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Economics Series

The Credit Channel of Monetary Policy
Case of Austria

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Abstract

The legal environment, the structure of the financial system as well as the concentration of corporate ownership and the development of the capital market suggest for Austria a high effectiveness of the monetary policy with a strong impact of the lending channel. This supposition was verified combining three supplementary empirical methods: Granger causality between the velocities of money and loans and the real output; impulse-response functions for VECs with the subsequently opened/closed money/credit channels; the predictive power of money and loan variables for a production forecast. Both various types of loans and the total volume of credits for separate banking groups were examined. The Austrian output showed to be highly sensitive to monetary policy innovations; both the money and the credit channel were significant. The dependence of Austrian firms on credits rather than on other financial resources was more pronounced for credits in domestic currency, mortgage loans and municipal notes.

Keywords

Monetary transmission mechanism, credit channel, Austria

JEL Classifications

E52, C50, C53

Contents

1. Introduction and literature overview

Modern macroeconomics considers several mechanisms by which monetary factors and the monetary policy can be transmitted into the real economy. In a closed economy with sticky prices or nominal wages, changes in money supply influence the real aggregate demand and output through the **interest rates channel**. This traditional Keynesian model, advocated by some researches (for example, Taylor 1995) to be a key component of the monetary transmission, is, however, criticised by other economists. In an open economy the transmission of the monetary policy operates through the **exchange rate channel** on net export: when nominal wages or prices are sticky, the exchange rate effect induces the substitution between foreign and domestic goods and subsequently influences aggregate demand and supply. In his overview for a symposium on “The Monetary Transmission Mechanism” Mishkin (1995) provides the following schematic diagrams for the **interest rate effect**: $M\downarrow \Rightarrow i\uparrow \Rightarrow I\downarrow \Rightarrow Y\downarrow$ and for the **exchange rate effect**: $M\downarrow \Rightarrow i\uparrow \Rightarrow E\uparrow \Rightarrow NX\downarrow \Rightarrow Y\downarrow$; where – as far as the **interest rate channel** is concerned – the contraction of the monetary aggregate $M\downarrow$ leads to a rise in real interest rates $i\uparrow$, which in turn raises the cost of capital, causing thereby a decline in investment spending $I\downarrow$, which leads to a decline in aggregate demand and a fall in output $Y\downarrow$; whereas – as far as the **exchange rate channel** is concerned – the contraction of money $M\downarrow$ raises the real interest rate, thus making domestic deposits more attractive than deposits denominated in foreign currencies, thereby appreciating the domestic currency rate $E\uparrow$. The higher value of the domestic currency makes domestic goods more expensive and thus causes a fall in net export $NX\downarrow$ and consequently in aggregate output.

However, traditional interest rate and exchange rate mechanisms have become a subject of criticism nowadays and many recent publications promote credit markets as a key component in the transmission of the monetary policy to the real economy (**credit channel mechanism**). In the traditional money view only two classes of assets are considered, namely money and all other assets. The crucial argument of the credit view is the distinct role played by financial assets and labilities. Firstly, internal funds, bank loans and other sources of financing are imperfect substitutes for firms. Secondly, a heterogeneous structure of borrowers leads to different reactions among them to changes in credit conditions. Thirdly, a wedge between external and internal financing can occur due to imperfect information or costly enforcement of contracts. And finally, the growth of interest rates influences firms with weaker balance sheets stronger. Two basic mechanisms are proposed for the explanation of the monetary policy transmission taking into account the heterogeneities in a credit market: the **bank lending channel** and a broader **financial-accelerator mechanism**. The **bank lending channel** assumes, that bank credits remain to be the dominant source of financing for small and medium-sized firms, whereas large firms can directly access the credit market issuing corporate securities like stocks and bonds. The schematic diagram for the bank lending channel by Mishkin (1995) states: $M\downarrow \Rightarrow bank\_deposits\downarrow \Rightarrow bank\_loans\downarrow \Rightarrow I\downarrow \Rightarrow Y\downarrow$.

The contraction in money supply decreases the volume of bank deposits, which can not be easily replaced by banks with other sources of funds, therefore some borrowers would be cut off from credits, thus increasing the external finance premium and reducing the real activity. The broader view of the credit channel mechanism is not only restricted to the bank lending channel. The heterogeneity of the financial positions of borrowers leads to different external finance premiums among them, and the quality of these borrowers' balance sheets influences the structure of financing. This **balance sheet channel** is often referred to as the **financial accelerator mechanism** since the movements in the borrowers' balance sheets can magnify business cycles. Mishkin (1995) suggests three diagrams, demonstrating different ways of the transmission of the monetary policy through the balance sheet channel.

$$M\downarrow \Rightarrow net\_worth\downarrow \Rightarrow adverse\_selection\uparrow \propto moral\_hazard\uparrow \Rightarrow lending\downarrow \Rightarrow I\downarrow \Rightarrow Y\downarrow$$

$$M\downarrow \Rightarrow i\uparrow \Rightarrow cash\_flow\downarrow \Rightarrow adverse\_selection\uparrow \propto moral\_hazard\uparrow \Rightarrow lending\downarrow \Rightarrow I\downarrow \Rightarrow Y\downarrow$$

$$M\downarrow \Rightarrow fin\_assets\downarrow \Rightarrow likelihood\_of\_fin\_distress\uparrow \Rightarrow expenditure\downarrow \Rightarrow Y\downarrow$$

Tight monetary policy weakens the borrowers' balance sheets in several ways: it weakens the financial position of a firm (by diminishing the value of the borrower's collateral and the value of the firm's net worth); it decreases net cash flows; and a rise in interest rates increases interest expenses (supposing that a firm has floating-rate or short-term debts). The adverse selection problem arises, when the drop in the net worth causes higher losses by adverse selection for lenders – this shrinks lending. The drop in the net worth of firms also makes owners more incentive to engage themselves in risky investment projects, which is referred to as being a moral hazard problem.

Cecchetti (1999) considers the impact of both the legal and the financial structure of a country on its conduction of monetary policy and introduces an index of the effectiveness of the monetary policy for four classes of legal environments (English common law, Scandinavian common law, French civil law and German civil law). The index shows higher values for countries that belong to the German "legal family", denoting the higher impact of interest rate changes on the real output. The difference between the relative importance of the money and the credit channel of the monetary policy transmission might depend on the following factors: that a better legal protection for shareholders and debtors implies a lower impact of the lending channel; that countries, in which the banking system is less healthier and less concentrated, have restricted possibilities for banks to preserve their balance sheets values while the policy changes, what imposes the domination of the lending channel; that countries, whose individual firms are more dependent on bank loans and have a limited direct access to the capital markets imply the stronger credit channel of the policy transmission. The Austrian bank system, on the one hand, has a very high ratio of number of banks per capita (namely 126 per million people) and is, on the other hand, composed of a network of relatively small banks. The health of the Austrian banking system measured by the return on assets, the loan loss provisions, the net interest margin and operating costs, was ranked into the second from four possible clusters. The underdevelopment of the Austrian capital market, the low number of publicly listed firms and the high ratio of bank loans in the total sources of financing put Austria among the countries with a high effectiveness of the monetary policy with a strong impact of the credit channel.

The purpose of the present paper is to examine empirically the above-mentioned assumption, paying attention to the possible heterogeneous bank-structure. The outline of the paper is as follows. Section 2 considers the discrimination between the money and the credit channel from different points of view: section 2.1 presents the macroeconomic framework for the monetary policy transmission, the theoretical model treats the interactions between a National Bank, commercial banks and private firms; section 2.2 covers the diagnostic tools to be used in empirical studies. The description of the dataset and a preliminary testing of it (unit root test and multivariate and bivariate cointegration analysis) are given in section 3. Section 4 demonstrates the results of empirical studies: section 4.1 introduces the definitions of the money and the loan velocity as error-correction terms, characterizing the deviations from common stochastic trends; section 4.2 examines the Granger causality between the money (or loan) velocity and the real sector output (measured in the form of industrial production index); section 4.3 investigates the impulse-response functions for the models that contain different measures of bank loans and money aggregates; section 4.4 analyses the relative predictive power of the money and the loan variable for the out-of-sample forecast of the real sector output. Finally, section 5 evaluates the results of the previous section and concludes the paper.

2. Discrimination between the money and the credit channel

2.1 Macroeconomic framework

The following briefly sketched macroeconomic model was introduced by Ramey (1993) as a framework for the analysis of the monetary transmission mechanism. The model originates from an extended IS_LM model and specifies the interactions between firms, banks and a National Bank. The rest of the economy is not formulated: the optimisation problem of the household sector and the market clearing conditions are not stipulated.

The **production function for goods of a representative firm:**

$$Y_t = f\left[K_t, N_{yt}, \frac{\theta_t M_{ft}}{P_t}, \frac{\eta_t L_t}{P_t}, \lambda_t\right] \tag{1}$$

connects output Y_t with input, which combines capital K_t, labour N_{yt}, real money balances $\frac{M_{ft}}{P_t}$ and real bank loans $\frac{L_t}{P_t}$; l, q and h stand for shocks in technology, the productivity of money and the productivity of bank loans. The balance sheet identity of a firm is given by $M_f = L + B$, assuming money M_f, bank loans L and corporate bonds B to be the firm's only assets and liabilities. The credit channel mechanism implies, that bank loans and corporate bonds are not perfect substitutes, therefore L enters the production function as a separate argument. The current real profit for a firm is given by:

$$F_{ft} = Y_t - \left(r_{mt} + i_t\right)\frac{M_{ft}}{P_t} - \left(r_{lt} - i_t\right)\frac{L_t}{P_t} - v_t N_{ft} - \left(i_t - p_t\right)K_t \ , \qquad (2)$$

where r_m denotes the fee for bank transactions, i is the nominal interest rate on bonds, r_l is the interest rate for bank loans, v is the real wage rate, p is the inflation rate, correspondently the rental price of capital $(i - p)$ is equal to the real interest rate. Equation (2) does not contain bonds directly, they are eliminated via substitution from the balance sheet identity. The firm maximises the current profit F_{ft} in (2), given the production function in (1). The supply function of goods takes the form:

$$Y_t^s = y\left[\underset{-}{(r_{mt} + i_t)}, \underset{?}{(r_{lt} - i_t)}, \underset{-}{v_t}, \underset{-}{(i_t - p_t)}, \underset{+}{l_t}, \underset{+}{q_t}, \underset{+}{h_t}\right] \ , \qquad (3)$$

where the sign under the argument indicates the sign of the derivative with respect to the argument. Here the presence of the credit channel mechanism implies, that the elasticity of the output with respect to $(r_l - i)$ is negative and significant. The rise in the interest rate for bank loans r_l will make credits more expensive for a firm. Since bank loans and other financial resources are imperfect substitutes for a firm, some borrowers will be cut off from this funds and therefore the aggregate production will decline. The ambiguous effect can occur, when large firms are indifferent to the sources of financing or are able to borrow abroad: confronted with the increase in the domestic credit rate, borrowers will switch to other financial resources or to cheaper foreign credits, therefore an increase in the loans' rate has no or even a positive influence on the real sector output.

The **representative bank's** balance sheet identity $M = R + L + B_b$ supposes, that the only liability are transaction deposits and that the only assets are reserves R, loans L and corporate bonds. The current real profit of a representative bank is:

$$F_{bt} = \left(r_{mt} + i_t\right)\frac{M_t}{P_t} - \left(r_{lt} - i_t\right)\frac{L_t}{P_t} - i_t\frac{R_t}{P_t} - b\left[v_t, \frac{R_t - tM_t}{P_t}, \frac{L_t}{P_t}, \frac{M_t}{P_t}, l_t\right] \qquad (4)$$

Bank revenues consist of: earnings ρ_m from transaction services M, earnings ρ_l from bank loans L and earnings of the nominal interest rate i from the holdings of corporate bonds. A bank's cost function b depends on real wages v (as far as banks use labour force to produce transactions and credit services), resources in the form of deposits and loans, excess reserves $\frac{R-\tau M}{P}$ (where τ is the reserve requirement on money) and the economy technology shock λ that also affects bank services' production. A bank's profit maximization will lead to the following supply functions for transaction and credit services:

$$\frac{M_t}{P_t} = m^s\left[\underset{+}{(i_t+\rho_{mt})}, \underset{?}{(\rho_{lt}-i_t)}, \underset{-}{\nu_t}, \underset{+}{R_t/P_t}, \underset{+}{\lambda_t}\right] \qquad (5)$$

$$\frac{L_t}{P_t} = i^s\left[\underset{?}{(i_t+\rho_{mt})}, \underset{+}{(\rho_{lt}-i_t)}, \underset{-}{\nu_t}, \underset{+}{R_t/P_t}, \underset{+}{\lambda_t}\right] \qquad (6)$$

The supply of each item depends positively on its price, the level of real reserves and the technology shock and is negatively related to the real wage. The presence of the credit channel assumes that banks transmit changes in the monetary policy into the real economy, therefore the elasticity of loan supply with respect to reserves in (6) must be high.

The **Federal Reserve (or National Bank)** sets the level of reserves according to the following reaction function, which supposes, that the supply of real reserves depends on the current state of the economy and a monetary shock:

$$\frac{R_t}{P_t} = k\left[Y_t, i_t, \pi_t\right]\mu_t \qquad (7)$$

Equilibrium quantities are the functions of shocks (such as a technology shock λ, a money demand shock θ, a loan demand shock η and a monetary policy shock μ) and the set *S* of any relevant state variables. The expression for the equilibrium output will be:

$$Y_t = \varphi\left[M(\mu_t, \lambda_t, \theta_t, S_t), L(\mu_t, K_t, \lambda_t, \eta_t), \lambda_t, S_t\right], \qquad (8)$$

where *M(.)* is the equilibrium money balance and *L(.)* is the equilibrium loan balance. The influence of a monetary policy shock on the real economy can be considered an elasticity with respect to μ:

$$\frac{\partial Y}{\partial \mu} = \frac{\partial \varphi}{\partial M}\frac{\partial M}{\partial \mu} + \frac{\partial \varphi}{\partial L}\frac{\partial L}{\partial \mu} \qquad (9)$$

If credit markets do not play a significant role in the transmission of the monetary policy, then only the first argument in (9) is important, whereas the presence of the credit channel mechanism alone implies that only the second term is significant. The relative importance of the money versus the credit channel is contained in the relative magnitude of both terms.

Different ways to transfer the monetary policy to the real economy can also be schematically represented by Figure 1. If the transmission mechanism consists of the money channel alone, then only the paths a_1 and a_2 operate, showing the influence of financial institutions on the money market, which in his turn influences the real economy, and path a_3 shows a reverse reaction of the real economy on the money market. In this case the value of the first term in equation (9) will highly dominate in forming the total value of the elasticity of the real economy with respect to monetary policy shocks. In case the conduction of monetary policy occurs through the credit channel alone, only the paths b_1 and b_2 function, demonstrating the impact of financial institutions on the credit market, which in his turn affects the real economy, and path b_3 accounts for a reverse response. Correspondently, in equation (9) only the value of the second term is significant. The relative magnitude of both terms in (9) determines, which of the two channels has a stronger impact on the transmission mechanism. Analogously, the comparison of the portions of shock that travel each of the ways *a* or *b* in Figure 1 is responsible of a relative extent of the money (credit) channel.

2.2 Methodology of empirical studies

Empirical studies on the relative importance of monetary policy channels meet essential restrictions in methodology, since some of the traditional methods could end in misleading results. Standard Granger-causality tests, which measure the significance of the coefficients in vector autoregressions (VAR), might be inadequate. For example, if a technology shock l reaches money or bank loans before it changes the output, then a reverse reaction a_3 or b_3 in Figure 1 appears before the real economy changes. In this case the lagged values of the money (or loan) variable will have significant coefficients in VAR and the causality between money (or loans) and the real activity is considered. Here, the predictive power of the money (or loans) variable is not due to the money (or credit) channel of the monetary policy transmission, but due to a delayed reaction of the real output on technology shocks (compared to the quick response of the money (or loans) aggregate to the shock). The direct use of impulse-response functions for VARs will also suffer from the above-mentioned issue. A shock in the money (or loan) variable cannot always be straightly attributed to the monetary transmission mechanism, therefore it is not sufficient to consider an impulse-response of the real economy to a money (or loan) shock.

We will use the following methodology, incorporating different issues of empirical studies on the relative importance of the channels for the conduction of the monetary policy into the real economy. According to modern tendencies in econometrics (Ramey (1993); Konishi, Ramey and Granger (1992)), we use **velocity type variables**, which capture short-run movements of financial variables in a very efficient way. Many implications of macroeconomic theory illustrate, that – considering for example technology shocks – output, consumption, investment and monetary aggregates are nonstationary – this supposition coincides with empirical investigations. If we assume a technology shock to be the only source of nonstationarity, then all variables in the model should share the same stochastic trend; however, empirical studies affirm this hypothesis only in some cases. Among several reasons for this disparity are incompleteness of a model, presence of other shocks in a model, nonstationarity of the nominal interest rates, etc. **Vector Error Correction** (VEC) models permit us to scrutinize the behaviour of velocity type variables. In the following VAR representation the vector Z consists of investigated variables:

$$Z_t = \eta + \sum_{i=1}^{k} A_i Z_{t-i} + \varepsilon_t \ ,$$

where η is a $(n+1)$ vector of deterministic variables, A_i, *i=1..k* is a $(n+1)\times(n+1)$ coefficient matrix and ε is a $(n+1)$ vector of white noise errors with zero mean and constant variance. The model can be reformulated in the error-correction form:

$$\Delta Z_t = \eta + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \Pi z_{t-1} + \varepsilon_t$$

where $\Gamma_i = -\sum_{j=i+1}^{k} A_j$, *i=1..k-1* is a coefficient matrix; $\Pi = \sum_{j=1}^{k} A_j - I$ is a $(n+1)\times(n+1)$ matrix with the rank equal to the number of cointegrating vectors. The full rank of Π corresponds to the stationarity of all the series, the zero rank implies the absence of any common stochastic trend. The number of cointegrating vectors and the specification of common stochastic trends is a crucial point in the investigation of the monetary transmission mechanism using velocity type variables for money and loans. The importance of a particular channel of the monetary transmission mechanism implies that the velocity of the money (or credit) aggregate Granger causes the output movement. We test **Granger causality** for the changes (first differences) in the industrial production using the Wald test for the joint significance of the regression coefficients. To verify the results of Granger causality studies, which measure the information content of an explanatory variable corresponding to the future movement of an endogenous variable, additional tests are performed. At first, we investigate **impulse-response functions**, which transmit the standard deviation of innovation in one variable to other endogenous variables in VEC. The reference impulse-response function of the industrial production to innovation in the National Bank rate (which accesses firstly money and loan markets and only then travels to the real economy) was compared with the impulse-response functions, which close the money (or credit) channel. The impulse-response function using the particular channel closed, that exhibits more differences from the reference function, is responsible for the preponderant channel of the monetary policy transmission. Secondly, we investigate the **predictive power** of money and loan variables for the **out-of-sample forecast** of the industrial production.

