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Is there a Credit Channel in Austria? The Impact of Monetary Policy on Firms' Investment Decisions

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Editorial

In this study Katrin Wesche investigates balance sheet and income statement data for Austrian firms to test for the existence of a credit channel. These effects are studied by descriptive statistics and by panel estimations. The study has two main results: First, the descriptive statistics gives evidence for the effects of monetary impulses via the balance sheet channel. Second, the panel estimation identifies firms, in which problems of asymmetric information are particularly strong, as more exposed to the effects of the credit channel than others..

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Is there a Credit Channel in Austria? The Impact of Monetary Policy on Firms' Investment Decisions

Katrin Wesche

Abstract:

Though most economists agree that monetary policy has significant effects on the real sector in the short run, interest-rate elasticities of macroeconomic aggregates in general are found to be low. Recently, the credit channel has been discussed as an additional channel through which monetary impulses can exert influence on the real economy. Though the credit channel is difficult to uncover with aggregate data, its distributional implications can be tested with micro data. We investigate balance sheet and income statement data for Austrian firms. Descriptive statistics do not reject the notion that monetary policy could have an effect through the so-called balance sheet channel. Panel estimation results show that firms, which are expected to be affected more by asymmetric information and moral hazard problems, are more responsive to internal funds in their investment decisions. Moreover, financial constraints become more severe in times of restrictive monetary policy.

JEL Classification: D92, E22, C23, G31, G32
Key words: Credit channel, balance sheet channel, investment, panel data

1. Introduction*

Though most economists agree that monetary policy has significant effects on the real sector in the short run, it remains a matter of discussion through which channels precisely these monetary impulses are transmitted. Traditional models presume that interest-rate changes affect investment by changing the required rate of return on an investment project. However, interest-rate elasticities of macroeconomic aggregates have been found to be surprisingly low.[1] Economists, therefore, have regarded the monetary transmission mechanism as a "black box" (Bernanke and Gertler, 1995) for a long time.

Recently, the literature has tried to shed more light on the details of the transmission mechanism. It has been argued that, apart from the traditional transmission of monetary impulses, the credit channel – which relies on the assumption of imperfect capital markets – might prove an additional channel through which monetary policy could exert its influence. If a credit channel is operative, the effects of monetary policy may differ between firms, industries or geographical regions, as market imperfections may differ among them. Differences in national financial systems may translate into different impacts of monetary policy impulses. Recent studies[2] point to the possibility of differential effects of monetary policy in the EMU member countries. These prospects have lead to renewed interest in the credit channel along with the start of European Monetary Union (EMU) on 1 January 1999.

While there is a lot of research on the credit channel and financial constraints for U.S. firms (for a survey see Hubbard, 1998) for most European countries only few studies exist.[3] Up to now, there are only two studies for Austria. Quehenberger (1997) analyses the evolution of bank credit during a monetary contraction and finds no evidence for the existence of a bank-lending channel. Gugler (1997) finds evidence for market failure in the

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1 For the interest elasticity of investment see e.g. Bernanke and Gertler (1995), for the interest elasticity of consumption see e.g. Hansen (1996) for Germany. Taylor (1995) comes to a differing assessment.

2 E.g. Dornbusch, Favero and Giavazzi, 1998; Ramaswamy and Sloek, 1997; Barran, Coudert, and Mojon, 1997.

3 Studies for other EMU countries include Winker (1996), Stöß (1996), Elston (1996), Funke et al. (1998) for Germany; de Haan (1996), van Ees et al. (1997), van Ees and Garretsen (1994), Broer and van Leeuwen (1994) for the Netherlands; Cieply and Paranque (1997) for France, Rondi et al. (1997), Rondi and Sembenelli (1998) for Italy; Watson (1999) for Spain, and Brunila (1994) for Finland. Bond et al. (1998) and Kadapakkam et al. (1998) perform comparative studies for several countries.

Austrian capital market, but his emphasis is on ownership structure and not on the transmission of monetary policy. Besides, the data base used in this study has not been investigated econometrically before. Therefore, Austria is an interesting case to examine the relevance of the credit channel, even more so as the claim that Austria reacts relatively little to monetary policy[4] has not yet been analyzed empirically. This study thus closes a gap in the current empirical literature on the monetary transmission mechanism in Europe.
The paper proceeds as follows. Section 2 discusses the implications of the credit channel on the investment decision of the firm. Then, in Section 3 a short survey on the monetary and economic environment in Austria since 1979 is given. Section 4 presents the data and some descriptive statistics to assess the relevance of the credit channel in Austria. In Section 5 regression estimates are presented and Section 6 concludes.

2. The Credit Channel and Firms' Investment

The recent literature discusses various transmission channels for monetary policy. Mishkin (1995) distinguishes between the interest-rate channel, the transmission through other prices like exchange rates or asset prices, and the credit channel. A restrictive monetary policy is followed by a rise in the interest rate, which induces a fall in investment, as the increased cost of finance reduces the number of profitable investment opportunities for the firm. With perfect capital markets this mechanism is economically efficient because those investment projects that do not earn the market rate of return are not realized.
While the transmission channels mentioned above work with perfect capital markets, the credit channel focuses on the consequences of imperfect capital markets (Hubbard, 1995). It argues that asymmetric information and moral hazard may cause firms to be financially constrained. Thus a wedge between the perceived cost of credit for the firm and the market interest rate arises, and some investment projects that would earn the market rate of return are not realized. The credit channel thus implies that the effects of monetary policy could be inefficient by foregoing valuable investment opportunities and, moreover, could have distributional consequences by affecting predominantly firms that are subject to asymmetric information problems.

[4] See e.g. Pech (1994) and Glück (1995).

