Asymmetric Information and the Transmission Mechanism of Monetary Policy

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Abstract

This paper analyzes the consequences of asymmetric information in credit markets for the monetary transmission mechanism. It shows that asymmetric information cannot only reinforce, but can also weaken or overcompensate the effects of the standard interest rate channel. Crucial is that informational problems lead to an external finance premium which can be positive or negative for marginal entrepreneurs. Tight money may lead to an increase in the absolute value of this premium, implying that there is a credit channel of monetary policy, but its working direction is ambiguous.

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1 Introduction

Which role does asymmetric information play in credit markets in the monetary transmission mechanism? What happens inside this “black box”? The credit channel theory states that asymmetric information amplifies and propagates the effects of the standard interest rate channel and that bank dependent borrowers - usually characterized as small and medium-sized firms that face a credit market burdened with significant informational asymmetries, that have low internally generated funds at their disposal, and whose loans are secured at a high degree - are especially vulnerable to a contractionary monetary impulse. They have to bear the brunt of tight money.

Against this background, Germany seems to be a country in which the typical conditions for credit channel effects appear to be perfectly met. The bulk of German firms is small and medium-sized, they rely heavily on bank finance, and collateralization plays an important role. However, so far, empirical evidence of a credit channel in Germany is inconclusive. Whereas Worms (2003), for example, finds credit channel effects in Germany, there are empirical studies as in Stoess (1996), Guender and Moersch (1997), and Kueppers (2001) which do not find evidence for significant credit channel effects in Germany. These authors argue that the traditional close and long-lasting relationship between banks and firms in Germany, which reduces informational problems in credit markets, might be one reason for their result.

We take a closer look at the underlying credit market models. We show that asymmetric information does not necessarily amplify the effects of the conventional interest rate channel, but that it can also weaken or even overcompensate these effects. Whereas Stoess, Guender, Moersch, and Kueppers argue that inside the “black box” there is no significant asymmetric information, this paper states that there is indeed asymmetric information, but that it is not clear what it does to a monetary impulse. We show that in addition to the standard interest rate channel of monetary policy impulses there is a transmission channel due to asymmetric information in credit markets, referred to as the credit channel, but its working direction is ambiguous. The interesting aspect is that independently of its working direction, firms mostly affected by the credit channel are bank dependent borrowers.

In the literature, the credit channel of monetary policy is usually divided into the bank lending channel, also referred to as the credit view, and the balance sheet channel, also known as the broad credit channel (Gertler and Gilchrist, 1993, 1994;
Bernanke and Gertler, 1995; Walsh, 2003, chapter 7). The focus of this paper is on the balance sheet channel. The balance sheet channel theory argues as follows: Asymmetric information between borrowers and lenders leads to additional capital costs of external funds which are reflected by an external finance premium, i.e. asymmetric information drives a wedge between the costs of external and internal funds. This external finance premium depends inversely on a borrower’s financial position since it enables the borrower to reduce the conflict of interest with the lender resulting from asymmetric information by self-financing a greater share of the investment or by offering more collateral. Tight money weakens a borrower’s financial position first by reducing cash flows net of interest and second by lowering the value of collateral assets. Therefore, a contractionary monetary impulse leads to an increase in the external finance premium. This means that a credit market burdened with asymmetric information implies a higher increase in capital costs in the wake of contractionary monetary policy than a credit market without these informational problems. Asymmetric information acts as a financial accelerator.1

Contrary to this balance sheet channel theory, this paper shows that the existence of asymmetric information may also result in a weakening or an overcompensation of the standard interest rate channel effects. The basic idea: Due to asymmetric information, entrepreneurs with investment projects of a different risk have to pay the same interest rate. This pooling rate is adequate for the average risk over all financed projects which implies an interest subsidy to the entrepreneurs with relatively risky projects by those with relatively safe ones. There is a premium for external funds due to asymmetric information comparable to the “lemon’s premium” in Akerlof (1970). However, this premium is only positive for low-risk entrepreneurs. They have to bear additional capital costs due to informational problems. High-risk entrepreneurs benefit from the informational asymmetries which means that their external finance premium is negative. A contractionary monetary impulse may lead to an increase in the absolute value of this premium. This implies that it depends on the type of the marginal entrepreneur whether there is an amplification or a dampening/overcompensation of the traditional interest rate effects. The type of the marginal entrepreneurs is determined by the relation between the investment

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projects’ probability of success and their return. If there is a mean preserving spread as in Stiglitz and Weiss (1981), the marginal entrepreneurs will be those with relatively safe projects, i.e. those which have to bear additional costs due to asymmetric information in credit markets. In this case, there may be a credit channel which amplifies the effects of the conventional interest rate channel. However, if there is a negative relation between the projects’ probability of success and their return, as in de Meza and Webb (1987), the marginal entrepreneurs will be those with relatively risky projects, i.e. those benefitting from the credit market imperfections. In this case, there may be a credit channel which dampens or overcompensates the traditional interest rate channel effects. Obviously, one would like to know which approach is likely to be more realistic. In the literature, this is discussed highly controversial, and empirical studies do not come up with a convincing answer but good arguments in favour of both kinds of approaches exist (for a latest discussion see, for example, Cressy, 2002 and de Meza, 2002). Therefore, our model considers both approaches.

