

# **Bank Lending and Asset Prices in the Euro Area<sup>\*</sup>**

Michael Frömmel, Leibniz Universität Hannover<sup>a</sup>

Torsten Schmidt, RWI Essen

Discussion Paper No. 342

July 2006, Revised: August 2006

ISSN 0949-9962

JEL classification: C32, G21

Keywords: Bank lending, credit demand, Euro area, Markov switching error correction, credit channel, asset prices, credit rationing

Abstract:

We examine the dynamics of bank lending to the private sector for countries of the Euro area by applying a Markov switching error correction model. We identify for Belgium, Germany, Ireland and Portugal stable, mean reverting regimes and unstable regimes with no tendency to return to the long term credit demand equation, whereas for some other countries there is only weak evidence. Furthermore, for these as well as for other countries we detect in the less stable regimes a strong co-movement with the development of the stock market. We interpret this as evidence for constraints in bank lending. In contrast, the banks' capital seems to have only marginal impact on the lending behaviour.

\* For helpful suggestions we would like to thank Michael Holz.

<sup>a</sup> Corresponding author: Leibniz Universität Hannover, Institute for Money and International Finance, Königsworther Platz 1, 30167 Hannover, Germany.

# Bank Lending and Asset Prices in the Euro Area

## 1. Introduction

The strong decline in asset prices followed by an economic slowdown in major economies beginning in 2001 has brought attention to the real economic effects of asset price bubbles yet another time (Bordo and Jeanne 2002; Borio and Lowe 2002; Detken and Smets 2004). The major findings are, first, and of great importance to consider in which asset markets the bubble occurs: Real effects are particularly severe if a bubble occurs in the real estate market, but also stock prices can have substantial effects. Second, the consequences are more severe the more private investment is involved. Hence, it is important to understand the propagation of an asset price shock to private investment. Third, as a stylized fact asset price slumps and recessions are often accompanied by financial crises. In particular this last finding highlights the importance of financial factors for the transmission of asset price shocks.

For this reason the relation between asset prices and bank lending has often been analyzed for periods of severe economic and financial crisis. Popular examples are the great depression 1929 in the United States (Bernanke 1983; Bernanke 1995; Eichengreen and Michener 2003), the collapse of real estate and stock prices in Japan in 1990 (Kim and Moreno 1994; Brunner and Kamin 1998), or the East Asia Crisis in 1997 (Stiglitz and Greenwald 2003; Caporale and Spagnolo 2003). These and other empirical studies of asset price bubbles provide details about how financial factors transmit asset price shocks to the real economy (Higgins and Osler 1997). Private investment can be affected at least through two channels: Directly by eroding private firms' value of equity capital, which might be required as collateral for a loan. Hence, firms lending opportunities shrink with subsequent effects on investment. Second, and more indirectly, the drop in asset prices may affect the balance sheets of banks and therefore their lending capacities. In addition, a decline in asset prices may also reduce firms' ability to issue new shares. These arguments contrast with

the view that a decline in asset prices reduces firms' investment opportunities by lowering their profitability.

However, as specified by the literature asset price busts are not always accompanied by a financial crisis (Bordo and Jeanne 2002). It is, however, also possible that a restriction in bank lending has dampening effects on economic activity but do not lead to a recession. Examples of such moderate real effects of bank lending are reported by the literature on the credit channel of monetary policy. Related empirical studies for the Euro Area find that changes in interest rates have effects on bank lending only in some countries and with different magnitudes (Altunbas et al. 2002; Angeloni et al. 2003; de Bondt 1999; Kakes and Sturm 2002, Gambacorta 2005). Thus, countries where the bank lending channel seems to play some role are Belgium, France, Germany, Italy, the Netherlands and Portugal. These countries seem to reflect the importance of the link between bank lending and business investment upon transmission of monetary policy (Angeloni et al. 2003). This result suggests that differences in the financial systems of the Euro Area member countries also matter for other financial market shocks.

The aim of this paper therefore is to analyze the relation between asset prices and bank lending before and after the stock market crash in 2000 in member countries of the European monetary union. Our main hypothesis is that bank lending is usually related to demand side factors such as GDP and interest rates, whereas some shorter periods are determined by other factors. First, we therefore test for cointegration between these variables. This approach stands roughly in line with an empirical study for Germany (Deutsche Bundesbank 2002). However, the recently established bank lending survey of the Eurosystem provides some evidence that bank lending at least in some countries was quite restrictive during recent years (Deutsche Bundesbank 2003). As suggested by the literature on asset price bubbles it seems likely that bank lending in the Euro area was affected by the recent decline in asset prices. To test this hypothesis we estimate an error correction equation including the long-run credit demand determinants and changes in share prices and banks' equity capital as short-term determinants. To account for the possibility that bank lending is affected by these short-term factors only during relatively short phases we allow the coefficients of this error correction equation to switch between

two states by estimation of a Markov regime switching model. Using this approach it is possible to distinguish between a regime of credit market equilibrium determined by demand factors and a regime where bank lending is affected by asset prices or banks' equity capital.

The outline of this paper is as follows: In section 2 we give a brief overview on empirical research on determinants of bank lending. After describing the data in section 3, we estimate aggregated credit demand equations for a sample of European countries in section 4. After this, in section 5, we investigate whether asset prices lead to a regime shift in determinants of credit demand during the asset price bust. We draw our attention in particular to the test whether the drop of asset prices is related to a slowdown or decline of bank lending. Section 6 summarizes and concludes.

## **2. The link between asset prices and bank lending**

Empirical studies on the determinants of bank lending find that measures of economic activity, like GDP or industrial production, and interest rates influence the outstanding credit volume. The relation between both variables and loans are usually interpreted as credit demand (Barajas and Steiner 2002; Calza et al. 2003; Ghosh and Ghosh 1999; Pazarbasioglu 1997). A credit demand equation of this form can be derived under simplifying assumptions from a private firm balance sheet constraint (Friedman and Kuttner 1993, p211). The reasoning behind the relation between GDP and loans is as follows: If a firm decides to increase investment outlays over its net revenues it can do it by either raising equity capital or the demand for loans. As for the latter, the economic activity indicator can be seen as a broad measure of firms' investment prospects and therefore in this case GDP is a proxy for credit demand. Instead, a reduction of expected revenues also influences firms' access to bank loans. In addition, if interest rates – the price for loans – increase, this will reduce credit demand.