Asymmetric information and moral hazard play a prominent role in modern theories of finance.[5] If asymmetric information makes it impossible for the lender to discriminate between good and bad borrowers, a risk premium will be charged for all borrowers, leading to a higher cost of external finance. Moral hazard has similar implications. Debt contracts in general include a fixed payment (as opposed to a share in profit) in case of a successful investment, whereas the loss for the borrower is bounded at zero. Thus, the borrower is tempted to invest external funds into riskier projects than he would have done with internal capital. As the lender knows these incentives, he will require either a risk premium or collateral. Monetary policy can affect the size of the risk premium as well as the worth of the collateral. Therefore, imperfect capital markets provide an additional channel for the influence of monetary policy.

In the literature, the credit channel is split into a bank-lending channel (narrow credit channel) and a balance-sheet channel (broad credit channel). The bank-lending channel assumes that a restrictive monetary policy reduces banks' credit supply. For the bank-lending channel to work, firstly, banks have to reduce lending because they cannot fully compensate the shortage in reserves by taking in deposits. Secondly, some firms have to be bank dependent, i.e., they cannot substitute bank credit for other forms of finance, which require access to capital markets. Consequently, bank-dependent firms should suffer more from a monetary contraction and should reduce their investment more than firms with access to capital markets.

The balance-sheet channel emphasizes the role of the firm's net worth for obtaining external finance. Lower net worth increases moral hazard and agency problems, making external finance more expensive by augmenting the risk premium. Monetary policy has several opportunities to impact on the net worth of a firm. A restrictive monetary policy increases interest payments for the firm, reducing cash flow and decreasing net worth. Additionally, rising interest rates cause share prices to fall and reduce the value of the firm. A third transmission mechanism works through unexpected price decreases leading to a higher debt burden and thereby making agency problems more acute.

Studies testing for the credit channel on the macroeconomic level face the difficulty to identify demand and supply effects on the credit market. [6] Another possibility to test for the

[5] See Stiglitz and Weiss (1981), Myers and Majluf (1984).

[6] If the volume of credit falls after a monetary contraction this could be due to credit rationing, but it could also mean that credit demand is lower because output has fallen. Different approaches to identify supply effects include the in-

existence of a credit channel therefore is to employ the distributional consequences of the theory. Specifically, borrowers that are more affected by asymmetric information or moral hazard should face a higher probability of credit rationing. Firms that are highly bank dependent should suffer more from a contraction of credit. As the distributional effects of the credit channel are not detectable with aggregate data, they can only be uncovered with micro (i.e. firm-level) data.

In the literature evidence for a credit channel is mixed. While studies on the macro level come to discordant assessments regarding the importance of a credit channel, investigations of firm-level data in general find that financing constraints are relevant, thus supporting the role of the credit channel as an additional transmission channel of monetary policy. This paper focuses on the effects of monetary policy on investment, with special emphasis on the broad credit channel. Before the results of the empirical analysis are presented, the next paragraph shortly reviews the monetary and economic conditions in Austria during the sample period.

3. The Monetary and Economic Environment in Austria

After the breakdown of the Bretton-Woods-System a new orientation for Austrian monetary policy became necessary. Instead of following a monetary target or to float Austria opted for fixing the exchange rate – first against a basket of currencies, which at the beginning of the 80s collapsed into a single currency, the German mark (Hochreiter and Knöbl, 1993). Since 1981, the exchange rate was virtually stable and Austria – which joined the European Union only in 1995 – was always regarded as a de-facto member of the European Monetary System. With increasing capital market integration since 1979, interest rate policy could not be used to smooth business cycles in the domestic economy because of the exchange rate target. Austrian interest rates, hence, closely followed those in Germany. Two different contractionary monetary policy periods can be identified. [7] Interest rates rose from 1979 to 1981. After a period of lower interest rates between 1984 and 1988, they started rising again until 1992. Since then interest rates have fallen gradually.

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vestigation of the timing of the reactions (Ramey, 1993), or the substitution effects with respect to other forms of finance (Kashyap, Stein, and Wilcox, 1993).

[7] See Fig. 1. Because of the exchange rate peg and close economic integration, these periods correspond to restrictive monetary policy periods in Germany, see e.g. Stöß (1996).

In the early 1980s Austria was hit by several negative shocks, the first one being the oil-price shock in 1978/80. In 1982/83 like many other industrialized countries Austria experienced a recession, induced by high real interest rates in the aftermath of the second oil crisis and the move towards a more stability oriented fiscal policy in many European countries. In addition, structural problems in the domestic sector initiated a major restructuring of the nationalized industry which led to a loss of almost 20,000 jobs in this sector (Hochreiter and Winckler, 1994). In contrast to most European countries, the international recession in the early 90s was relatively mild in Austria, because the opening up of the Eastern European countries and German unification exerted a positive impact on the Austrian economy (Gnan, 1994).

Austria is an interesting case to investigate the effects of the credit channel on business investment. The Austrian economy is characterized by the predominance of small and medium-sized businesses, with only 2.5 % of Austrian firms having more than 100 employees. Very few businesses have access to the national or international capital markets. In addition, capital markets are not well developed and business financing is mainly through banks (Pech, 1994; Glück, 1995). These features should imply a relatively high exposure to monetary policy measures and would lead to the conclusion that the credit channel is of importance for Austria. On the other hand, it has been argued that the interest rate only has a negligible impact on the real economy in Austria, due to the prevalence of subsidized credit and the close relations between banks and businesses (Pech, 1994). The high share of subsidized credits – in 1991, e.g., 47 % of credit to the Austrian industry was subsidized (Wenko, 1993) – mitigates the effect of interest-rate changes and would lead one to expect only a small influence of monetary policy on investment. Moreover, the close relations between businesses and their house banks may lessen information problems and thus avoid bank-credit shortages in the case of a monetary tightening.

4. The Data

The Oesterreichische Nationalbank collects data on balance sheets and income statements of Austrian firms in the course of her discount activities. The database contains annual data for the years 1979 to 1998. [8] Before 1987 approximately 1000 observations are available each year. Since then the database includes almost 3000 firms per year, which

makes a total of 36,789 firm years. Nevertheless, the time-series dimension is comparatively small for most firms, e.g., only 120 firms are observed over the whole sample period, whereas 1550 firms appear only once in the sample. Table 1 shows the structure of the data.