3. Data description and preliminary testing

3.1 Data description

We use the monthly data from KGEN and IFS databases (maintained by WIFO) and the internal IHS-prognose database, the sample period covers 1983:12 – 2000:9 (see Table 1 for the description of the dataset). The variables employed are industrial production (*P*) as a measure of the real economy output, consumer price index (*CPI*) as an inflation measure; money supply aggregates were calculated from the available data series of deposits and cash using the following formulas:

$$\mathrm{M1} = \text{Banknotes in circulation} - \text{Coins in circulation} + \text{Sight deposits};$$

$$\mathrm{M2} = \mathrm{M1} + \text{Time deposits}; \qquad \mathrm{M3} = \mathrm{M2} + \text{Saving deposits}.$$

The interest rates, which were used in the model, contain the following components: the Austrian National Bank interest rate /*Referenzzinsatz der Oesterreichischen Nationalbank*/ I^{Refer} (as an analogy to the Federal Fund rate); short-term interest rates: the 3-months interest rate of the German National Bank /*Zinssatz für 3-Monatsgelder der Deutschen Bundesbank*/ I^{3m} and the Austrian overnight rate */AUT Zinssatz für täglich fällige Gelder/ rdkb*; the Austrian deposit rate I^{Dep}; the secondary market rate */Sekundärmarktrendite/ rs* and a long-term interest rate in the form of the ten-year German bond interest rate I^{10y}. The rates RDKB and RS were taken from the IHS-prognose database and the I^{10y} from the IHS term-structure forecast database (this series was estimated on the basis of real bond prices). The data for bank loans were taken in the forms of: bank-drafts to domestic non-banking firms */Wechselkredite an inländische Nichtbanken/* Cr^{W}; mortgage loans and municipal notes */Hypothekar -, Kommunaldarlehen/* Cr^{HK}; the total volume of credits in domestic currency */Schilling-Kredite an inländische Nichtbanken/* Cr^{ATS} and the total volume of credits in foreign currencies */Fremdwährungskredite/* $Cr^{\$}$. The total volume of bank loans was calculated as a sum of the credits in the domestic and foreign currencies: $Cr^{Tot} = Cr^{ATS} + Cr^{\$}$. Bank loans' data are available for the whole banking system as well as for separate banking groups such as joint-stock banks */Aktienbanken und Bankiers/*, savings banks */Sparkassensektor/*, regional (federal) mortgage banks */Landes-Hypothekenbanken/* and banks from other sectors of the Austrian banking system, namely Raiffeisensektor, Volksbankensektor, Bausparkassen and Sonderbanken (this division by sectors reflects the ownership structure). Unfortunately, the dataset of credits given to different types of borrowers has not been updated since 1995, therefore an analysis that takes into account the heterogeneous borrowers' structure is impossible. All the variables except the interest rates were transformed to logarithms.

3.2 Unit root test

The results of the Augmented Dickey-Fuller (ADF) test for unit root are presented in Table 2, the null-hypothesis of a unit root is not rejected for the levels of *IP*, *M1*, *M2*, *M3*, *CPI* and the credit data, whereas it is rejected for the first differences for most of the series, except credits in foreign currencies. The latter type of credits experienced substantial growth in the last period, which is most likely connected to the formation of the European Monetary Union. These results are coinciding with the majority of economic and econometric theories, which treat macro-economic series as first-order integrated processes. Even though the nonstationarity of real interest rates contradicts the classical theory, the comprehension of nonstationary shocks into the system can introduce the stochastic trend to the interest rates, too.

3.3 Cointegration analysis

Table 3 demonstrates the results of the Johansen cointegration test for a system of seven variables, namely: bank loans, money supply, inflation *CPI*, industrial production *IP* and three interest rates: long-term I^{10y}, short-term I^{3m} and the National Bank reference rate I^{Refer}. *M2* and *M3* aggregates were subsequently used as the measure of money supply. The total volume of bank loans Cr^{Tot}, bank-drafts to domestic non-banking firms Cr^{W}, mortgage loans and municipal notes Cr^{HK}, the total volume of credits in domestic currency Cr^{ATS} and in foreign currencies $Cr^{\$}$ were consecutively employed as the measure of bank loans. The total volume of bank loans granted by different banking groups was applied in order to investigate possible discrepancies in the credit channel for different bank types. Table 3A shows a summary of the Johansen cointegration test for different types of loans given by specific banking groups, namely joint-stock banks and regional (federal) mortgage banks. As our data are not seasonally adjusted, twelve lags were included. Analysis was also performed both with and without seasonal dummies as exogenous variables.[1] The summary of five specifications for trend in data and trend-intercept in cointegration equations is presented.[2]

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[1] Inclusion of seasonal variables={0,1} affects both the mean and the trend, Johansen suggests to use centered seasonal dummies, which only shift mean without contribution to the trend. To avoid the multicolliniarity problem, 11 seasonal dummies were employed; 12th seasonal dummy together with the constant term would form exactly collinear set.

[2] The investigated specifications correspond to E-Views ones:

1. no deterministic trends in series and no intercepts in cointegrating equations,
2. no deterministic trends in series and intercepts in the cointegrating equations,
3. linear trends in data and intercept in cointegrating equations,
4. linear trends in both series and cointegrating equations,
5. quadratic trends in series and linear trend in cointegrating equations.

While the results for different types of credits give about the same number of cointegrating vectors (except for bank-drafts to domestic non-banking firms and the sub-table with the inclusion of seasonal dummies and *M2*), the employment of the total volume of credits for different banking groups changes the cointegration rank of a system very much. For later use we will fix the cointegration specification to the third assumption, which allows a linear trend in the original series and an intercept in the cointegrating vectors. Firstly, this choice is based on the postulation, that long-run equilibrium conditions between macroeconomic variables such as industrial production and consumption do not have trends in the majority of cases. Secondly, a linear trend in data (taken in logarithms) coincides with the supposition of economic growth, and finally, the third specification of trend-intercept demonstrates the most stable results for the number of cointegrating vectors among the other specifications. If we employ different credit types for the whole banking system or the total volume of credits as the loan variable, then the third specification gives five cointegrating vectors for the system of seven variables in most of the cases, with the exception of bank-drafts to domestic non-banking firms Cr^{W} (where it decreases to four cointegration vectors) and the sub-table with the inclusion of seasonal dummies and *M2* (where the common stochastic trends were not found for the total volume of credits and for domestic currency credits). The utilization of credits granted by different banking groups as the loan variable varies the result of the Johansen cointegration test from four cointegrating vectors (which corresponds to three common stochastic trends) to seven (which stands for independent non-stationary series).

The **bivariate cointegration test** (Table 3-B) is carried out to control the results of the mutual check. The test is executed for the second and the third specification of the cointegration option and with and without seasonal dummies. One more time the third specification reveals more stable properties for our data set: if it shows the presence of cointegration, then the number of cointegrating vectors for the second specification is equal to one, too. The opposite does not hold: the second specification demonstrates cointegration too often, what is rejected by the third specification. Interest rate series were found to be not cointegrated with each other, as well as monetary aggregates. The short-term interest rate I^{3m} exhibits cointegration with the industrial production *IP,* and the National Bank rate I^{Refer} is cointegrated with *CPI* (for both of the investigated cointegration specifications). Credit variables also demonstrate the absence of bivariate cointegration, but they are cointegrated with some monetary aggregates, so the total volume of loans Cr^{Tot} is cointegrated with *M2,* and bank-drafts to domestic non-banking firms Cr^{W} with *M3*. As a result we have three bivariate cointegrating vectors: the short-rate with *IP*, the National Bank rate with *CPI* and loans with monetary aggregates (Cr^{Tot} with *M2* and Cr^{W} with *M3*), what does not contradict the final upshot of five (or four) cointegrating vectors for the system of seven variables.

4. Results of the empirical analysis

4.1 Velocity of money and loans

On the basis of the results of the Johansen cointegration test (Table 3), VEC models were estimated for the system of seven variables: bank loans, money supply, inflation *CPI*, industrial production *IP* and three interest rates with an application of different measures of bank loans and money aggregates. The third specification for trend-intercept in cointegrating vectors was used and the number of cointegrating vectors for every measure of bank loans and money aggregates was taken as suggested by the Johansen test. Also, twelve lags of every explanatory variable were included in VECs with and without seasonal dummies as exogenous arguments. Cointegrating vectors identify the long-run relationships of endogenous variables, while error-correction terms are responsible for the convergence of the deviations from cointegrating equations back to equilibrium. The error-correction term that includes the money (or loan) variable can be considered as the **velocity of money** (loan) and is responsible for the short-run dynamics that depict the adjustment process of the deflection from the long-run equilibrium path. The error-correction term representing **money velocity** (*MV*) has the form:

$$MV_t = M_{t-1} + a_{CPI}CPI_{t-1} + a_{IP}IP_{t-1} + a_{const}$$ for 5 cointegrating vectors in VEC;

$$MV_t = M_{t-1} + a_{CPI}CPI_{t-1} + a_{IP}IP_{t-1} + a_{I\_refer}I\_refer_{t-1} + a_{const}$$ for 4 cointegrating vectors.

The error-correction term representing **loan velocity** (*LV*) has the form:

$$LV_t = L_{t-1} + a_{CPI}CPI_{t-1} + a_{IP}IP_{t-1} + a_{const}$$ for 5 cointegrating vectors in VEC;

$$LV_t = L_{t-1} + a_{CPI}CPI_{t-1} + a_{IP}IP_{t-1} + a_{I\_refer}I\_refer_{t-1} + a_{const}$$ for 4 cointegrating vectors;

where *M* is a chosen monetary aggregate and *L* is a loan variable. Table 4-A/4-B exhibits the lags coefficients for the error-correction terms, representing the money velocity and the loan velocity correspondently; the lag coefficient for M_{t-1}/L_{t-1} is set to one by construction of the error-correction term. Velocity type variables characterize short-run divergences from common stochastic trends and are appropriate terms to investigate the impact of the monetary policy on the real economy.

4.2 Granger causality between velocities of money and loans and changes in industrial production

To study the impact of money and loan velocities on changes in the real output, the Granger causality test for joint significance of regression coefficients was performed. Granger causality measures the information content of an explanatory variable corresponding to the future movement of an endogenous variable. Table 5 presents p-values of Wald statistics for regressions, each of which contains twelve lags of the change in the industrial production and a constant. At first, we check the **basic regressions** (those, which do not contain monetary or credit variables), and include the changes in *CPI* or spread as an explanatory variable. The Wald test demonstrates the significance of spread for the future real output behaviour and that the first difference of *CPI* is not significant for regressions with only one explanatory variable. The basic regressions, which include both lags of *CPI* and spread, turn to reject the significance of both variables for the changes in the industrial production. Subsequent regressions use money and credit velocities as explanatory variables as well. These velocity variables were calculated for 36 cases, utilizing different measures of money and loans, see Table 4 for coefficients for error-correction terms, representing velocities of money and loan. Groups 1-18 use different types of credits as the loan variable, out of which groups 1-10 utilize *M3* as the measure of money, whereas groups 11-18 employ *M2*; groups 19-36 include credits for different bank sectors, out of which groups 19-28 contain *M3* monetary aggregate and groups 29-36 *M2*. While odd groups do not include seasonal dummies as explanatory variables, even groups do contain them. For every group out these 36, the seven following regressions, employing twelve lags of explanatory variables, twelve lags of the changes in the industrial production and a constant, were estimated:

1. the loan velocity is used as an explanatory variable;
2. the money velocity is used as an explanatory variable;
3. the loan and the money velocities are used as explanatory variables;
4. the loan and the money velocities and the changes in *CPI* are used as explanatory variables;
5. the loan and the money velocities and spread are used as explanatory variables;
6. the loan velocity and spread are used as explanatory variables;
7. the money velocity and spread are used as explanatory variables.

The first and the second regression examine the significance of the credit or the money channel alone; to study the independence of the credit (or the money) channel from the other monetary transmission channels, we add further explanatory variables to the regression. Considering the different types of credits (groups 1-18), we find that the credit channel alone (first regression) was important only for the first group (the total volume of credits, *M3* as the monetary variable without seasonal dummies). This significance vanishes, if we review the regression together with spread. The hypothesis of the importance of the credit channel is rejected, if we employ foreign currency credits $Cr^{\$}$ and bank-drafts to domestic non-banking firms Cr^{W} (groups three, four, nine, ten, seventeen and eighteen of Table 5). ATS credits Cr^{ATS} and mortgage loans and municipal notes Cr^{HK} exhibit interesting properties: the credit channel is never significant alone, but becomes significant together with the money channel in the majority of cases. It is interesting, that, as far as domestic currency loans Cr^{ATS} or mortgage loans and municipal notes Cr^{HK}, accompanied by *M3* aggregate are concerned, neither the money or the credit channel alone nor taken together with spread is significant, but they become significant, as soon as they are added (also together with spread). Looking at Granger causality for the loan velocities, which were calculated for credits granted by different bank types, we find that the credit channel is never vital for Bausparkassen, the Raiffeisensektor and Sonderbanken (groups 21, 22, 25-28, 33-36), whereas it generally is significant alone (or together with the other explanatory variables) for joint-stock banks and regional (federal) mortgage banks. To study the relative importance of the credit and the money channel, we need to perform additional investigations.

4.3 Impulse responses for industrial production in VECs

As an additional step in the investigation of the relative impact of the money and the credit channel in the monetary policy transmission, we use impulse-response functions, which trace out the effect of a standard deviation shock to one variable on the behaviour of the other endogenous variables in VEC. Corresponding VECs were estimated at section 4.1 for the system of seven variables: *CPI*, *IP*, three interest rates, bank loan and money aggregate. From the 36 combinations of the loan-money variables (inspected in section 4.2), we use only those cases, in which the credit channel was found to be significant alone or together with the money channel, namely the groups one, five-eight, 13-16, 19-20, 23-24, 29-32. Impulse-response functions allow us to explore different ways to transfer a shock in the monetary policy variable (the National Bank rate) to the real output (Figure 1). As was mentioned before, the mere consideration of the impulse-response of the real economy to a shock in money aggregates (or loans) is not sufficient, since it might be not related to the monetary transmission mechanism. At first we calculate the **reference impulse-response functions** of the industrial production to innovations in the National Bank rate, which access at first money and loan markets before they travel to the real economy (in Figure 1 channels a_1 and b_1 operate before a_2 and b_2). A positive standard deviation of I^{Refer} in VEC affects all the variables in the following order: the money aggregate, loan, interest rates, *CPI*, *IP*. Then we consecutively close the money and the credit channel by simply changing the order in which a shock in the monetary policy affects the real economy. For the **closed money channel** the order in which a shock in I^{Refer} is transmitted to *IP* is: loans, interest rates, *CPI*, *IP*, the money aggregate, whereas for the **closed credit channel** it is: the money aggregate, interest rates, *CPI*, *IP*, loans. If the impulse-response function of *IP* with one channel closed varies notably from the reference impulse-response function, then the corresponding channel is important for the monetary policy transmission. Figures 2 show impulse-response functions of *IP* to a positive one-standard-deviation shock in the National Bank rate for the reference case (with both channels open) and for the closed money and the closed credit channel; Figure 3 demonstrates the effects of a shock in the National Bank rate on the money aggregates and loans.

As regards groups 1-18, that contain different types of credits, we see that the credit channel is more pronounced than the money channel for both the investigated domestic currency credits Cr^{ATS} (Figures 2-A and 2-C) and mortgage loans and municipal notes Cr^{HK} (Figures 2-B and 2-D), no matter which of the money aggregates (*M2* or *M3*) is used and whether seasonal dummies are present or absent. However, Figure 2_I shows that the credit channel was not important in the transmission of the monetary policy shock to *IP* for the total volume of loans Cr^{Tot} (group one). This coincides with the results of the Granger causality test, where the credit channel was found to be significant alone, but not taken together with the money channel. If we employ credits granted by different banking groups for the loan variable, the outcome depends on the bank type applied. For joint-stock banks (Cr^{aktb}, groups 19-20, 29-30) the money channel is more pronounced when *M3* is used as the money aggregate (Figure 2-E), though the utilization of *M2* leads to both of the channels having about the same impact in the monetary policy transmission as it illustrated by Figure 2-G. Figures 2-F and 2-H demonstrate the dominance of the credit channel in the transmission of a National Bank rate shock to the real economy when regional (federal) mortgage banks loans (Cr^{land}, groups 23-24, 31-32) are used as the loan variable for most of the cases, except for group 23, where both credit/ money channels exhibit about the same qualities. Figure 3 shows, that the direct response of the money aggregates to a shock in the National Bank rate is consistent with the money view in the long run in most cases. Positive innovations in I^{Refer}, which are attached to the tightening of the monetary policy, cause a decline in deposits and therefore bring forth a decay in the monetary aggregates and a fall in credits on the asset side of depository institutes. Even though some of the impulse-response functions for the money aggregates exhibit a short-term (three months) increase, later they drop. For the total volume of credits (group one), however, such a reduction is not observed; this model probably does not capture all the properties of a system.

4.4 Relative predictive power of money and loan variables for IP forecast

The subsequent investigation of the relative performance of the money and the credit channel was done on the basis of out-of-sample forecasts. To study the influence of the different measures of money and loans (on their own or together with interest rates and *CPI*) on the real output forecasting, VEC models were applied for different groups of explanatory variables. The following assembly of explanatory indicators was used to generate 1296 groups of variables to be investigated: *IP*; *CPI*; the money aggregate (*M1*, *M2*, *M3*); the measure of loans in the form of different types of credits (Cr^{Tot}, Cr^{W}, Cr^{ATS}, Cr^{HK}, $Cr^{\$}$) and the total volume of credits given by different banking groups (Cr^{aktb}, Cr^{land}, Cr^{raif}, Cr^{spar}, Cr^{sond}, Cr^{volks}); interest rates (I^{Refer}, I^{3m}, I^{10y}, I^{dep}, *rdkb*, *rs*). In every group we include *IP* and a constant and allow the group to contain not more than one measure of loans and not more than one money aggregate; however, there is no limitation on the number of interest rates that can be included in one group. Although the common strategy for VEC modelling is based on the initial testing for the number of cointegrating vectors and number of lags included in the model, we use an approach, that allows us to avoid significant "handwork". VEC models for every group of explanatory variables were estimated for the range of one up to *(n-1)* cointegrating vectors, for twelve lags in the AR process and for the second and the third specification of the cointegration option (see section 3.3), where *n*- is the number of variables included in the group. Engle and Yoo (1987) show, that for cointegrated systems both VECs and VARs in levels are appropriate specifications (although for longer forecast horizons VEC models are performing better). Therefore, also VARs in levels were used for the investigation of dependencies of the real output on money and credit aggregates. These VAR models were carried out with twelve lags for the same 1296 groups of explanatory variables. Unrestricted VARs often require an estimation of the large number of parameters and therefore can produce poor forecast, because they might reflect the sample-specific temporary relationships and carry them through the out-of-sample period. This can be avoided via either the elimination of some lags (but scrutinizing all the feasible combinations of lags requires a lot of time and computer resources and makes it impossible in practice) or via imposing restrictions, like an a-priori information on the parameters that are to be estimated (Bayesian approach). All VARs were estimated for four different specifications of lags:

1) **unrestricted model** with a lag length of twelve for all the variables (all lags from one to twelve are included);

and **restricted models**:

2) lags with corresponding p-levels of t-statistics less than 50% are included;
3) lags with corresponding p-levels of t-statistics less than 20% are included;
4) lags with corresponding p-levels of t-statistics less than 10% are included;
5) lags with corresponding p-levels of t-statistics less than 5% are included.