The contribution of this paper to the literature is threefold. First, it shows that asymmetric information in credit markets does not necessarily amplify but may also dampen the effects of the conventional interest rate channel. In a similar vein, Bacchetta and Caminal (2000) show that the output response to specific shocks as anticipated productivity shocks, fiscal shocks or saving shocks is not necessarily amplified but can be dampened by the presence of asymmetric information. In the first place, this paper distinguishes from theirs by focussing on monetary policy. We show that asymmetric information may dampen the effects of the traditional interest rate channel. The second contribution of this paper to the literature is the development of a theoretical model of the balance sheet channel by using a simple credit market model with adverse/favourable selection due to asymmetric information. In the literature, theoretical models of the balance sheet channel usually assume a costly state verification problem as in Bernanke and Gertler (1989) and Bernanke et al. (1996, 1999) or a moral hazard problem as in Oliner and Rudebusch (1996) and Repullo and Suarez (2000). And third, whereas the existing literature discusses the type of models used in this paper mainly against the background whether small and medium sized enterprizes face a funding gap due to asymmetric information in credit markets and if, whether they should be subsidized (see, for example, Cressy, 2002 and de Meza, 2002), this paper analyzes the consequences for monetary policy.
The remainder of this paper is organized as follows: Section 2 presents the credit market model and derives the equilibrium interest rates with and without asymmetric information. Section 3 discusses the implications: the existence of an external finance premium and the possible reinforcement, weakening or overcompensation of the standard interest rate channel of monetary policy. Section 4 summarizes and concludes this paper.

2 The Model

Credit Demand

There is a continuum of risk-neutral entrepreneurs normalized to one. Each of these entrepreneurs has a cash flow $W$ which can either be invested in the capital market or in an investment project. This cash flow depends inversely on the risk free interest rate since an upsurge in the interest rate level implies an increase in interest payments on short term liabilities. We assume that

$$\frac{\partial W}{\partial \rho} = -K,$$

where $\rho$ stands for the risk free interest rate and $K$ denotes the amount of short term liabilities. As in a couple of other studies (see, for example, Oliner and Rudebusch, 1996) the risk free interest rate is taken as the instrument of monetary policy. Therefore, equation (1) reflects the first way through which the credit channel operates: tight money reduces an entrepreneur’s cash flow net of interest.

Concerning the relation between the projects’ probability of success and their return, two different cases are considered. In case $I$, the expected return is given by

$$R^I_i = p_i R^{s,I}_i,$$

in case $II$ by

$$R^{II}_i = p_i R^{s,II}_i.$$  

The variable $p_i$ denotes the probability of success, the variables $R^{s,I}_i$ and $R^{s,II}_i$ stand for the return in case of success. The return will equal zero if the project fails. The subscript $i$ indicates project-specific variables. Variables differing in the two cases are indexed by $I$ and $II$. Equation (2) shows that in case $I$, projects are characterized by a mean preserving spread. All projects yield the same expected return $R^I$, but may differ in the probability of success $p_i$ and in their return $R^{s,I}_i$. 


Equation (3) reveals that in case II, there is no mean preserving spread. All projects have the same return in case of success $R^{s,II}$, but may differ in $p_i$ and therefore in the expected return $R^{II}_i$.2

The investment projects are indivisible and require an investment $I$, where $I > W$. Therefore, an entrepreneur must borrow $(I - W)$ from a bank to realize his project. This loan has to be secured by additional outside assets. It is assumed that each entrepreneur has collateralizable wealth $S$, where $S < I - W$. This wealth cannot be used to finance the project directly. For the sake of simplicity, collateral is made up of consols yielding a risk free rate of return $\rho$. $b$ denotes the number of these bonds held by each entrepreneur. Therefore, collateral value is given by

$$S = \frac{b}{\rho},$$

Equation (4) reflects the second way through which the credit channel operates: tight money reduces the value of collateral assets.