However, most of these empirical studies include variables which are related to credit supply and can be derived from a bank balance sheet (Friedman and Kuttner 1993, p214). Here we find two sets of variables: The first set indicates banks'

ability to lend. In this context the most important variables are equity capital of banks and bank deposits. In addition, the portfolio approach suggests that banks aim at holding assets in specific relations to each other. Thus, if the value of one asset changes substantially, the bank will adjust other assets, too, to maintain these relations. Second, the theory of credit rationing highlights the importance of banks' willingness to lend and stresses the importance of non-price variables. All these ideas stand in line with the findings of empirical studies that interest rates are highly important for credit demand. Indicators of the banks' willingness to lend are related measures for the riskiness of assets and assets which can be used as collateral (Jaffee and Stiglitz 1990).

Recently, the interaction of asset prices, bank lending and investment was analyzed in an extension of the Kiyotaki and Moore model (1997), in which bank capital as well as the firm's net worth serve as collateral (Chen 2001). In this model, a reduction in return on investments reduces the net worth of firms as well as banks and therefore constraints the sum of bank loans and investment. In addition, this reduction in investment lowers the prices of collateralized assets and again erodes firms' net worth and banks' lending ability. This line of argument highlights the interaction of asset prices and bank lending reinforcing each other and therefore amplifying the initial shock. The model offers an explanation for the fact that depressions in asset markets are often accompanied by banking crises. Nevertheless, it is not necessary to focus only on financial crises or economic recessions because the strong effect in the Kiyotaki and Moore model relies on some extreme assumptions. Under more general specifications collateral constraints may still amplify unexpected shocks in the economy but consequently, real effects will then be expected to be smaller (Kocherlakota 2000; Cordoba and Ripoll 2004). Hence, this model already provides some insights for the investigation of the phase after the asset price bust in 2000.

Moreover the approach can be extended by credit rationing, allowing credit market conditions to change over time. Azariadis and Smith (1998) allow credit market conditions to switch between a competitive market allocation and credit rationing. Both regimes depend on private information about loan repayment probabilities. In the following we use this model as a theoretical basing point. It

provides a link between theoretical models of credit rationing and empirical studies by allowing demand factors to determine the outstanding credit volume in the regime of credit market equilibrium. On the other hand supply factors may also affect bank lending in the credit rationing regime. This model of switching credit market conditions depicts changes in credit growth over the business cycle though it is also possible to use it as a theoretical basis for analyzing singular events.

Periods in which unusual events cause credit markets to be temporarily in a disequilibrium and restricted from the supply side are often called a credit crunch or capital crunch. The ability or willingness of banks to lend is then reduced: changes in the volume of credits are not in line with equilibrium determinants such as overall economic activity and interest rates. This definition of a credit crunch is closely related to the regime switching model described above, emphasizing the supply side of the loan market. Hence it is not surprising that empirical studies of credit crunches try to detect changing determinants of the outstanding credit volume (recent examples are Barajas and Steiner 2002; Ghosh and Ghosh 1999; Pazarbasioglu 1997). While credit demand is usually assumed to be related to interest rates and economic activity, the main problem lies upon identifying variables which only affect credit supply and are related to the source of the credit crunch.

As mentioned above, a first source of a credit crunch can be a burst of an asset price bubble. An often cited example is the banking crisis in Japan after the plunge of asset prices in the stock market and in the housing market in the early nineties (Brunner and Kamin 1998; Kim and Moreno 1994). The case of Japan stresses the crucial role of property as collateral for loans. A significant relation between asset prices and bank lending was found for a number of countries (Hofmann 2004). However, the erosion of collateral was aggravated by the fact that Japanese banks were allowed to hold shares. This means that the stock valuations affect bank balance sheets and therefore their ability to lend. The reduction of outstanding credit in the Euro Area after the strong decline in asset prices could be an indication for a credit crunch at least in some EU countries like Germany (Nehls and Schmidt 2004). Moreover, these factors are likely to play a role in Austria and Belgium, too.

A second trigger of a credit crunch is seen in major reforms of regulation standards for the banking sector. The first Basle Accord for example may have caused the credit crunch in the United States in the early nineties (Bernanke and Lown 1991). In this case the crunch occurred due to banks that were forced to improve their balance sheet positions and therefore had to reduce their lending activity for fulfilling the demands by the new regulation. With regard to the importance of banks' equity capital, some authors prefer to call this situation a *capital* crunch. As stressed in the literature on the bank lending channel the magnitude of the effects of asset price changes on bank balance sheets depend on the structure of the banking system. The more recent discussion of a reform of regulation standards (Basle II) starting in 2000 could have already forced banks to adjust their capital positions (Estrella 2004). Again, the discussion about new capital standards could have led to a new credit crunch. This possibility is in particular important for Germany as it is often argued that the equity capital position of German banks is weak compared to international banking standards. But it is also likely that the preparation for the new capital standards has led to adjustments in bank balance sheets in other countries.

In the following we investigate whether we can identify periods during which outstanding bank credit in several European countries deviates from its long run equilibrium. In addition, we study whether these deviations are related to factors like asset prices or banks equity capital positions which are usually seen as supply side determinants of bank lending.

### **3. Data description**

In this analysis we use quarterly data for the period 1993 to 2004. Credit volume is measured by MFI lending to non-financial corporations which is drawn from national central banks as well as equity capital of banks. Several structural breaks in these series are removed. We use nominal GDP and ten year government bond yield from the EUROSTAT database, except for Portugal where we use data from the OECD database. The share price indices used are those of Morgan Stanley. All variables except interest rates are in logarithms. While the sample period covers the first quarter of 1993 till the fourth quarter of 2004 for most countries, due to reasons of data availability the series are shorter Ireland (1997:1), Italy (1998:2) and Portugal

(1995:1). Furthermore, for Ireland no data on banks' equities were available to us. Finally we do not present the results for Greece, as the available series are too short.<sup>1</sup>

Table 1 shows the results of standard Phillips-Perron unit root tests for the data. The results show that credit volume, GDP, interest rates and banks equity capital are  $I(1)$ . We therefore test for a cointegration relation between credit volume, GDP and interest rates. In contrast, due to our hypothesis that banks equity capital has only short run effects on credit volume we use first differences in the error correction equations. Finally, share prices (i.e. deviations of the share prices from their long term trend) are stationary, which means that we can use this series without any further modification in the error correction equation<sup>2</sup>.