First, we present an informal descriptive analysis, illustrating the basic properties of the data. Then, panel regressions are estimated to assess the influence of monetary policy on investment.

Tables 2 and 3 show the coverage of the data used. As the focus of this study is the impact of monetary policy on the non-financial sector, financial institutions are not considered. Moreover, the data do not cover the sectors *hotels and catering*, *agriculture, forestry*, *schooling* and *health care*. Of these sectors, only *hotel and catering* presents a major omission, because tourism is an important sector in Austria which is dominated by small enterprises. Therefore this sector is likely to face credit constraints and to react strongly to monetary policy measures.

Table 2 shows the coverage of the data by number of firms. While only 0.6 % of firms with less than 50 employees are covered, the coverage is around 67 % for larger firms. Especially in the sectors *mining*, *manufacturing, energy and water*, and *construction* the majority of large Austrian firms is present in the database. Table 3 shows the sectoral representation of the data in terms of employment. Again, *manufacturing* and *energy and water* are well covered with a share of 47 % and 59 % of total employment in these sectors. With shares between 20 % and 25 %, the sectors *mining*, *trade* and *construction* are also fairly well represented. Regarding economy-wide employment the average share covered by the database is 26 %. Coverage is only marginal for *transport and communication*, *real estate* and *other services*. However, except for *transport and communication*, these sectors presumably do not account for the bulk of investment. Investment in the sample represents on average 38 % of total investment in the national accounts (see Fig. 2). Though investment accounts only for a relatively moderate share in GDP of 24 %, it shows a high volatility in comparison to the other components of GDP, and explains about 44 % of the variance of GDP growth. Thus it seems warranted to investigate the effects of monetary policy on investment as this makes out an important part of the fluctuations in economic activity.

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[8] For 1988 only 320 observations are available as the submission of annual accounts is still incomplete.

In conclusion, the sample can be considered as highly representative for the Austrian economy. Nevertheless, there is a bias towards relatively large and solvent businesses and corporations in the database. The data therefore may underestimate the effect of the credit channel in monetary transmission. Moreover, this bias becomes more severe when only those firms are regarded for which longer time series exist, since these are comparatively large firms.

To set up the panel, we consider only firms for which at least 6 consecutive observations are available. This reduces the number of firm years to 21,852, including a total of 2,103 firms. As it is well known from empirical work with firm data, one has to account carefully for outliers. Therefore, the data first are checked for plausibility. Negative values for assets or investment are excluded as well as firms with implausibly large changes, and firms with negative profits for most of the observations. [9] After excluding 99 firms, 20,807 observations are left for the panel regressions.

Next, variables have to be chosen to proxy for information asymmetries. [10] For the descriptive analysis four different splitting criteria are employed. Table 4 gives an overview on the cutoff values used to split the sample. First, the size of a firm, proxied by total assets or the number of employees, may play a role for information asymmetries. [11] Large firms can access capital markets more easily and therefore can substitute bank credit for other forms of finance if credit becomes more expensive or is rationed after a monetary tightening. Small firms therefore are more likely to be credit constrained in their investment decision. Next, the sample is split according to business form. Stock corporations, which have to obey certain accounting standards and to publish balance sheets and income statements, may be affected less by asymmetric information than small unincorporated partnerships. On the other hand, partnerships in general face unlimited liability for their debts. In combination with highly collateralized lending and lender-friendly laws, information asymmetries could be less relevant. We distinguish between 5 different business forms (see Table 4), though observations on ordinary partnerships (OHG) and partnerships (Einzelunternehmung) are scarce while private limited companies (GmbH) predominate in the sam-

[9] For Austria, this is especially relevant for the state industry which went through a major restructuring in the first half of the 1980s. Firms with changes in business form were only excluded if the change lead to untypical behavior of balance sheet variables.

[10] Besides the criteria used here, in the literature credit ratings, age and dividend payout have been used to identify credit constrained firms, but this information is not available in the present dataset.

[11] As the database contains holdings, which have only few employees but control a large balance sheet, total assets may better capture asymmetric information problems related to size.

ple. Finally, a high debt ratio may increase moral hazard problems. Therefore, the debt to total assets ratio is used as proxy.

Table 5 gives descriptive statistics for the sample, grouped by business form, total assets, employees and debt ratio.[12] The splitting criteria for size and debt ratio were chosen so that the groups have similar size. While the size differences between small- and medium-sized firms are not especially pronounced, large firms (in the last group), measured by total assets or by employees, are significantly larger, with average assets and employees almost 10 times higher than for the other groups. The same applies for stock corporations which also differ markedly from the other groups with respect to size and employment. Larger firms in general have a lower debt ratio and their investment-to-sales ratio is higher. The same applies for stock corporations. For the splitting with respect to the debt ratio no clear relation to size can be detected. Profits as well as investment decrease with a rising debt ratio. Thus the descriptive statistics are in line with the existence of a balance sheet channel of monetary policy. The same conclusion emerges if the cost of finance is regarded. Fig. 3 shows the ratio of average interest payments to total debt for the different groups of firms. It turns out that interest payments are higher for small firms, for partnerships and for highly indebted firms.[13] Thus – as the theory would lead us to expect – external finance is more expensive for firms that are more exposed to asymmetric information and moral hazard problems.

As the results for the different splitting criteria are fairly similar, in the following only the splitting with respect to the size of the balance sheet is investigated further.

5. Estimation

To substantiate the last section's results, panel estimations are performed. As in most of the literature, investment equations are derived from the optimization problem of a firm.[14] Assuming a Cobb-Douglas production function with constant returns to scale, the desired capital stock of firm i at time t, K^*_{it}, can be expressed as

[12] Since the structure of the panel changes over time, with mostly large businesses covered in the early years and much more smaller businesses included into the surveys after 1986, we did not use quintiles to split up the sample but absolute values.