P-levels for restricted models correspond to the estimation done for the whole available data set.

Every model was estimated for the sample from 1983:12 to 1995:12; the twelve-steps-ahead forecast was calculated starting from 1996:01, and for every following iteration the window was shifted by one month. This forecasting procedure was repeated until the end of the whole available sample (2000:06) and the best 25 models of every type were chosen on the basis of the out-of-sample forecast performance for forecast intervals of six steps ahead (one half of a year) and twelve steps ahead (one year prediction). Different error measures[33] were used as an out-of-sample evaluation of the model's performance, paying attention to the different goodness-of-fit characteristics of the forecast, where the mean absolute error (MAE) corresponds to the forecast bias, the out-of-sample coefficient of determination *(R^2)* constitutes the measure-of-fit of the forecast and the Theil's coefficient measures the superiority of our forecast against the random walk (RW) model (where the best one-step prediction meets the case of non-change forecast). Two types of Theil' coefficients were calculated: $THIC_1$ uses the one-step-ahead RW prediction and $THIC_2$ applies the two-steps-ahead non-change forecast. For the n-steps-ahead forecast the denominator of $THIC_1$ looks like $\sum_{t=1}^{T}\sum_{i=1}^{n}(y_i - y_{i-1})^2$ and the denominator of $THIC_2$ is equal to $\sum_{t=1}^{T}\sum_{i=1}^{n}(y_i - y_{t-2})^2$. To obtain error coefficients for average n-steps-ahead forecasts, the forecast errors for the first, second ...*n^{th}* step were added together with equal weights; at the end of the whole available sample the n-steps-ahead forecast horizon decreases from *n* and reaches one at the last point examined.

The statistics for the forecast-performance of the 25 leading VEC models are presented in Table 6; Table 7 demonstrates the forecast-performance of the 25 leading VARs. As far as MAE and RMSE appear to be the most reliable measures for the analysis of the forecast-performance, the results are ordered by minimising MAE and subsequently minimising RMSE. Panels A correspond to the average best prediction of twelve observations ahead

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[3] Description of utilized error-measures:

Adjusted mean absolute percentage error: $$AMAPE = \frac{1}{N}\sum_{n=1}^{N}\left|\frac{y_n - \hat{y}_n}{y_n + \hat{y}_n}\right| * 100$$

Mean absolute error: $$MAE = \frac{1}{N}\sum_{n=1}^{N}\left|y_n - \hat{y}_n\right| * 100$$

Root mean square error: $$RMSE = 100 * \sqrt{\frac{1}{N}\sum_{n=1}^{N}(y_n - \hat{y}_n)^2}$$

Mean error: $$ME = \frac{100}{N}\sum_{n=1}^{N}(y_n - \hat{y}_n)$$

Coefficient of determination: $$R^2 = 1 - \frac{\sum_{n=1}^{N}(y_n - \hat{y}_n)^2}{\sum_{n=1}^{N}(y_n - \bar{y})^2}$$

Theil's coefficient of inequality: $$Theil = \frac{\sum_{n=1}^{N}(y_n - \hat{y}_n)^2}{\sum_{n=1}^{N}(y_n - y_{n-1})^2} * 100$$

(one year forecast), Panels B accord to the models with the average best prediction of six observations ahead (half a year forecast). The forecast-performance of VEC models does not achieve the accuracy of the restricted VARs for both forecast horizons; VARs exhibit lower errors and higher values of the out-of-sample R^2. The 25 leading VECs and VARs for the one-year-forecast horizon (Panels A) contain monetary aggregates alone (without loans) in 64% and 44% of the cases respectively, include both loan and money variables in 36% of the cases (for both VEC and VAR models) and incorporate credit variables alone in 20% of the cases for VARs and in no case in the leading VECs. The shortening of the forecast-interval to six months (Panels B) changes the results as follows: the 25 leading models contain monetary aggregates alone in 28% of the cases for VECs and in 16% of the cases for VARs, the "best" forecasting models include both money and loan indicators in 72% of the cases for VECs and in 56% of the cases for VARs and the leading models, that embed credit variables alone, form 28% of the cases for VARs and do not occur among leading VECs. These percentages underline the high predictive power of monetary indicators for the real activity for a one-year horizon and the reduction of the predictive power with the decrease of the forecast-interval. A six months' timespan would rather be considered a more appropriate period for the monetary policy transmission than a one-year horizon, since it reflects the essential delay for the real sector to react on changes in the monetary policy. However, among the 25 leading models the simultaneous operation of both the money and the credit channel (specified by the inclusion of both the monetary and the loan indicators in the model) turns out to have a higher predictive power than the operation of a single channel. This empirical method doesn't allow us to analyse the relative impact of a single channel during its simultaneous functioning, but it allows us to find out the importance of different loan variables for the credit channel operation. Among all the cases, in which loan variables were involved in leading models, the total volume of credits in domestic currency (Cr^{ATS}) occurred in 36% of the cases for VECs and in 28% of the cases for VARs. The total volume of mortgage loans and municipal notes (Cr^{HK}) appeared in 32% of the cases for VECs and in 20% of the cases for VARs. The other credit variables were not as important as mentioned above and included only the total volume of different types of loans attracted by all the Austrian banks and not the loans granted by different banking groups. The combination of these three empirical methods emphasizes the superior role of two types of loans (the total volume of credits in domestic currency Cr^{ATS} and the total volume of mortgage loans and municipal notes Cr^{HK} attracted by all the Austrian banks) in the operation of the credit channel. This reflects that these credits are more connected to the changes in the real sector growth than the other loan variables.

5. Concluding remarks

The effectiveness of the monetary policy, expressed in the extent, to which changes in the National Bank rate are transferred into the real economy sector, as well as the relative impact of different channels on the monetary policy conduction are closely connected to the structure of the legal and the financial system of a country, the health and the concentration of its banking system, the availability of non-banking sources of finance and the development of the capital market. Theories of the transmission mechanism distinguish between the traditional money view and the credit channel, in which financial assets and liabilities play a prominent role in the transfer of monetary impulses into the real sector output. The imperfections of the Austrian capital market, the limited number of listed corporate securities and the superior position of bank credits compared to other financial resources imply the high sensitivity of the Austrian economy to changes in the monetary policy. The above-mentioned arguments would also suppose a relatively strong impact of the lending channel in the distribution of monetary innovations to the real sector. The heterogenous structure of borrowers and banks could lead to divergences in the transmission of the monetary policy, taking into account different types of loans. The available dataset didn't provide an opportunity to investigate credits given to different types of borrowers but supplied the total volume of loans granted by different banking groups as well as several types of loans attracted by all the Austrian banks. *M2* and *M3* monetary aggregates were employed as financial indicators to link the monetary policy with the real output. The result of the examination of the total volume of loans granted by all the Austrian banks implies, that the money channel is more important than the credit channel in the transmission mechanism of policy shocks. However, the significance of the credit channel was marked by each of the three employed empirical methods (incorporating different econometric issues), when we link the total volume of credits in domestic currency and the total volume of mortgage loans and municipal notes to the dynamic response of the real output to monetary policy shocks. The impulse-response functions of VEC models strongly suggest, that the credit channel was more pronounced for these types of loans, no matter which of the money variable was used. The results of the out-of-sample forecast of the industrial production confirm the significant predictive power of the total volume of ATS-credits and mortgage loans and municipal notes - they were the most frequently used credit variables in the leading VEC and VAR models for both six-months and one-year forecast horizons. Granger causality tests together with the impulse-response functions for VECs propose two other loan variables (namely, credits granted by joint-stock banks and regional (federal) mortgage banks) to play an important role in the credit channel functioning. But, as these credit variables never appeared in the leading VEC and VAR models for the out-of-sample IP forecast, we suppose that the use of the total volume of ATS-credits and mortgage loans and municipal notes as credit indicators captures the properties of the dynamic response of the real sector output to monetary shocks better.

It may be interesting to continue studies in two directions: At first, richer specifications of banking loans would provide us with an opportunity to investigate specific ways of the credit channel operation, for example the creation of loan buffers (as it was studied by Kakes, 1998, for the Netherlands). The second extension may be the comparison of the credit channel mechanism in different countries in the European Monetary Union.

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APPENDIX

Table 1: Description of Dataset

Code for later use	**Name**	**Source**	Code in Source	Seas. Adjust.	Currency/ Unit	Transfor-mation
Credit Data						
Cr^{W}	Bank-drafts to domestic non-banking firms/ *Wechselkredite an inlandische Nichtbanken*	KGEN	WECN"M	n	ATS	log
Cr^{HK}	Mortgage loans and municipal notes/ *Hypothekar -, Kommunaldarlehen*	KGEN	HYSN"M	n	ATS	log
Cr^{ATS}	Total volume of credits in domestic currency/ *Schilling-Kredite an inlandische Nichtbanken*	KGEN	ESMN"M	n	ATS	log
$Cr^{\$}$	Total volume of credits in foreign currencies/ *Fremdwährungskredite*	KGEN	FRWN"M	n	ATS	log
Cr^{1}	Short-term credits with (up to 1 year)	KGEN	L1MN"M	n	ATS	log
Cr^{1-5}	Middle-term credits (1-5 years)	KGEN	L2MN"M	n	ATS	log
Cr^{5}	Long-term credits (more than 5 years)	KGEN	L3MN"M	n	ATS	log
Money Aggregates						
CASH	Banknotes in circulation	KGEN	FBARGN"M	n	ATS	log
COIN	Coins in circulation	KGEN	FSCHMN"M	n	ATS	log
SI	Sight deposits	KGEN	FSIGMN"M	n	ATS	log
TI	Time deposits	KGEN	FTEAMN"M	n	ATS	log
SPI	Saving deposits	KGEN	FSPGMN"M	n	ATS	log
M1		calculated	M1=CASH-COIN+SI	n	ATS	log
M2		calculated	M2=M1+TI	n	ATS	log
M3		calculated	M3=M2+SPI	n	ATS	log
Inflation						
CPI	Consumer price index	IFS	122"64"M	n	index	log
Output						
IP	Industrial production	IFS	122"66"M	n	ATS	log
Interest rates						
I^{Refer}	Austrian National Bank interest rate/ *Referenzzinsatz der Österreichischen Nationalbank*	KGEN	FRLOMN"M		**%**	
I^{3M}	3-months rate of German National Bank/ *Zinssatz für 3-Monatsgelder der Deutschen Bundesbank*	KGEN	WREU3N"M		**%**	
I^{10y}	10-years German bond's rate	IHS_prognose			**%**	
I^{dep}	Austrian deposit rate	IFS	122"60L"M		**%**	
rdkb	Austrian overnight rate/ *AUT Zinssatz für täglich fällige Gelder*	IHS_prognose			**%**	
rs	Austrian secondary market rate/ *AUT Sekundärmarktrendite*	IHS_prognose			**%**	

Prefixes for Credit Data for different Banks

AKTIENBANKEN UND BANKIERS	FAC	VOLKSBANKENSEKTOR	FGC	LANDES-HYPOTHEKENBANKEN	FHC	SONDERBANKEN	FPC
SPARKASSENSEKTOR	FSC	BAUSPARKASSEN	FUC	RAIFFEISENSEKTOR	FLC	INSGESAMT	FC

Table 2: Augmented Dickey-Fuller tests of a unit root

Variable	Level				1st Difference			
	with intercept		with trend		with intercept		with trend	
	ADF test statistics	signif.	ADF test statistics	signif.	ADF test statistics	signif.	ADF test statistics	signif.
IP	0.34		-1.66		-5.47	***	-5.53	***
M1	2.93		0.40		-2.31		-3.55	**
M2	1.95		0.45		-4.07	***	-4.54	***
M3	0.93		-1.88		-6.63	***	-6.73	***
CPI	-0.70		-0.62		-5.68	***	-5.71	***
$Cr^{\$}$	4.47		3.74		-0.14		-1.71	
Cr^{W}	0.13		-1.21		-3.54	***	-3.76	**
Cr^{HK}	-2.16		0.39		-4.29	***	-4.82	***
Cr^{ATS}	-2.34		0.56		-4.09	***	-4.74	***
Cr^{Tot}	-1.18		-0.85		-5.18	***	-5.27	***
I^{3M}	-3.18	**	-2.65		-4.31	***	-4.67	***
I^{DEP}	-1.98		-1.98		-3.25	**	-3.34	*
I^{REFER}	-1.97		-2.03		-2.91	**	-2.88	
rdisk	-2.02		-2.00		-2.92	**	-2.83	
rdkb	-1.38		-1.50		-3.48	**	-3.43	*
rs	-1.45		-2.00		-3.17	**	-3.16	*

MacKinnon critical values for rejection of hypothesis of a unit root:

	with intercept			with trend	
1% Critical Value	-3.52	***	1% Critical Value	-4.01	***
5% Critical Value	-2.90	**	5% Critical Value	-3.43	**
10% Critical Value	-2.59	*	10% Critical Value	-3.14	*

Table 3: Johansen cointegration test summary:
Number of cointegrating vectors, result of LR test.

M3 as the money variable

Credit variable included	Type of bank or credit	Data Trend: None		None		Linear		Linear		Quadratic	
		Cointegration equations: No Intercept No Trend		Intercept No Trend		Intercept No Trend		Intercept Trend		Intercept Trend	
Cr^{Tot}	Total volume of credits	5	5	7	6	5	5	6	6	5	5
$Cr^{\$}$	Foreign currency credits	5	5	7	6	5	5	6	6	5	5
Cr^{ATS}	ATS credits	5	5	7	7	5	5	6	6	5	5
Cr^{HK}	Mortgage loans and municipal notes	5	6	7	7	5	5	6	6	5	5
Cr^{W}	Bank-drafts to domestic non-banking firms	7	7	7	7	4	4	5	5	4	5
Cr^{aktb}	Credits granted by joint-stock banks	5	5	5	5	4	4	5	5	4	5
Cr^{bau}	Credits granted by Bausparkassen	5	5	6	6	5	5	6	5	4	4
Cr^{land}	Credits granted by regional mortgage banks	5	4	6	6	5	5	6	5	7	5
Cr^{raif}	Credits granted by the Raiffeisensektor	5	5	6	6	4	4	6	5	5	5
Cr^{spar}	Credits granted by savings banks	6	5	7	6	7	4	7	5	7	5
Cr^{volk}	Credits granted by Volksbankensektor	6	6	7	7	7	7	5	5	4	4
Cr^{sond}	Credits granted by other banks	7	5	5	5	4	4	4	4	4	5
	Seasonal dummies	+	-	+	-	+	-	+	-	+	-

M2 as the money variable

Credit variable included	Type of bank or credit	Data Trend: None		None		Linear		Linear		Quadratic	
		Cointegration equations: No Intercept No Trend		Intercept No Trend		Intercept No Trend		Intercept Trend		Intercept Trend	
Cr^{Tot}	Total volume of credits	5	5	6	6	7	5	6	5	5	5
$Cr^{\$}$	Foreign currency credits	5	4	6	6	7	5	6	5	5	5
Cr^{ATS}	ATS credits	5	5	6	6	5	5	6	6	6	6
Cr^{HK}	Mortgage loans and municipal notes	5	5	7	7	5	5	6	6	6	6
Cr^{W}	Bank-drafts to domestic non-banking firms	7	5	6	6	4	4	5	4	4	4
Cr^{aktb}	Credits granted by joint-stock banks	5	4	6	6	4	4	5	5	5	5
Cr^{bau}	Credits granted by Bausparkassen	4	4	6	6	7	7	5	5	5	4
Cr^{land}	Credits granted by regional mortgage banks	5	5	5	5	4	4	6	5	5	7
Cr^{raif}	Credits granted by the Raiffeisensektor	5	4	6	6	4	4	5	5	4	5
Cr^{spar}	Credits granted by savings banks	5	5	6	6	7	7	5	5	5	5
Cr^{volk}	Credits granted by Volksbankensektor	5	5	7	7	7	7	6	4	5	4
Cr^{sond}	Credits granted by other banks	5	5	5	6	4	4	4	4	4	4
	Seasonal dummies	+	-	+	-	+	-	+	-	+	-

Table 3-A: Johansen cointegration test summary for loans of Joint-stock banks and Regional (federal) mortgage banks: Number of cointegrating vectors, result of LR test.

