

Scharler, Johann

Working Paper

## Understanding the Stock Market's Response to Monetary Policy Shocks

Working Paper, No. 93

**Provided in Cooperation with:**

Oesterreichische Nationalbank (OeNB), Vienna

*Suggested Citation:* Scharler, Johann (2004) : Understanding the Stock Market's Response to Monetary Policy Shocks, Working Paper, No. 93, Oesterreichische Nationalbank (OeNB), Vienna

This Version is available at:

<https://hdl.handle.net/10419/264685>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

W O R K I N G P A P E R 9 3

UNDERSTANDING THE STOCK MARKET'S  
RESPONSE TO MONETARY POLICY SHOCKS

JOHANN SCHARLER

## **Editorial Board of the Working Papers**

Eduard Hochreiter, Coordinating Editor  
Ernest Gnan,  
Guenther Thonabauer  
Peter Mooslechner  
Doris Ritzberger-Gruenwald

## **Statement of Purpose**

The Working Paper series of the Oesterreichische Nationalbank is designed to disseminate and to provide a platform for discussion of either work of the staff of the OeNB economists or outside contributors on topics which are of special interest to the OeNB. To ensure the high quality of their content, the contributions are subjected to an international refereeing process. The opinions are strictly those of the authors and do in no way commit the OeNB.

Imprint: Responsibility according to Austrian media law: Guenther Thonabauer, Secretariat of the Board of Executive Directors, Oesterreichische Nationalbank

Published and printed by Oesterreichische Nationalbank, Wien.

The Working Papers are also available on our website:

<http://www.oenb.at>

## **Editorial**

In this paper, the author explores whether a limited participation model of the monetary transmission mechanism can account for the observed response of stock market returns to monetary policy shocks. It is found that the model generates responses that broadly match the empirical counterparts, although the magnitudes are somewhat too small. Moreover, the results suggest that the increased exposure of bank-dependent firms to liquidity shocks cannot fully account for the heterogeneous responses of returns that are observed across firms.

December 29, 2004



# Understanding the Stock Market's Response to Monetary Policy Shocks\*

Johann Scharler<sup>†</sup>

November 2004

## Abstract

This paper explores whether a limited participation model of the monetary transmission mechanism can account for the observed response of stock market returns to monetary policy shocks. It is found that the model generates responses that broadly match the empirical counterparts, although the magnitudes are somewhat too small. Moreover, the results suggest that the increased exposure of bank-dependent firms to liquidity shocks cannot fully account for the heterogeneous responses of returns that are observed across firms.

*JEL Classification:* E4, E5, G1

*Keywords:* limited participation, asset pricing, stock market

---

\*I would like to thank David Andolfatto, Brian Krauth, Claudia Kwapil, Jim Malley, seminar participants at the OeNB and an anonymous referee for helpful comments. The views expressed in this paper are those of the author and do not necessarily represent the position of the Oesterreichische Nationalbank.

<sup>†</sup>Oesterreichische Nationalbank, Economic Analysis Division, Otto-Wagner-Platz 3, POB 61, A-1011 Vienna, Austria, E-mail address: johann.scharler@oenb.at

# 1 Introduction

Although not without controversy, empirical evidence suggests that monetary policy influences real economic activity and asset prices in a systematic manner.<sup>1</sup> However, the theoretical links are not well understood. The purpose of this paper is to study the transmission of monetary policy shocks into stock market returns in a dynamic general equilibrium model. In particular, a variant of the limited participation model in Christiano et al. (1997) is analyzed to answer two questions: First, can the friction introduced via the limited participation assumption and the resulting monetary non-neutrality generate responses of stock market returns to monetary policy shocks that are consistent with the data. And second, can the model replicate the heterogeneous responses of the returns on small and large firms documented in the empirical literature, where firm size is usually interpreted as a proxy for financial market access.

Gertler and Gilchrist (1994) argue that small firms are more strongly affected by monetary policy shocks since they are likely to be relatively more constrained in financial markets. Ehrmann and Fratzscher (2004), Perez-Quiros and Timmermann (2000) and Thorbecke (1997) show that monetary policy exerts a more important effect on the returns of small firms. These results are interpreted as evidence in favor of the hypothesis that financial market imperfections and in particular the access to credit are important elements of the monetary transmission mechanism.

Macroeconomic theory offers basically two complementary views on how financial factors influence the business cycle, namely the bank lending channel and the credit channel. The credit channel emphasizes borrower's balance

---

<sup>1</sup>See among others, Bernanke and Kuttner (2004), Rigobon and Sack (2002), Lastrapes (1998) and Thorbecke (1997).

sheet positions and net worth, whereas the bank lending channel focuses on the special role of the banking sector. A distinction that has implications for the monetary transmission mechanism.<sup>2</sup> However, empirically it has proven hard to distinguish between the credit view and the bank lending view as the relevant financial friction.

This paper studies whether the bank-lending view can account for the observed heterogeneity of the responses to policy shocks across firms. For this purpose the model in Christiano et al. (1997) is modified such that it is consistent with the main characteristics of the bank lending channel as emphasized by Kashyap and Stein (1994): Some firms in the economy are dependent on bank loans as a source of external finance, banks cannot easily compensate policy induced variations in reserves and money is non-neutral.

Hence, the simulations conducted in this paper can help to shed some light on the issue of whether the bank lending channel alone plays a relevant role for the variation in the responses of returns across firms.

The class of limited participation models appears to be a promising starting point since these models can be rather easily augmented to include the main features of the bank lending channel. Furthermore, as shown by Christiano et al. (1997) this class of models is in general rather successful in matching the results of the large empirical literature on the effects of monetary policy shocks.<sup>3</sup> In addition, limited participation models have been successfully used as a framework for the study of asset prices by Evans and Marshall (1998) and Jordá and Salyer (2003). Both these papers analyze the term structure of nominal interest rates.