#### **4. The Long-Term Credit Equations**

To get an error correction equation for credit demand we use the two step procedure by Engle and Granger (1987). At first we estimate the long run credit demand equation. It is common to assume that credit volume is in the long run determined by the demand for credit (Bernanke und Blinder 1988, Fase 1995, Calza et al. 2003). We follow the literature, modeling the demand for loans as a function of economic activity, GDP, and financing costs, which are given by the interest rate. The GDP is expected to have a positive impact on the demand for loans. This textbook effect can be explained by the influence of economic activity on income and profits, and therefore finally on an increased level of investment and consumption (see inter alia Kashyap et al. 1993). The interest rate on the other hand reveals a negative impact on the demand of loans, as the demand for loans depends on their price.

---

<sup>1</sup> We did, however, perform all estimations for Greece. The results are in line with those for the other countries. But as we have some doubts on the reliability due to the low number of observations we decided not to include them, they are available on request.

<sup>2</sup> There are only few series showing a different behaviour, this may be due to structural breaks and the short sample period. The overall picture, however, seems to be quite clear.



**TABLE 1.** Phillips-Perron unit root tests for the data

	Credits		GDP		Interest Rate		Share Prices		Equity Capital	
	Level (c,t)	Change (c)	Level (c,t)	Change (c)	Level (c,t)	Change (c)	Level (none)	Change (none)	Level (c,t)	Change (c)
Austria	0.604	-4.689***	-2.817	-5.431***	-2.578	-4.735***	-1.617*	--	-1.206	-4.011***
Belgium	-0.327	-5.973***	-2.459	-4.489***	-2.335	-4.555***	-1.701*	--	-1.454	-6.721***
Finland	-1.639	-4.886***	-2.352	-4.620***	-2.952	-3.757***	-1.581	--	-1.741	-5.408***
France	-2.248	-3.876***	-3.218*	-9.395***	-2.669	-4.034***	-1.622*	--	-1.706	-6.558***
Germany	7.532	-3.753***	-3.034	-6.386***	-2.582	-4.574***	-1.730*	--	1.071	-4.204***
Ireland	-2.366	-5.837***	-0.988	-8.502***	-2.740	-4.629***	-1.802*	--	n.a.	n.a.
Italy	-1.312	-3.864***	-2.341	-5.681***	-2.169	-3.923***	-1.960*	--	-3.629***	--
Netherlands	-1.229	-6.013***	-1.669	-6.545***	-2.735	-4.534***	-1.468	-7.236***	-0.527	-6.037***
Portugal	-1.909	-2.336	0.485	-4.257***	-2.038	-4.454***	-1.788*	--	-1.053	-4.528***
Spain	-4.769***	--	-5.020	--	-2.204	-4.042***	-1.707*	--	-2.171	-6.935***

Asterisks refer to level of significance, \*\*\*: 1 per cent, \*\*: 5 per cent, \*: 10 per cent, MacKinnon (1996) one-sided-p-values.

c, t: a constant and a trend is included.

c: only a constant is included.

None: neither a constant nor a trend is included.

Our analysis therefore starts with a long-term credit demand equation of the form

$$k_t = \omega + \alpha \cdot y_t + \beta \cdot i_t + \varepsilon_t \quad (1)$$

where  $k_t$  is the log of the credit volume,  $y_t$  the log of GDP,  $i_t$  the long-term interest rate and  $\varepsilon_t$  is an error term.

**TABLE 2.** Estimation of long-term credit equations

	Austria	Belgium	Finland	France	Germany
$\omega$	-0.027 (0.163)	5.137*** (1.335)	5.698*** (0.951)	2.558** (1.119)	-11.564*** (2.113)
$\alpha$	1.090*** (0.103)	0.570*** (0.117)	0.427*** (0.088)	0.812*** (0.085)	1.434*** (0.158)
$\beta$	-0.029*** (0.010)	-0.021* (0.012)	-0.001 (0.010)	0.028*** (0.009)	-0.047*** (0.011)
KPSS	0.120	0.122	0.148	0.177*	0.125
-----					
	Ireland <sup>1</sup>	Italy <sup>2</sup>	Netherlands	Portugal	Spain
$\omega$	-5.279*** (0.471)	-10.250*** (0.484)	0.826 (0.741)	-22.703*** (0.550)	-1.949*** (0.579)
$\alpha$	1.654*** (0.042)	1.850*** (0.038)	0.964*** (0.060)	3.246*** (0.052)	1.781*** (0.047)
$\beta$	-2.31E-05 (0.014)	-0.001 (0.005)	-0.009 (0.011)	0.015*** (0.004)	0.004 (0.004)
KPSS	0.146	0.113	0.124	0.122	0.107

Standard errors given in parentheses. Asterisks refer to level of significance, \*\*\*: 1 per cent, \*\*: 5 per cent, \*: 10 per cent, Shin (1994) critical values.

<sup>1</sup> From 1997:1

<sup>2</sup> From 1998:2

The estimation results for eq. 1 are shown in Table 2. All estimated coefficients  $\alpha$  for the impact of GDP on credit volume are significant and have the expected sign. For most countries the size of  $\alpha$  covers the range between 0.427 (Finland) and 1.850 (Spain). For Portugal the elasticity of the credit volume with respect to the output is higher and exceeds 3.246. All coefficients for the influence of

the output, however, stand in line with theory, i.e. they have a significantly positive sign, and they are close to the results of other empirical studies<sup>3</sup>.