M3 as the money variable

Credit variable included	Type of bank or credit	Data Trend: None		None		Linear		Linear		Quadratic	
		Cointegration equations: No Intercept No Trend		Intercept No Trend		Intercept No Trend		Intercept Trend		Intercept Trend	
Cr^{ATS_aktb}	ATS credits, Joint-stock banks	5	5	6	5	4	4	5	4	4	4
$Cr^{\$\_aktb}$	Foreign curr.credits, Joint-stock banks	5	5	6	6	4	5	6	6	5	7
Cr^{HK_aktb}	Mortgage loans, Joint-stock banks	7	7	7	6	6	5	6	6	5	6
Cr^{W_aktb}	Bank-drafts, Joint-stock banks	5	5	6	6	5	4	6	4	7	4
Cr^{ATS_land}	ATS credits, Regional mortgage banks	5	5	6	6	5	4	6	6	4	4
$Cr^{\$\_land}$	Foreign curr.credits, Regional mortgage banks	5	5	7	6	5	5	6	6	7	7
Cr^{HK_land}	Mortgage loans, Regional mortgage banks	7	7	7	6	6	5	6	6	5	6
Cr^{W_land}	Bank-drafts, Regional mortgage banks	5	5	6	6	4	4	6	5	4	4
	Seasonal dummies	+	-	+	-	+	-	+	-	+	-

M2 as the money variables

Credit variable included	Type of bank or credit	Data Trend: None		None		Linear		Linear		Quadratic	
		Cointegration equations: No Intercept No Trend		Intercept No Trend		Intercept No Trend		Intercept Trend		Intercept Trend	
Cr^{ATS_aktb}	ATS credits, Joint-stock banks	5	5	5	5	4	4	5	5	5	5
$Cr^{\$\_aktb}$	Foreign curr.credits, Joint-stock banks	5	4	6	6	7	5	6	5	5	5
Cr^{HK_aktb}	Mortgage loans, Joint-stock banks	6	6	6	6	7	7	6	6	5	5
Cr^{W_aktb}	Bank-drafts, Joint-stock banks	5	4	6	6	7	7	4	4	4	4
Cr^{ATS_land}	ATS credits, Regional mortgage banks	5	5	6	6	5	4	6	6	4	4
$Cr^{\$\_land}$	Foreign curr.credits, Regional mortgage banks	5	5	6	6	5	5	6	5	7	7
Cr^{HK_land}	Mortgage loans, Regional mortgage banks	6	6	6	6	7	7	6	6	5	5
Cr^{W_land}	Bank-drafts, Regional mortgage banks	5	5	6	5	4	3	5	4	4	4
	Seasonal dummies	+	-	+	-	+	-	+	-	+	-

Table 3-B: Bivariate Johansen cointegration test summary for the second and the third cointegration option

Number of cointegrating vectors, result of LR test

	IP		CPI		M1		M2		M3		Cr^{Tot}		$Cr^{\$}$		Cr^{ATS}		Cr^{W}		Cr^{HK}		I^{3m}		I^{10y}	
Cointegration option	b	c	b	c	b	c	b	c	b	c	b	c	b	c	b	c	b	c	b	c	b	c	b	c
CPI	0	0																						
M1	1	0	0	0																				
M2	0	0	2	0	0	0																		
M3	1	0	2	2	2	0	0	0																
Cr^{Tot}	0	0	0	0	0	0	**1**	**1**	1	0														
$Cr^{\$}$	0	0	0	0	0	0	1	2	1	0	0	0												
Cr^{ATS}	0	0	0	0	0	0	1	0	2	2	0	0	0	0										
Cr^{W}	1	0	0	0	1	0	0	0	**1**	**1**	0	0	0	0	0	0								
Cr^{HK}	1	0	1	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0						
I^{3m}	**1**	**1**	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0				
I^{10y}	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0		
I^{Refer}	1	0	**1**	**1**	0	0	0	0	1	0	1	2	1	2	0	0	0	0	0	0	0	0	0	0

Table 4-A: Lags Coefficients for the Error Correction Term, representing the Money Velocity

Variables used in VEC					Lag's coefficients at corresponding terms			
Credits		Money	# of CV	seas dum	I_Refer (-1)	CPI(-1)	IP(-1)	const
Total volume of credits	Cr^{Tot}	M3	5			-1.29	-0.47	-2.76
Total volume of credits	Cr^{Tot}	M3	5	+		-1.18	-0.45	-3.04
Foreign currency credits	$Cr^{\$}$	M3	5			-1.43	-0.25	-2.92
Foreign currency credits	$Cr^{\$}$	M3	5	+		-1.24	-0.24	-3.32
ATS credits	Cr^{ATS}	M3	5			18.76	-29.15	14.51
ATS credits	Cr^{ATS}	M3	5	+		6.20	-10.93	3.17
Mortgage loans and municipal notes	Cr^{HK}	M3	5			-3.75	3.42	-5.64
Mortgage loans and municipal notes	Cr^{HK}	M3	5	+		-15.19	21.90	-19.67
Bank-drafts to domestic non-banking firms	Cr^{W}	M3	4		-0.02	-1.79	-0.14	-2.33
Bank-drafts to domestic non-banking firms	Cr^{W}	M3	4	+	-0.02	-1.80	-0.24	-2.10
Total volume of credits	Cr^{Tot}	M2	5			0.58	-1.74	-3.35
Foreign currency credits	$Cr^{\$}$	M2	5			0.48	-1.57	-3.49
ATS credits	Cr^{ATS}	M2	5			0.73	-2.21	-2.70
ATS credits	Cr^{ATS}	M2	5	+		0.17	-1.29	-3.44
Mortgage loans and municipal notes	Cr^{HK}	M2	5			0.90	-2.56	-2.37
Mortgage loans and municipal notes	Cr^{HK}	M2	5	+		0.26	-1.38	-3.43
Bank-drafts to domestic non-banking firms	Cr^{W}	M2	4		0.00	0.52	-1.79	-3.15
Bank-drafts to domestic non-banking firms	Cr^{W}	M2	4	+	-0.02	0.53	-1.90	-2.81
Credits granted by joint-stock banks	Cr^{aktb}	M3	4		-0.01	-1.58	-0.40	-2.26
Credits granted by joint-stock banks	Cr^{aktb}	M3	4	+	-0.02	-1.76	-0.27	-2.16
Credits granted by Bausparkassen	Cr^{bau}	M3	5			-1.13	-0.29	-3.43
Credits granted by Bausparkassen	Cr^{bau}	M3	5	+		-1.00	-0.57	-3.14
Credits granted by regional mortgage banks	Cr^{land}	M3	5			-1.43	-0.56	-2.32
Credits granted by regional mortgage banks	Cr^{land}	M3	5	+		-1.39	-0.58	-2.36
Credits granted by the Raiffeisensektor	Cr^{raif}	M3	4		-0.02	-1.96	-0.01	-2.24
Credits granted by the Raiffeisensektor	Cr^{raif}	M3	4	+	-0.02	-1.99	0.00	-2.21
Credits granted by other banks	Cr^{sond}	M3	4		-0.02	-1.68	-0.33	-2.17
Credits granted by other banks	Cr^{sond}	M3	4	+	-0.02	-1.71	-0.28	-2.21
Credits granted by joint-stock banks	Cr^{aktb}	M2	4		0.00	0.78	-2.04	-3.16
Credits granted by joint-stock banks	Cr^{aktb}	M2	4	+	-0.01	0.31	-1.57	-3.10
Credits granted by regional mortgage banks	Cr^{bau}	M2	4		0.04	1.36	-2.69	-3.26
Credits granted by regional mortgage banks	Cr^{bau}	M2	4	+	0.02	0.89	-2.26	-3.08
Credits granted by the Raiffeisensektor	Cr^{raif}	M2	4		-0.01	0.20	-1.42	-3.22
Credits granted by the Raiffeisensektor	Cr^{raif}	M2	4	+	0.00	0.21	-1.46	-3.16
Credits granted by other banks	Cr^{sond}	M2	4		-0.02	0.64	-1.89	-3.06
Credits granted by other banks	Cr^{sond}	M2	4	+	-0.01	0.54	-1.85	-3.00

The lag coefficient for M_{t-1} is set to one

Table 4-B: Lags Coefficients for the Error Correction Term, representing the Loan Velocity

Variables used in VEC					Lag's coefficients at corresponding terms			
Credits		Money	# of CV	seas dum	i_refer (-1)	CPI(-1)	IP(-1)	const
Total volume of credits	Cr^{Tot}	M3	5			-1.45	-4.44	0.28
Total volume of credits	Cr^{Tot}	M3	5	+		-1.64	-4.52	0.82
Foreign currency credits	$Cr^{\$}$	M3	5			1.02	-5.19	3.17
Foreign currency credits	$Cr^{\$}$	M3	5	+		0.23	-5.28	4.91
ATS credits	Cr^{ATS}	M3	5			42.99	-64.25	36.26
ATS credits	Cr^{ATS}	M3	5	+		16.48	-25.66	12.08
Mortgage loans and municipal notes	Cr^{HK}	M3	5			-7.20	8.17	-8.24
Mortgage loans and municipal notes	Cr^{HK}	M3	5	+		-33.82	51.19	-40.97
Bank-drafts to domestic non-banking firms	Cr^{W}	M3	4		-0.17	-9.54	9.64	-4.04
Bank-drafts to domestic non-banking firms	Cr^{W}	M3	4	+	-0.18	-10.72	9.96	-2.31
Total volume of credits	Cr^{Tot}	M2	5			-1.20	-4.51	-0.07
Foreign currency credits	$Cr^{\$}$	M2	5			1.62	-5.15	1.92
ATS credits	Cr^{ATS}	M2	5			1.19	-5.50	2.27
ATS credits	Cr^{ATS}	M2	5	+		0.08	-3.86	1.21
Mortgage loans and municipal notes	Cr^{HK}	M2	5			0.64	-5.56	3.49
Mortgage loans and municipal notes	Cr^{HK}	M2	5	+		-0.56	-3.45	1.66
Bank-drafts to domestic non-banking firms	Cr^{W}	M2	4		-0.22	-9.27	9.87	-4.77
Bank-drafts to domestic non-banking firms	Cr^{W}	M2	4	+	-0.26	-9.51	9.81	-3.89
Credits granted by joint-stock banks	Cr^{aktb}	M3	4		-0.01	3.36	-6.35	-4.28
Credits granted by joint-stock banks	Cr^{aktb}	M3	4	+	-0.02	3.16	-6.22	-4.14
Credits granted by Bausparkassen	Cr^{bau}	M3	5			-7.52	23.64	-38.76
Credits granted by Bausparkassen	Cr^{bau}	M3	5	+		-5.66	21.12	-37.42
Credits granted by regional mortgage banks	Cr^{land}	M3	5			-2.33	-7.67	10.92
Credits granted by regional mortgage banks	Cr^{land}	M3	5	+		-2.37	-7.63	10.91
Credits granted by the Raiffeisensektor	Cr^{raif}	M3	4		0.10	2.47	-8.30	1.14
Credits granted by the Raiffeisensektor	Cr^{raif}	M3	4	+	0.09	2.49	-8.30	1.21
Credits granted by other banks	Cr^{sond}	M3	4		-0.19	-31.39	21.80	10.82
Credits granted by other banks	Cr^{sond}	M3	4	+	-0.19	-32.11	22.66	10.52
Credits granted by joint-stock banks	Cr^{aktb}	M2	4		-0.01	3.32	-6.38	-4.16
Credits granted by joint-stock banks	Cr^{aktb}	M2	4	+	-0.02	3.10	-6.15	-4.15
Credits granted by regional mortgage banks	Cr^{bau}	M2	4		0.07	-0.67	-9.18	10.22
Credits granted by regional mortgage banks	Cr^{bau}	M2	4	+	0.03	-1.82	-8.12	10.62
Credits granted by the Raiffeisensektor	Cr^{raif}	M2	4		0.13	2.48	-8.92	2.21
Credits granted by the Raiffeisensektor	Cr^{raif}	M2	4	+	0.11	2.30	-8.74	2.30
Credits granted by other banks	Cr^{sond}	M2	4		-0.42	-34.47	26.46	9.04
Credits granted by other banks	Cr^{sond}	M2	4	+	-0.27	-33.38	24.74	9.40

The lag coefficient for L_{t-1} is set to one

Table 5: Granger Causality Tests for Industrial Production

P-values for F-statistics of Wald test's of joint significance of lag coefficients

	coefficients at lags of corresponding variables						coefficients at lags of corresponding variables					
	LV	MV	d(CPI)	spread	adj R^2		LV	MV	d(CPI)	spread	seas.dummy	adj R^2
	Basic regression with spread						+ seasonal dummies					
				0.02	0.91					0.04	+	0.92
	Basic regression with CPI changes						+ seasonal dummies					
			0.12		0.90				0.11		+	0.92
	Basic regression with both variables						+ seasonal dummies					
			0.43	0.12	0.91				0.17	0.08	+	0.92
1	Total volume of credits Cr^{Tot}, M3					2	+ seasonal dummies					
	0.01				0.90		0.06				+	0.92
		0.08			0.90			0.03			+	0.92
	0.05	0.17			0.91		0.15	0.08			+	0.92
	0.38	0.24	0.58		0.91		0.30	0.15	0.41		+	0.92
	0.39	0.13		0.06	0.92		0.41	0.01		0.01	+	0.93
	0.25			0.09	0.91		0.25			0.19	+	0.92
		0.04		0.01	0.92			0.00		0.00	+	0.93
3	Foreign currency credits $Cr^{\$}$, M3					4	+ seasonal dummies					
	0.15				0.90		0.06				+	0.92
		0.08			0.90			0.03			+	0.92
	0.28	0.17			0.91		0.15	0.08			+	0.92
	0.49	0.25	0.50		0.91		0.28	0.11	0.39		+	0.92
	0.67	0.02		0.01	0.92		0.41	0.01		0.06	+	0.93
	0.32			0.06	0.91		0.19			0.14	+	0.92
		0.01		0.00	0.92			0.00		0.00	+	0.93
5	ATS credits Cr^{ATS}, M3					6	+ seasonal dummies					
	0.42				0.90		0.24				+	0.92
		0.43			0.90			0.27			+	0.92
	0.05	0.05			0.91		0.01	0.01			+	0.93
	0.08	0.05	0.13		0.91		0.08	0.01	0.25		+	0.93
	0.02	0.02		0.01	0.91		0.01	0.01		0.03	+	0.93
	0.48			0.03	0.91		0.22			0.04	+	0.92
		0.49		0.03	0.91			0.36		0.07	+	0.92
7	Mortgage loans Cr^{HK}, M3					8	+ seasonal dummies					
	0.50				0.90		0.29				+	0.92
		0.23			0.90			0.24			+	0.92
	0.05	0.02			0.91		0.01	0.01			+	0.93
	0.05	0.04	0.15		0.91		0.03	0.01	0.17		+	0.93
	0.09	0.03		0.01	0.92		0.01	0.01		0.04	+	0.93
	0.21			0.01	0.91		0.19			0.03	+	0.92
		0.07		0.01	0.91			0.13		0.02	+	0.92
9	Bank-drafts to non-banks Cr^{W}, M3					10	+ seasonal dummies					
	0.08				0.90		0.54				+	0.92
		0.01			0.91			0.05			+	0.92
	0.89	0.26			0.91		0.79	0.13			+	0.92
	0.89	0.26	0.52		0.91		0.71	0.26	0.36		+	0.92
	0.95	0.16		0.13	0.91		0.85	0.09		0.13	+	0.92
	0.52			0.22	0.91		0.91			0.18	+	0.92
		0.02		0.07	0.91			0.09		0.09	+	0.92

Table 5: Granger Causality Tests for Industrial Production

P-values for F-statistics of Wald test's of joint significance of lag coefficients

	coefficients at lags of corresponding variables						coefficients at lags of corresponding variables					
	LV	MV	d(CPI)	spread	adj R^2		LV	MV	d(CPI)	spread	seas.dummy	adj R^2
11	Total volume of credits Cr^{Tot}, M2					12	Foreign currency credits $Cr^{\$}$, M2					
	0.08				0.90		0.19					0.90
		0.01			0.91			0.01				0.91
	0.41	0.06			0.91		0.71	0.07				0.91
	0.69	0.13	0.67		0.91		0.86	0.14	0.57			0.91
	0.39	0.01		0.01	0.92		0.66	0.01		0.01		0.92
	0.21			0.06	0.91		0.27			0.04		0.91
		0.00		0.01	0.92			0.01		0.01		0.92
13	ATS credits Cr^{ATS}, M2					14	+ seasonal dummies					
	0.19				0.90		0.45				+	0.92
		0.02			0.91			0.01			+	0.92
	0.07	0.07			0.91		0.31	0.01			+	0.92
	0.05	0.01	0.24		0.91		0.33	0.01	0.15		+	0.93
	0.02	0.04		0.01	0.92		0.07	0.01		0.01	+	0.93
	0.07			0.01	0.91		0.08			0.01	+	0.92
		0.01		0.01	0.92		0.01			0.04	+	0.93
15	Mortgage loans Cr^{HK}, M2					16	+ seasonal dummies					
	0.11				0.90		0.21				+	0.92
		0.03			0.91			0.01			+	0.92
	0.01	0.00			0.92		0.06	0.00			+	0.93
	0.02	0.01	0.60		0.92		0.19	0.00	0.32		+	0.93
	0.00	0.00		0.04	0.93		0.14	0.02		0.01	+	0.94
	0.02			0.00	0.91		0.01			0.00	+	0.93
		0.02		0.01	0.91			0.01		0.04	+	0.93
17	Bank-drafts to non-banks Cr^{W}, M2					18	+ seasonal dummies					
	0.07				0.90		0.43				+	0.92
		0.01			0.91			0.02			+	0.92
	0.41	0.08			0.91		0.93	0.16			+	0.92
	0.061	0.14	0.55		0.91		0.59	0.06	0.07		+	0.92
	0.84	0.02		0.06	0.91		0.95	0.10		0.13	+	0.92
	0.49			0.21	0.91		0.86			0.21	+	0.92
		0.01		0.01	0.92			0.05		0.09	+	0.93

Table 5: Granger Causality Tests for Industrial Production

P-values for F-statistics of Wald test's of joint significance of lag coefficients

	coefficients at lags of corresponding variables						coefficients at lags of corresponding variables					
	LV	MV	d(CPI)	spread	adj R^2		LV	MV	d(CPI)	**spread**	seas.dummy	adj R^2
19 Joint-stock banks Cr^{aktb}, M3						20 + seasonal dummies						
	0.01				0.91		0.01				+	0.92
		0.01			0.91			0.03			+	0.92
	0.05	0.03			0.91		0.04	0.11			+	0.93
	0.05	0.21	0.42		0.91		0.05	0.26	0.37		+	0.93
	0.02	0.03		0.02	0.92		0.03	0.09		0.06	+	0.93
	0.02			0.02	0.91		0.02			0.07	+	0.93
		0.02		0.05	0.91			0.06		0.08	+	0.93
21 Bausparkassen Cr^{bau}, M3						22 + seasonal dummies						
	0.71				0.90		0.52				+	0.92
		0.07			0.90			0.03			+	0.92
	0.87	0.15			0.90		0.77	0.08			+	0.92
	0.81	0.37	0.34		0.90		0.41	0.02	0.09		+	0.92
	0.68	0.01		0.00	0.92		0.75	0.01		0.00	+	0.93
	0.21			0.00	0.91		0.26			0.02	+	0.92
		0.00		0.00	0.92			0.00		0.00	+	0.93
23 Reg. mortgage banks Cr^{land}, M3						24 + seasonal dummies						
	0.00				0.92		0.00				+	0.93
		0.14			0.90			0.04			+	0.92
	0.00	0.04			0.92		0.00	0.12			+	0.94
	0.00	0.27	0.27		0.92		0.00	0.04	0.17		+	0.94
	0.00	0.01		0.02	0.93		0.00	0.01		0.04	+	0.94
	0.00			0.13	0.92		0.00			0.18	+	0.93
		0.06		0.01	0.91			0.01		0.01	+	0.93
25 Raiffeisensektor Kr_raif, M3						26 + seasonal dummies						
	0.57				0.90		0.70				+	0.91
		0.01			0.91			0.03			+	0.92
	0.63	0.01			0.91		0.59	0.03			+	0.92
	0.56	0.04	0.42		0.91		0.49	0.07	0.33		+	0.92
	0.41	0.01		0.05	0.91		0.14	0.01		0.02	+	0.93
	0.81			0.06	0.90		0.68			0.05	+	0.92
		0.03		0.08	0.91			0.07		0.09	+	0.93
27 Other banks Cr^{sond}, M3						28 + seasonal dummies						
	0.99				0.90		0.87				+	0.91
		0.01			0.91			0.04			+	0.92
	0.75	0.00			0.91		0.69	0.03			+	0.92
	0.59	0.04	0.37		0.91		0.72	0.10	0.46		+	0.92
	0.28	0.00		0.02	0.91		0.28	0.02		0.02	+	0.93
	0.98			0.03	0.90		0.68			0.03	+	0.92
		0.04		0.07	0.91			0.07		0.08	+	0.93

