and constant nonsingular covariance matrix μ. The Γ_i matrices are reduced form coefficient matrices because Γ_0 is assumed to be an identity matrix. The first term on the right-hand side of system (1) is the error correction term with $\beta' y_{t-1}$ representing the cointegration relations to which the intercept and shift dummy are restricted. Furthermore, a is the loading matrix, which contains the short-run adjustment coefficients that capture the short-run adjustment of the system in order to maintain the long-run equilibrium.

The bank lending supply is assumed to be a function of the level of economic activity and the spread between the banks' lending rate and banks' lending opportunity costs proxied by call-money rate. Another variable expected to influence the bank lending supply is the financial crisis proxied by a shift dummy. The use of call-money rate as a proxy for bank lending opportunity costs is due to the fact that for many commercial banks it serves as one of important sources of funds as well as a place to invest their excess supply of funds. Another advantage is that a short-run dynamic analysis of the effects of a monetary policy contraction on the credit market may be conducted since the call-money rate plays a role of monetary policy instrument variable. It is expected that both spread and level of economic activity are positively related to the bank lending supply.

The bank lending demand is a function of the level of economic activity and bank lending rate. While the former explanatory variable is expected to be positively related, the latter is expected to be negatively related to the bank lending demand.

Two separate models are devised to represent two bank credit markets in Indonesia: the working capital credit market and investment credit market. Each model consists of five variables, namely the Real GDP (Y_t) as a measure of the level of economic activity, bank loans, call-money rate ($R1_t$), lending rate, and the shift dummy (DU_t) that has zero for observations before the second month of 1999 and one thereafter (A unit root test that allows for one unknown break date in the next section finds that these two markets share one common break date, the second month of 1999, which coincides with the period of the crisis. Inspection of the data also confirms this break date). While in the former market bank loans are represented by Working Capital Loans in real terms ($RCWCRP_t$) and the lending rate by Working Capital Lending Rate (RWC_t), in the latter they are represented by Investment Capital Loans in real terms ($RCINVRP_t$) and Investment Capital Lending rate ($RINV_t$), respectively. All variables, except interest rates, are stated in natural logarithm.

The specification of these markets is as follows.

Bank Working Capital Credit Market

Supply

(2)

Demand

$$LRCWCRP_t^D = b_1 LY_t + b_2 RWC_t \quad (3)$$

where it is expected that a_1>0, a_2>0, a_3<0, b_1>0, and b_2<0.

Bank Investment Credit Market

Supply

$$LRCINVRP_t^S = c_0 + c_1 LY_t + c_2 (RINV_t - R1_t) + c_3 DU_t \quad (4)$$

Demand

$$LRCINVRP_t^D = d_1 LY_t + d_2 RINV_t \quad (5)$$

where it is expected that c_1>0, c_2>0, c_3<0, d_1>0, and d_2<0.

In this study monthly data are employed starting from the first month of 1985 to the last month of 2007, covering a total of 276 observations. All the data except real GDP (Y) are available in a monthly frequency. Therefore, the frequency of Y series has been converted from quarterly into monthly by using the distributive method (Using RATS procedure DISTRIB.SRC, it computes a distribution of a series, changing the frequency to a higher one while maintaining the sum of each original period, e.g. producing a monthly "GNP" estimate from quarterly GNP. The procedure is available at http://www.estima.com/

Interpolation.shtml#DISTRIB.SRC). The precise data sources are given in Table 1 and the series are plotted in Figure 1.