Denoting the interest rate on bank loans by $r^{j}_{assym}$, where $j$ stands for I or II, an entrepreneur’s expected profit from his project is given by

$$E[\pi^I_i] = p_i[R^{s,I}_i - (1 + r^{I}_{assym})(I - W) - W] + (1 - p_i)(-W - S)$$

and

$$E[\pi^{II}_i] = p_i[R^{s,II}_i - (1 + r^{II}_{assym})(I - W) - W] + (1 - p_i)(-W - S).$$

Equations (5) and (6) reveal that there is asymmetric information in the credit market. Independently of a project’s specific probability of success $p_i$, each entrepreneur has to pay the same interest rate $r^{j}_{assym}$. Banks are not able to assess a project’s specific probability of success which leads to this pooling interest rate. By assumption, an entrepreneur must use all his bonds to secure the loan. This implies that it is not possible for banks to separate the credit market by offering contracts differing in interest rates and collateral requirements, i.e. a self-selection as in Bester (1985) cannot occur.3 Generally, there are further possibilities of overcoming infor-

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2These two approaches go back to Stiglitz and Weiss (1981) and de Meza and Webb (1987). Stiglitz and Weiss model a mean preserving spread and show that in this case, asymmetric information can lead to credit rationing which is generally interpreted as underinvestment. Modelling a negative relationship between the projects’ probability of success and their return, de Meza and Webb show that despite asymmetric information, the credit market always clears and that the equilibrium can be characterized by overinvestment.

3This assumption reflects that firms may not have enough collateral allowing them to choose between different contracts, or that it may be too costly for banks to offer different types of contracts.
mational problems as the evaluation and the monitoring of (potential) borrowers\(^4\) or signalling\(^5\). However, we assume that there is irreducible asymmetric information because a further reduction is simply too costly or not possible due to a lack of adequate means to do so.

Investing \(W\) in the capital market, an entrepreneur receives the risk free rate of return \(\rho\). Therefore, an entrepreneur will only apply for funds if

\[
E[\pi_i] \geq W\rho,
\]

This condition implies that in both cases, \(I\) and \(II\), there exists a critical probability of success given by

\[
p_{\text{crit},I} = \frac{R^I - W(1 + \rho) - S}{(1 + r^I_{\text{asym}})(I - W) - S}
\]

and

\[
p_{\text{crit},II} = \frac{(1 + \rho)W + S}{R_{s,II} - (1 + r^I_{\text{asym}})(I - W) + S}.
\]

If \(p_i > p_{\text{crit},I}\), an entrepreneur’s expected profit will be smaller than from the alternative investment in the capital market, so that he prefers the latter. Consequently, in case \(I\), the marginal entrepreneurs are those with relatively safe projects. In case \(II\), an entrepreneur’s expected profit from his project will be smaller than from an investment in the capital market if \(p_i < p_{\text{crit},II}\). Therefore, only those entrepreneurs with \(p_i \geq p_{\text{crit},II}\) demand for funds which implies that in case \(II\), the marginal entrepreneurs are those with relatively risky projects.

**Credit Supply**

A bank’s supply of loanable funds is absolutely elastic at the risk free interest rate \(\rho\).\(^6\) If a project succeeds, a bank will get principal and interest payments. Should

\(^4\)Indeed, the often discussed reason for the existence of banks as intermediaries is their capability of reducing informational asymmetries between deficit and surplus units. See for example Leland and Pyle (1977), Diamond (1984), Mayer (1988), Hellwig (1991), von Thadden (1995), and Freixas and Rochet (1997, chapter 2).

\(^5\)See, for example, Leland and Pyle (1977) and Freixas and Rochet (1997, chapter 2.3).

\(^6\)This implies that the availability of credits plays no role in this model, but the focus is on the price, i.e. on the interest rate. In Stiglitz and Weiss (1981), a specific ”restriction” on loanable funds is a necessary condition for credit rationing to occur. Stiglitz and Weiss model this restriction in the form of increasing marginal costs of loanable funds. Capital adequacy requirements for banks may be another ”restriction” on loanable funds (Brinkmann and Horvitz, 1995). However, credit channel effects do not hinge on whether or not there is credit rationing, neither the balance sheet channel, which is shown in this paper, nor the bank lending channel (Kashyap and Stein, 1994, p. 222).
a project fail, it will receive collateral $S$. Due to asymmetric information, a bank does not know a project’s specific probability of success $p_i$, so that it is not able to offer a risk-adequate interest rate $r_i$. But a bank knows the distribution of $p_i$ across the entrepreneurs so that it can assess the average probability of success over the projects to be financed. Consequently, a pooling interest rate is offered.

We assume $p_i$ to be uniformly distributed across the entrepreneurs in the interval $[p_{\min}, p_{\max}]$ so that
\[
p_{\max} = \mu + \sqrt{3}\sigma^2 \quad \text{and} \quad p_{\min} = \mu - \sqrt{3}\sigma^2,
\]
with $\mu$ denoting the mean and $\sigma^2$ denoting the variance of the distribution. The reason for the assumption of a uniform distribution is to have with the variance $\sigma^2$ a tractable measure of the extent of asymmetric information. The qualitative results of this paper are insensitive to this specification of the distribution.