In this paper, it is found that the asset pricing implications of the limited

---

<sup>2</sup>For a more detailed discussion, see Kashyap and Stein (1994).

<sup>3</sup>See Leeper et al. (1996) and Christiano et al. (1999) for extensive surveys of the empirical literature.



participation model studied here are fairly consistent with empirical regularities. However, the model generates stock return responses that are smaller in magnitude than their empirical counterparts. Moreover, it turns out that although the fact that some firms depend on bank loans as a source of external finance plays a substantial role, it cannot fully account for the heterogeneous responses of returns across firms that are observed in the data.

The remainder of the paper is structured as follows: Section 2 describes the setup of the model. Section 3 discusses the calibration of the model and presents the results. Section 4 concludes the paper.

## **2 The model**

This section presents a variant of the limited participation model in Christiano et al. (1997) modified to include the main features of the bank lending channel. In particular it is assumed that due to informational asymmetries the business sector of the model economy partly depends on bank loans. Moreover, an asset market is introduced, on which claims to the dividends of the firms are traded. As it is standard in the class of limited participation models, households must make a portfolio decision before the state of the world is revealed. The timing of events is as follows: At the beginning of the period households deposit funds at the financial intermediaries. After the monetary policy shock is realized and the state of the world is revealed, all other decisions are made. In particular, firms hire workers and households supply labor and consume. Furthermore, households can rebalance their portfolios by using the funds deposited at the intermediaries to buy stocks. It is important to note that funds that have been deposited at the beginning of the period can only be exchanged for stocks and not for consumption goods in the current period. Therefore the rigidity that is necessary for the liquidity

effect is still in place, although households can adjust their asset holdings. At the end of the period, firms repay loans to the financial intermediaries and distribute profits in the form of dividends. Financial intermediaries repay deposits and make interest payments to the households.

## 2.1 Firms

The business sector of the economy consists of a continuum of firms normalized to have unit mass. The firms produce a homogenous consumption good and are of two types, depending on whether their output is subject to idiosyncratic shocks. Each firm  $i$  hires labor,  $H_{it}$ , and produces output according to:

$$Y_{it} = \theta_i H_{it}^{1-\alpha}, \quad (1)$$

where  $\alpha \in (0, 1)$ . The parameter  $\theta_i$  represents an idiosyncratic shock, in particular

$$\theta_i = \begin{cases} 1 & \text{with probability } \pi \\ 0 & \text{with probability } 1 - \pi \end{cases}$$

for  $i \in [0, \lambda]$  and  $\theta_i = 1$  for  $i \in [\lambda, 1]$ . Hence, firms in the interval  $[0, \lambda]$  can only repay their debt with probability  $\pi$ . In case of default, firms can walk away from their obligations. Moreover, the realizations of  $\theta_i$  are not publicly observable for  $i \in [0, \lambda]$ . In this setup only the financial intermediaries have access to a monitoring technology that allows verification of the realizations of  $\theta_i$ . Due to the assumption that labor is paid in advance of production, firms have to borrow working capital in order to finance the wage bill. In principle, each firm has two sources of credit. They can either issue nominal bonds which are sold directly to the households and are redeemed at the end of the period, or they can enter into debt contracts with a financial intermediary. However, since the realizations of the idiosyncratic shocks are not public

knowledge, firms in the interval  $[0, \lambda]$  have an incentive to misreport their output and default on bonds owned by households. Consequently, these firms will not be able to issue bonds in the first place and will be forced to borrow from the financial intermediaries instead. Let  $R_t^L$  denote the interest rate charged on bank loans. Since all borrowing and hiring decisions are made after the monetary shock has occurred, optimality requires:

$$R_t^L \frac{W_t}{P_t} = (1 - \alpha) H_{it}^{-\alpha}, \quad (2)$$

for  $i \in [0, \lambda]$ , where  $W_t$  is the nominal wage and  $P_t$  denotes the price level.

For firms in the interval  $i \in [\lambda, 1]$ , the fact that  $\theta_i = 1$  is common knowledge, therefore debt contracts do not involve any default risk. Hence, these firms are able to sell bonds directly to the households without the need for a financial intermediary. The interest rate on directly placed debt is denoted by  $R_t^B$ . Assuming that  $R_t^L > R_t^B$ , the optimal amount of bonds to be issued is determined by

$$R_t^B \frac{W_t}{P_t} = (1 - \alpha) H_{it}^{-\alpha}, \quad (3)$$

for  $i \in [\lambda, 1]$ .<sup>4</sup> At the end of the period loans and bonds are repaid and profits are distributed to the households, conditional on the realization of the idiosyncratic shock.

## 2.2 Households

Households maximize their expected lifetime utility

$$E_0 \sum_{t=0}^{\infty} \beta^t u(C_t, L_t), \quad (4)$$

where  $\beta$  is a discount factor,  $C_t$  is consumption in period  $t$ ,  $L_t$  denotes labor supply in period  $t$ , and

$$u(C_t, L_t) = \log \left[ C_t - \frac{\psi_0}{1 + \psi} L_t^{1+\psi} \right], \quad (5)$$

---

<sup>4</sup>Note that  $R_t^L > R_t^B$  will always be satisfied in equilibrium.

$\psi, \psi_0 > 0$ . This specification of the period utility function has the property that the household's labor supply function has a constant real wage elasticity of  $1/\psi$ .