Table 1. Description and Sources of Data

No	Variable	Description	Sources
1	R1	Interbank call-money rate	IFS-IMF
2	RWC	Bank working capital landing rate	IFS-IMF
3	RINV	Bank investment landing rate	IFS-BI
4	RCWCRP	Real bank working capital rupiah loan	IFS-BI
5	RCINVRP	Real bank investment rupiah loan	IFS-BI
6	CPI	Consumer Price Index (2000=100)	IFS-IMF
7	Y	Real Gross Domestic Product (2000 =100)	BPS

BPS = Badan Pusat Statistik (Central Bureau of Statistics) Indonesia
IFS-IMF = International Financial Statistics – International Monetary Fund (IMF) (CD-ROM database)
IFS-BI = Indonesian Financial Statistics – Bank Indonesia (Published monthly and at < http://www.bi.go.id >)
MSCI = Morgan Stanley Capital International Inc, available at < http://www.msci.com/equity/index2.html>.

Unit Root and Cointegration Tests

Unit Root Test with Structural Break

This subsection investigates the degree of integration of the variables of interest. It is widely known that macroeconomic series often experience various breaks in their realizations. This is especially true for transition and emerging market economies, which often suffer from shocks due to radical policy changes or crises (For example, Altinay and Karagol (2004) find that the Turkish macroeconomic series are trend stationary after including one structural break in their unit-root test). Vogelsang and Perron (1998), through simulations, find that the unit root test size is sensitive to structural breaks and hence ignoring these breaks in the model specification may weaken the test power, thereby resulting in a misleading conclusion about the unit root hypothesis. Therefore, a unit root test whose size is invariant to the presence of structural breaks is needed. This study implements a unit root test that allows for one structural break whose date is determined endogenously.

Following Perron (1997), the data generating process of each of the variables is assumed to follow an additive outlier (*AO*) model (Perron, 1989; considers the 1929 Great Crash as an example of structural break that occurred gradually because it lasted several years and hence assuming the DGP is of innovation outlier (*IO*), while the 1973 oil price shock as a break that occurred instantly. Accordingly, he modelled these two cases differently by applying *IO* to the former and *AO* to the latter in accordance with the DGP). Vogelsang and Perron (1998) argue that the application of the *AO* model is superior when the break date is chosen using the significance of the break parameters, because the test size is invariant to the change in the magnitude of the breaks. Since the structural breaks especially due to the 1998 financial crisis, experienced by the Indonesian economy arguably are of a larger magnitude than those of developed economies the resulting shifts in both intercepts and slopes of its data series realizations are also possibly larger in magnitude. Hence, the use of the additive outlier (*AO*) framework is preferable. Equation (1) represents the *AO* framework that has two steps: (*i*) detrending the series by regressing it on the trend components (constant, time-trend, and break dummy), and (*ii*) applying the Augmented Dickey–Fuller (ADF) test without trend function to the residuals of the first step.

$\mu \quad \beta \quad \theta$ ***and***

$$\tilde{} = \hat{\alpha} \tilde{} + \sum \Delta \tilde{} + \qquad (6)$$

where TB is the break date determined endogenously, D_t is pulse dummy that equals 1 for $t = TB$ and zero otherwise, and $DU_t = 1$ if $t > TB$ and 0 otherwise is a post-break intercept dummy. The break date is estimated by maximizing the absolute value of t statistic for the coefficient on the intercept break (| |). The unit root hypothesis is rejected if the a coefficient is statistically significant. Table 2 summarizes the results.