The average probabilities of success over the financed projects become
\[
\theta^I = \frac{p_{\min} + p^{\text{crit},I}}{2}
\]
and
\[
\theta^{II} = \frac{p_{\max} + p^{\text{crit},II}}{2}.
\]
Equations (10) and (11) will hold only if $p_{\min} \leq p^{\text{crit},j} \leq p_{\max}$. If $p^{\text{crit},I} \geq p_{\max}$, all entrepreneurs will realize their projects and $\theta^I = \mu$. Analogously, $\theta^{II} = \mu$ if $p^{\text{crit},II} \leq p_{\min}$. If $p^{\text{crit},I} < p_{\min}$ ($p^{\text{crit},II} > p_{\max}$), the expected return of the entrepreneurs with the most risky (safest) projects will be lower than the return from the investment in the capital market implying the credit demand to be zero. In the remainder of the paper we focus on the case in which $p_{\min} < p^{\text{crit},j} < p_{\max}$.

The conditional expectation of the rate on return from loan $i$ (before costs of loanable funds) is:
\[
E[Q^j_i|\theta^j] = (1 + r_{\text{asym}}^j)^{\theta^j} + (1 - \theta^j)\frac{S}{I - W} - 1 = E[Q^j].
\]

Due to a competitive banking industry, a bank can only yield the normal profit, i.e.
\[
E[Q^j_i|\theta^j] = \rho,
\]
where the risk free interest rate $\rho$ stands for the banks’ costs of loanable funds. Setting $S/(I - W) \equiv c$, so that $c$ reflects the degree of collateralization, one obtains
\[
r_{\text{asym}}^j = \frac{1 + \rho - (1 - \theta^j)c}{\theta^j} - 1
\]
for the offered interest rate which corresponds to the banks’ reservation interest rate.

**Equilibrium - Asymmetric Information**

Bringing credit demand and supply together, the pooling interest rate in equilibrium becomes

\[
    r_{asym}^j = \frac{1 + \rho - (1 - \theta_j^*)c}{\theta_j^*} - 1, \tag{15}
\]

where

\[
    \theta_j^* = \mu - \sqrt{3\sigma^2} + \frac{p_{crit,I^*}}{2}, \tag{16}
\]

\[
    p_{crit,I^*} = \frac{(\mu - \sqrt{3\sigma^2})[R^I - W(1 + \rho) - S]}{(1 + \rho)(2I - W) - R^I - S}, \tag{17}
\]

\[
    \theta_{II^*} = \frac{\mu + \sqrt{3\sigma^2} + p_{crit,II^*}}{2}, \tag{18}
\]

and

\[
    f(p_{crit,II^*}) = R_{II^*}[p_{crit,II^*}(\mu + \sqrt{3\sigma^2}) + (p_{crit,II^*})^2] \\
    - (1 + \rho)W[(\mu + \sqrt{3\sigma^2}) - p_{crit,II^*}] \\
    - 2I(1 + \rho)p_{crit,II^*} + S[p_{crit,II^*} - (\mu + \sqrt{3\sigma^2})]. \tag{19}
\]

Equation (15) shows that the equilibrium interest rate is determined by the risk free interest rate \(\rho\), the average probability of success \(\theta_j^*\), and the degree of collateralization \(c\).

The crucial point is that due to asymmetric information the equilibrium interest rate depends on the average probability of success \(\theta_j^*\), and the degree of collateralization \(c\).

The crucial point is that due to asymmetric information the equilibrium interest rate depends on the average probability of success over the financed projects. Therefore, there is an interest subsidy to the entrepreneurs with relatively risky projects by those with relatively safe ones. Hence, in case \(I\), the marginal entrepreneurs bear the costs resulting from credit market imperfections, they subsidize. In case \(II\), on the other hand, the marginal entrepreneurs benefit from the credit market imperfections, they are subsidized.
Equilibrium - Benchmark Case

In credit markets not burdened with informational problems (benchmark case), a bank knows the probability of success $p_i$ of any project which means that a risk-adequate interest rate $r_i$ is offered to each entrepreneur. Due to the competitive banking industry, the equilibrium interest rate $r_{sym,i}^*$ corresponds to a bank’s reservation interest rate. Solving the model considering that the expected probability of repayment is $p_i$ instead of $\theta^j$, we obtain for the reservation interest rate, and therefore, for the risk adequate equilibrium interest rate

$$r_{sym,i}^* = \frac{1 + \rho - (1 - p_i)c}{p_i} - 1.$$  \hspace{1cm} (20)

Equation (20) shows that the equilibrium interest rate is determined by the risk free interest rate $\rho$, the project-specific probability of success $p_i$, and the degree of collateralization $c$.