Table 5: Granger Causality Tests for Industrial Production

P-values for F-statistics of Wald test's of joint significance of lag coefficients

	coefficients at lags of corresponding variables						coefficients at lags of corresponding variables					
	LV	MV	d(CPI)	spread	adj R^2		LV	MV	d(CPI)	spread	seas.dummy	adj R^2
29	Joint-stock banks Cr^{aktb}, M2					30	+ seasonal dummies					
	0.01				0.91		0.01				+	0.92
		0.01			0.91			0.01			+	0.92
	0.12	0.09			0.91		0.16	0.13			+	0.93
	0.05	0.18	0.18		0.91		0.13	0.11	0.13		+	0.93
	0.05	0.02		0.00	0.92		0.07	0.07		0.04	+	0.93
	0.02			0.02	0.91		0.01			0.07	+	0.93
		0.01		0.01	0.92			0.02		0.07	+	0.93
31	Reg. mortgage banks Cr^{land}, M2					32	+ seasonal dummies					
	0.05				0.91		0.01				+	0.92
		0.06			0.91			0.07			+	0.92
	0.00	0.00			0.92		0.00	0.01			+	0.93
	0.00	0.01	0.19		0.92		0.00	0.02	0.04		+	0.94
	0.00	0.00		0.04	0.92		0.00	0.03		0.15	+	0.93
	0.16			0.08	0.91		0.02			0.09	+	0.93
		0.08		0.03	0.91			0.10		0.07	+	0.92
33	Raiffeisensektor Cr^{raif}, M2					34	+ seasonal dummies					
	0.40				0.90		0.60				+	0.91
		0.00			0.91			0.01			+	0.92
	0.90	0.04			0.91		0.88	0.03			+	0.92
	0.86	0.06	0.38		0.91		0.91	0.02	0.19		+	0.92
	0.98	0.02		0.03	0.91		0.82	0.00		0.07	+	0.93
	0.77			0.09	0.91		0.75			0.09	+	0.92
		0.00		0.01	0.92			0.01		0.06	+	0.93
35	Other banks Cr^{sond}, M2					36	+ seasonal dummies					
	0.59				0.90		0.78				+	0.91
		0.00			0.91			0.01			+	0.92
	0.79	0.01			0.91		0.63	0.01			+	0.92
	0.57	0.02	0.29		0.91		0.75	0.01	0.25		+	0.92
	0.91	0.00		0.04	0.91		0.48	0.01		0.06	+	0.93
	0.98			0.15	0.90		0.79			0.06	+	0.92
		0.00		0.01	0.92			0.02		0.07	+	0.93

Table 6: 25 Leading VEC Models for the Out-of-sample IP forecast

Panel A. The average best prediction of twelve observations ahead (one-year forecast horizon)

#	Group	# CV	Coint. option	MAE	ME	AMAPE	RMSE	R^2	$THIC_1$	$THIC_2$
1	IP M1 I^{10y} I^{Refer} rs	4	c	10.95	-2.14	2.65	14.31	0.928	8.24	5.10
2	IP M1 I^{10y} I^{Refer} rs	4	b	10.96	-0.63	2.66	14.32	0.927	8.25	5.11
3	IP M1 I^{10y} I^{Refer} rs	3	c	11.09	-2.18	2.69	14.52	0.925	8.49	5.26
4	IP M1 I^{10y} I^{Refer} rs	3	b	11.09	-0.85	2.69	14.48	0.926	8.45	5.23
5	IP M1 I^{10y} I^{Refer} rs	2	b	11.32	-0.75	2.74	14.76	0.922	8.82	5.46
6	IP M1 I^{10y} rs rdkb	4	b	11.38	-0.45	2.76	14.52	0.926	8.43	5.22
7	IP M1 I^{10y} I^{Refer} rs	2	c	11.39	-2.26	2.76	14.94	0.920	9.10	5.64
8	IP M1 I^{10y} rs rdkb	4	c	11.52	-0.69	2.79	14.65	0.924	8.60	5.32
9	IP Cr^{ATS} M1 I^{10y} rs rdkb	4	b	11.66	-2.85	2.83	15.29	0.915	9.62	5.96
10	IP M1 I^{10y} rs rdkb	2	b	11.70	-1.92	2.84	15.10	0.918	9.28	5.75
11	IP M1 I^{10y} rs	3	c	11.70	0.52	2.84	14.66	0.925	8.55	5.30
12	IP M1 I^{10y} rs rdkb	2	c	11.83	-2.68	2.87	15.45	0.914	9.77	6.05
13	IP Cr^{ATS} M1 I^{10y} rs rdkb	3	b	11.86	-2.90	2.87	15.70	0.911	10.13	6.27
14	IP CPI Cr^{HK} M3 I^{10y} rs rdkb	2	c	11.91	3.38	2.89	15.67	0.912	9.97	6.18
15	IP M1 I^{3m} I^{10y} rs	3	c	11.91	-3.10	2.89	15.55	0.913	9.95	6.16
16	IP Cr^{ATS} M1 I^{10y} rs rdkb	3	c	12.00	-3.70	2.91	15.87	0.909	10.38	6.43
17	IP Cr^{ATS} M1 I^{10y} rs rdkb	5	c	12.02	-5.46	2.91	15.70	0.910	10.18	6.30
18	IP CPI Cr^{ATS} M3 I^{10y} rs rdkb	2	c	12.04	-2.44	2.93	15.57	0.915	9.69	6.00
19	IP M2 I^{10y} rs	3	b	12.08	1.86	2.91	15.46	0.923	8.70	5.39
20	IP M2 I^{10y} rs	3	c	12.10	1.97	2.91	15.47	0.924	8.69	5.38
21	IP Cr^{ATS} M1 I^{10y} I^{Refer} rs	3	c	12.13	-3.50	2.94	15.67	0.912	10.02	6.20
22	IP Cr^{HK} M1 I^{10y} rs rdkb	4	b	12.14	-2.62	2.94	15.91	0.909	10.31	6.39
23	IP M1 I^{10y} rs rdkb	3	b	12.16	-3.42	2.95	15.47	0.915	9.68	5.99
24	IP M1 I^{3m} I^{10y} rs	4	b	12.20	-3.80	2.96	15.81	0.910	10.25	6.35
25	IP Cr^{HK} M3 I^{10y} rs	3	b	12.21	-1.01	2.96	15.23	0.916	9.52	5.90

Panel B. The average best prediction of six observations ahead (half a year forecast horizon)

#	Group	# CV	Coint. option	MAE	ME	AMAPE	RMSE	R^2	$THIC_1$	$THIC_2$
1	IP CPI Cr^{HK} M3 I^{10y} rs rdkb	2	c	1.21	0.27	2.95	1.65	0.908	10.88	6.73
2	IP Cr^{HK} M3 I^{10y} I^{Refer} rs	1	c	1.22	-0.30	2.97	1.58	0.915	10.06	6.22
3	IP CPI Cr^{HK} M3 I^{10y} rs rdkb	3	c	1.22	0.30	2.98	1.67	0.905	11.28	6.97
4	IP M2 I^{3m} rs	1	c	1.23	-0.11	3.00	1.51	0.923	9.13	5.64
5	IP CPI Cr^{HK} M3 I^{10y} rs rdkb	4	c	1.23	0.30	3.01	1.70	0.901	11.71	7.24
6	IP Cr^{ATS} M1 I^{10y} rs rdkb	4	b	1.25	-0.12	3.04	1.61	0.911	10.52	6.50
7	IP Cr^{ATS} M1 I^{10y} rs rdkb	3	c	1.25	-0.20	3.04	1.63	0.909	10.81	6.68
8	IP Cr^{ATS} M1 I^{10y} I^{Refer} rs	3	c	1.25	-0.23	3.05	1.61	0.912	10.41	6.44
9	IP Cr^{ATS} M1 I^{10y} rs rdkb	5	c	1.25	-0.39	3.05	1.63	0.910	10.72	6.62
10	IP Cr^{ATS} M3 I^{10y} rs	3	b	1.25	-0.15	3.05	1.60	0.914	10.22	6.32
11	IP CPI Cr^{HK} M3 I^{10y} rs rdkb	5	c	1.26	0.33	3.06	1.74	0.896	12.27	7.58
12	IP CPI Cr^{HK} M3 I^{10y} rs rdkb	6	c	1.26	0.37	3.06	1.74	0.896	12.28	7.59
13	IP M1 I^{10y} I^{Refer} rs	4	b	1.26	-0.12	3.07	1.62	0.911	10.55	6.52
14	IP M1 I^{10y} I^{Refer} rs	4	c	1.26	-0.22	3.07	1.61	0.912	10.42	6.44
15	IP CPI Cr^{ATS} M3 I^{10y} rs rdkb	4	c	1.26	0.19	3.07	1.73	0.899	11.98	7.41
16	IP Cr^{HK} M3 I^{10y} rs	1	c	1.26	0.12	3.07	1.62	0.911	10.58	6.54
17	IP CPI Cr^{ATS} M3 I^{10y} rs rdkb	3	c	1.26	0.07	3.08	1.70	0.902	11.57	7.15
18	IP Cr^{ATS} M1 I^{10y} rs rdkb	3	b	1.27	-0.14	3.09	1.65	0.907	11.05	6.83
19	IP M1 I^{10y} I^{Refer} rs	3	c	1.27	-0.22	3.09	1.63	0.910	10.66	6.59
20	IP Cr^{HK} M3 I^{10y} rs	3	b	1.27	-0.03	3.08	1.61	0.911	10.48	6.48
21	IP Cr^{Tot} M1 I^{3m}	3	c	1.27	0.24	3.09	1.67	0.908	10.93	6.75
22	IP M1 I^{10y} I^{Refer} rs	3	b	1.27	-0.12	3.09	1.64	0.909	10.74	6.63
23	IP M2 I^{3m} rs	2	b	1.27	-0.03	3.09	1.59	0.917	9.82	6.07
24	IP M2 I^{3m} rs	3	c	1.27	0.20	3.09	1.64	0.912	10.42	6.44
25	IP CPI Cr^{ATS} M3 I^{10y} rs rdkb	2	c	1.27	-0.16	3.11	1.68	0.904	11.35	7.01

All of VEC models include twelve lags

Table 7: 25 Leading VAR Models for the Out-of-sample IP forecast

Panel A. The average best prediction of twelve observations ahead (one year forecast horizon)

#	Group	lags	MAE	ME	AMAPE	RMSE	R^2	$THIC_1$	$THIC_2$
1	IP CPI Cr^{ATS} I^{3m} I^{10y} I^{Refer} rs	**	0.955	-0.14	0.231	1.24	0.946	6.09	3.77
2	IP CPI Cr^{ATS} I^{3m} I^{10y} rs	**	0.969	-0.10	0.235	1.26	0.944	6.35	3.93
3	IP M1 I^{10y} I^{Refer} rs	*	0.998	-0.15	0.242	1.35	0.936	7.32	4.54
4	IP M1 I^{3m} I^{10y} rs	*	1.006	-0.15	0.244	1.36	0.934	7.49	4.64
5	IP Cr^{ATS} M1 I^{10y} I^{Refer} rs	*	1.015	-0.11	0.246	1.30	0.940	6.82	4.22
6	IP M1 I^{10y} rs	*	1.030	-0.18	0.250	1.35	0.936	7.26	4.50
7	IP Cr^{HK} M1 I^{10y} I^{Refer} rs	*	1.034	-0.05	0.250	1.33	0.939	6.97	4.32
8	IP M1 I^{10y} rs rdkb	*	1.036	-0.01	0.251	1.33	0.937	7.15	4.43
9	IP M2 I^{10y} rs	*	1.050	0.06	0.254	1.33	0.940	6.81	4.22
10	IP $Cr^{\$}$ M1 I^{10y} I^{Refer} rs	*	1.064	0.18	0.258	1.43	0.930	7.96	4.93
11	IP CPI Cr^{ATS} I^{10y} I^{Refer} rs	*	1.064	0.19	0.258	1.32	0.941	6.75	4.18
12	IP CPI Cr^{HK} I^{3m} I^{10y} I^{Refer} rs	**	1.066	-0.04	0.258	1.37	0.938	7.04	4.36
13	IP M1 I^{3m} I^{10y} I^{Refer} rs	*	1.070	-0.19	0.260	1.46	0.925	8.55	5.30
14	IP Cr^{Tot} M1 I^{3m} I^{Refer} rdkb	+	1.070	-0.18	0.260	1.37	0.934	7.51	4.65
15	IP CPI Cr^{HK} M1 I^{3m} I^{10y} I^{Refer} rs	**	1.072	-0.35	0.260	1.38	0.933	7.60	4.71
16	IP M2 I^{3m} I^{10y} rs	*	1.074	-0.04	0.261	1.41	0.930	7.94	4.92
17	IP Cr^{Tot} M1 I^{3m}	*	1.075	0.16	0.261	1.44	0.929	8.08	5.01
18	IP CPI Cr^{HK} I^{3m} I^{10y} I^{Refer} rs	***	1.075	0.27	0.261	1.38	0.935	7.35	4.55
19	IP M1 I^{3m} I^{10y} I^{Refer} rs rdkb	*	1.079	-0.24	0.262	1.43	0.928	8.21	5.09
20	IP Cr^{Tot} M1 I^{Refer} rs	**	1.081	0.11	0.262	1.39	0.932	7.75	4.80
21	IP CPI M3 I^{10y} I^{Refer} rs rdkb	***	1.082	0.28	0.261	1.35	0.936	7.28	4.51
22	IP Cr^{Tot} M1 I^{3m} I^{Refer} rs	**	1.084	0.12	0.264	1.45	0.925	8.53	5.29
23	IP Cr^{Tot} M1 I^{3m} rs	**	1.084	0.22	0.263	1.46	0.924	8.59	5.32
24	IP CPI M2 I^{3m} I^{10y} I^{Refer} rs	**	1.085	0.05	0.262	1.38	0.937	7.19	4.45
25	IP M1 I^{10y} I^{Refer} rs rdkb	*	1.086	-0.18	0.263	1.41	0.931	7.80	4.83

Panel B. The average best prediction of six observations ahead (half a year forecast horizon)

#	Group	lags	MAE	ME	AMAPE	RMSE	R^2	$THIC_1$	$THIC_2$
1	IP CPI Cr^{ATS} I^{3m} I^{10y} I^{Refer} rs	**	0.937	0.04	0.228	1.24	0.948	6.16	3.81
2	IP CPI Cr^{ATS} I^{3m} I^{10y} rs	**	0.946	0.05	0.230	1.25	0.947	6.23	3.85
3	IP Cr^{Tot} M2 rs rdkb	***	0.989	0.12	0.240	1.28	0.945	6.55	4.05
4	IP Cr^{Tot} M2 I^{Refer} rs rdkb	***	0.997	0.09	0.242	1.28	0.945	6.47	4.00
5	IP Cr^{Tot} M2 I^{Refer} rs rdkb	**	1.018	0.02	0.248	1.32	0.942	6.89	4.26
6	IP CPI M2 I^{Refer} rs rdkb	***	1.033	0.14	0.251	1.33	0.940	7.14	4.41
7	IP Cr^{Tot} M2 rs rdkb	**	1.054	0.02	0.256	1.34	0.940	7.07	4.37
8	IP CPI Cr^{HK} I^{3m} I^{10y} I^{Refer} rs	**	1.057	0.09	0.257	1.38	0.938	7.33	4.53
9	IP Cr^{Tot} M1 I^{Refer} rs	**	1.057	0.10	0.258	1.40	0.934	7.81	4.83
10	IP CPI Cr^{HK} M1 I^{3m} I^{10y} I^{Refer} rs	**	1.058	-0.22	0.257	1.39	0.935	7.73	4.78
11	IP CPI Cr^{HK} I^{3m} I^{10y} rs	**	1.060	-0.29	0.258	1.38	0.935	7.69	4.75
12	IP CPI Cr^{Tot} M2 I^{Refer} rs rdkb	***	1.064	0.29	0.258	1.41	0.934	7.85	4.85
13	IP CPI Cr^{ATS} I^{10y} I^{Refer} rs	*	1.071	0.06	0.260	1.33	0.941	6.97	4.31
14	IP CPI M3 I^{10y} I^{Refer} rs rdkb	***	1.073	0.28	0.260	1.36	0.939	7.27	4.49
15	IP Cr^{ATS} M1 I^{10y} I^{Refer} rs	*	1.073	-0.15	0.262	1.37	0.936	7.56	4.67
16	IP Cr^{ATS} M1 I^{3m} rs rdkb	**	1.075	-0.31	0.263	1.45	0.929	8.45	5.22
17	IP CPI Cr^{HK} I^{3m} I^{10y} I^{Refer} rs	***	1.077	0.31	0.262	1.41	0.933	7.90	4.88
18	IP M2 I^{Refer} rs rdkb	**	1.082	0.14	0.263	1.36	0.938	7.36	4.55
19	IP Cr^{W} M3 I^{10y} I^{Refer} rs	*	1.083	0.13	0.263	1.38	0.935	7.64	4.72
20	IP Cr^{ATS} M1 I^{3m} I^{Refer} rs	**	1.087	-0.29	0.266	1.48	0.925	8.87	5.48
21	IP Cr^{Tot} M1 I^{3m} I^{Refer} rdkb	**	1.087	0.21	0.265	1.47	0.927	8.62	5.33
22	IP M1 rs	**	1.089	0.17	0.265	1.46	0.929	8.44	5.22
23	IP CPI Cr^{ATS} I^{Refer} rs	***	1.094	0.66	0.266	1.48	0.926	8.78	5.42
24	IP CPI $Cr^{\$}$ M2 I^{Refer} rs rdkb	***	1.094	0.32	0.265	1.43	0.931	8.19	5.06
25	IP Cr^{HK} M1 rs rdkb	**	1.098	0.33	0.268	1.46	0.928	8.57	5.29

One star in the lag specification corresponds to 50% p-level for the restricted VAR model, two stars - to 20% p-level, and three stars - to 10% p-level and a plus sign – to 5% p-level.