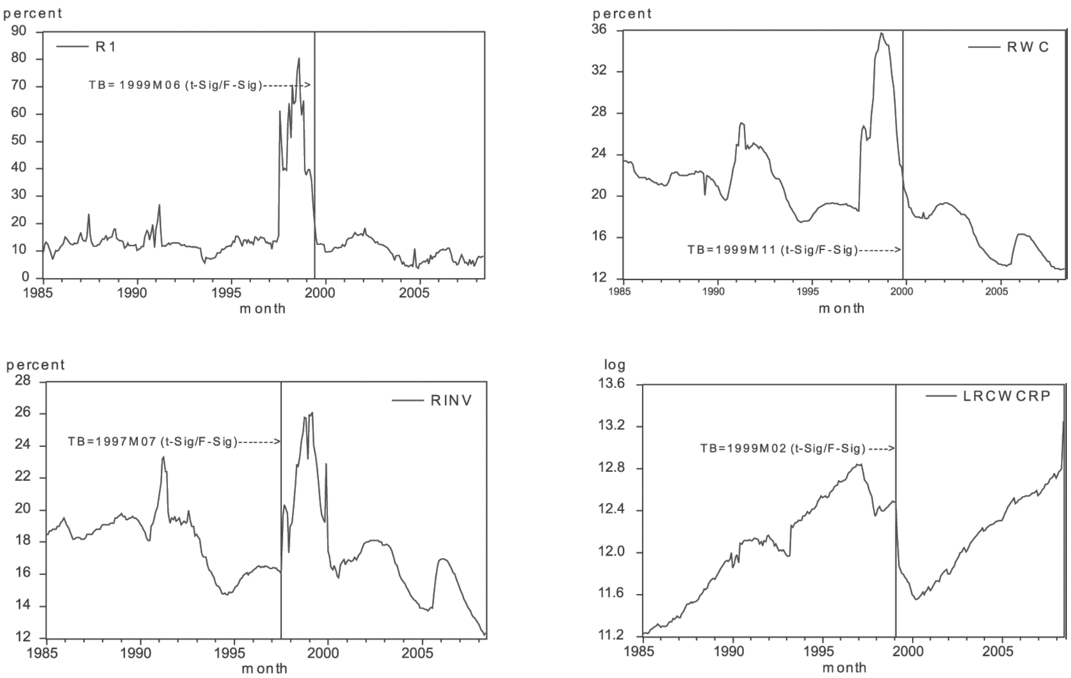
all cases the break dates coincide with the period of financial crisis that spanned roughly between 1997M07 and 1999M12. Of particular importance is the estimated break date for LRCWCRP and LRCINVRP which are used to construct the shift dummy DU_t that has zero for observations before the second month of 1999 and one thereafter. Further, all estimated coefficients on the shift dummy (DU_t) for intercept shift ( ) are highly

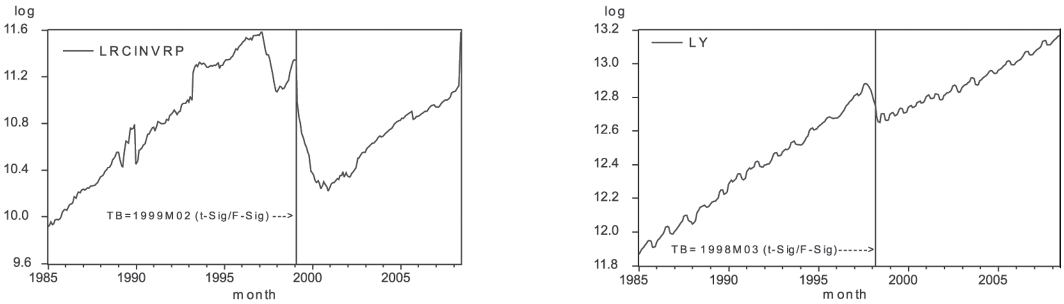
Table 2. Unit Root Test with One Unknown Break in Intercept

No	Variable	$\hat{TB}$	K[1]	$\hat{\beta}$	$t_{\hat{\beta}}$	$\hat{\theta}$	$t_{\hat{\theta}}$	$\hat{\alpha}$	$t_{\hat{\alpha}}$ [2]	S/N
1	R1	1999:06	15	0.14	8.72	-21.82	-8.50	0.81	-3.80	N
2	RWC	1999:11	14	0.02	3.80	-5.44	-7.97	0.94	-3.09	N
3	RINV	1997:07	12	-0.03	-9.68	4.57	10.01	0.91	-3.14	N
4	LRCWCRP	1999:02	15	0.01	45.19	-1.37	-42.23	0.89	-2.55	N
5	LRCINVRP	1999:02	9	0.01	38.69	-1.54	-39.42	0.93	-1.82	N
6	Y	1998:03	14	0.01	75.24	-0.33	-29.36	0.93	-1.37	N

S = Stationary, N = Non-stationary.
[1] The truncation parameter ( ) is calculated using the general-to-specific method based on t statistic (Perron, 1997).
[2] The critical value at 2.5%, 5%, and 10% are -4.40, -4.17, and -3.90, respectively (Vogelsang and Perron, 1998).