At the beginning of each period households hold the entire stock of money,  $M_{t-1}$ , and must decide how much money to use for consumption in the current period, for deposits at the financial intermediaries,  $A_t$ , and for purchases of bonds,  $B_t$ , issued by firms. Deposits yield a gross interest rate of  $R_t^D$ . Interest rates are determined after the state of the world is revealed. Households supply  $L_t$  units of labor at a nominal wage of  $W_t$ . Labor income,  $L_t W_t$ , can be used for contemporaneous purchases in the goods market. Hence, the households face the following cash-in-advance constraint:

$$P_t C_t \leq M_{t-1} - A_t - B_t + W_t L_t. \quad (6)$$

After the state of the world is revealed, households can adjust their portfolio by using the funds deposited at the beginning of the period to buy stocks. They face the following constraint in the asset market:

$$S_{1t} q_{1t} + S_{2t} q_{2t} + A_t = N_t + S_{1t-1} q_{1t} + S_{2t-1} q_{2t}, \quad (7)$$

where  $S_{it-1}$ ,  $i = 1, 2$  are stock holdings of bank-dependent ( $i = 1$ ) and bond-financed ( $i = 2$ ) firms, carried over from period  $t - 1$  and  $q_{it}$  denote stock prices in nominal terms. Note that since households can not verify the realizations of the idiosyncratic shocks, households can not enforce dividend payments. Hence, it is assumed that the stock portfolios are managed by financial intermediaries on behave of the households, since the financial intermediaries can monitor the firms and enforce payments. Funds that are left with the financial intermediary are denoted by  $N_t$ . The amount of money the households carry over into the next period is

$$M_t = W_t L_t + M_{t-1} - N_t - B_t - P_t C_t + R_t^A (N_t + X_t) + R_t^B B_t +$$

$$+q_{1t}(S_{1t-1} - S_{1t}) + S_{1t}D_{1t} + q_{2t}(S_{2t-1} - S_{2t}) + S_{2t}D_{2t}, \quad (8)$$

where  $D_{it}$  are current period profits distributed as dividends at the end of period  $t$  and  $X_t$  represents a cash injection by the central bank.

The household solves the dynamic programming problem:

$$V\left(\frac{M_{t-1}}{P_t}, S_{it-1}\right) = \max_{A_t} E_{t-1} \left\{ \max_{C_t, L_t, N_t, M_t, S_{it}} \left[ u(C_t, L_t) + \beta E_t V\left(\frac{M_t}{P_{t+1}}, S_{it}\right) \right] \right\} \quad (9)$$

subject to (6), (7) and (8). The optimal solution to this maximization problem must satisfy the transversality condition:

$$\lim_{k \rightarrow \infty} u_{c,t+k} q_{it+k} S_{it+k} = 0, \quad (10)$$

for  $i = 1, 2$ . Moreover, the necessary conditions associated with this maximization problem are:

$$\beta E_{t-1} \left( R_t^A \frac{u_{c,t+1}}{P_{t+1}} \right) = E_{t-1} \left( \frac{u_{c,t}}{P_t} \right), \quad (11)$$

$$\beta E_{t-1} \left( R_t^B \frac{u_{c,t+1}}{P_{t+1}} \right) = E_{t-1} \left( \frac{u_{c,t}}{P_t} \right), \quad (12)$$

$$\frac{W_t}{P_t} = \frac{u_{L,t}}{u_{c,t}}, \quad (13)$$

$$\beta E_t \left( \frac{u_{c,t+2}}{P_{t+2}} q_{it+1} R_{t+1}^A \right) = E_t \left( \frac{u_{c,t+1}}{P_{t+1}} \right) (q_{it} R_t^A - D_{it}). \quad (14)$$

Equations (11) and (12) determine optimal deposits and bond holdings. Note that these decisions are made prior to the realization of the period  $t$  money growth rate therefore the expectations are taken with respect to information available in period  $t - 1$ . According to (13) households equate their marginal rates of substitution between labor and leisure to the real wage when making their labor supply decisions. In contrast to (11) and (12), the expectation in

(14) is taken with respect to period  $t$  information since the stock market is assumed to open after the period  $t$  shock has been realized. The right hand side of (14) shows the utility cost of increasing stock holdings in period  $t$ . Buying one additional stock reduces the amount of money that can be used for consumption in  $t + 1$  by  $R_t^A q_t$ . However, since dividends are paid at the end of the period, they can be used for consumption in the next period and are therefore subtracted. If the additional shares purchased in  $t$  are sold in  $t + 1$  the funds can be deposited and will earn interest. Thus consumption in  $t + 2$  is increased by  $q_{it+1} R_{t+1}^A / P_{t+2}$ . It follows that the stock price is affected by four factors: current and expected dividends, the deposit rate, which influences the opportunity cost of buying shares, the expected inflation rate and the marginal utility of consumption.

### 2.3 Financial Intermediaries

The financial intermediaries can eliminate idiosyncratic default risk by lending to an infinite number of borrowers.<sup>5</sup> At the beginning of the period, financial intermediaries receive deposits from the households and cash injections from the monetary authority. The total amount of loanable funds,  $N_t + X_t$ , is used to provide loans to firms which cannot borrow from households directly. In contrast to households, financial intermediaries can observe the realization of idiosyncratic shocks and are therefore able to enforce debt contracts. For simplicity, it is assumed that financial intermediation and monitoring are costless and competitive. At the end of the period, the financial intermediaries receive payments from their solvent borrowers and return deposits with interest to the household. The remaining profits are paid to the households as dividends.

---

<sup>5</sup>See Diamond (1984).

The objective of the financial intermediary is to choose the optimal amount of loans such that the expected present value of the dividend stream is maximized. The dividend is given by

$$F_t = \pi(N_t + X_t)R_t^L - (N_t + X_t)R_t^A. \quad (15)$$

Free entry into the banking sector ensures that  $R_t^A = \pi R_t^L$  and that  $F_t = R_t^A X_t$  will be paid to the households in form of dividends.