Regarding the influence of interest rates the results are less convincing. The coefficients show the expected negative sign in 8 out of 11 cases, only four of them being significant. For three countries (France, Portugal and Spain) the coefficient is positive, in the cases of Portugal and France even significant. This observation, however, may be explained by the steadily declining real and nominal interest rates in the Euro area prior to and following the launch of EMU and is in line with other recent studies (see for instance Calza et al., 2003). We have also tried other specifications of the long term credit equation, including real variables and GMM estimators with various sets of instrument variables<sup>4</sup>. However, as the results do not substantially differ and Psaradakis et al. (2004) point out that OLS estimates will be super-consistent, we rely on the OLS estimation as given in Table 2. Furthermore and following the approach by Psaradakis et al. (2004), a KPSS test cannot reject the null hypothesis of cointegration, therefore we turn to the next step – the analysis of the deviations from the long-term equation.

## 5. Analysis of Deviations from the Long-Term Credit Demand

Assuming that the credit equations from section 4 form a long run equilibrium, one may model the short term dynamic as an error correction model (ECM):

$$\begin{aligned}\Delta k_t &= a + b \cdot [k_{t-1} - (\omega + \alpha \cdot y_{t-1} + \beta \cdot i_{t-1})] + c \cdot \Delta k_{t-1} + u_t \\ &= a + b \cdot \varepsilon_{t-1} + c \cdot \Delta k_{t-1} + u_t\end{aligned}\tag{2}$$

---

<sup>3</sup> For instance Calza et al. (2003) find a coefficient for the whole Euro area of 1.457 for GDP, Bundesbank (2003) find for Germany, depending on the type of loans, between 1.14 and 1.67. Hofmann (2004) finds for various European countries values between 1.269 and 2.169. The IMF (2006) reports 2.31 for Germany.

<sup>4</sup> The estimation results are available from the authors on request.

where  $\varepsilon_t$  is the residual from eq. 1, that is the deviation of credit volume from the long run equation. Furthermore, and taking some autocorrelation in the error terms into account, we add the lagged change in credit volume  $\Delta k_{t-1}$  to the equation. While it is common to assume that the error correction coefficient  $b$  is always present and constant over time, we use a Markov switching error correction model (MS-ECM)<sup>5</sup>, in which the presence or the speed of adjustment may differ depending on the unobservable regime  $s_t$ . This state variable  $s_t$  may take the values 1 and 2, therefore equation (2) emerges to:

$$\Delta k_t = \begin{cases} a_1 + b_1 \cdot \varepsilon_{t-1} + c_1 \cdot \Delta k_{t-1} + u_t, s_t = 1 \\ a_2 + b_2 \cdot \varepsilon_{t-1} + c_2 \cdot \Delta k_{t-1} + u_t, s_t = 2 \end{cases} \quad (3)$$

where the state variable  $s_t$  follows a first order Markov process, characterized by the transition probabilities:

$$\begin{aligned} p &= P(s_t=1 \mid s_{t-1}=1) \\ 1-p &= P(s_t=2 \mid s_{t-1}=1) \\ q &= P(s_t=2 \mid s_{t-1}=2) \\ 1-q &= P(s_t=1 \mid s_{t-1}=2) \end{aligned} \quad (4)$$

We refer to this model as the basic model. The specification of eq. (3) and (4) provides much flexibility to the estimation: As we do not place any prior assumption on the adjustment process to the long run equation, it may be present or not, or just

---

<sup>5</sup> This model has been - for instance - applied for estimating bubbles in British house prices (Hall et al., 1997), for exchange rates in the European Monetary System (Bessec, 2002). For some theoretical considerations and an application to the stock market see Psaradakis et al. (2004).

simply differ in speed between the states (Psaradakis et al. 2004). The model is flexible enough to deal with a permanent change<sup>6</sup>.

Estimation results of eq. (3) and (4) are presented in Table 3. In the estimation the error correction coefficient  $b_1$  respectively  $b_2$  is of main interest. Most countries show one regime which is stabilizing, i.e.  $b_1$  (we regard to the stabilizing regime as regime 1 without any loss of generality) is significantly smaller than zero.

**TABLE 3.** Estimation of basic MS-ECM

	<b>Austria</b>	<b>Belgium</b>	<b>Finland<sup>1</sup></b>	<b>France</b>	<b>Germany</b>
<b>Regime 1</b> (stable regime):					
$a_1$	-0.008*** (0.001)	-0.015*** (0.003)	0.024*** (0.000)	0.008*** (0.003)	0.023*** (0.000)
$b_1$	-0.597*** (0.144)	-0.090** (0.040)	-0.141** (0.055)	-0.226*** (0.071)	-0.067** (0.025)
$c_1$	-0.215 (0.236)	-0.419** (0.171)	--	0.361** (0.154)	-0.501*** (0.000)
<b>Regime 2</b> (unstable regime):					
$a_2$	0.005*** (0.002)	0.017*** (0.003)	0.000 (0.395)	-0.003* (0.002)	-0.003* (0.002)
$b_2$	-0.050 (0.031)	0.081 (0.052)	0.010 (0.393)	-0.110*** (0.040)	0.068* (0.035)
$c_2$	0.539*** (0.125)	-0.246 (0.147)	--	-0.035 (0.195)	0.039 (0.309)
$p$	0.881	0.835	0.853	0.971	0.981
$q$	0.980	0.902	0.932	0.972	0.972
Wald 2 ( $b_1=b_2$ )	13.833	7.443	3.100	2.079	10.410
Wald 3 ( $c_1=c_2$ )	9.553	0.534	--	2.520	2.641

Table 3 to be continued on the following page

<sup>6</sup> Hamilton (1993) states: "Some might object that a change in regime could be represented as a *permanent* change..., rather than the cycling and back and forth between states 1 and 2 that seems to be implicit in (1.2) [i.e. the Markov chain]. However, the specification (1.2) allows the possibility of a permanent change as a special case if  $p_{21}=0$ ." (p.235).