Table 2 suggests that the unit root hypothesis cannot be rejected for all of the series and hence they are I(1). As for the estimated break date, in significant. Figure 1 depicts the plot for each series along with its respective estimated break date.





3.2. Cointegration Test with Structural Break

Figure 1. Plots of Data Series with Endogenously-Determined One Break Date

Instead of Johansen's trace test (Johansen and Juselius, 1990), another test introduced by Lütkepohl and Saikkonen (2000) is used to determine the cointegrating relations of the endogenous variables. The latter is a variant of the former and especially designed to account for structural shifts that present in all the series. Since a shift dummy is included the Johansen trace tests are hardly useful. Their critical values are calculated for the case where shift dummy variable is not present in the deterministic terms. The inclusion of a shift dummy affects the asymptotic distribution under the null hypothesis thereby requiring simulation of new critical values. For this purpose Lütkepohl and Saikkonen (2000) introduce a test (henceforth the L&S test) that is asymptotically unaffected by shift dummies. Critical values are tabulated by Lütkepohl and Saikkonen (2000).

Table 3 reports the L&S cointegration test results. This test assumes that the endogenous variables follow an error correction process where the intercept is restricted and time trend is absent. For the working capital credit market model the test suggests two cointegrating vectors when the lag order is 15 and three when the lag order is 6, given the maximum lag order being 18 (The former and latter lag orders are based on the AIC and SBC, respectively. The maximum lag order is set at 18 because the two cointegrating vectors are best identified as supply and demand relations when the system has lag order of 15 that results from the Akaike and Hannan-Quinn selection criteria). Based on this result two cointegrating vectors are assumed for this model. As for the investment credit market model, the maximum lag order is set at 12. The test results suggest one and two cointegrating vectors when 12 lags and 6 lags are included, respectively.

Table 3. Cointegration Test of Credit Market VEC Model

	Working Capital Credit Market					Investment Capital Credit Market				
	k-maximum=18; k=15 (AIC & HQ)					k-maximum=12; k=12(AIC)				
r0	LR	p-val	90 %	95 %	99 %	LR	p-val	90 %	95 %	99 %
0	37.26	0.08	37.04	40.07	46.20	39.29	0.06	37.04	40.07	46.20
1	27.58	0.01	21.76	24.16	29.11	17.68	0.27	21.76	24.16	29.11
2	7.62	0.27	10.47	12.26	16.10	5.03	0.57	10.47	12.26	16.10
3	0.03	0.91	2.98	4.13	6.93	1.15	0.33	2.98	4.13	6.93
r0	k-maximum=18; k=6 (SBC)					k-maximum=12; k=6 (HQ & SBC)				
0	86.97	0.00	37.04	40.07	46.20	92.45	0.00	37.04	40.07	46.20
1	44.68	0.00	21.76	24.16	29.11	24.30	0.05	21.76	24.16	29.11
2	13.55	0.03	10.47	12.26	16.10	7.97	0.17	10.47	12.26	16.10
3	0.56	0.51	2.98	4.13	6.93	1.63	0.24	2.98	4.13	6.93

Note: k=number of lag; AIC=Akaike Information Crit erion; HQ= Hannan - Quinn criterion; SBC = Schwarz-Bayesian Criterion