## 2.4 Monetary Authority

The monetary authority provides liquidity to the financial sector of the economy. The monetary growth rate is defined as:  $x_t = \frac{X_t}{M_{t-1}}$ . The money supply process is assumed to be exogenous and the monetary growth rate follows a three-state Markov process. In particular, let  $x_t \in \{\mu + \sigma, \mu, \mu - \sigma\}$  and let  $\delta_{ij} = Prob(x_{t+1} = x_j | x_t = x_i)$  where  $\delta_{ij} = \bar{\delta}$  for  $i = j$  and  $\delta_{ij} = (1 - \bar{\delta})/2$  for  $i \neq j$ . This specification implies that  $E(x_t) = \mu$ ,  $Var(x_t) = \frac{2}{3}\sigma^2$  and the first order autocorrelation of the money growth process is given by  $Corr(x_t, x_{t-1}) = (3\bar{\delta} - 1)/2$ .

## 2.5 Equilibrium

A stationary competitive equilibrium for the model economy is characterized by stochastic sequences of allocations  $\{C_t, H_{it}, M_t, N_t, B_t, S_{it}\}_{t=0}^{\infty}$ ,  $i = 1, 2$ , prices  $\{R_t^D, R_t^L, R_t^B, q_{it}, P_t, W_t\}_{t=0}^{\infty}$ ,  $i = 1, 2$ , and monetary growth rates  $\{x_t\}_{t=0}^{\infty}$  such that: (i) The household's necessary conditions (11), (12), (13), the constraints (6), (8) and the transversality conditions in (10) are satisfied. (ii) The necessary conditions that determine optimal borrowing for bank-dependent firms (2), and for bond-issuing firms (3) hold. (iii) The markets for labor, goods, loans, bonds and stocks clear:

$$L_t = \int_0^1 H_{it} di, \quad C_t = \int_0^1 H_{it}^{1-\alpha} di,$$

$$N_t + X_t = W_t \int_0^\lambda H_{it} di, \quad B_t = W_t \int_\lambda^1 H_{it} di,$$

$$S_{1t} = S_1, \quad S_{2t} = S_2.$$

Note that the number of shares is assumed to be constant at  $S_1$  and  $S_2$ .

## 3 Calibration and Results

### 3.1 Parameter values

The model is calibrated to monthly US data to facilitate comparability with the empirical literature. As it is standard in the literature, the discount factor is set to  $\beta = (1.03)^{-1/12}$ . For the labor supply elasticity,  $1/\psi$ , a value of unity is chosen and  $\psi_0$  is set to 1.5 which implies that labor supply is equal to unity in the steady state as in Christiano et al. (1997). The parameter  $\alpha$  in the production function is set to 0.36. Cecchetti (2001) reports that bank loans account for 21 percent of a forms of finance in the US. Hence,  $\lambda$  is set to 0.21.<sup>6</sup> The default probability,  $1 - \pi$ , is set to one percent which is close to the values chosen by Cooley and Nam (1998) and by Carlstrom and Fuerst (1997) who set this parameter to 2 percent and 0.974 percent respectively.

Monetary policy is parameterized according to Evans and Marshall (1998). The unconditional monetary growth rate is set to  $\mu = 0.00667$  and for  $\sigma$  the value 0.0015 is chosen, which implies that an unanticipated decline in the monetary growth rate from  $\mu$  to  $\mu - \sigma$ , is equivalent to a one standard deviation shock in the monetary growth process estimated by Evans and Marshall (1998). The first order autocorrelation of the process is set to zero. The calibration of the model is summarized in Table 1.

---

<sup>6</sup>Note that the fraction of bank-dependent firms does not necessarily correspond exactly to bank loans as a fraction of all finance. However, in the model, the difference is quantitatively negligible.



## 3.2 Results

All results are reported as the impact response of the variable under consideration to a reduction in the monetary growth rate from  $\mu$  to  $\mu - \sigma$ . For the macroeconomic variables in the model the responses are reported as percentage changes and for returns as percentage point changes, where returns are calculated as  $ret_{it} = (q_{it} + D_{it})/q_{it-1}$ ,  $i = 1, 2$ . The return on the market as a whole is calculated as a weighted average of  $ret_{1t}$  and  $ret_{2t}$ . Real returns are obtained by subtracting the ex-post inflation rate from nominal returns.

Results for macroeconomic variables are reported in Table 2. A monetary contraction induces an increase in the bank lending rate due to the liquidity effect and also a slight increase in the bond yield. The higher interest rates lead to an increase in the cost of working capital and consequently firms reduce the amount of labor they hire. Thus output declines by 0.04 percent. Moreover, the price level declines by around 0.1 percent. Overall these responses are similar to those reported in the literature.<sup>7</sup>

Table 3 shows the responses of financial variables in the model. The nominal returns on the stocks of bank-dependent and bond-financed firms decline by 0.58 and 0.52 percentage points in response to a monetary contraction. The return on the overall market declines by 0.53 percentage points.

Intuitively, the monetary shock leads to a higher lending rate which makes working capital more costly for bank-dependent firms, implying a lower dividend. The bond yield increases only marginally therefore the shock has only a small effect on bond-financed firms. Furthermore, the higher deposit rate increases the opportunity cost of holding stocks for the households. In sum, these effects have a negative impact on the price of a stock. However, it turns out that changes in the deposit rate are rather large in this model,

---

<sup>7</sup>See for instance Christiano et al. (1997) or Evans and Marshall (1998).

since liquidity shocks have to be absorbed by a relatively small fraction of the business sector of the economy. Hence, the deposit rate along with the corporate lending rate has to react substantially. However, changes in the deposit rate affect the stock prices of bank-dependent and bond-financed firms symmetrically, therefore the higher variability in the dividend stream of bank-financed firms does not add much in terms of the relative response of bank-dependent firms.

Ultimately, the goal of the paper is to determine whether monetary shocks affect stock returns in accordance with the empirical evidence. Thorbecke (1997) presents evidence from a structural VAR and finds that monthly stock returns decline by 0.8 percentage points on average in response to a monetary policy shock. Moreover, results for size portfolios indicate that monetary policy has a more pronounced effect on the return on small firms, whereas for large firms, the effect is smaller. In particular, the impact of a monetary policy shock on the returns on the smallest firms is about 30 to 60 percent stronger than for larger firms in the sample. Similarly, Ehrmann and Fratzscher (2004) report that financially constrained firms react by approximately 60 percent stronger to monetary policy shocks than unconstrained firms.