[13] Surprisingly, the average interest rate in Fig. 3 is generally below the market rate. A possible explanation is that subsidized credits were, especially in the 1980s, a prevalent feature in the Austrian economy. Also, some forms of external finance may be without explicit interest. However, it cannot be excluded that data on interest payments are incomplete.

$$K_{it}^{*} = \alpha_i \frac{Y_{it}}{r_{it}}, \quad (1)$$

with Y_{it} denoting output, r_{it} the real user cost of capital and α_i the share of capital it the pr o-duction function. Denoting logarithms of K_{it} and Y_{it} with small letters and relaxing the co n-straints of a proportional reaction of capital to output and the user cost, equ ation (1) reads $k_{it}^{*} = \alpha_i \quad \beta y_{it} \quad \gamma r_{it}$.

Next, it is assumed that implementing investment takes time and the actual capital stock can deviate from the desired capital stock.

$$k_{it} = k_{it}^{*} \quad \varepsilon_{it}$$

Taking first differences and using $k_{it} \quad I_{it} / K_{i,t\ 1} \quad \delta$ (with δ denoting depreciation) as a p-proximation we arrive at an error-correction model as empirical specification. Lagged di f-ferences are included to account for dynamics and η_{it} denotes the firm specific constants.

$$\frac{I_{it}}{K_{i,t\ 1}} = \rho\left(\frac{I_{i,t\ 1}}{K_{i,t\ 2}}\right) \quad \beta_0 \ y_{it} \quad \beta_1 \ y_{i,t\ 1} \quad \gamma_0 \ r_{it} \quad \gamma_1 \ r_{i,t\ 1} \quad (2)$$
$$\phi\left(k_{i,t\ 2} \quad \beta_2 y_{i,t\ 2} \quad \gamma_2 r_{i,t\ 2}\right) \quad \eta_{it} \quad \upsilon_{it}$$

With perfect capital markets, the well-known Modigliani-Miller theorem holds, stating that the value of the firm is independent from its financial decisions. This would mean that monetary policy influences investment only through the interest rate, and other financial variables would have no role in explaining investment decisions. However, if information asymmetries or moral hazard exist, this is no longer the case. Since the interest rate may not capture the actually perceived user cost of capital, it is alternatively assumed that the wedge between the observed interest rate and the user cost faced by the firm is a function of financial variables reflecting the creditworthiness or the net worth of the firm:

$$r = f(\text{financial variables})$$

First, the model in eq. (2) is estimated as a benchmark, including as explanatory variables the capital stock, real sales, and the interest rate. The first column of Table 6 shows the results. As the investment-to-capital ratio for some firms shows a number of large spikes, a set of dummies was included.[15] The interest rate chosen is the long-term bond yield. To account for firm specific effects all variables enter the regression as deviations from the

[14] For a survey of empirical research on investment see Caballero (1999).

[15] The lumpiness of investment is a well-known phenomenon that the neoclassical model cannot explain (see e.g., Doms and Dunne, 1998).

firm specific means. Weighted Least Squares are used to control for cross-equation heteroscedasticity. Since the panel includes a lagged dependent variable, instrumental variable estimation is used to get consistent estimates. The level of the dependent variable, lagged two periods, and the levels of the exogenous variables, lagged once, are used as instruments (see Anderson and Hsiao, 1982).

Most coefficients are significant and have the right sign. However, the long-run interest-rate elasticity of investment is insignificant while the short-run interest-rate elasticities even have the wrong sign. In addition, coefficients are very small, so that their economic significance is questionable. Nevertheless, this finding does not preclude that monetary policy may have an influence through the credit channel. Therefore, we include the financial variables instead of the interest rate to assess the influence of financial market imperfections. Financial variables comprise the ratio of cash flow (net of interest payments) to sales and the ratio of external debt to total assets. A significant impact of these variables is interpreted as the relevance of financial constraints. The ratio of liquid assets to the capital stock is included to control for the possibility that some firms may accumulate liquid assets to provide for a large investment projects in the future. Since contemporaneous financial variables are endogenous and therefore correlated with the error term, lagged values are used.

The second column of Table 6 shows the results. All coefficients have the expected sign and, except for the short-run coefficient on the debt ratio, are significant. The results imply that a higher cash flow or a lower level of external debt lead to more investment. A higher level of liquid assets also raises the investment-to-capital ratio. The evidence thus is consistent with the existence of financial restrictions. Next, we investigate if financial restrictions are more relevant for smaller firms by splitting the sample into 3 size classes and estimating the regressions separately. The results show that small and medium sized firms are much more sensitive to cash flow and the debt ratio in their investment decision.

In the literature, the interpretation of financial variables like cash flow as indicating financial constraints has been discussed (Hubbard, 1997; Kaplan and Zingales, 1997). If cash flow is a proxy for expected profits, a significant sensitivity of investment to cash flow does not necessarily mean that the firm is financially constrained. Though the possibility exists that the cash-flow coefficient may capture other effects, it can be assumed that the results in fact reflect the existence of financial constraints on investment. The significance and the

sign of the other two financial variables, the debt ratio and liquid assets, stress the fact that financial variables matter. It is more difficult to interpret liquid assets and the debt ratio as indicator of future profits.

Finally, we investigate the effect of monetary policy on the financial restrictions. Following Kashyap and Stein (1997) a two stage, nonlinear, procedure is used. In the first stage, separate cross-section regressions are run for each time period and each size class. From each regression a coefficient for the financial restriction is obtained. In the second stage, a time series of these coefficients is regressed on a monetary policy measure for each size class. This second regression gives a notion of how monetary policy affects the financial constraints for different firms sizes. The model in the first stage is parameterized more parsimoniously than the error correction model, as only the coefficient on the financial constraint is of interest. Following Kashyap and Stein (1997) a lagged dependent variable and the cash flow variable are included into the first-stage model. [16,17] Fig. 4 shows the coefficients on the financial restrictions. [18] As the credit channel leads us to expect, the financial restrictions coefficient is highest for the small and medium sized firms. For all firms, the financial restrictions decrease over time, presumably reflecting increased capital market integration in Europe.