RESEARCH FINDINGS

Estimated Model

The resulting two cointegrating vectors have to be identified as two different long-run relations, which, for the purpose of this study, represent bank lending supply relation and bank lending demand relation. However, for these two cointegrating vectors to be identified an enough number of restrictions have to be imposed. For both models of credit markets a total of six restrictions are imposed to identify the cointegrating vectors as bank lending supply and demand relations, while only four restrictions are actually needed to just identify the vectors. Thus, these two additional restrictions are considered as over-identifying restrictions. Among these six, three are exclusion restrictions, two normalization restrictions, and one equality restriction (Exclusion restrictions set coefficients on $R1_t$, intercept and *SD98* equal to zero in the demand relation; equality restriction sets the coefficient on RWC_t equal to negative coefficient on $R1_t$ in the supply equation; and normalization restrictions set coefficients on $RCWCRP_t$ in both supply and demand relations equal to on). The outcome of these identifying restrictions along with the short-run adjustments coefficients for both models is reported in Tables 4 and 5. These two tables report that the overidentifying restrictions in both models cannot be rejected by the LR test as the *p*-value is far higher than 0.10. Hence, the long-run bank lending supply and demand relations in both models are identified and supported by the data (figures in parentheses are standard errors).

Table 4. Estimated Bank Lending Supply and Demand Relations and Loadings (Working Capital Credit Market)

Estimated Cointegrating Relations[a,b]

Supply : $LRCWCRP_t^S = 5.087 + 1.659\ LY_t + 0.013\ (RWC_t - R1_t) - 1.033\ DU_t$

(1.405) (0.128) (0.009) (0.122)

Demand : $LRCWCRP_t^D = 1.871\ LY_t - 0.466\ RWC_t$

(0.801) (0.459)

Estimated Short-term Adjustment Coefficients (Loadings)[c]

	• LY_t	• $LRCWCRP_t$	• RWC_t	• $R1_t$
$EC1_{t-1}$ (Supply)	-0.035	**-0.106**	0.428	-1.135
	(-2.580)	(-3.317)	(-0.997)	(-0.397)
$EC2_{t-1}$ (Demand)	0.002	**-0.012**	-0.008	-0.494
	(1.101)	(-2.842)	(-0.135)	(-1.257)

[a] LR Test of Restrictions CHSQ(2)= 0.677 (**0.713**)
[b] Figures in parentheses are standard errors.
[c] Figures in parentheses are *t* statistics.

Table 5. Estimated Bank Lending Supply and Demand Relations and Loadings (Investment Credit Market)

Estimated Cointegrating Relations[a,b]				
Supply : $LRCINVRP_t^S = 7.904 + 1.817\ LY_t + 0.014\ (RINV_t - R1_t) - 1.343\ DU_t$ (0.881) (0.096) (0.005) (0.137)				
Demand : $LRCINVRP_t^D = 1.175\ LY_t - 0.217\ RINV_t$ (0.205) (0.143)				
Estimated Short-term Adjustment Coefficients (Loadings)[c]				
	• Y_t	• $LRCINVRP_t$	•$RINV_t$	•$R1_t$
$EC1_{t-1}$ (Supply)	-0.047	**-0.170**	-1.135	-17.824
	(-2.607)	(-4.191)	(-2.972)	(-5.675)
$EC2_{t-1}$ (Demand)	-0.000	**-0.019**	-0.168	-3.020
	(0.248)	(-3.127)	(-2.959)	(-6.461)

[a] LR Test of Restrictions CHSQ(1)= 0.5345 (**0.765**)
[b] Figures in parentheses are standard errors.
[c] Figures in parentheses are *t* statistics.