Comparing these empirical findings to the results in Table 3 shows that the model generates responses which are similar to the empirical counterparts, although the magnitudes are somewhat too small. However, it has proved hard for monetary and non-monetary asset pricing models to account for the observed high variability of stock returns. The limited participation model considered here manages to generate responses with magnitudes that are substantially closer to what is observed in the data than other models.<sup>8</sup>

---

<sup>8</sup>For instance, Marshall (1992) finds that the response of real returns to a money shock in his model is about ten times smaller than in the data.

The model also suggests that bank-dependent firms react by more than bond-financed firms to policy shocks. In the model, the return on stocks of bank-dependent firms reacts about 11 percent stronger than the return on the stocks of bond-financed firms which is smaller than what Thorbecke (1997) and Ehrmann and Fratzscher (2004) find in the data. Thus, it appears that the bank lending channel can only account for part of the variation of stock returns observed in the data.

Some additional insights can be gained by comparing the impact responses for different financial structure parameters. Table 4 displays the impact responses of nominal returns for different values of  $\lambda$ . Clearly, increasing the fraction of bank-dependent firms results in larger relative responses. This occurs because a higher fraction of bank-dependent firms implies that a larger part of the economy is subject to liquidity shocks. Hence, liquidity shocks become relatively less important at the level of the individual firm which also means that the lending rate does not have to react by as much as in the benchmark case. Thus, the response of dividends becomes a more important determinant of the return responses. And since the dividends of bank-dependent firms are more closely related to policy shocks, the relative impact on the return on bank-dependent firms increases. However, at the same time the response of the overall return on stocks declines with an increase in  $\lambda$ .

Another interesting result concerns the correlation of real stock returns and inflation. As can be seen from Tables 2 and 3 that the short run dynamics of the price level and real stock returns are in opposite directions. Hence, the model suggests that stocks are a hedge against inflation. This result is in contrast to the negative correlation between ex-post real stock returns and

inflation that is documented in the empirical literature.<sup>9</sup> One conclusion that can be drawn from this result is that the observed negative correlation is due to the price level effects of real shocks and cannot be attributed to monetary shocks.

## 4 Concluding Remarks

This paper investigates the reaction of stock market returns to monetary shocks in a general equilibrium model. In the model, the transmission of monetary policy shocks into stock prices works primarily through changes in current and expected interest rates and dividends. A monetary contraction leads to higher nominal interest rates, which in turn increase the opportunity cost of holding stocks and at the same time decreases dividend payments since firms have to borrow working capital. Both these effects put downward pressure on stock prices.

In the model, monetary policy shocks have a substantial impact on the stock market. However, the responses generated by the model are somewhat smaller than in the data. Hence, the limited participation assumption does not generate enough monetary non-neutrality to fully account for the response of stock returns that is observed empirically.

The model also suggests that the returns on bank-dependent firms react stronger to policy induced liquidity shocks, which is consistent with empirical evidence. Nevertheless, the relative impact on the return on the stocks of bank-dependent firms as compared to bond-financed firms is smaller than in the data. Hence, additional financial frictions are likely to play a role in this context. This appears to be an interesting result since empirically it has proven hard to isolate the effects of the bank lending channel as opposed

---

<sup>9</sup>See Giovannini and Labadie (1991) and the references therein.

to the credit channel. However, the analysis presented in this paper points towards a non-negligible role for frictions beyond the bank lending channel. Thus, exploring the link between monetary policy shocks and asset prices in models that contain a credit channel appears to be an interesting topic for future research.

## References

- Bernanke, B. S., Kuttner, K. K., 2004. What explains the stock market's reaction to federal reserve policy? Working paper, NBER.
- Carlstrom, C. T., Fuerst, T. S., 1997. Agency costs, net worth, and business fluctuations: A computable general equilibrium analysis. *American Economic Review* 87, 893–910.
- Cecchetti, S. G., 2001. Legal structure, financial structure and the monetary policy transmission mechanism. In: Deutsche Bundesbank (Ed.), *The Monetary Transmission Process*. Palgrave, New York.
- Christiano, L., Eichenbaum, M., Evans, C., 1997. Sticky price and limited participation models of money: A comparison. *European Economic Review* 41, 1201–1349.
- Christiano, L., Eichenbaum, M., Evans, C., 1999. Monetary policy shocks: What have we learned and to what end? In: Taylor, J. B., Woodford, M. (Eds.), *Handbook of Macroeconomics*. North-Holland, Amsterdam.
- Cooley, T., Nam, K., 1998. Asymmetric information, financial intermediation, and business cycles. *Economic Theory* 12, 599–620.
- Diamond, D., 1984. Financial intermediation and delegated monitoring. *Review of Economic Studies* 51, 393–414.

- Ehrmann, M., Fratzscher, M., 2004. Taking stock: Monetary policy transmission to equity markets. *Journal of Money, Credit, and Banking* 36, 719–738.
- Evans, C. L., Marshall, D. A., 1998. Monetary policy and the term structure of interest rates: Evidence and theory. *Carnegie-Rochester Conference Series on Public Policy* 49, 53–111.
- Gertler, M., Gilchrist, S., 1994. Monetary policy, business cycles, and the behavior of small manufacturing firms. *Quarterly Journal of Economics* 59, 309–40.
- Giovannini, A., Labadie, P., 1991. Asset prices and interest rates in cash-in-advance models. *Journal of Political Economy* 99, 1215–1251.
- Jordá, O., Salyer, K. D., 2003. The response of term rates to monetary policy uncertainty. *The Review of Economic Dynamics* 6, 941–962.
- Kashyap, A. K., Stein, J. C., 1994. Monetary policy and bank lending. In: Mankiw, N. G. (Ed.), *Monetary Policy*. University of Chicago Press for NBER.
- Lastrapes, W. D., 1998. International evidence on equity prices, interest rates and money. *Journal of International Money and Finance* 17, 377–406.
- Leeper, E., Sims, C., Zha, T., 1996. What does monetary policy do? *Brookings Papers on Economic Activity* 2, 1–63.
- Marshall, D. A., 1992. Inflation and asset returns in a monetary economy. *Journal of Finance* 47, 1315–1342.
- Perez-Quiros, G., Timmermann, A., 2000. Firm size and cyclical variations in stock returns. *Journal of Finance* 55, 1229–1262.