Table 3 continued from the previous page

<b>Regime 1 (stable regime):</b>					
	<b>Ireland</b>	<b>Italy</b>	<b>Nether-lands</b>	<b>Portugal</b>	<b>Spain</b>
a <sub>1</sub>	0.062*** (0.017)	0.062*** (0.017)	-0.038*** (0.009)	0.048*** (0.013)	0.005* (0.003)
b <sub>1</sub>	-0.685*** (0.193)	-0.684*** (0.119)	-0.335 (0.345)	-0.495*** (0.007)	-0.046 (0.038)
c <sub>1</sub>	0.448 (0.280)	0.448 (0.278)	-0.919** (0.476)	0.269 (0.205)	0.833*** (0.103)
<b>Regime 2 (unstable regime):</b>					
a <sub>2</sub>	0.045*** (0.009)	0.043*** (0.000)	0.013*** (0.004)	0.008* (0.004)	0.068*** (0.009)
b <sub>2</sub>	0.077 (0.121)	0.068 (0.119)	-0.003 (0.055)	-0.102 (0.089)	0.593*** (0.213)
c <sub>2</sub>	-0.154 (0.185)	-0.232 (0.186)	0.145 (0.163)	0.433** (0.203)	-1.003*** (0.229)
p	0.770	0.760	0.574	0.894	0.948
q	0.912	0.899	0.951	0.938	0.876
Wald 2 (b <sub>1</sub> =b <sub>2</sub> )	10.259	10.402	0.906	3.976	8.874
Wald 3 (c <sub>1</sub> =c <sub>2</sub> )	3.142	4.007	4.277	0.333	52.465

Standard errors are given in parentheses. Asterisks refer to level of significance, \*\*\*: 1 per cent, \*\*: 5 per cent, \*: 10 per cent.

Wald 1 (2, 3): Wald test against the null hypothesis that the constant (coefficient for error correction/lagged credit volume) is equal in both regimes.

<sup>1</sup> Model with lagged change of credit volume does not converge for Finland.

The only exceptions are the Netherlands and Spain, for which b<sub>1</sub> is negative without being significant. The results, however, differ for b<sub>2</sub>: For France it is significantly negative, too, indicating that both regimes are characterized by an adjustment to the equilibrium, with different speeds. For Spain and Germany b<sub>2</sub> takes a significantly positive value, whereas for the majority of countries b<sub>2</sub> does not significantly differ from zero at all. It is therefore informative to look at standard Wald tests against the null of b<sub>1</sub>=b<sub>2</sub>. The results are given in the rows at the bottom of Table 3. In effect, for all countries but France we find significantly different values of b<sub>1</sub> and b<sub>2</sub> in both regimes. recapitulating to this stage, evidence show for most countries of the Euro area - France being the only exception - a stable regime with mean reversion to the long-term credit equation and an unstable regime, which is at

its best inconclusive without any tendency to return to the demand equation. The differences between  $b_1$  and  $b_2$  are for these countries statistically significant.

It is now straightforward to introduce additional explanatory variables. The rationale is that the credit volume may react in different ways to other factors depending from whether we are in the stable (mean reversion to the long term relationship) or in the unstable regime (no tendency to return). Therefore we extend equation (3) to equation (5)

$$\Delta k_t = \begin{cases} a + b_1 \cdot \varepsilon_{t-1} + c_1 \cdot \Delta BC_t + d_1 \cdot \text{shares}_t + e_1 \cdot \Delta k_{t-1} + u_t, s_t = 1 \\ a + b_2 \cdot \varepsilon_{t-1} + c_2 \cdot \Delta BC_t + d_2 \cdot \text{shares}_t + e_2 \cdot \Delta k_{t-1} + u_t, s_t = 2 \end{cases} \quad (5)$$

which additionally considers the availability of banks' capital and the influence of asset prices, representing the bank lending and the balance sheet channel of transmission. Whilst the variable  $\Delta BC$  is defined as the change in logs of the bank capital, the variable *shares* measures the deviation of the respective national stock index from its long term trend<sup>7</sup>. This reflects ongoing under- or overvaluation of companies, which may perpetually prevent banks from expanding their credit offers to companies.

We apply this extended MS-ECM to the countries from table 3. The estimation results are given in [table 4](#). Indeed the estimations provide some additional insights. Results for *Belgium*, *Germany*, *Ireland* and *Portugal* show significant differences (in terms of the Wald test) between the significant ECM coefficient  $b_1$  of the stable regime and the respective coefficient  $b_2$  of the unstable regime. Furthermore, there are significant differences in the influence of the stock market development between the regimes for these countries. For Belgium, Germany and Portugal there is a clear pattern: During unstable periods there is a strong positive influence of stock market movements on the credit volume. This means that deviations from the long-term

---

<sup>7</sup> We assume a constant long term rate of return for the stock market. For both variables we tried different specifications, among them a bank capital to credit volume ratio instead of  $\Delta BC$  and log changes of the stock market index for *shares*. These variations do not substantially change results, but in the case of *shares* the significance suffers.

development of the credit volume proceed with movements in the stock market: the credit volume tends to decline (increase) when shares prices are below (above) average. During the stable regime, however, a similar behavior for banks' capital seems not to exist, except for Germany. In contrast to these three countries we find a relation in the opposite direction for Ireland: here the positive relation is in the stable regime, meaning that an increase in stock prices realizes the credit volume closer to the long term trend.

For *Austria, Finland, Italy and Spain* the results remain inconclusive. Although there are different degrees of stability between the regimes, most coefficients are not statistically significant and the Wald tests do not indicate significant differences between regimes.