All estimated coefficients in the relations are correctly signed. The estimated income elasticities of demand for working capital loans is 1.87, which is close to that found in Agung *et al*. (2002) and Kakes (2000). But the estimated income elasticities of demand for investment capital loans is 1.18, which is less than that found in Agung *et al*. (2002). Agung e*t al.* (2002) found the income elasticity of demand for working capital loans 1.8 and for investment loans 2.7. Kakes (2002) found for the elasticity for credit market as a whole 1.76. This may be attributable to the different measure of the spread and the inclusion of the shift dummy. Although much higher than those found in Agung *et al*. (2002), the estimated interest rate elaticities,10.08 and 3.99 respectively, offer similar intuition (The interest rate elasticity of demand for bank credit is the product of estimated coefficient on the lending rate (semi elasticity of the rate) and the sample mean of that rate. Thus, the working capital rate elasticity is (0.466×21.65) = 10.08 and the investment credit rate is (0.217×17.41) = 3.99). That is, the demand for the working capital loans is more sensitive to the loan rate than the demand for investment loan since the latter is long-term loans which are more likely subject to long-term contract. However, the coefficient on the interest rate in the demand for working capital loans market is statistically not significant. This may raise an issue as to whether the demand for working capital loans in fact responds negatively to interest rates in Indonesia. As expected the estimated coefficient on the shift dummy is correctly signed and statistically significant. Since in both models of credit markets the shift dummy is present only in the supply relation the negative sign of its coefficient may be interpreted as evidence for the existence of credit crunch following the financial crisis (An attempt is made not to impose a restriction on the shift dummy in the demand relation for both market models, but the estimated coefficients are not significant. Instead, when an exclusion restriction is imposed the result improves statistically). That is the decline in the bank loans following the financial crisis originates from the supply side rather than the demand side.

Tables 4 and 5 also report the corresponding short-term adjustment coefficients, which indicate for each variable the speed towards the long-run equilibrium relationships. Looking at the equation for bank loans in both markets ($LRCWCRP_t$ and $LRCINVRP_t$) it appears that bank loans adjust significantly in the direction of both long-run supply and demand equations. However, comparing the magnitude and significance, the adjustment to the supply equation is greater in absolute magnitude and statistically more significant than the adjustment to the demand equation. This is true for both markets. The estimated coefficients are -0.170 and -0.019 in the working capital loans market and -0.106 and -0.012 in the investment loans market. This suggests that in the short run both loans markets are dominated by supply rather than demand.

Impulse Response Analysis

The above results alone are not sufficient to suggest that bank lending channel plays an important role in the monetary transmission mechanism in Indonesia. They remain silent on the second aspect of bank lending channel hypothesis, namely that the decline in the bank loans is capable of reducing the level of economic activity due to the significance of bank-dependent borrowers. The short-run dynamic analysis that uses impulse responses function in this subsection deals with this deficiency. To that end the impulse response functions based on the previous VEC models of loans markets are estimated. However, the two cointegrating vectors are now just identified by imposing two normalization restrictions on Y_t and quantity of loans ($RCWCRP_t$ or $RCINVRP_t$) and another two exclusion restrictions. The monetary tightening shock is measured by a surprise increase in the call-money rate ($R1_t$) - The monetary tightening shock is measured by an exogenous increase in the call-money rate by roughly 144 basis points. The confidence intervals of impulse response function is calculated based on Hall's bootstrap procedure as proposed by Benkwitz *et al.* (2001) as it has a built-in bias correction in contrast to standard bootstrap confidence intervals (Lütkepohl and Wolters, 2003).

For the impulse response function analysis to identify the bank lending channel it must show that a shock arising from a monetary tightening will shift the supply schedule of bank loans leftward, and in turn the level of economic activity declines. Note that a leftward shift in either the supply or demand schedule of bank loans in response to a monetary tightening equally results in a decline in bank loans. Yet their impact on the price of bank loans is different. While the former increases the price, the latter reduces it. Figure 2 depicts a simple diagram of the demand and supply curve and helps illustrate the idea (This graphical analysis draws heavily on Suzuki (2004).. If a monetary tightening works through the lending channel, the supply curve of bank loans will shift leftward from *S* to *S'* It follows that the price will rise and the quantity decrease, so long as the demand schedule lies between *D'* and *D"* Thus, for the lending channel of monetary policy to be dominant the following must hold: the quantity of bank loans at least does not increase, the price of the bank loans increases, and the output level decreases following a monetary tightening. While the first two requirements belong to the first part of the hypothesis of bank lending channel, the third requirement belongs to the second part of the hypothesis.