Rigobon, R., Sack, B., 2002. The impact of monetary policy on asset prices.  
Working paper, NBER.

Thorbecke, W., 1997. On stock market returns and monetary policy. *Journal of Finance* 52, 635–654.

Table 1: Calibration

Preferences and Technology			
$\beta$	$\psi$	$\psi_0$	$\alpha$
$(1.03)^{-(1/12)}$	1	1.5	0.36
Financial Structure			
$\lambda$	$\pi$		
0.2	0.99		
Monetary Policy			
$\mu$	$\sigma$	$\bar{\delta}$	
0.00667	0.0015	0	

Table 2: Impact Responses of macroeconomic variables to a monetary contraction

$dc$	$dp$	$drl$	$drb$
-0.041	-0.108	0.446	0.002

Notes to Table 2: Impact responses are reported as  $dz = \log(z'/z) * 100$ , where  $z'$  denotes the value of a variable in state  $(\mu, \mu - \sigma)$  and  $z$  denotes the value in state  $(\mu, \mu)$ . Interest rate responses are reported as percentage point changes.



Table 3: Impact Responses of financial variables to a monetary contraction

Nominal Returns			
$dret_1$	$dret_2$	$dret$	$dret_1/dret_2$
-0.569	-0.510	-0.522	1.116

  

Real Returns			
$dret_1$	$dret_2$	$dret$	$dret_1/dret_2$
-0.461	-0.401	-0.413	1.147

Notes to Table 3: Impact responses are reported as percentage point differences. Real returns are calculated by subtracting the ex-post inflation rate from the nominal return.

Table 4: Impact Responses of nominal returns for different financial structures

$\lambda$	$dret_1$	$dret_2$	$dret$	$dret_1/dret_2$
0.3	-0.428	-0.355	-0.377	1.203
0.4	-0.361	-0.273	-0.308	1.321
0.5	-0.326	-0.220	-0.273	1.482
0.6	-0.309	-0.181	-0.258	1.708

Notes to Table 4: Impact responses of returns are reported as percentage point differences.

## Index of Working Papers:

August 28, 1990	Pauer Franz	1 <sup>1)</sup>	Hat Böhmerland Recht gehabt? Zum Zusammenhang zwischen Handelsbilanzpassivum und Budgetdefizit in den USA <sup>2)</sup>
March 20, 1991	Backé Peter	2 <sup>1)</sup>	Ost- und Mitteleuropa auf dem Weg zur Marktwirtschaft - Anpassungskrise 1990
March 14, 1991	Pauer Franz	3 <sup>1)</sup>	Die Wirtschaft Österreichs im Vergleich zu den EG-Staaten - eine makroökonomische Analyse für die 80er Jahre
May 28, 1991	Mauler Kurt	4 <sup>1)</sup>	The Soviet Banking Reform
July 16, 1991	Pauer Franz	5 <sup>1)</sup>	Die Auswirkungen der Finanzmarkt- und Kapitalverkehrsliberalisierung auf die Wirtschaftsentwicklung und Wirtschaftspolitik in Norwegen, Schweden, Finnland und Großbritannien - mögliche Konsequenzen für Österreich <sup>3)</sup>
August 1, 1991	Backé Peter	6 <sup>1)</sup>	Zwei Jahre G-24-Prozess: Bestandsaufnahme und Perspektiven unter besonderer Berücksichtigung makroökonomischer Unterstützungsleistungen <sup>4)</sup>
August 8, 1991	Holzmann Robert	7 <sup>1)</sup>	Die Finanzoperationen der öffentlichen Haushalte der Reformländer CSFR, Polen und Ungarn: Eine erste quantitative Analyse
January 27, 1992	Pauer Franz	8 <sup>1)</sup>	Erfüllung der Konvergenzkriterien durch die EG-Staaten und die EG-Mitgliedswerber Schweden und Österreich <sup>5)</sup>
October 12, 1992	Hochreiter Eduard (Editor)	9 <sup>1)</sup>	Alternative Strategies For Overcoming the Current Output Decline of Economies in Transition
November 10, 1992	Hochreiter Eduard and Winckler Georg	10 <sup>1)</sup>	Signaling a Hard Currency Strategy: The Case of Austria

1) vergriffen (out of print)