In the second stage, the time series for the coefficients on the financial restrictions are regressed on a measure of monetary policy (Table 7). This second stage regression is meant to uncover the effects of monetary policy on the financial restrictions of the firm. We try two different measures for monetary policy: a short-term interest rate (money market rate) and a monetary policy indicator, constructed as in Bernanke and Mihov (1998). [19] The money market rate is often used as indicator of monetary policy, as most central banks use a short term interest rate as operating target. However, if the central bank has changed its operating procedures during the sample period, it might be more instructive to combine information from different variables into a measure of monetary policy. This is done by using the approach of Bernanke and Mihov (1998) and calculating an indicator of the overall stance of monetary policy from a structural vector autoregression. [20]

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[16] Results are qualitatively the same, if a full error correction model is estimated in the first stage.
[17] As the residuals from this reduced model were highly non-normal, some more outliers were dropped.
[18] Financial restrictions for 1998 could not be estimated, as too few observations were present.
[19] I would like to thank Prof. Bernanke for generously providing me with his computer code.
[20] For the construction of the monetary policy indicator see the Appendix.

Coefficients on both variables have the right sign, and in each equation at least one measure is significant. Moreover, the results are broadly consistent with the credit channel, though the results for the medium-sized firms do not fit exactly into the picture. Nevertheless, point estimates are higher for smaller firms, meaning that for smaller firms financial restrictions become more severe during monetary contractions than for larger firms. However, results have to be regarded with caution as the number of time series observations is rather small.

6. Conclusion

This paper assesses the influence of monetary policy on investment by investigating firm-level data. While the traditional interest-rate channel is negligible for Austrian enterprises, monetary policy seems to have an effect on investment through the credit channel. Descriptive statistics show that small firms, partnerships, and highly indebted firms have higher average interest expenses and a lower investment-to-sales ratio. Panel estimation results confirm that small and medium sized firms react more to financial variables. Using a two stage, nonlinear approach it is shown that financial restrictions indeed increase with a restrictive monetary policy. Again, this increase is larger for small firms. Thus, the credit channel seems to play a role in the transmission of monetary policy to investment, implying that small firms are disproportionally affected by the impacts of monetary policy.

Nevertheless, the economic relevance of the credit channel is difficult to assess. The present data set is likely to underestimate the effects of the credit channel because small firms are only barely covered. On the other hand, though small firms represent the majority of Austrian enterprises, their economic significance is much smaller, as could be seen in the summary statistics on employment and investment.

While this study presents a first assessment of the existence of a credit channel for the Austrian economy, many open questions remain. Although no significant reaction of fixed investment to interest rate changes is found, the possibility remains that inventory investment may react more to interest rates than fixed investment. Fixed investment is mainly determined by expectations of economic activity in the future, while inventory investment can adapt easier to changes in the interest rate. Another interesting question is how monetary policy affects the indebtedness of the firm. These questions are left to future research.

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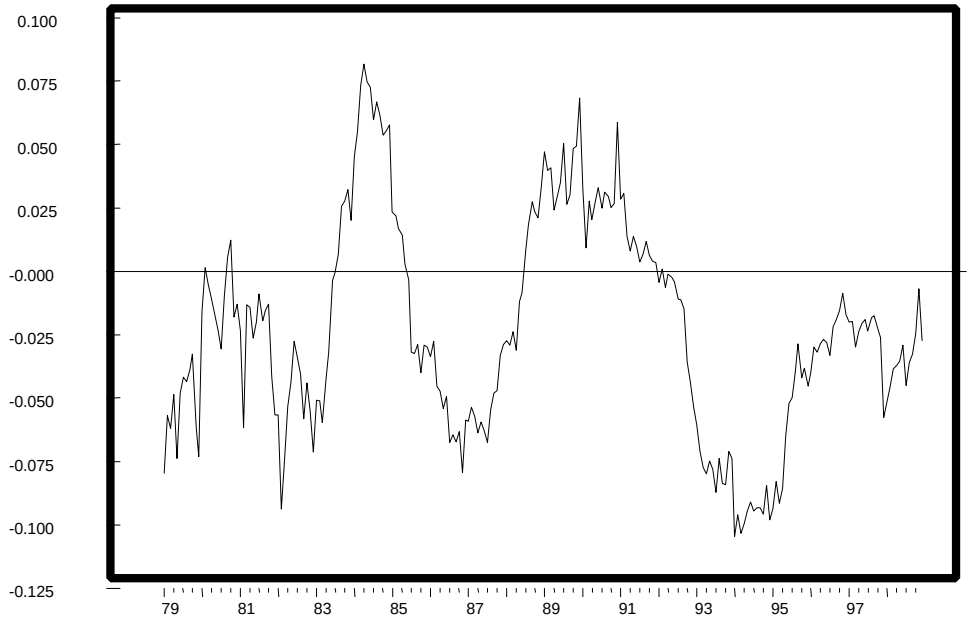
Appendix

For the construction of the Bernanke and Mihov (1998) monetary policy measure a structural VAR is estimated with monthly data for Austria from 1972 to 1998. It includes 3 non-policy variables (industrial production, consumer prices, and commodity prices) and 3 policy variables (total reserves, nonborrowed reserves, and the money market rate). Borrowed reserves are discount loans, nonborrowed reserves are open market operations plus lombard loans. Both series are adjusted for changes in the required reserves and effects of the adoption of the European legislation in 1994 by regressing the series on a constant, a trend, the required reserves ratio and a dummy which is one after 94:1.

The just identified version of the VAR is used which has as the main identifying restriction that the central bank accommodates demand shocks to total reserves in the short run. The monetary policy measure is constructed as that linear combination of the policy variables for which the structural VAR innovations correspond to the monetary policy shocks.

Though Bernanke and Mihov (1998) developed their model for the FED's monetary policy procedure, the results for Austria are quite plausible so that the use of the monetary policy indicator seems warranted.