**FIGURE 1:** Estimated long-run credit equations, credit volume and regimes for the plain model

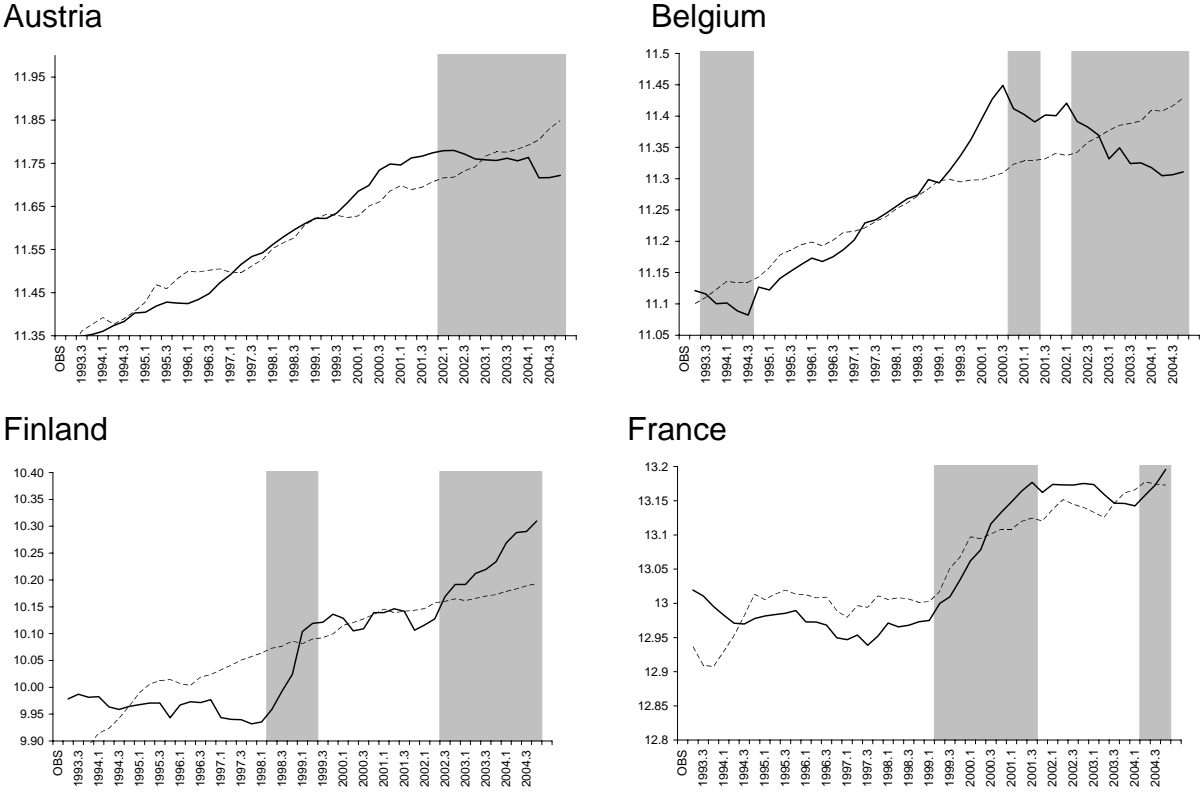
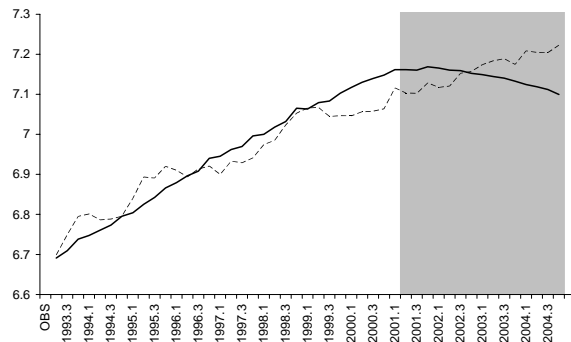


Figure 1 to be continued on the following page

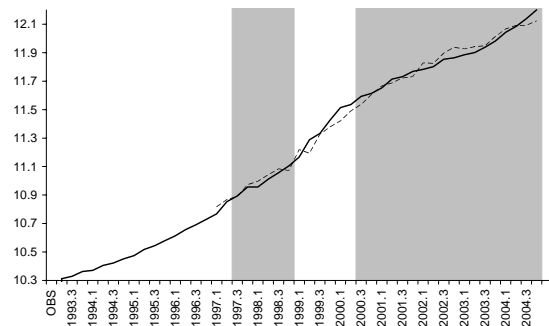


Figure 1 continued from the previous page

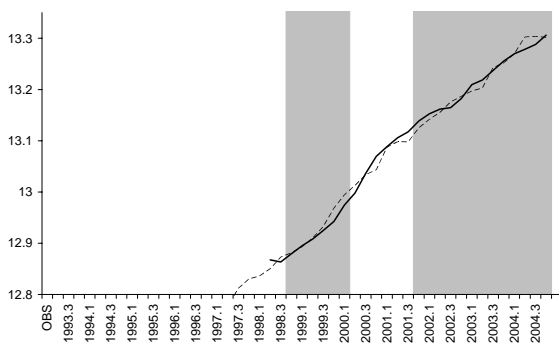
### Germany



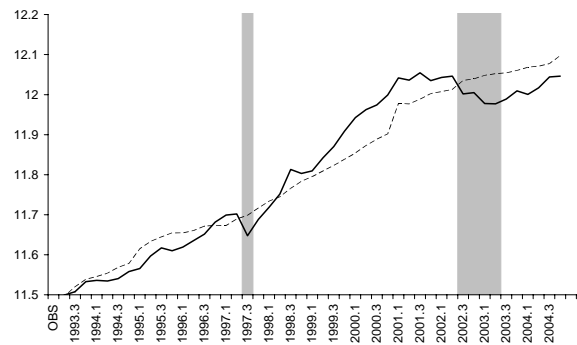
### Ireland



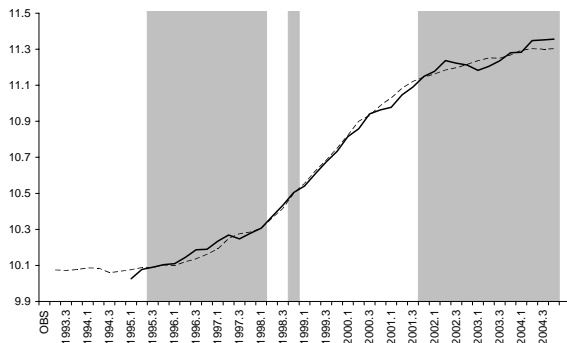
### Italy



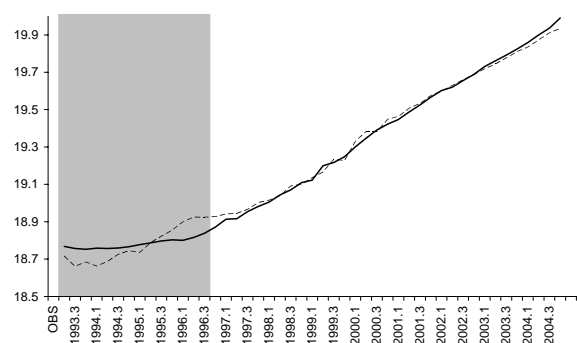
### Netherlands



### Portugal



### Spain



Bold line: credit volume, dotted line: estimated long-run relation, the shadowed rectangles represent the periods as being in the bubble regime, that is when  $P(s_t=1 | \Phi_T) > 0.5$ .