2) In abgeänderter Form erschienen in Berichte und Studien Nr. 4/1990, S 74 ff

3) In abgeänderter Form erschienen in Berichte und Studien Nr. 4/1991, S 44 ff

4) In abgeänderter Form erschienen in Berichte und Studien Nr. 3/1991, S 39 ff

5) In abgeänderter Form erschienen in Berichte und Studien Nr. 1/1992, S 54 ff

March 12, 1993	Hochreiter Eduard (Editor)	11	The Impact of the Opening-up of the East on the Austrian Economy - A First Quantitative Assessment
June 8, 1993	Anulova Guzel	12	The Scope for Regional Autonomy in Russia
July 14, 1993	Mundell Robert	13	EMU and the International Monetary System: A Transatlantic Perspective
November 29, 1993	Hochreiter Eduard	14	Austria's Role as a Bridgehead Between East and West
March 8, 1994	Hochreiter Eduard (Editor)	15	Prospects for Growth in Eastern Europe
June 8, 1994	Mader Richard	16	A Survey of the Austrian Capital Market
September 1, 1994	Andersen Palle and Dittus Peter	17	Trade and Employment: Can We Afford Better Market Access for Eastern Europe?
November 21, 1994	Rautava Jouko	18 <sup>1)</sup>	Interdependence of Politics and Economic Development: Financial Stabilization in Russia
January 30, 1995	Hochreiter Eduard (Editor)	19	Austrian Exchange Rate Policy and European Monetary Integration - Selected Issues
October 3, 1995	Groeneveld Hans	20	Monetary Spill-over Effects in the ERM: The Case of Austria, a Former Shadow Member
December 6, 1995	Frydman Roman et al	21	Investing in Insider-dominated Firms: A Study of Voucher Privatization Funds in Russia
March 5, 1996	Wissels Rutger	22	Recovery in Eastern Europe: Pessimism Confounded ?
June 25, 1996	Pauer Franz	23	Will Asymmetric Shocks Pose a Serious Problem in EMU?
September 19, 1997	Koch Elmar B.	24	Exchange Rates and Monetary Policy in Central Europe - a Survey of Some Issues
April 15, 1998	Weber Axel A.	25	Sources of Currency Crises: An Empirical Analysis

May 28, 1998	Brandner Peter, Diebalek Leopold and Schuberth Helene	26	Structural Budget Deficits and Sustainability of Fiscal Positions in the European Union
June 15, 1998	Canzeroni Matthew, Cumby Robert, Diba Behzad and Eudey Gwen	27	Trends in European Productivity: Implications for Real Exchange Rates, Real Interest Rates and Inflation Differentials
June 20, 1998	MacDonald Ronald	28	What Do We Really Know About Real Exchange Rates?
June 30, 1998	Campa José and Wolf Holger	29	Goods Arbitrage and Real Exchange Rate Stationarity
July 3, 1998	Papell David H.	30	The Great Appreciation, the Great Depreciation, and the Purchasing Power Parity Hypothesis
July 20, 1998	Chinn Menzie David	31	The Usual Suspects? Productivity and Demand Shocks and Asia-Pacific Real Exchange Rates
July 30, 1998	Cecchetti Stephen G., Mark Nelson C., Sonora Robert	32	Price Level Convergence Among United States Cities: Lessons for the European Central Bank
September 30, 1998	Christine Gartner, Gert Wehinger	33	Core Inflation in Selected European Union Countries
November 5, 1998	José Viñals and Juan F. Jimeno	34	The Impact of EMU on European Unemployment
December 11, 1998	Helene Schuberth and Gert Wehinger	35	Room for Manoeuvre of Economic Policy in the EU Countries – Are there Costs of Joining EMU?
December 21, 1998	Dennis C. Mueller and Burkhard Raunig	36	Heterogeneities within Industries and Structure-Performance Models
May 21, 1999	Alois Geyer and Richard Mader	37	Estimation of the Term Structure of Interest Rates – A Parametric Approach
July 29, 1999	José Viñals and Javier Vallés	38	On the Real Effects of Monetary Policy: A Central Banker's View
December 20, 1999	John R. Freeman, Jude C. Hays and Helmut Stix	39	Democracy and Markets: The Case of Exchange Rates

March 01, 2000	Eduard Hochreiter and Tadeusz Kowalski	40	Central Banks in European Emerging Market Economies in the 1990s
March 20, 2000	Katrin Wesche	41	Is there a Credit Channel in Austria? The Impact of Monetary Policy on Firms' Investment Decisions
June 20, 2000	Jarko Fidrmuc and Jan Fidrmuc	42	Integration, Disintegration and Trade in Europe: Evolution of Trade Relations During the 1990s
March 06, 2001	Marc Flandreau	43	The Bank, the States, and the Market, A Austro-Hungarian Tale for Euroland, 1867-1914
May 01, 2001	Otmar Issing	44	The Euro Area and the Single Monetary Policy
May 18, 2001	Sylvia Kaufmann	45	Is there an asymmetric effect of monetary policy over time? A Bayesian analysis using Austrian data.
May 31, 2001	Paul De Grauwe and Marianna Grimaldi	46	Exchange Rates, Prices and Money. A Long Run Perspective
June 25, 2001	Vítor Gaspar, Gabriel Perez-Quiros and Jorge Sicilia	47	The ECB Monetary Strategy and the Money Market
July 27, 2001	David T. Llewellyn	48	<i>A Regulatory Regime</i> For Financial Stability
August 24, 2001	Helmut Elsinger and Martin Summer	49	Arbitrage Arbitrage and Optimal Portfolio Choice with Financial Constraints
September 1, 2001	Michael D. Goldberg and Roman Frydman	50	Macroeconomic Fundamentals and the DM/\$ Exchange Rate: Temporal Instability and the Monetary Model
September 8, 2001	Vittorio Corbo, Oscar Landerretche and Klaus Schmidt-Hebbel	51	Assessing Inflation Targeting after a Decade of World Experience
September 25, 2001	Kenneth N. Kuttner and Adam S. Posen	52	Beyond Bipolar: A Three-Dimensional Assessment of Monetary Frameworks