Figure 1

Monetary Policy Transmission

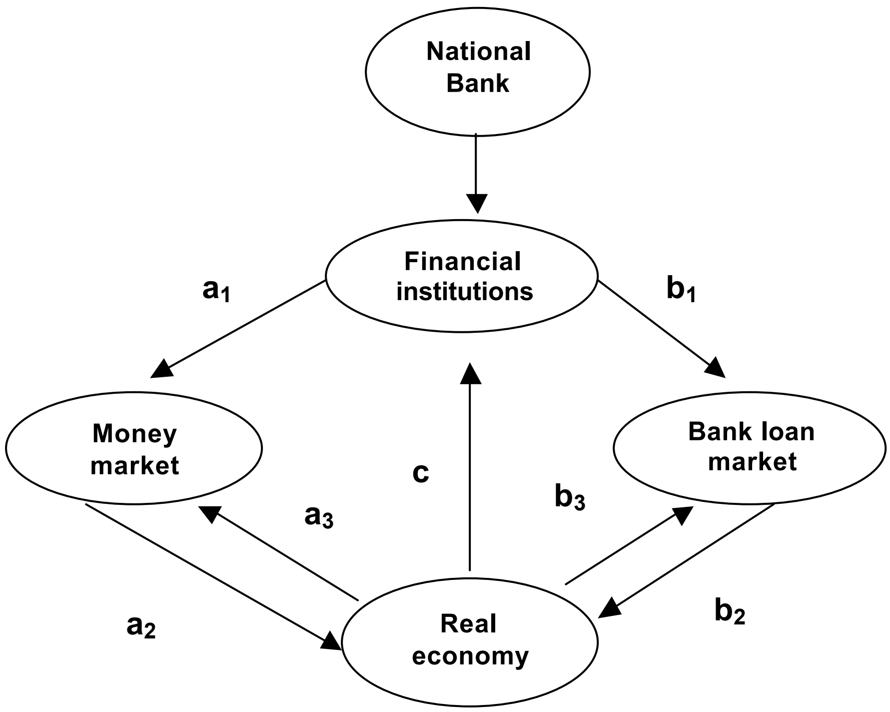
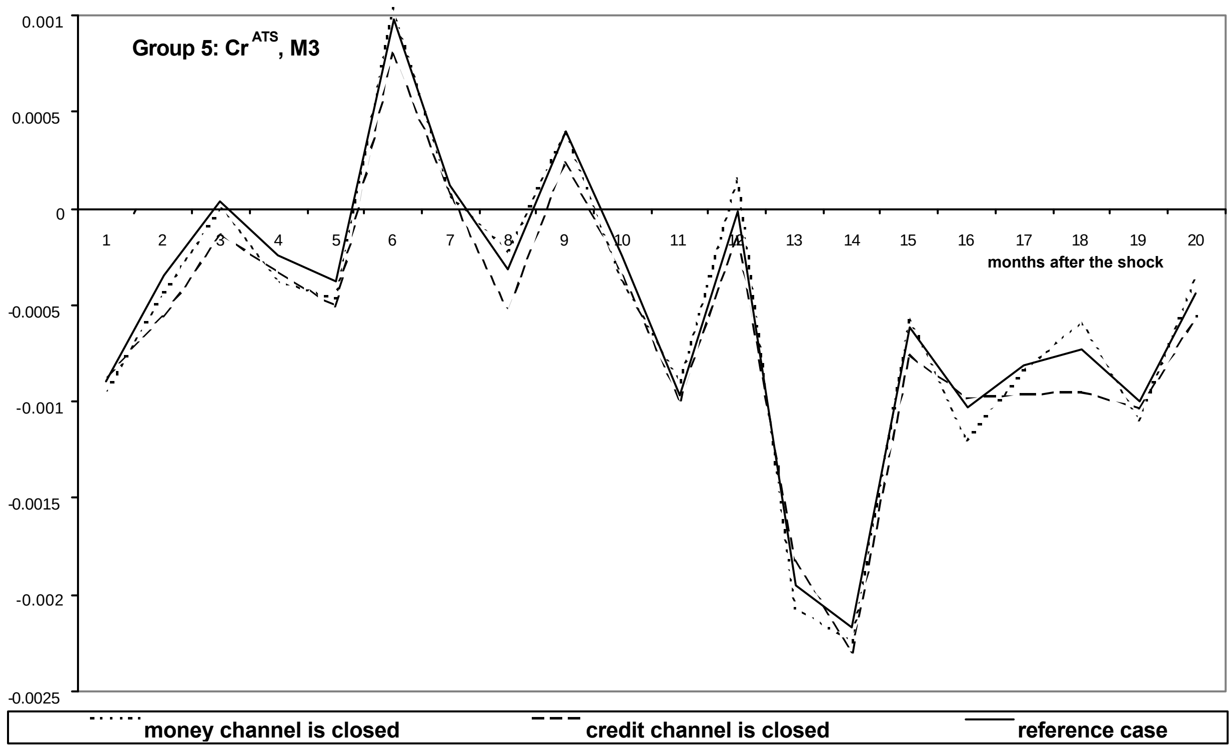


Figure 2-A

Response of IP to a positive innovation in government rate

Credits in domestic currency are used as the loan variable and M3 is used as the money variable



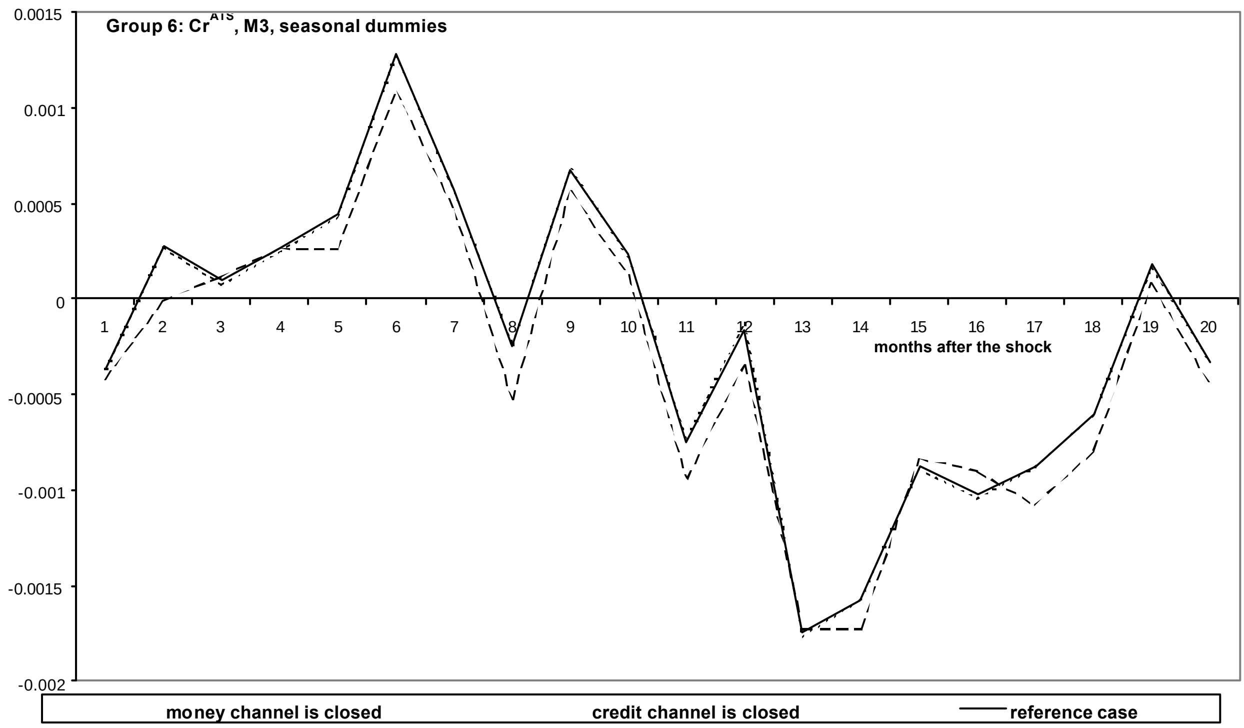
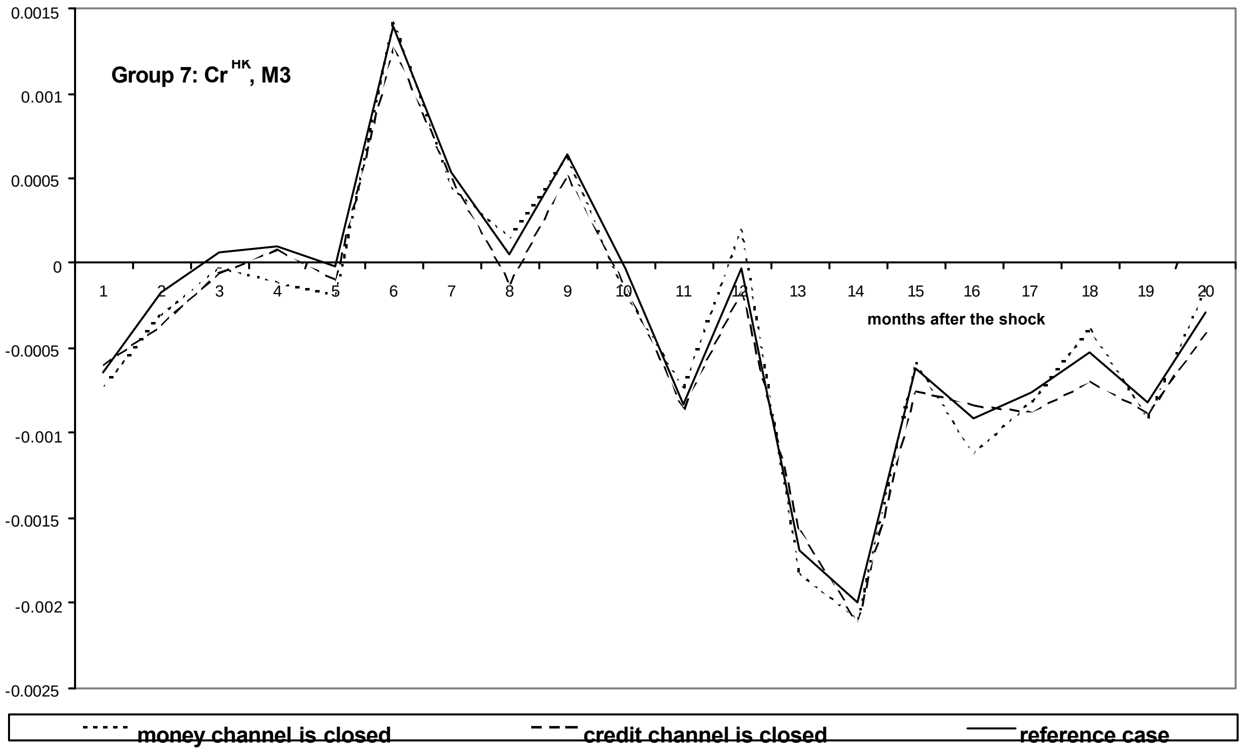


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 2-B

Response of IP to a positive innovation in government rate
Mortgage loans and municipal notes are used as the loan variable and M3 is used as the money variable



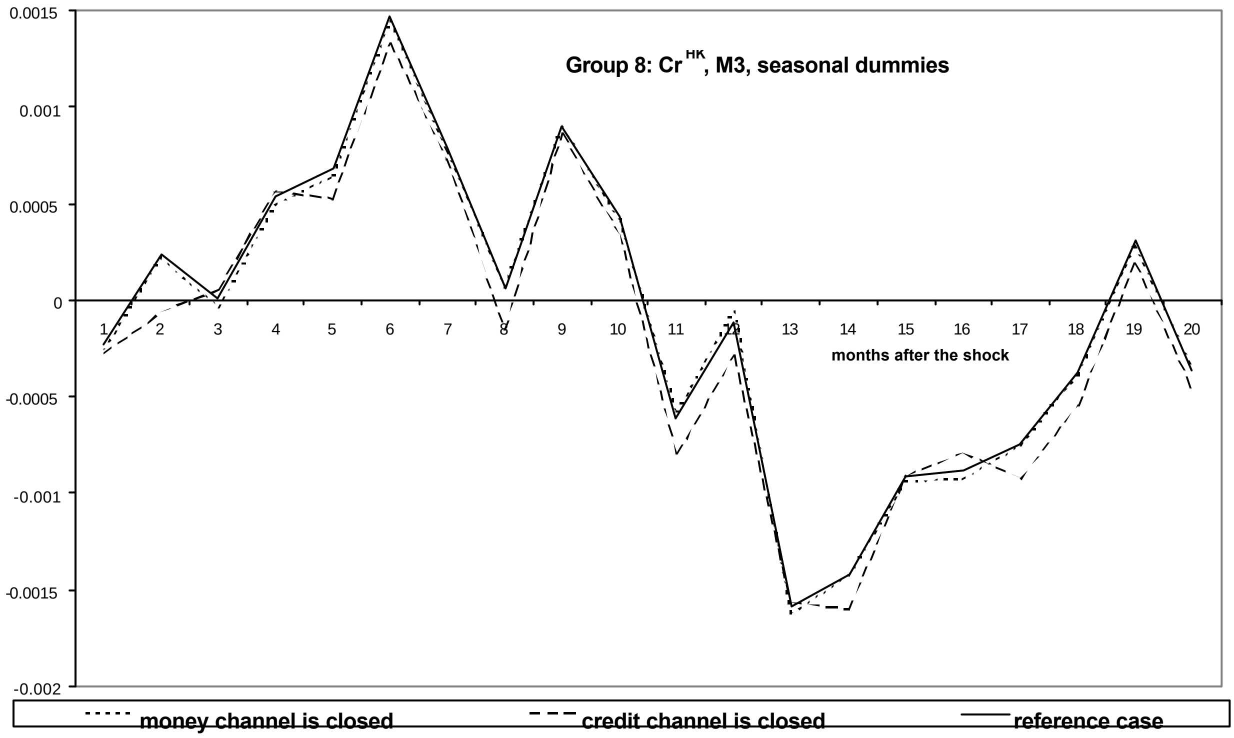
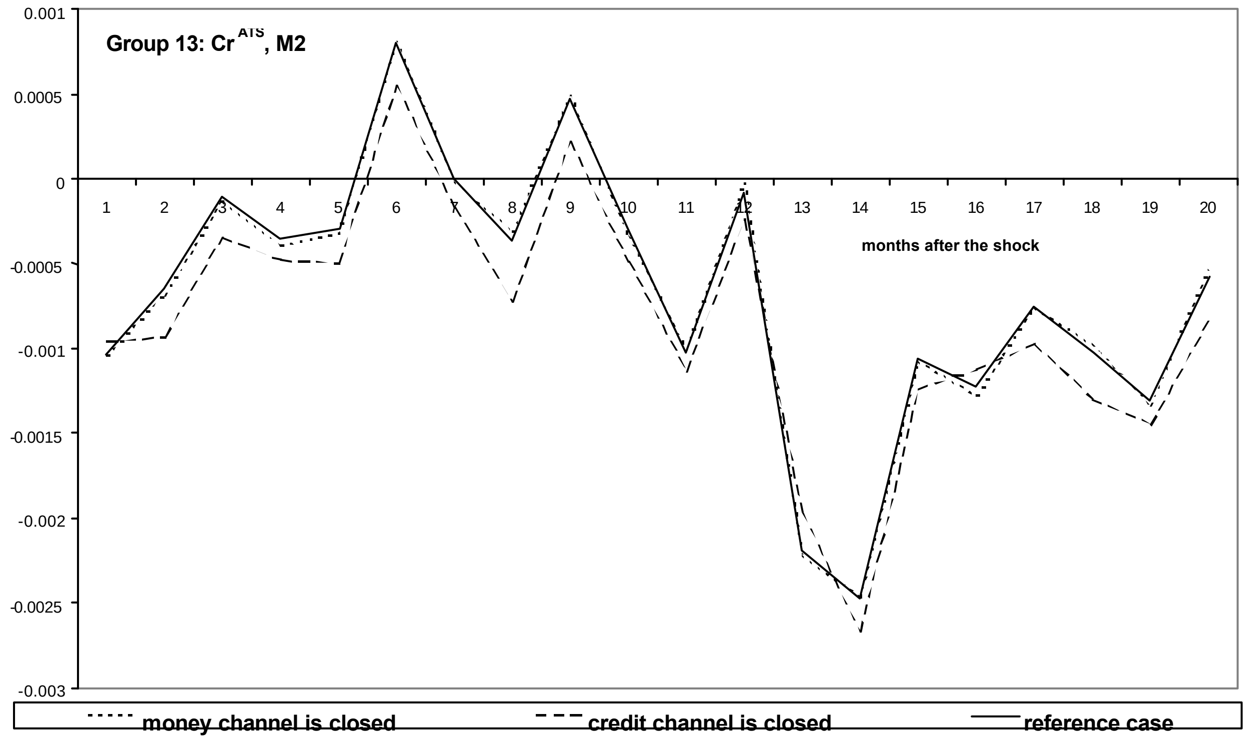


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 2-C

Response of IP to a positive innovation in government rate

Credits in domestic currency are used as the loan variable and M2 is used as the money variable



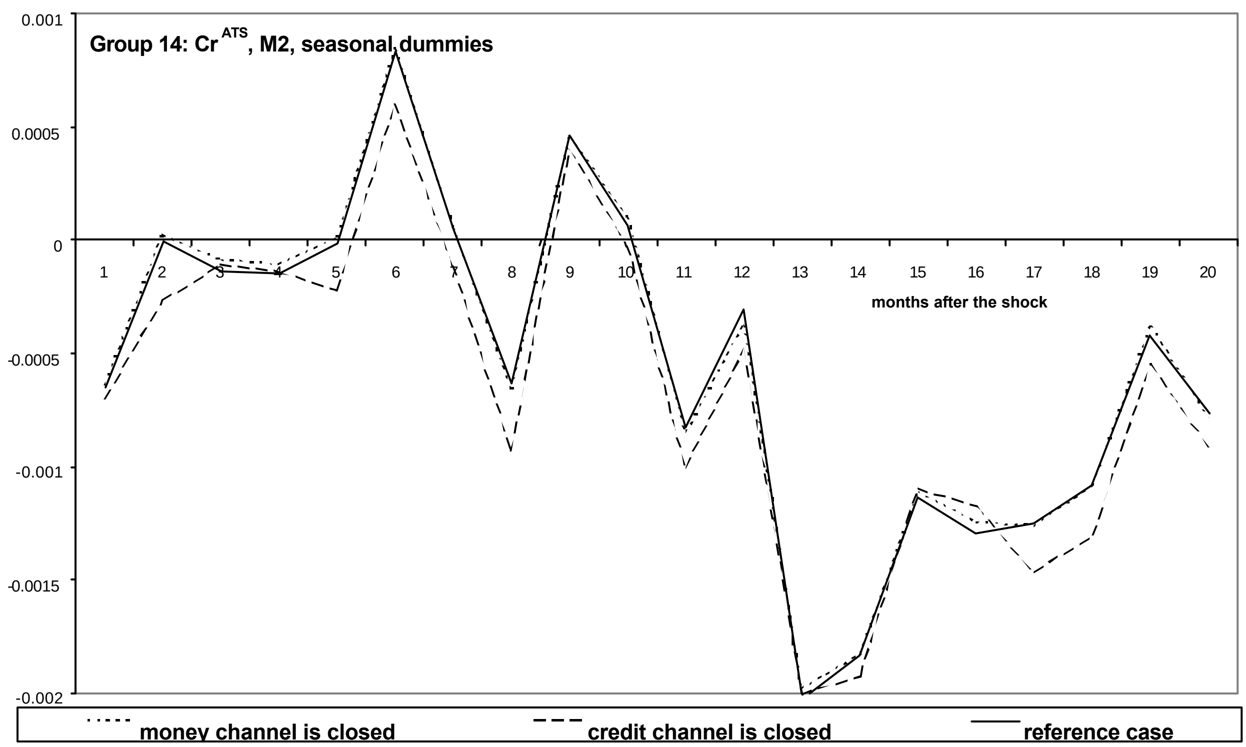
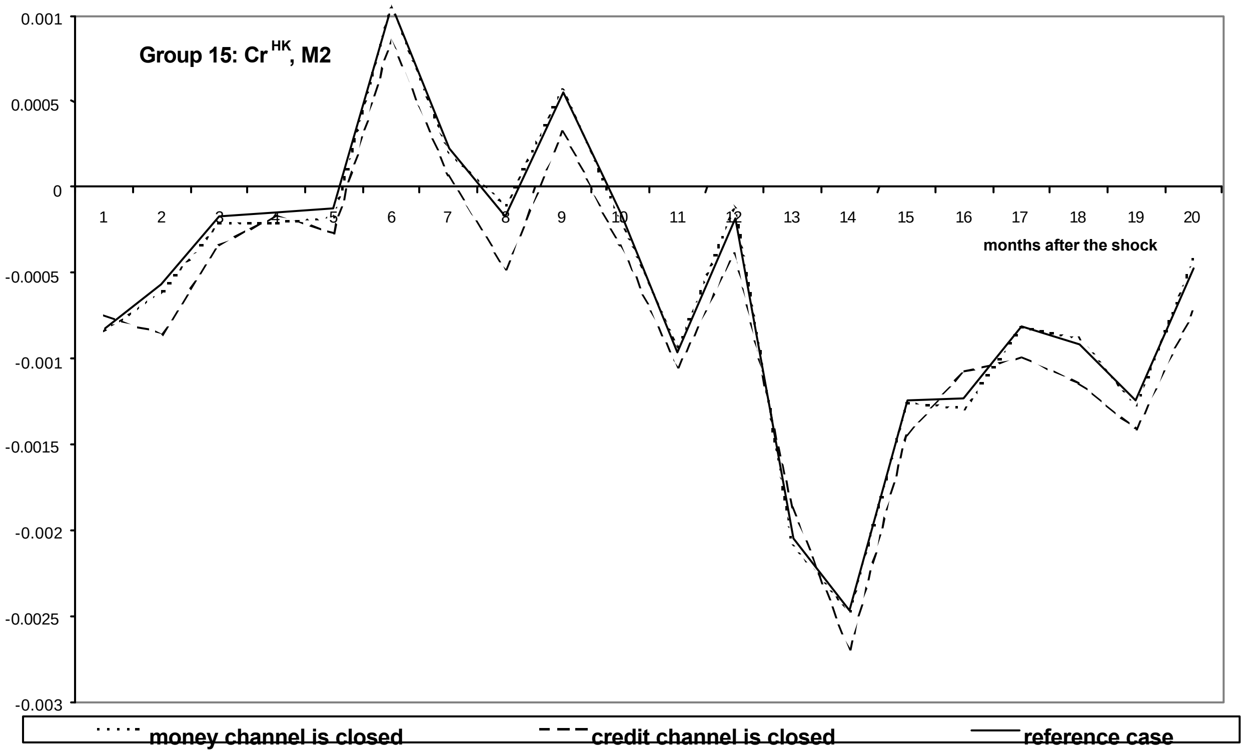