*France and the Netherlands, finally, show two stable regimes with significantly negative ECM coefficients. The two regimes only differ in the speed of adjustment. However, both countries show a higher influence of shares prices in the unstable than in the stable regime (significantly different only for the Netherlands). We interpret this as a slightly dampening effect of the stock market on the credit growth.*

**TABLE 4.** Estimation of the extended MS-ECM

	<b>Austria</b>	<b>Belgium</b>	<b>Finland</b>	<b>France</b>	<b>Germany</b>
<b>Regime 1:</b>					
const.	0.005*** (0.002)	0.009*** (0.002)	0.015*** (0.003)	0.001 (0.002)	0.023*** (0.001)
b <sub>1</sub> (ECM)	-1.111 (1.496)	-0.329*** (0.052)	-0.083 (0.091)	-0.237** (0.099)	-0.188*** (0.039)
c <sub>1</sub> ( $\Delta$ BC)	-0.648 (2.168)	0.017 (0.021)	-0.076** (0.029)	0.462 (0.299)	-0.340*** (0.011)
d <sub>1</sub> (Shares)	-0.297 (0.311)	0.014 (0.010)	-0.007 (0.005)	0.016 (0.013)	0.017*** (0.005)
e <sub>1</sub> ( $\Delta$ K <sub>t-1</sub> )	0.275 (1.037)	-0.324** (0.012)	0.156 (0.149)	-0.062* (0.033)	-0.260* (0.132)
<b>Regime 2:</b>					
const.	0.005*** (0.002)	0.009*** (0.002)	0.015*** (0.003)	0.001 (0.002)	0.023*** (0.001)
b <sub>2</sub> (ECM)	-0.032 (0.031)	0.042 (0.041)	0.032 (0.047)	-0.103*** (0.034)	0.331*** (0.108)
c <sub>2</sub> ( $\Delta$ BC)	0.079 (0.057)	0.034* (0.017)	0.311 (0.452)	-0.042 (0.057)	0.406 (0.256)
d <sub>2</sub> (Shares)	0.013 (0.011)	0.069*** (0.011)	0.051*** (0.014)	0.036*** (0.011)	0.067*** (0.017)
e <sub>2</sub> ( $\Delta$ K <sub>t-1</sub> )	0.437*** (0.129)	-0.356** (0.154)	0.215 (0.233)	-0.029 (0.233)	-2.120 (1.706)
p	0.870	0.768	0.974	0.952	0.982
q	0.980	0.805	0.974	0.976	0.961
Wald 2 (b <sub>1</sub> =b <sub>2</sub> )	0.520	32.668***	1.143	1.564	19.003***
Wald 3 (c <sub>1</sub> =c <sub>2</sub> )	0.112	0.427	0.728	2.937	6.605**
Wald 3 (d <sub>1</sub> =d <sub>2</sub> )	0.994	15.055***	14.257***	1.172	8.683***
Wald 3 (e <sub>1</sub> =e <sub>2</sub> )	0.024	0.029	0.045	0.018	1.196

-----  
*Table 4 to be continued on the following page*

Table 4 continued from the previous page

	<b>Irland</b>	<b>Italien</b>	<b>Nether-lands</b>	<b>Portugal</b>	<b>Spain</b>
<b>Regime 1:</b>					
const.	0.046*** (0.008)	-0.001*** (0.000)	0.010** (0.004)	0.022*** (0.004)	0.023*** (0.000)
b <sub>1</sub> (ECM)	-0.578*** (0.155)	-0.018 (0.437)	-0.374** (0.170)	-0.660** (0.304)	-0.163*** (0.042)
c <sub>1</sub> ( $\Delta$ BC)	--	-0.042 (0.459)	0.004 (0.107)	0.249* (0.145)	-0.085*** (0.025)
d <sub>1</sub> (Shares)	0.083*** (0.030)	-0.067 (1.257)	0.019 (0.016)	0.011 (0.019)	0.048*** (0.008)
e <sub>1</sub> ( $\Delta$ K <sub>t-1</sub> )	0.245 (0.177)	-0.001 (0.485)	0.031 (0.178)	-0.158 (0.260)	-0.219 (0.140)
<b>Regime 2:</b>					
const.	0.046*** (0.008)	-0.001*** (0.000)	0.010** (0.004)	0.022*** (0.004)	0.023*** (0.003)
b <sub>2</sub> (ECM)	0.084 (0.126)	-0.005 (0.011)	-0.305** (0.135)	-0.001 (0.066)	0.045 (0.185)
c <sub>2</sub> ( $\Delta$ BC)	--	0.011 (0.008)	-0.047 (0.105)	0.045 (0.049)	0.019 (0.033)
d <sub>2</sub> (Shares)	0.017 (0.017)	-0.001* (0.000)	0.066*** (0.021)	0.051*** (0.009)	0.002 (0.013)
e <sub>2</sub> ( $\Delta$ K <sub>t-1</sub> )	-0.223 (0.222)	1.045*** (0.018)	0.086 (0.195)	0.314** (0.128)	0.354*** (0.119)
p	0.722	0.915	0.968	0.517	0.978
q	0.853	0.999	0.962	0.903	0.971
Wald 2 (b <sub>1</sub> =b <sub>2</sub> )	10.646***	0.001	0.107	4.280**	1.172
Wald 3 (c <sub>1</sub> =c <sub>2</sub> )	--	0.013	0.130	1.880	6.216**
Wald 3 (d <sub>1</sub> =d <sub>2</sub> )	2.970*	0.003	4.036**	3.356*	8.612***
Wald 3 (e <sub>1</sub> =e <sub>2</sub> )	3.961**	4.647**	0.050	3.359*	18.243***

Standard errors given in parentheses. Asterisks refer to level of significance, \*\*\*: 1 per cent, \*\*: 5 per cent, \*: 10 per cent.