October 1, 2001	Luca Dedola and Sylvain Leduc	53	Why Is the Business-Cycle Behavior of Fundamentals Alike Across Exchange-Rate Regimes?
October 10, 2001	Tommaso Monacelli	54	New International Monetary Arrangements and the Exchange Rate
December 3, 2001	Peter Brandner, Harald Grech and Helmut Stix	55	The Effectiveness of Central Bank Intervention in the EMS: The Post 1993 Experience
January 2, 2002	Sylvia Kaufmann	56	Asymmetries in Bank Lending Behaviour. Austria During the 1990s
January 7, 2002	Martin Summer	57	Banking Regulation and Systemic Risk
January 28, 2002	Maria Valderrama	58	Credit Channel and Investment Behavior in Austria: A Micro-Econometric Approach
February 18, 2002	Gabriela de Raaij and Burkhard Raunig	59	Evaluating Density Forecasts with an Application to Stock Market Returns
February 25, 2002	Ben R. Craig and Joachim G. Keller	60	The Empirical Performance of Option Based Densities of Foreign Exchange
February 28, 2002	Peter Backé, Jarko Fidrmuc, Thomas Reininger and Franz Schardax	61	Price Dynamics in Central and Eastern European EU Accession Countries
April 8, 2002	Jesús Crespo- Cuaresma, Maria Antoinette Dimitz and Doris Ritzberger- Grünwald	62	Growth, Convergence and EU Membership
May 29, 2002	Markus Knell	63	Wage Formation in Open Economies and the Role of Monetary and Wage-Setting Institutions
June 19, 2002	Sylvester C.W. Eijffinger (comments by: José Luis Malo de Molina and by Franz Seitz)	64	The Federal Design of a Central Bank in a Monetary Union: The Case of the European System of Central Banks

July 1, 2002	Sebastian Edwards and I. Igal Magendzo (comments by Luis Adalberto Aquino Cardona and by Hans Genberg)	65	Dollarization and Economic Performance: What Do We Really Know?
July 10, 2002	David Begg (comment by Peter Bofinger)	66	Growth, Integration, and Macroeconomic Policy Design: Some Lessons for Latin America
July 15, 2002	Andrew Berg, Eduardo Borensztein, and Paolo Mauro (comment by Sven Arndt)	67	An Evaluation of Monetary Regime Options for Latin America
July 22, 2002	Eduard Hochreiter, Klaus Schmidt-Hebbel and Georg Winckler (comments by Lars Jonung and George Tavlas)	68	Monetary Union: European Lessons, Latin American Prospects
July 29, 2002	Michael J. Artis (comment by David Archer)	69	Reflections on the Optimal Currency Area (OCA) criteria in the light of EMU
August 5, 2002	Jürgen von Hagen, Susanne Mundschenk (comments by Thorsten Polleit, Gernot Doppelhofer and Roland Vaubel)	70	Fiscal and Monetary Policy Coordination in EMU
August 12, 2002	Dimitri Boreiko (comment by Ryszard Kokoszcyński)	71	EMU and Accession Countries: Fuzzy Cluster Analysis of Membership
August 19, 2002	Ansgar Belke and Daniel Gros (comments by Luís de Campos e Cunha, Nuno Alves and Eduardo Levy-Yeyati)	72	Monetary Integration in the Southern Cone: Mercosur Is Not Like the EU?
August 26, 2002	Friedrich Fritzer, Gabriel Moser and Johann Scharler	73	Forecasting Austrian HICP and its Components using VAR and ARIMA Models

September 30, 2002	Sebastian Edwards	74	The Great Exchange Rate Debate after Argentina
October 3, 2002	George Kopits (comments by Zsolt Darvas and Gerhard Illing)	75	Central European EU Accession and Latin American Integration: Mutual Lessons in Macroeconomic Policy Design
October 10, 2002	Eduard Hochreiter, Anton Korinek and Pierre L. Siklos (comments by Jeannine Bailliu and Thorvaldur Gylfason)	76	The Potential Consequences of Alternative Exchange Rate Regimes: A Study of Three Candidate Regions
October 14, 2002	Peter Brandner, Harald Grech	77	Why Did Central Banks Intervene in the EMS? The Post 1993 Experience
October 21, 2002	Alfred Stiglbauer, Florian Stahl, Rudolf Winter-Ebmer, Josef Zweimüller	78	Job Creation and Job Destruction in a Regulated Labor Market: The Case of Austria
October 28, 2002	Elsinger, Alfred Lehar and Martin Summer	79	Risk Assessment for Banking Systems
November 4, 2002	Helmut Stix	80	Does Central Bank Intervention Influence the Probability of a Speculative Attack? Evidence from the EMS
June 30, 2003	Markus Knell, Helmut Stix	81	How Robust are Money Demand Estimations? A Meta-Analytic Approach
July 7, 2003	Helmut Stix	82	How Do Debit Cards Affect Cash Demand? Survey Data Evidence
July 14, 2003	Sylvia Kaufmann	83	The business cycle of European countries. Bayesian clustering of country-individual IP growth series.
July 21, 2003	Jesus Crespo Cuaresma, Ernest Gnan, Doris Ritzberger-Gruenwald	84	Searching for the Natural Rate of Interest: a Euro-Area Perspective
July 28, 2003	Sylvia Frühwirth-Schnatter, Sylvia Kaufmann	85	Investigating asymmetries in the bank lending channel. An analysis using Austrian banks' balance sheet data



September 22, 2003	Burkhard Raunig	86	Testing for Longer Horizon Predictability of Return Volatility with an Application to the German DAX
May 3, 2004	Juergen Eichberger, Martin Summer	87	Bank Capital, Liquidity and Systemic Risk
June 7, 2004	Markus Knell, Helmut Stix	88	Three Decades of Money Demand Studies. Some Differences and Remarkable Similarities
August 27, 2004	Martin Schneider, Martin Spitzer	89	Forecasting Austrian GDP using the generalized dynamic factor model
September 20, 2004	Sylvia Kaufmann, Maria Teresa Valderrama	90	Modeling Credit Aggregates
Oktober 4, 2004	Gabriel Moser, Fabio Rumler, Johann Scharler	91	Forecasting Austrian Inflation
November 3, 2004	Michael D. Bordo, Josef Christl, Harold James, Christian Just	92	Exchange Rate Regimes Past, Present and Future
December 29, 2004	Johann Scharler	93	Understanding the Stock Market's Response to Monetary Policy Shocks