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 2-D

Response of IP to a positive innovation in government rate

Mortgage loans and municipal notes are used as the loan variable and M2 is used as the money variable



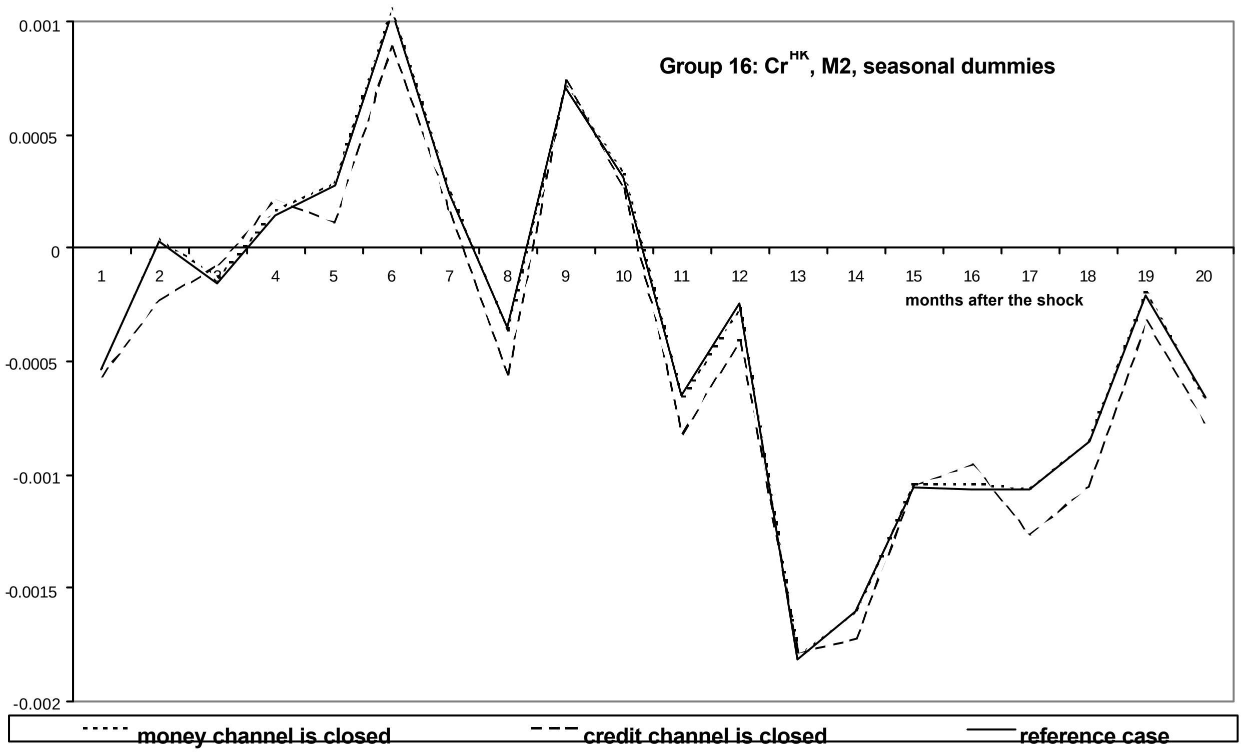
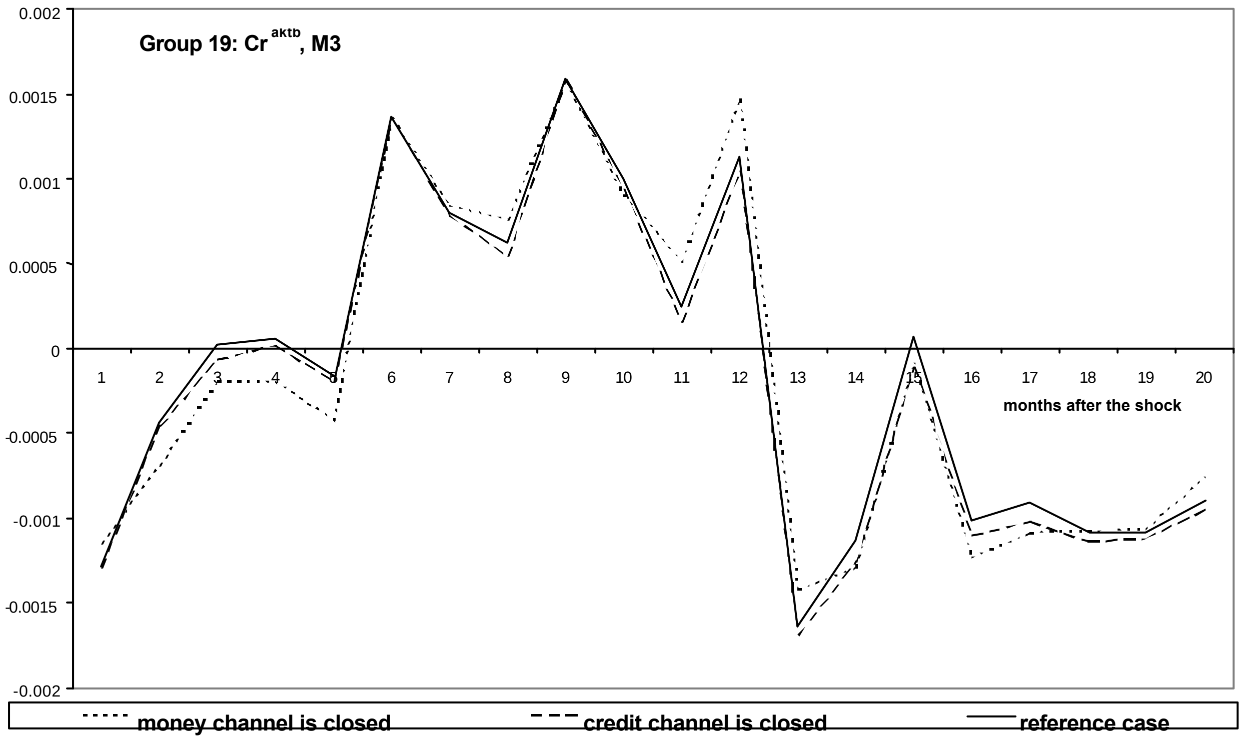


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 2-E

Response of IP to a positive innovation in government rate

Credits granted by joint-stock banks are used as the loan variable and M3 is used as the money variable



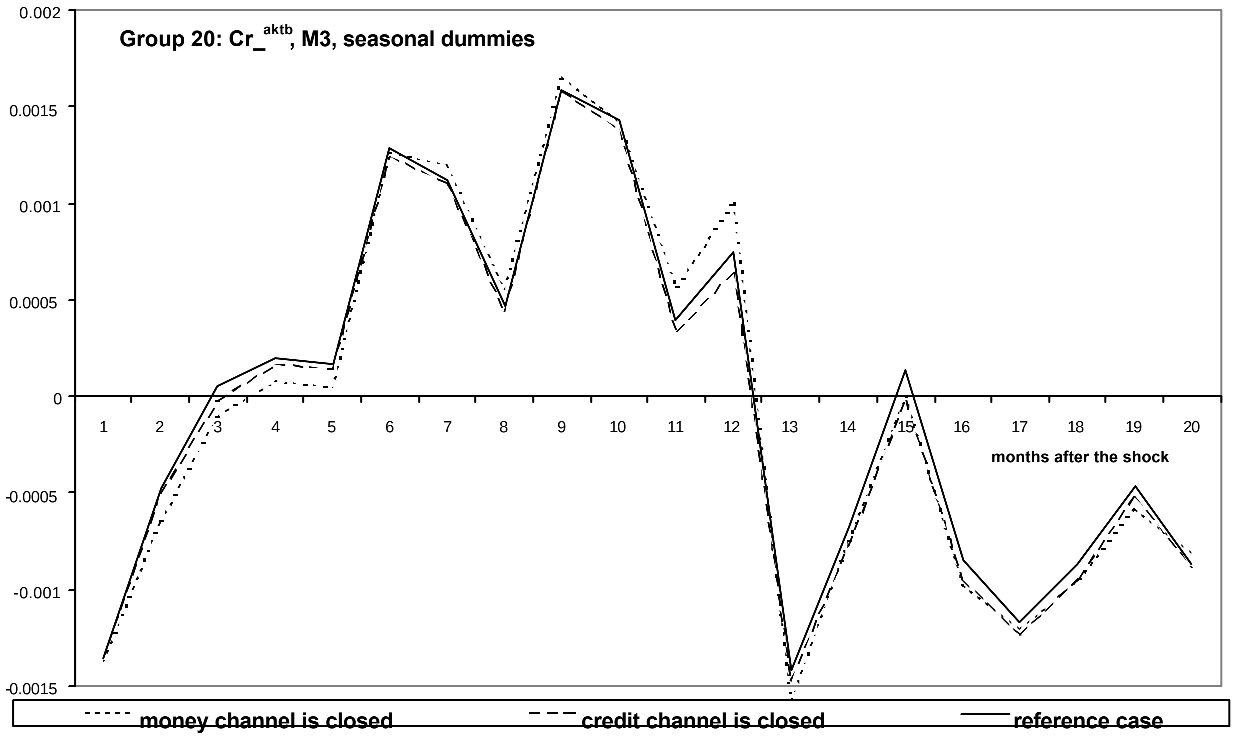
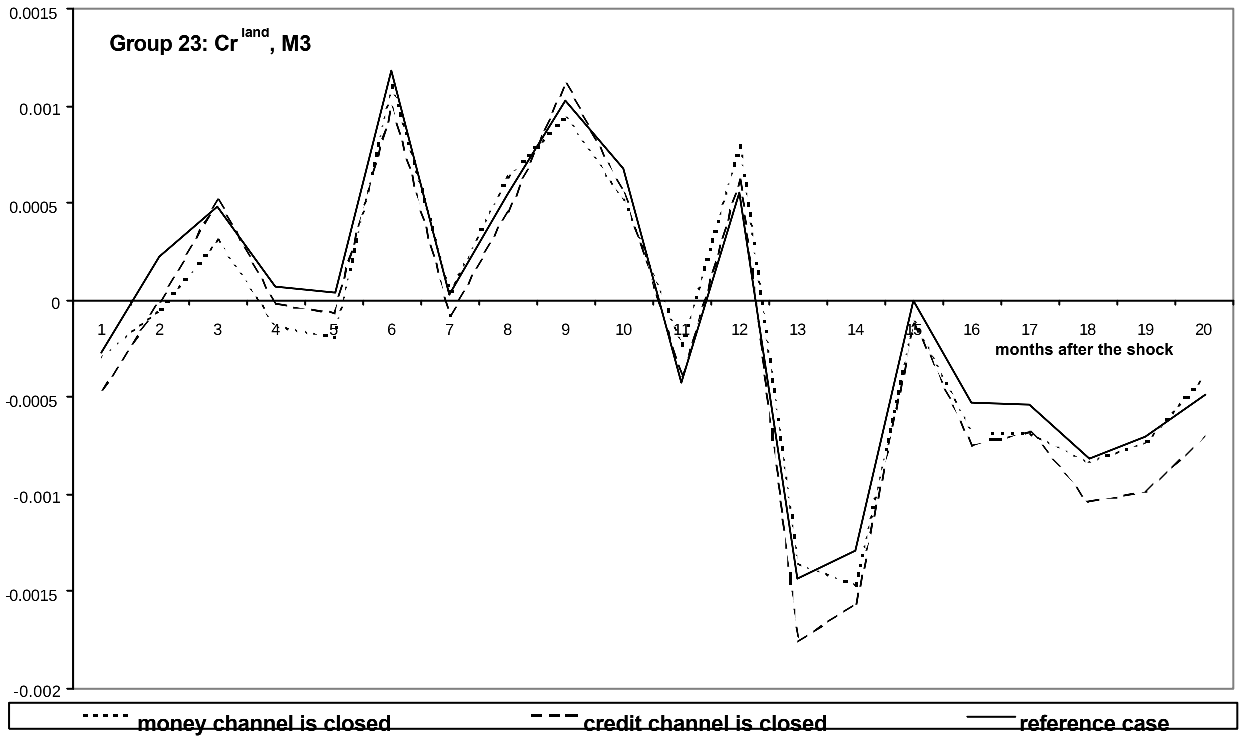


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 2-F

Response of IP to a positive innovation in government rate

Regional mortgage banks loans are used as the loan variable and M3 is used as the money variable



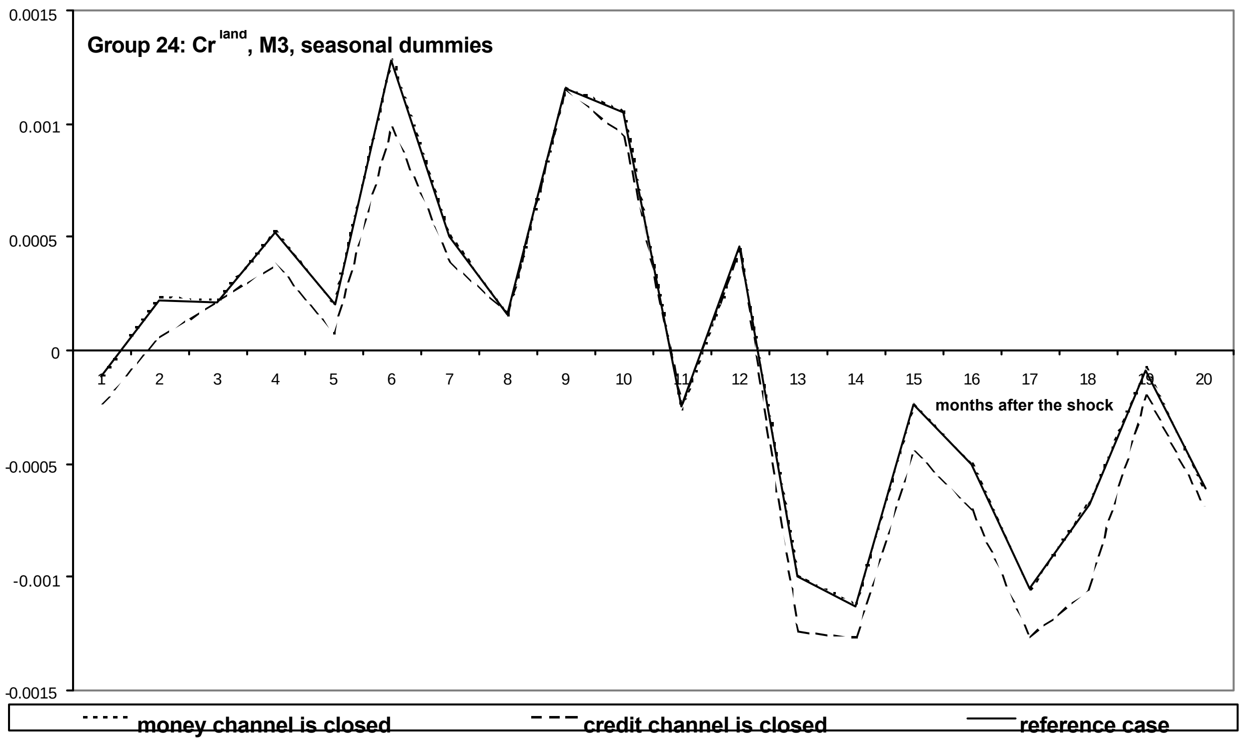
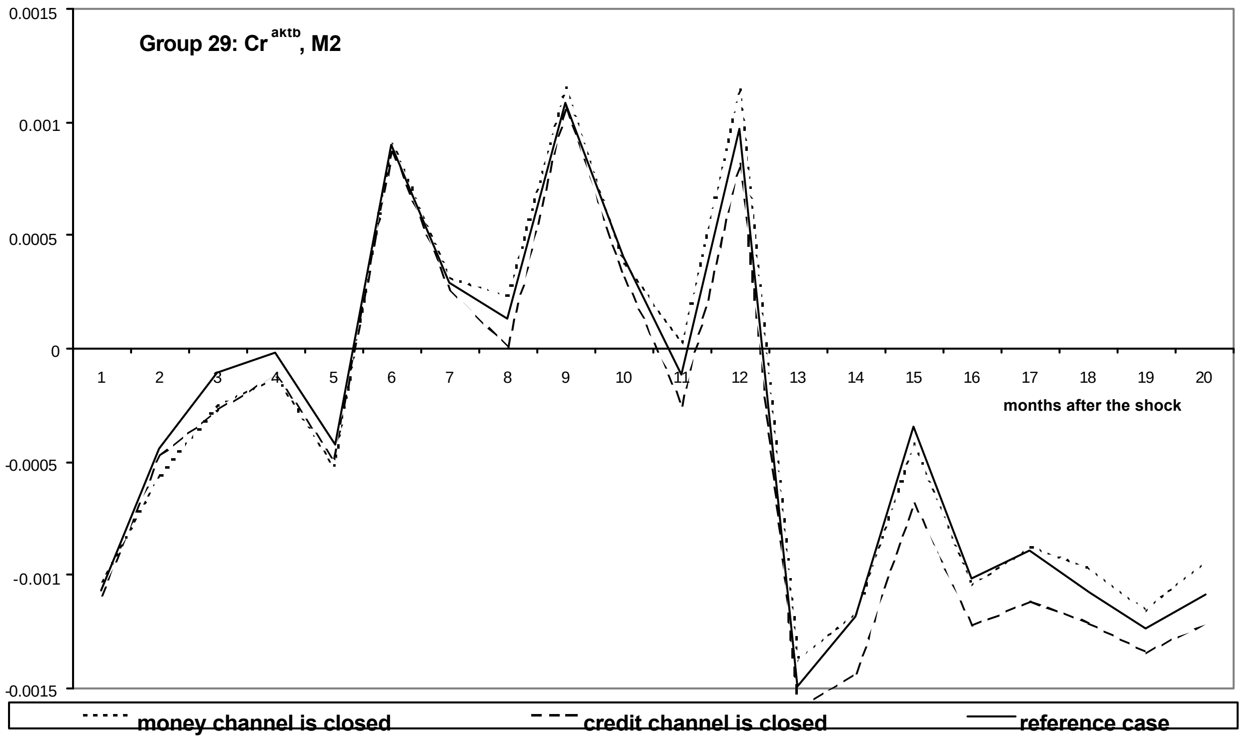