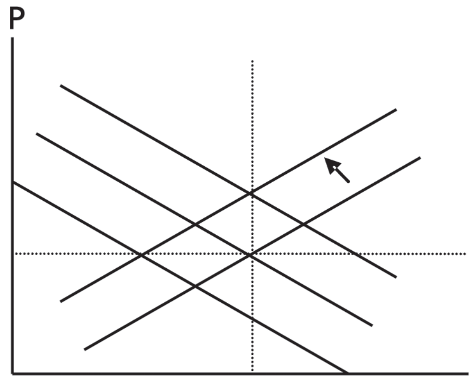


Figure 2. Shift in Supply Curve Due to MP Shock

Since the impulse response function of say $LRCWCRP_t$ to a monetary tightening shock can be defined as

$$\frac{\partial}{\partial \varepsilon} \quad \text{for } i = 0, 1, \ldots \qquad (7)$$

where $\partial \varepsilon$ is a structural innovation to call-money rate ($R1_t$), then, following Suzuki (2004), the testing of hypotheses that bank lending channel of monetary policy may be formulized as follows. The hypothesis of bank lending channel of monetary policy for each credit market is not rejected if

Working Capital Credit Market

H1: $\frac{\partial RWC_{t+i}}{\partial \varepsilon_t^{R1}} > 0$; H2: $\frac{\partial LRCWCRP_{t+i}}{\partial \varepsilon_t^{R1}} = 0$;

H3: $\frac{\partial Y_{t+i}}{\partial \varepsilon_t^{R1}} < 0$, for i = 1, 0, ... (8)

Investment Credit Market

H1: $\frac{\partial RWC_{t+i}}{\partial \varepsilon_t^{R1}} < 0$; H2: $\frac{\partial LRCINVRP_{t+i}}{\partial \varepsilon_t^{R1}} = 0$;

H3: $\frac{\partial Y_{t+i}}{\partial \varepsilon_t^{R1}} < 0$, for i = 1, 0, ...(9)

Both the left-hand and right-hand panels of Figure 3 depict the point and interval estimates of the responses of output, bank loans (*$LRCWCRP_t$* or *$LRCINVRP_t$*) and loan price (*RWC_t* or *$RINV_t$*) to a monetary tightening shock estimated using a 95 per cent confidence interval. As can be seen, all three hypotheses of bank lending channel cannot be rejected at 5 per cent significance level. Following a monetary tightening shock the reaction of the credit market is that the quantity of loans decreases while the price of loans increases. Note that this is true for both point estimate (solid line) and interval estimate (dotted line), all of which are clearly below the base line for the quantity of loans and above the base line for the price. This suggests that H1 and H2 cannot be rejected at any standard level of significance for both markets. Thus, the observed decline in the bank loans originates from the supply side. This confirms the first part of the bank lending channel hypotheses. That is, the monetary tightening by the central bank results in scarcer or more expensive liquidities which in turn force the banking system to reduce their supply of loans.