3 Implications

3.1 External Finance Premium

Comparing the equilibrium interest rates of the credit market burdened with asymmetric information and of the credit market in the benchmark case (equations (15) and (20)) reveals that there is an external finance premium $e_i^j = r_{asym}^j - r_{sym,i}^*$ due to irreducible asymmetric information given by

$$e_i^j = \frac{(1 + \rho - c) \cdot (p_i - \theta^j)}{\theta^j \cdot p_i}.$$  \hspace{1cm} (21)

Since $c < 1$, equation (21) shows that $e_i^j$ is only positive for entrepreneurs whose project’s probability of success is higher than the average ($p_i > \theta^j$). Entrepreneurs whose project’s probability of success lies below the average ($p_i < \theta^j$) benefit from informational problems. Their external finance premium is negative. Crucial is the sign of the external finance premium of the marginal entrepreneurs. In case I, $e_{marg}^{I} > 0$ which reflects that the marginal entrepreneurs have to bear additional costs resulting from irreducible asymmetric information in credit markets. In case II, on the other hand, $e_{marg}^{II} < 0$ which shows that the marginal entrepreneurs benefit from the informational problems. Their costs are lower compared to a situation without informational asymmetries.
3.2 Monetary Policy

A contractionary monetary impulse is reflected by an increase in the risk free interest rate $\rho$. Decisive for a possible credit channel is the innovation to the external finance premium given by

$$\frac{\partial e^i}{\partial \rho} = \left(1 - \frac{1}{1-W} \frac{\partial S}{\partial \rho} - \frac{c}{1-W} \frac{\partial W}{\partial \rho}\right) \left(\theta^i p_i - \theta^i S\right) - \frac{(1 + \rho - c) \frac{\partial \theta^i}{\partial \rho}}{\theta^i S}, \quad (22)$$

where

$$\frac{\partial \theta^i}{\partial \rho} = \frac{-\left(\mu - \sqrt{3\sigma^2}\right)}{[(2I - W)(1 + \rho) - R^I - S]^2} \cdot \left\{ [R^I (I - W) - IS] + [R^I - I(1 + \rho)] \left[(1 + \rho)K + \frac{S}{\rho}\right] \right\} < 0 \quad (23)$$

and

$$\frac{\partial \theta^I}{\partial \rho} = \frac{(p_{\text{max}} - p_{\text{crit},I}) \left(W - (1 + \rho)K - \frac{S}{\rho}\right)}{2 [2(R^I \theta^I - I(1 + \rho)] + R^I p_{\text{crit},I^*} + W(1 + \rho) + S} < 0. \quad (24)$$

Case I: Reinforcement of the Conventional Interest Rate Effects

Since $\partial W/\partial \rho < 0$ and $\partial S/\partial \rho < 0$ and since in case I, the probability of success of the marginal entrepreneurs’ projects lies above the average ($p_{\text{marg}} > \theta^I$), equations (22) and (23) reveal that tight money leads to an increase in the marginal entrepreneurs’ external finance premium $e^I$, i.e. in their additional costs due to the informational asymmetries.\textsuperscript{7} Consequently, there is a credit channel effect reinforcing the effects of the conventional interest rate channel. The intuition is the following. The subsidy effect, and therefore the additional costs of the marginal entrepreneurs, is the higher the higher the costs of external capital are. A contractionary monetary impulse leads to an increase in these costs for three reasons: First, the general interest rate level rises, reflected by an increase in $\rho$. Second, the degree of collateralization, which is $c \equiv S/(I - W)$, shrinks due to a decrease in collateral value ($\partial S/\partial \rho < 0$) and internally generated funds ($\partial W/\partial \rho < 0$). Third, the average probability of

\textsuperscript{7}$\partial \theta^I/\partial \rho < 0$ because $\mu - \sqrt{3\sigma^2} = p_{\text{min}} > 0$, and $R^I (I - W) - IS > 0$ since $R > I$ and $I - W > S$, and $R^I - I(1 + \rho) > 0$.\textsuperscript{11}
success over the financed projects declines ($\partial \theta^*/\partial \rho < 0$) due to adverse selection. The innovations in $e^I_{marg}$ due to the increase in $\rho$ (direct effect) and the decreases in $W$ and $S$ (indirect effects) are reflected by the first fraction. The second fraction reveals the adverse selection effect (indirect effect).