Fig. A1. Monetary Policy Indicator



Tables and Figures

Table 1. Structure of the Data

No. of time series observations	No. of Firms	No. of time series observations	No. of Firms
19	120	9	230
18	125	8	284
17	100	7	311
16	89	6	376
15	99	5	458
14	69	4	565
13	105	3	759
12	133	2	935
11	232	1	1550
10	215		

Notes: The first column in each panel gives the time-series dimension, the next column the number of firms for which this number of observations is available.

Table 2. Number of Firms by Employees

Employees	1-49	50-99	100-249	250-499	500-999	>1000	Sum
Mining	280	15	5	2	0	1	303
Sample	10	12	5	2	0	1	31
in %	3.6	80.0	100.0	100.0	-	100.0	10.2
Manufacturing	23436	919	706	271	116	61	25509
Sample	301	306	445	212	100	51	1415
in %	1.3	33.3	63.0	78.2	86.2	83.6	5.6
Energy & Water	551	26	12	3	8	13	613
Sample	3	3	3	3	6	12	30
in %	0.5	11.5	25.0	100.0	75.0	92.3	4.9
Construction	15116	439	191	47	14	10	15817
Sample	62	43	56	26	12	10	209
in %	0.4	9.8	29.3	55.3	85.7	100.0	1.3
Trade	63340	659	364	84	50	34	64531
Sample	497	172	159	53	19	19	918
in %	0.8	26.1	43.7	63.1	38.0	55.9	1.4
Communication	11001	162	74	21	5	8	11271
Sample	29	15	16	10	1	4	75
in %	0.3	9.3	21.6	47.6	20.0	50.0	0.7
Real Estate	30505	204	131	41	11	8	30900
Sample	30	4	11	3	0	1	49
in %	0.1	2.0	8.4	7.3	0.0	12.5	0.2
Other Services	12375	83	44	19	3	3	12527
Sample	1	1	0	2	0	1	5
in %	0.0	1.2	0.0	10.5	0.0	33.3	0.0
Total[1]	156604	2507	1527	488	207	138	161471
Sample	933	556	695	311	138	99	2732
in %	0.6	22.2	45.5	63.7	66.7	71.7	1.7

Notes: [1] Total excludes the sectors *hotels and catering, schooling, financial services* and *health care*, which are not covered in the database.

Table 3. Share of Employment by Sector

Sector	Total	Sample	Share
Mining	14598	3865	26.48
Manufacturing	643880	299992	46.59
Energy and Water	32562	19097	58.65
Construction	268317	53853	20.07
Trade	479173	106360	22.20
Transport and Communication	228917	16681	7.29
Real Estate	185216	4790	2.59
Other Services	71529	2157	3.02
Total	1924192	506795	26.34

Notes: Data are for 1995. Total figure excludes the sectors *hotels and catering*, *schooling*, *financial services* and *health care*, which are not covered in the database.

Table 4. Definition of Categories

Category	Total Assets (S)	Nobs	Employees (E)	Nobs
Small	< 80 Mio. ATS	3695	< 90	3804
Medium	80-250 Mio. ATS	3640	90-220	3466
Large	> 250 Mio. ATS	4993	> 220	4952
Category	**Debt Ratio (D)**	**Nobs**	**Business Form (R)**	**Nobs**
Low	> 0.77	4016	partnership (EU)	607
Medium	0.60-0.77	3695	ordinary partnership (OHG)	541
High	< 0.60	3765	limited partnership (KG)	4295
			private lim. company (GmbH)	11952
			stock corporation (AG)	3124

Notes: The debt ratio is defined as external debt to total assets. Nobs: Number of observations.

Table 5. Sample Averages by Different Groupings

	Employees	Assets in Mio. ATS	Sales in Mio. ATS	I/Sales in %	Π/Sales in %	Debt Ratio in %
Assets						
small	70	46	85	5.29	2.85	0.72
medium	161	149	248	6.91	3.39	0.67
large	801	1460	1504	8.19	3.77	0.65
Employees						
small	51	75	130	5.89	3.09	0.72
medium	144	180	279	6.93	3.45	0.67
large	823	1373	1402	7.55	3.46	0.65
Debt Ratio						
low	326	547	610	7.34	6.28	0.46
medium	362	683	711	6.84	2.89	0.69
high	333	403	495	6.19	0.84	0.89
EU	131	123	187	6.96	2.98	81.1
OHG	234	229	312	7.58	5.23	67.5
KG	178	169	231	6.12	4.71	68.8
GmbH	268	351	479	6.92	3.48	66.9
AG	1169	2559	2171	9.99	3.68	61.2

Notes: I: Investment, Π Profits.

Table 6. Panel regressions

	all	all	small	medium	large
$\frac{I_{t\ 1}}{K_{t\ 2}}$	-0.159 (-19.65)	-0.161 (-19.41)	-0.246 (-14.89	-0.170 (-12.37)	-0.153 (-9.30)
Δy_t	0.048 (0.89)	0.109 (2.01)	0.060 (0.73)	0.162 (1.90)	0.347 (2.63)
Δy_{t-1}	0.116 (6.38)	0.128 (7.09)	0.143 (3.78)	0.159 (4.66)	0.169 (5.33)
Δi_t	0.008 (4.42)				
Δi_{t-1}	0.004 (3.52)				
Δcf_{t-1}		0.149 (7.42)	0.245 (4.01)	0.308 (6.20)	0.032 (1.72)
Δdr_{t-1}		-0.029 (-1.59)	-0.001 (-0.02)	-0.074 (-2.22)	-0.016 (-0.51)
Δliq_{t-1}		0.029 (7.20)	0.024 (3.27)	0.016 (2.35)	0.028 (4.39)
EC_{t-2}	-0.283 (-49.74)	-0.281 (-49.88)	-0.383 (-25.68)	-0.315 (-28.46)	-0.244 (-31.68)
y_{t-2}	-0.404 (-7.29)	-0.426 (-7.66)	-0.407 (-4.69)	-0.472 (-4.67)	-0.633 (-5.53)
i_{t-2}	-0.002 (-0.70)				
cf_{t-2}		-0.838 (-9.73)	-0.713 (-3.84)	-1.497 (-7.86)	-0.504 (-5.52)
dr_{t-2}		0.200 (4.20)	0.275 (3.58)	0.211 (2.62)	0.051 (0.73)
liq_{t-2}		-0.134 (-8.23)	-0.049 (-1.88)	-0.068 (-2.60)	-0.222 (-8.51)
adj. R^2	0.44	0.45	0.43	0.44	0.44
# observations	14466	14466	4168	4866	5542