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 2-G

Response of IP to a positive innovation in government rate

Credits granted by joint-stock banks are used as the loan variable and M2 is used as the money variable



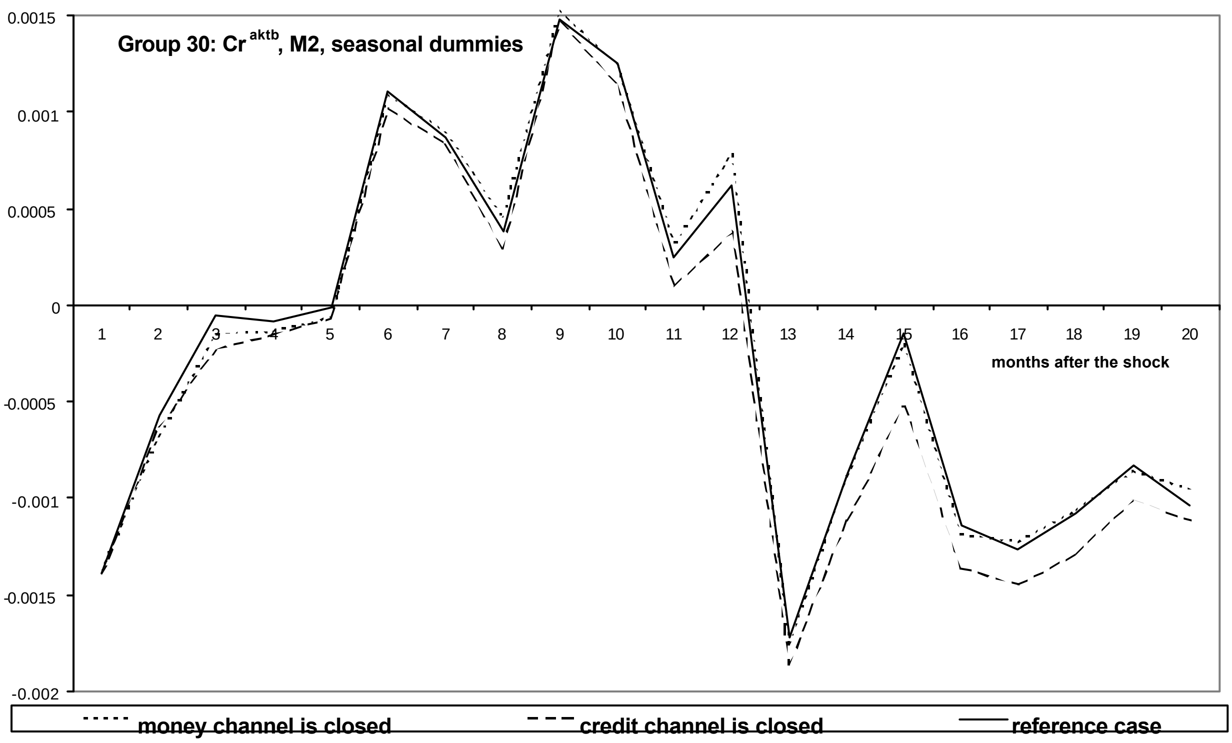
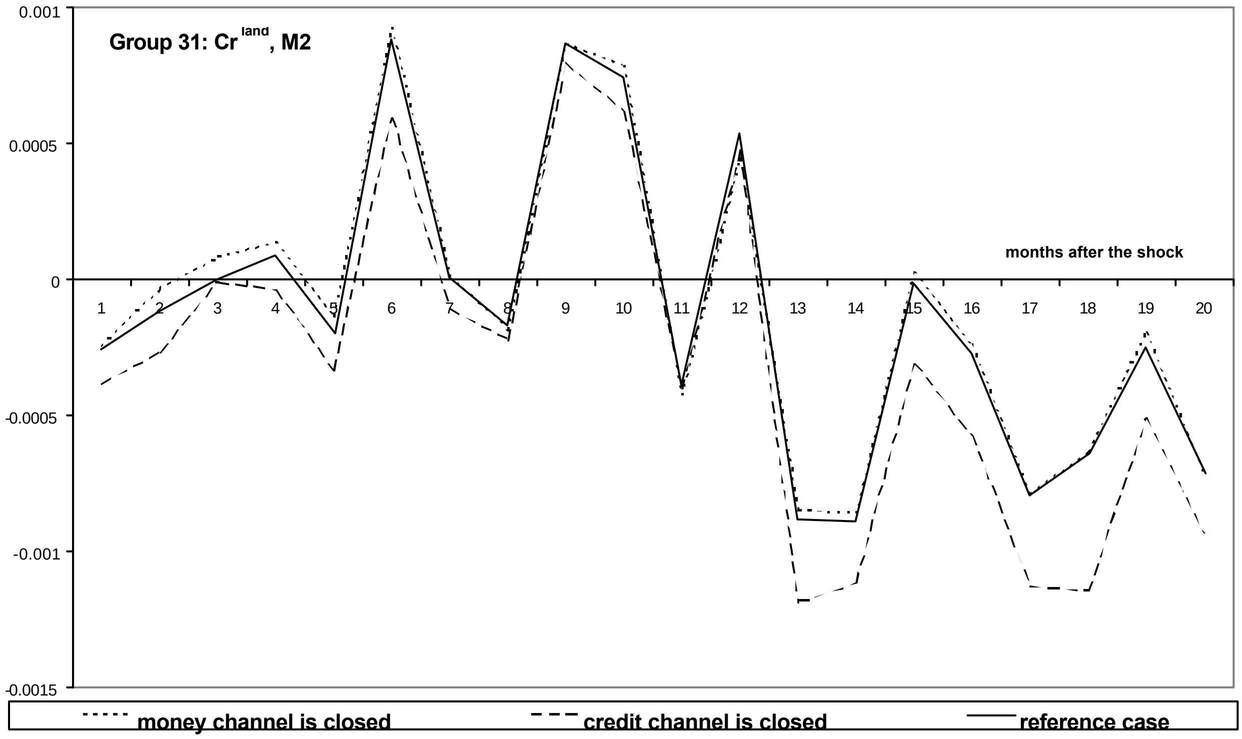


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 2-H
Response of IP to a positive innovation in government rate

Regional mortgage banks loans are used as the loan variable and M2 is used as the money variable



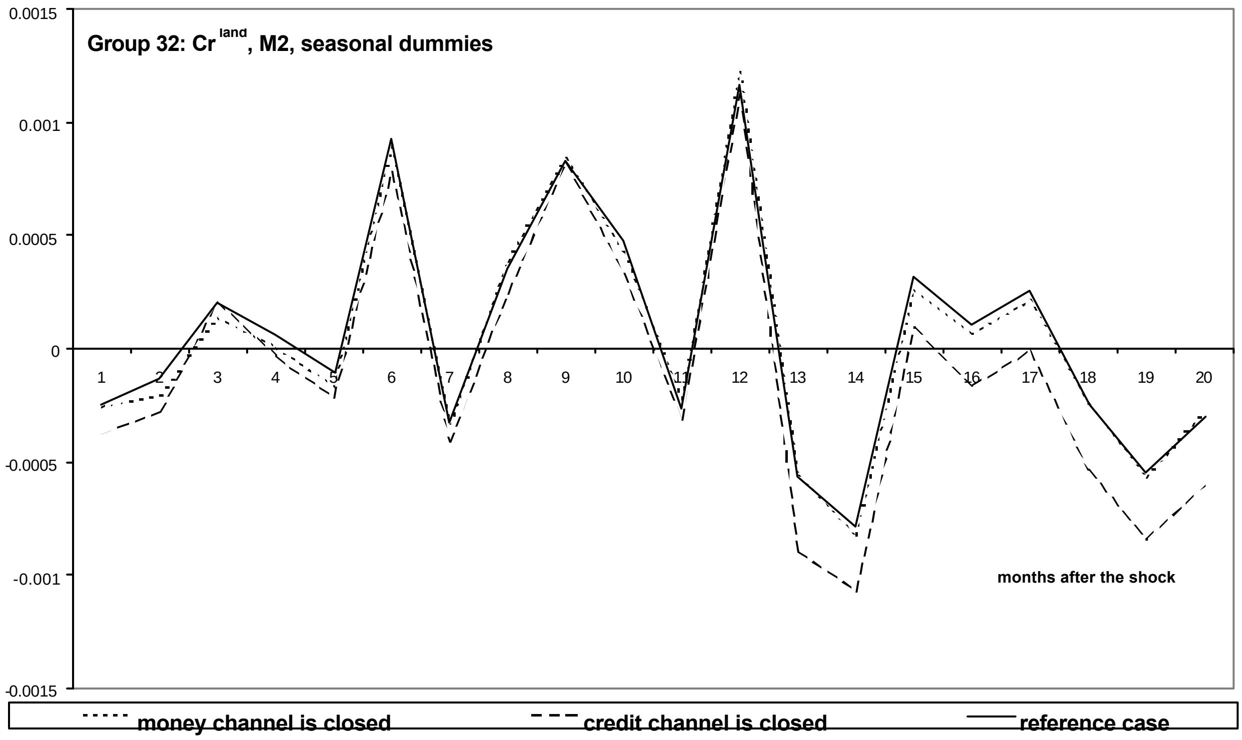


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 2-I

Response of IP to a positive innovation in government rate

Total volume of credits is used as the loan variable and M3 is used as the money variable

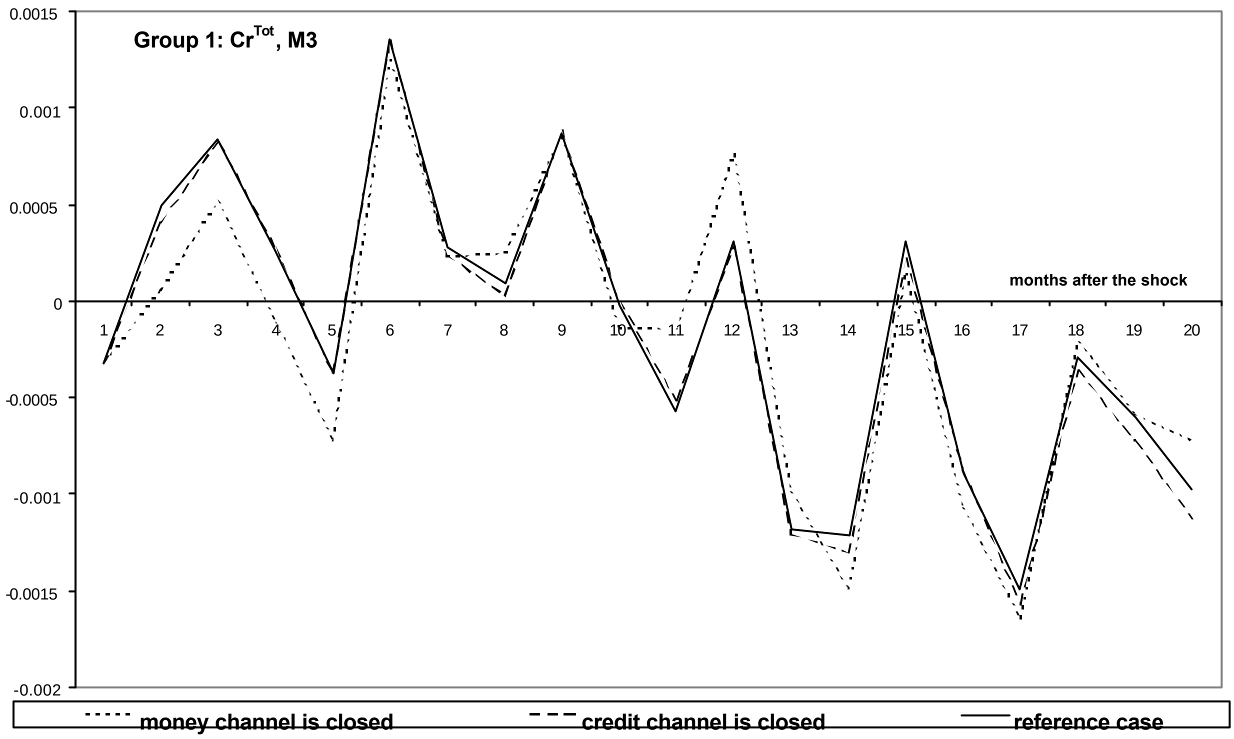
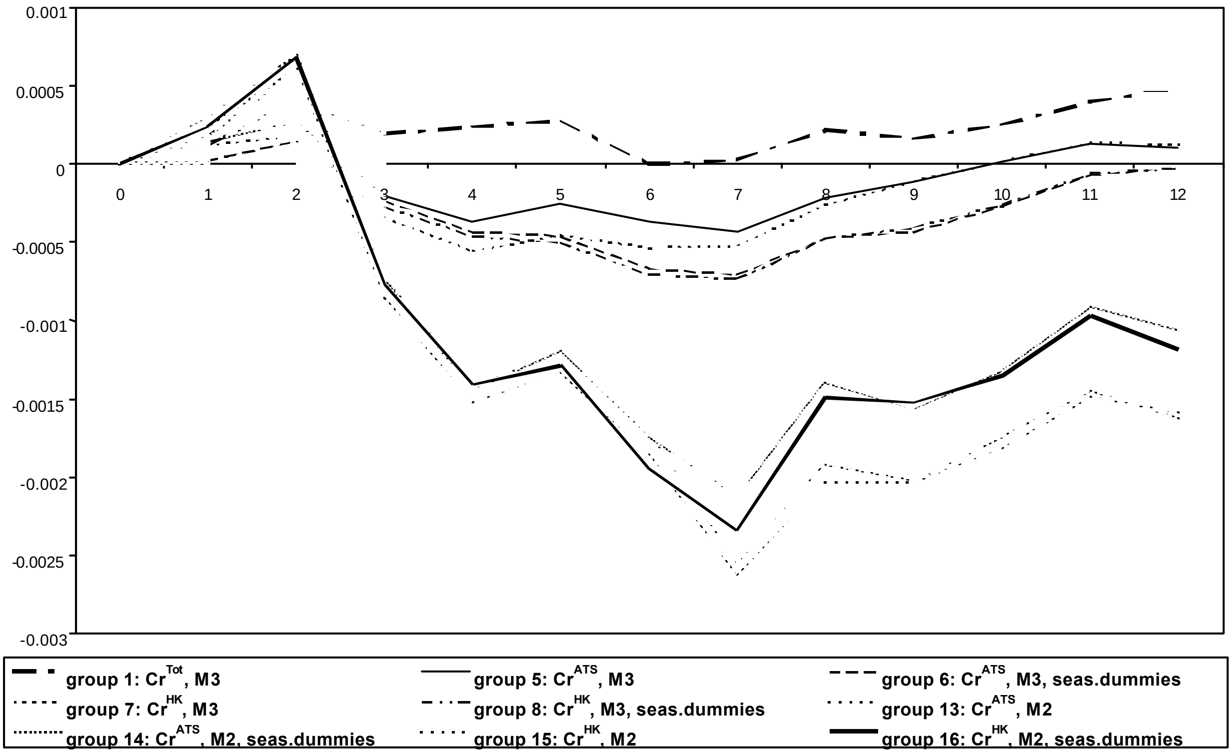
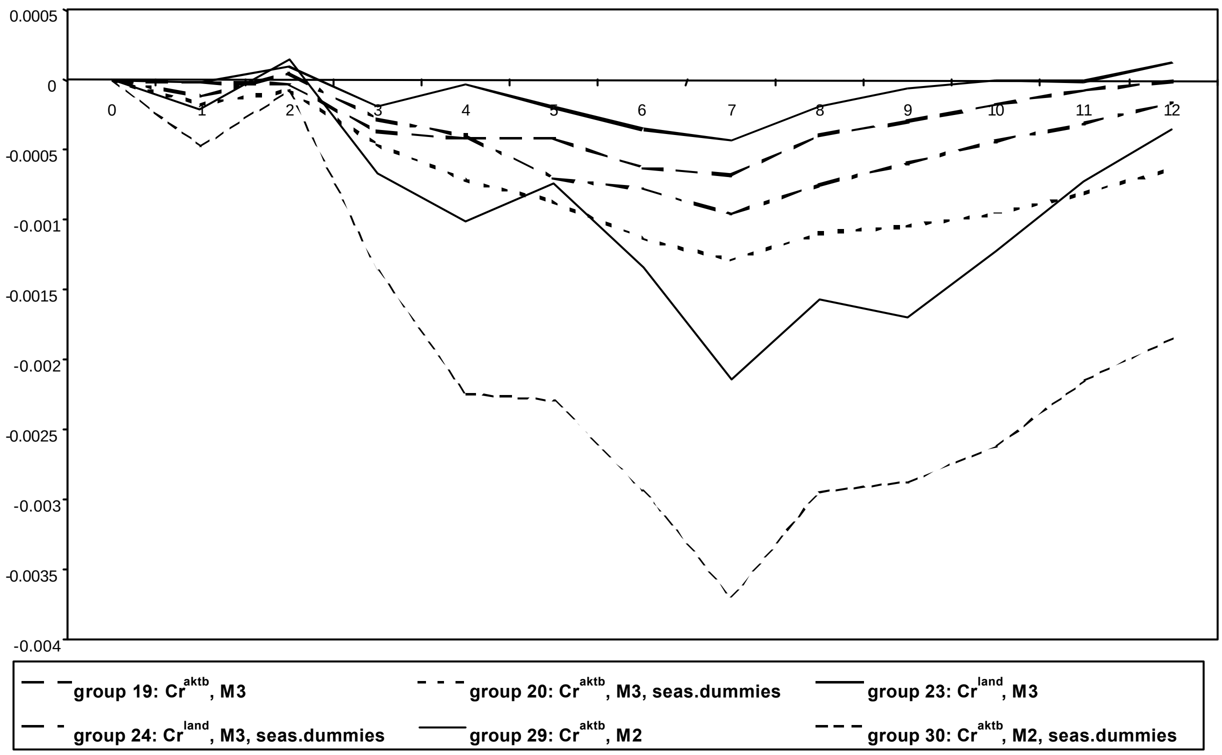


Figure compares the reference impulse-response function of the industrial production in VEC to an innovation in the monetary policy variable (which firstly accesses the money and the loan markets and secondly the real output) with the impulse responses with the closed money / credit channel (where a shock is firstly entry the real sector and secondly the money / credit market)

Figure 3

Response of the money to a positive innovation in government rate





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