What kind of entrepreneurs are especially affected by this credit channel? First, entrepreneurs facing a credit market which is burdened with significant informational asymmetries (without these informational problems, there is no external finance premium). Second, entrepreneurs having relatively low internally generated funds at their disposal. The reason is that the external capital of the marginal entrepreneurs is burdened with additional costs due to informational asymmetries. Since these additional costs increase after a contractionary monetary impulse, entrepreneurs with a relatively high share of external funds in financing investments are especially vulnerable to tight money. Third, entrepreneurs securing their loans are especially affected by this credit channel because the collateralization of loans reduces the additional costs of external capital. Since collateral value declines after a contractionary monetary impulse, capital costs of entrepreneurs who secure their loans increase relatively more. Summing up, firms usually characterized as bank dependent borrowers are especially affected by this credit channel which reinforces the effects of the standard interest rate channel.

**Result 1:** *If the relation between the projects’ probability of success and their return is characterized by a mean preserving spread, capital costs of the marginal entrepreneurs will increase more in the wake of a contractionary monetary impulse if the credit market is burdened with asymmetric information. Therefore, there is a credit channel of monetary policy, amplifying the conventional interest rate channel effects. Mostly affected are firms usually characterized as bank dependent borrowers.*

**Case II:** *Weakening and Overcompensation of the Conventional Interest Rate Effects is Possible*

In case II, the effects of the conventional interest rate channel can be weakened, overcompensated or reinforced. The reason for this ambiguity is that tight money may have effects on the asymmetric information benefits to the marginal entrepreneurs which work in the opposite direction: These benefits, which are reflected by the absolute value of the external finance premium $|e^I_{marg}|$, are the higher, the higher
the costs of external capital are. A contractionary monetary impulse has two positive effects on these costs. The positive effects are the same as in case I. The first positive effect is due to the rise in the interest rate level reflected by the increase in \(\rho\) (direct effect). The second positive effect results from the decline in the degree of collateralization \(c\) (indirect effects). However, there may be also a negative effect due to a possible favourable selection reflected by a possible increase in \(\theta^{II*}\) (indirect effect).

Equations (22) and (24) reveal the ambiguous reaction of \(|e^{II*}_{marg}|\) to innovations in \(\rho\). The positive effect on \(|e^{II*}_{marg}|\) is reflected by the first fraction of equation (22). The second fraction reveals the possible negative effect. The following description of the three scenarios which can occur in the wake of a contractionary monetary impulse elucidates the ambiguous reaction of \(\theta^{II*}\).

First Scenario: Weakening of the Standard Interest Rate Channel. A weakening of the standard interest rate effects means that after a contractionary monetary impulse less investment projects are realized, but that this decline would be stronger without informational problems. The decline in investment implies an increase in \(\theta^{II*}\) since the marginal entrepreneurs are the high-risk ones (favourable selection). However, in this scenario this negative effect does not outweigh the positive effects on \(|e^{II*}_{marg}|\), so that \(|e^{II*}_{marg}|\) increases which means that after the contractionary monetary impulse, the marginal entrepreneurs benefit even more from the informational asymmetries in credit markets. But these additional benefits again do not outweigh the additional costs resulting from the conventional interest rate channel, i.e. the latter is only dampened but not overcompensated.

Second Scenario: Overcompensation of the Standard Interest Rate Channel. An overcompensation of the standard interest rate channel effects means that after a contractionary monetary impulse even more investment projects are realized. In this scenario, the benefits to the marginal entrepreneurs due to the informational problems increase in such a way that the additional costs resulting from the standard interest rate channel are outweighed, i.e. the increase in \(|e^{II*}_{marg}|\) is that high that capital costs of the marginal entrepreneurs decrease. In this case, \(\partial\theta^{II*}/\partial\rho < 0\), i.e. the average probability of success declines since more entrepreneurs with relatively risky projects seek for outside financing. There is no favourable selection.

Third Scenario: Reinforcement of the Standard Interest Rate Channel. Reinforcement of the standard interest rate channel means that in the wake of a contractionary
monetary impulse, the decline in realized investment projects will be stronger if the credit market is burdened with asymmetric information. In this scenario, the asymmetric information benefits to the marginal entrepreneurs shrink. The absolute value of their external finance premium \( |e_{II}^{* \text{marg}}| \) decreases since the negative effect due to a favourable selection reflected by \( \partial \theta^{II*} / \partial \rho > 0 \) outweighs the positive effects described by the first fraction of equation (22). The decline in these benefits imply that capital costs of the marginal entrepreneurs increase more than in the benchmark case.