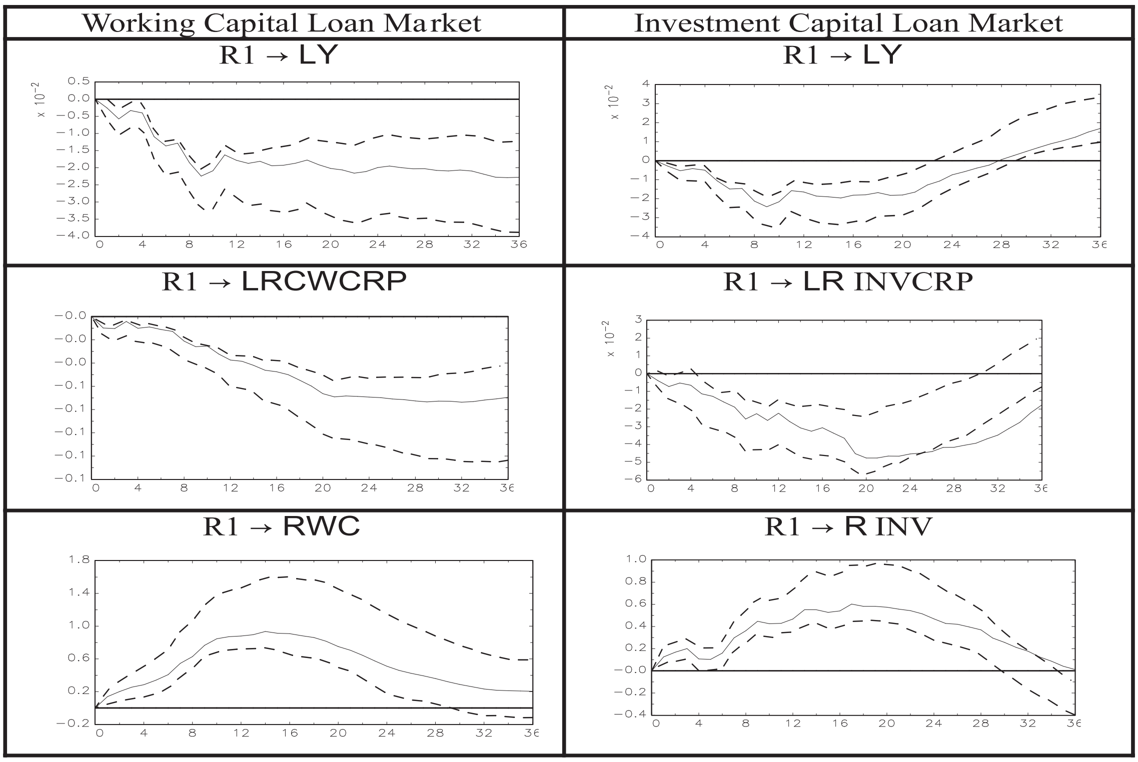


Figure 3. Bank Loan Markets Short-Run Adjustment to a Monetary Shock

The next step is testing the second part of the bank lending channel hypotheses (H3), namely the decline in bank loan supply reduces aggregate spending and hence output due to the significance of bank-dependent borrowers that cut their spending. As the upper panels of Figure 3 depict, both the point and interval estimates show that output decreases in response to a monetary tightening, suggesting that H3 also cannot be rejected at any standard significance level. Therefore, overall the bank lending channel of monetary policy transmission is at work in Indonesia.

CONCLUSION AND SUGGESTION

Conclusion

This paper has attempted to identify the existence of bank landing channel of monetary policy transmission in Indonesia. In so doing it has developed a five-variable VEC model of the Indonesian bank credit market. Two separate models have been estimated: the working capital credit market and investment credit market models. Departing from previous studies, each model takes account of one structural break associated with the 1998 financial crisis. The exact date of the crisis has been endogenously determined by implementing a unit root test that allows for one structural break. The break dates turn out to coincide with the 1998 financial crisis and the five macroeconomic series are *I(1)*. A cointegration test procedure that takes account of one structural break has been implemented and suggests two cointegrating vectors for the VEC system of both markets. The identification of these two cointegrating vectors as bank lending supply and demand relations is supported by the data.

Suggestion

The estimated equation for bank loans in the VEC system produces a result that bank loans adjust more strongly in the direction of the supply equation. This is true for both markets. This suggests that in the short run both loans markets are dominated by supply rather than demand. Similarly, the vectors identification is supported by the data when the shift dummy enters the supply equation only, with a correctly signed and statistically significant coefficient, which may be interpreted as evidence for the existence of credit crunch following the financial crisis. The impulse response analysis corroborates the results.

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