Notes: Regression as in equation (2). Annual data from 1979-1998, t-values in parenthesis. The dependent variable is the ratio of investment to the capital stock at the beginning of the period, excluding financial investment; *y*: sales, *i*: bond yield, *cf*: ratio of cash flow (net of interest payments) to sales, *dr*: ratio of external debt to total assets, *liq*: ratio of liquid assets to the capital stock; *EC*: error-correction coefficient. Dummy and firm-specific constants not shown.

Table 7. Financial Restrictions and Monetary Policy

	Small	Medium	Large
MPI_{t-1}	3.43	1.87	1.90
	(1.54)	(2.12)	(2.31)
MMR_{t-1}	0.08	0.01	0.02
	(2.17)	(0.97)	(1.90)
Y_{t-1}	-3.24	-1.26	-3.97
	(-0.44)	(-0.44)	(-1.47)
R^2	0.30	0.28	0.34
Durbin-Watson	1.62	1.40	1.63

Notes: *MPI*: monetary policy indicator, *MMR* money market rate, *Y* output growth. Though output growth was insignificant it was kept as it lessened autocorrelation of the residuals. T-values in parentheses, Annual data from 1981 to 1997.

Fig. 2. Interest Rate and GDP-Growth

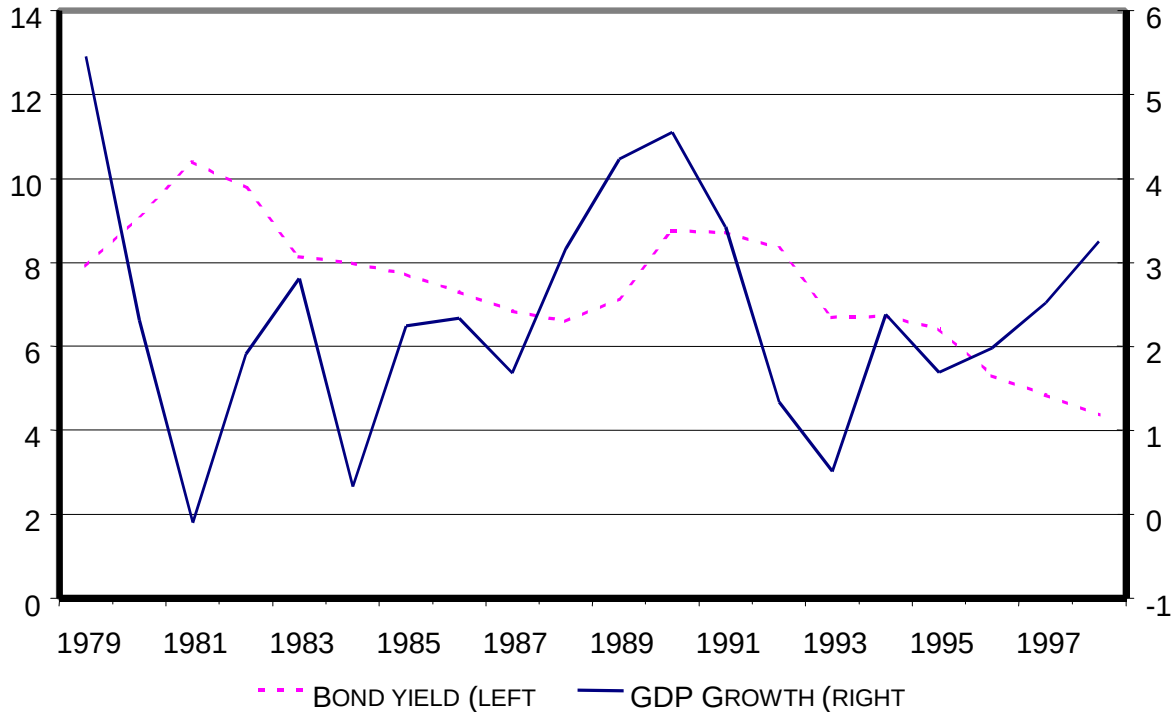


Fig. 3. Investment in the Panel and from the National Accounts

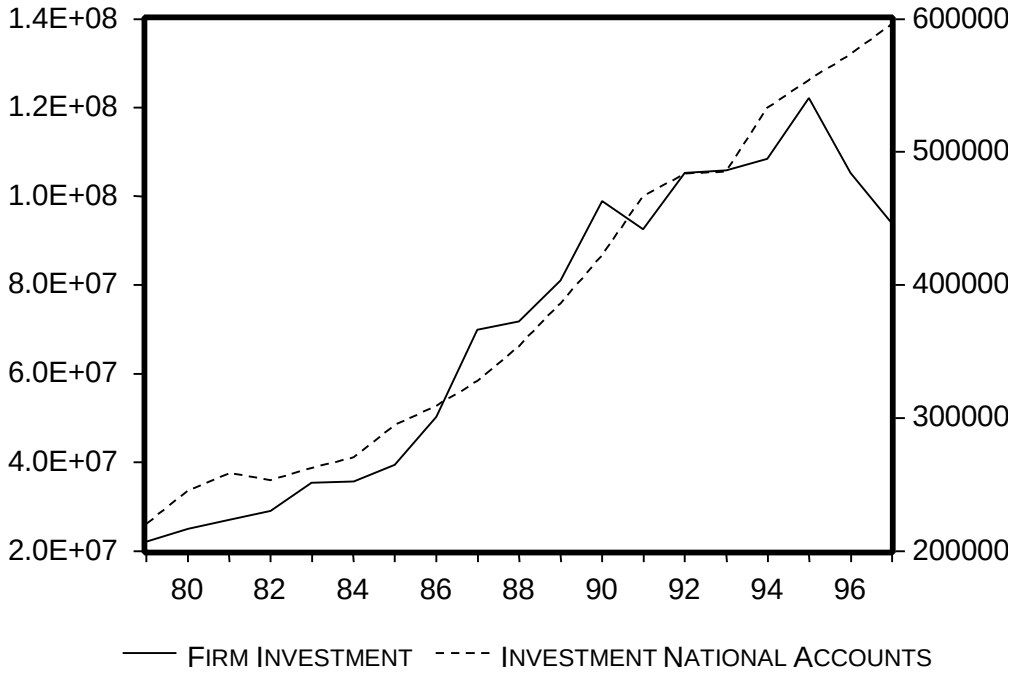


Fig. 3. Interest Rates for Different Firm Groupings

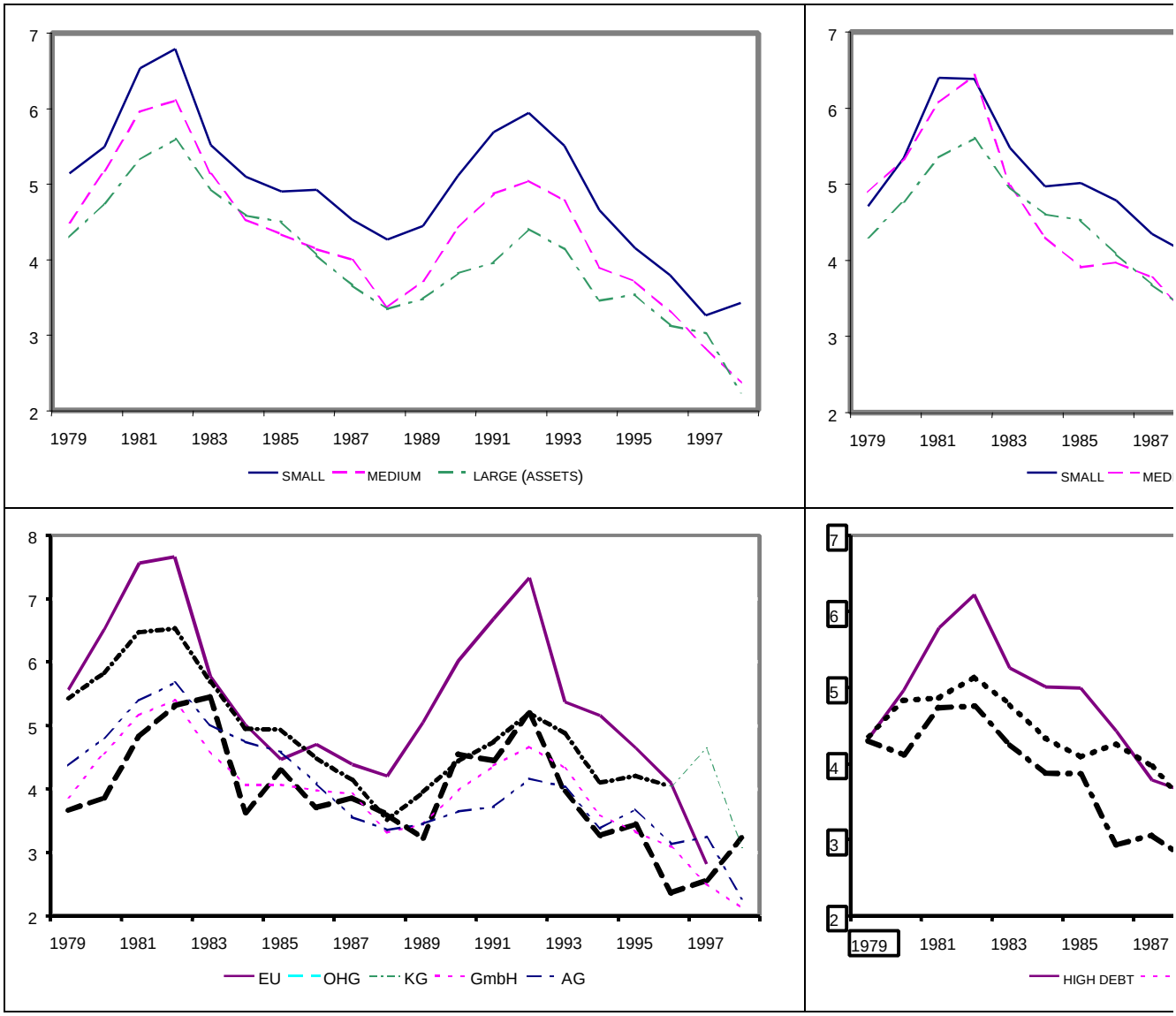
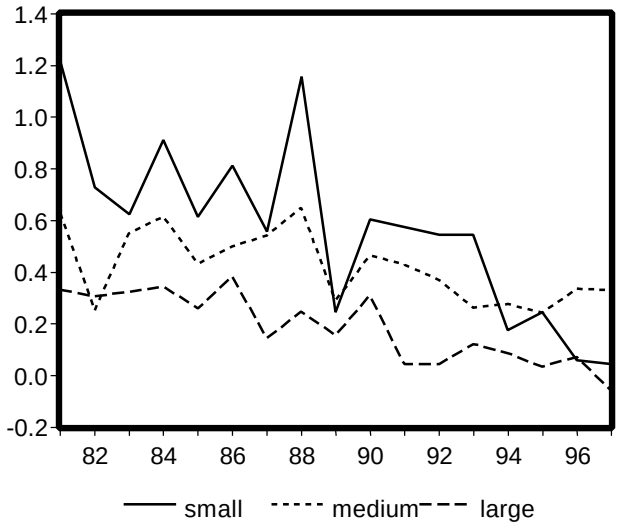


Fig. 4. Coefficients on the Financial Restriction



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