Under which conditions each scenario will occur? For the reinforcement scenario to occur, there must be a significant favourable selection effect, so that the negative effect on \( |e_{II}^{* \text{marg}}| \) (second fraction of equation (22)) outweighs the positive effects (first fraction of equation (22)). Equation (24) shows that for such a favourable selection effect to occur \( (W - (1 + \rho)K - S/\rho) > 0 \), i.e. the amount of internally generated funds must be relatively high and collateralization should not play an important role. This means that the reinforcement scenario will occur if there are entrepreneurs not showing the characteristics of bank dependent borrowers. To the contrary, bank dependent borrowers will be strongly affected if the effects of the conventional interest rate channel are dampened or overcompensated. First, usually they face a credit market burdened with significant informational problems which is a prerequisite for a significant credit channel effect to occur. Second, usually they have a relatively high share of external funds in financing investments and the increase in the asymmetric information benefits to the marginal entrepreneurs after a contractionary monetary impulse concern their external capital. Third, a decline in the value of collateral assets implies an increase in the asymmetric information benefits to the marginal entrepreneurs, i.e. \( |e_{II}^{* \text{marg}}| \) increases. Since tight money leads to a decline in collateral value, bank dependent borrowers, that usually secure their loans, are strongly affected.

**Result 2:** If there is asymmetric information in a credit market and if there is a negative relation between the projects’ probability of success and their return, tight money may imply that the capital costs of the marginal entrepreneurs increase less compared to a situation without informational problems or even decrease. In these cases, a credit channel of monetary policy weakens or even overcompensates the effects of the conventional interest rate channel. Mostly affected are firms usually characterized as
bank dependent borrowers.

This result is illustrated by a numerical example given in the appendix.

4 Summary and Conclusions

This paper shows that asymmetric information in credit markets may not only reinforce the effects of the conventional interest rate channel, but that it is also possible that asymmetric information weakens or overcompensates these effects. In our model, there is asymmetric information in credit markets because banks cannot assess project specific risks. This leads to a pooling interest rate implying that entrepreneurs with relatively risky projects are subsidized by those with relatively safe ones. This subsidy effect is reflected by an external finance premium which is positive for entrepreneurs with relatively safe projects, entrepreneurs with relatively risky projects face a negative external finance premium. A contractionary monetary impulse leads to an increase in the absolute value of the marginal entrepreneurs' external finance premium. If the entrepreneurs with the relatively safe projects are the marginal ones, the effects of the conventional interest rate channel are amplified. If the entrepreneurs with the relatively risky projects are the marginal ones, the effect of the interest rate channel may be weakened or overcompensated. Therefore, this paper shows that from a theoretical point of view it is not clear what happens inside the “black box”: there is a credit channel of monetary policy due to asymmetric information in credit markets, but its working direction is ambiguous. This might be one reason for not finding the typically reinforcing credit channel effects in Germany although in Germany all the typical conditions for such a channel appear to be met.

The result of this paper leads to the following conclusions: First, the pure existence of a large number of bank dependent borrowers within an area a monetary authority is responsible for, does not mean that monetary policy impulses are amplified. Second, if there are credit market imperfections leading to a pooling interest rate, there will always be firms benefiting from these market imperfections. This means that bank dependent borrowers do not necessarily bear the brunt of tight money. Contrary, a share of these firms, namely those with relatively risky projects, faces a relatively smaller increase in capital costs in the wake of a contractionary monetary impulse than firms which do not face significant informational problems.
Appendix: Numerical Examples for Case II

For the numerical examples presented in table 1, we assume that the cash flow $W$ is explicitly given by

$$W = U - \rho K,$$

where $U$ denotes the cash flow before interest payments on short term liabilities which are $\rho K$. In all three examples, the contractionary monetary impulse is reflected by an increase in the risk-free interest rate from 4 % to 5 %. The crucial differences between the three examples are the amount of short term liabilities $K$, the number of consols $b$, and the extent of informational problems $\sigma^2$. These differences have been chosen because the balance sheet channel operates through $K$ and $b$ ($K$ determines internal finance and $b$ collateral) and because $\sigma^2$ is the reason for the existence of the credit channel. In all three examples, the entrepreneurs have an indivisible project which requires an investment $I$ of 1 million euro.

In example I, the cash flow which can be invested $W$ is 0.3 million euro. Therefore, an entrepreneur needs a loan of 0.7 million euro in order to realize his project. This loan is secured to 70 %. Informational problems in the credit market imply a pooling interest rate $r_{I\text{I}_\text{II},\text{asym}}$ of 6.3 %. If the credit market is not burdened with asymmetric information, the entrepreneurs with the safest projects will only pay an interest rate $r_{I\text{I},\text{max},\text{sym}}$ of 5.6 % which will rise by 2.1 percentage points after the contractionary monetary impulse. However, if there are informational asymmetries, their interest rate will rise by 2.4 percentage points reflecting the increase in the subsidy they have to pay. Since the entrepreneurs with relatively risky projects benefit from this subsidy, their capital costs increase less compared to the benchmark case. Since they are the marginal ones, the contractionary monetary impulse is weakened by asymmetric information in credit markets as the increase in the external finance premium of the entrepreneurs with the safest projects $e_{I\text{I},\text{max}}$ and of the critical probability of success $p_{\text{crit},I\text{I}_\text{II}}$ show. (The increase in $p_{\text{crit},I\text{I}_\text{II}}$ shows that after the contractionary monetary impulse less entrepreneurs realize their project, so that the increase in $e_{I\text{I},\text{max}}$ dampens but does not an overcompensate the conventional interest rate channel.)

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8The different return $R^{*,II}$ and the different average risk $\mu$ in example III have been chosen for a better illustration only.
### Table 1: Numerical Examples for the Consequences of a Contractionary Monetary Impulse

<table>
<thead>
<tr>
<th>Exog. Var.</th>
<th>Example I</th>
<th>Example II</th>
<th>Example III</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I$</td>
<td>1 mio €</td>
<td>1 mio €</td>
<td>1 mio €</td>
</tr>
<tr>
<td>$R^s,II$</td>
<td>1.13 mio €</td>
<td>1.13 mio €</td>
<td>1.36 mio €</td>
</tr>
<tr>
<td>$U$</td>
<td>0.7 mio €</td>
<td>0.7 mio €</td>
<td>0.7 mio €</td>
</tr>
<tr>
<td>$K$</td>
<td>10 mio €</td>
<td>3.3 mio €</td>
<td>12 mio €</td>
</tr>
<tr>
<td>$b$</td>
<td>19600</td>
<td>7200</td>
<td>24000</td>
</tr>
<tr>
<td>$\mu$</td>
<td>92 %</td>
<td>92 %</td>
<td>83 %</td>
</tr>
<tr>
<td>$\sigma^2$</td>
<td>2 %</td>
<td>1 %</td>
<td>7 %</td>
</tr>
<tr>
<td>$\rho$</td>
<td>4 %</td>
<td>5 %</td>
<td>4 %, 5 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>End. Var.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$W$</td>
<td>0.3 mio €</td>
<td>0.2 mio €</td>
</tr>
<tr>
<td>$I - W$</td>
<td>0.7 mio €</td>
<td>0.8 mio €</td>
</tr>
<tr>
<td>$S$</td>
<td>0.49 mio €</td>
<td>0.39 mio €</td>
</tr>
<tr>
<td>$\theta^{II*}$</td>
<td>93.6 %</td>
<td>93.9 %</td>
</tr>
<tr>
<td>$p^{\text{crit},II*}$</td>
<td>91.6 %</td>
<td>92.2 %</td>
</tr>
<tr>
<td>$p_{\text{min}}, p_{\text{max}}$</td>
<td>88.5 %, 95.5 %</td>
<td>90.3 %, 93.7 %</td>
</tr>
<tr>
<td>$r_{\text{II*}}^{\text{axsym}}$</td>
<td>6.3 %</td>
<td>8.7 %</td>
</tr>
<tr>
<td>$r_{\text{II*}}^{\text{max, sym}}$</td>
<td>5.6 %</td>
<td>7.7 %</td>
</tr>
<tr>
<td>$e_{\text{II*}}^{\text{max}}$</td>
<td>0.7 %</td>
<td>1 %</td>
</tr>
</tbody>
</table>

| Result | Weakening | Amplification | Overcompensation |

Table 1: Numerical Examples for the Consequences of a Contractionary Monetary Impulse
The differences in the exogenous variables in example II compared to the first are less severe informational problems, lower short term liabilities, and less collateral. In this example, the positive effect of the contractionary monetary impulse on the external finance premium is so small that the negative effect (favourable selection) outweighs, i.e. the external finance premium shrinks. For the entrepreneurs with relatively risky projects this implies that their capital costs do not only rise due to the standard interest rate effects, but also because of the decrease in the subsidy. Therefore, the monetary impulse is amplified by asymmetric information in credit markets.

In the third example, the extent of informational problems, the amount of short term liabilities and the number of consols are the highest. The relatively high liabilities lead to relatively low internally generated funds, and the high number of consols means that collateralization plays a significant role (75 % of the loan is secured). This implies a large positive effect of the contractionary monetary impulse on the external finance premium. The premium increases from 3.6 % to 7.1 %. This relatively high increase in the subsidy means that total capital costs of the marginal entrepreneurs actually decrease as a consequence of the contractionary monetary impulse. The effect of the conventional interest rate channel is overcompensated. Before the monetary impulse, all entrepreneurs with a project showing a probability of success of at least 74.4 % realize their project. After the monetary impulse, all projects having a probability of success of at least 72.6 % are financed.

References