Summarizing at this stage, we find evidence for the existence of a stable (tendency to return to the credit demand equation) and an unstable (no tendency to

return) regime for Belgium, Germany, Ireland and Portugal. The unstable regime occurs for most countries during the last years (see Figure 1), which is in line with recent empirical work (ECB 2006 for aggregated data on the whole Euro area, IMF 2006 for Germany) Except for Ireland, the movement away from the demand equation shows a positive relation to the movement of the stock market. For Germany we even find some evidence for a relation to the growth bank capital. Above all and even for France and the Netherlands, whereat no unstable (i.e. mean-reverting) regimes are found, the stock market development affects the speed of adjustment to the long term equation. For the other countries (Austria, Finland, Italy and Spain) the evidence is inconclusive.

## **6. Conclusions**

This paper analyses the development of the credit volume in the countries of the Euro area. The analysis is based on the construction of a long-term credit demand equation. The actual credit volume is then compared to this long-term trend and deviations are analyzed in detail by applying a Markov switching error correction model to the deviations. For several European countries (Belgium, Germany, Ireland and Portugal) we find strong evidence for switching between a stable, mean reverting regime, and one unstable, bubble-like regime, which does not show a tendency to return to the long run demand equation. While France, Greek and the Netherlands show two regimes with different speeds of adjustments only, the three remaining countries (Austria, Italy and Spain) show only weak evidence of regime switches.

Furthermore, we find a positive relation between the credit volume and the development of the stock market in the unstable regime for Belgium, Germany and Portugal, as well as for Finland, France and the Netherlands in the regime with lower adjustment speed, which is significantly higher than in the other regime. A significant influence of the banks' capital, however, is only visible in the case of Germany.

From these results we conclude, that there are constraints, which may temporarily dampen lending of banks to the private sector, and even displace the credit volume from the long term demand equation. Whether these constraints lead to a real lack of credits, or only affect the adjustment speed, seems to depend on country-specific characteristics. A crucial role is attributed to the development of

stock markets and therefore our analysis is linked to the literature on the credit channel. The results, however, do not clearly indicate, whether the impact of the asset price growth works via the supply side or the demand side. In contrast, the availability of bank capital seems to play only a minor role in most countries, except of Germany. Our findings even affect monetary policy, which ought to consider the development of asset prices when conducting monetary policy, as there seems to be a substantial, and between countries of the Euro area asymmetric effect on the transmission mechanism.

## References

- Altunbas, Yener, Otabek Fazylov and Philip Molyneux (2002). Evidence on the Bank Lending Channel in Europe, *Journal of Banking and Finance* 26, 2093-2110.
- Angeloni, Ignazio, Anil K. Kashyap, Benoit Mojon and Daniele Terlizzese (2003). Monetary Policy Transmission in the Euro Area: Where do we Stand?, Ignazio. Angeloni, Anil K. Kashyap and Benoit Mojon (eds.): *Monetary Policy Transmission in the Euro Area*, Cambridge: Cambridge University Press.
- Azariadis, Costas and Bruce D. Smith (1998). Financial Intermediation and Regime Switching in Business Cycles, *American Economic Review* 88, 516-536.
- Barajas, Adolfo and Roberto Steiner (2002). Why don't they Lend? Credit Stagnation in Latin America, *IMF Staff Papers* 49, 156-184.
- Bernanke, Ben S. (1983). Non-Monetary Effects of the Financial Crisis in the Propagation of the Great Depression, *American Economic Review* 73, 257-276.
- Bernanke, Ben S. (1995). The Macroeconomics of the Great Depression: A Comparative Approach, *Journal of Money, Credit and Banking* 27, 1-28.
- Bernanke, Ben S. and Alan S. Blinder (1988). Credit, Money and Aggregate Demand, *American Economic Review, Papers and Proceedings* 78, 435-439.
- Bernanke, Ben S. and Carla S. Lown (1991). The Credit Crunch, *Brookings Papers on Economic Activity* 2, 205-248.

- Bessec, Marie (2002). Mean Reversion versus Adjustment to PPP: The Two Regimes of Exchange Rate Dynamics under the EMS, 1979-1998, *Economic Modelling* 20, 141-164.
- Bordo, Michael and Olivier Jeanne (2002). Boom-Busts in Asset Prices, Economic Instability and Monetary Policy, *NBER Working Paper* 8966.
- Borio, Claudio and Philip Lowe (2002). Asset Prices, Financial and Monetary Stability: Exploring the Nexus, *Bank for International Settlements Working Paper* 114.
- Brunner, Allan D. and Steven B. Kamin (1998). Bank Lending and Economic Activity in Japan: Did 'Financial Factors' Contribute to the Recent Downturn?, *International Journal of Finance and Economics* 3, 73-89.
- Calza, Alessandro, Christine Gartner and João Soucasaux Meneses e Sousa (2003). Modelling the Demand for Loans to the Private Sector in the Euro Area, *Applied Economics* 35, 107-117.
- Caporale, Guglielmo and Nicola Spagnolo (2003). Asset Prices and Output Growth Volatility: The Effects of Financial Crisis, *Economics Letters*, 79, 69-74.
- Chen, Nan-Kuang (2001). Bank Net Worth, Asset Prices and Economic Activity, *Journal of Monetary Economics* 48, 415-436.
- Cordoba, Juan-Carlos and Marla Ripoll (2004). Credit Cycle Redux, *International Economic Review* 45, 1011-1046.
- De Bondt, Gabe J. (1999). Banks and Monetary Transmission in Europe: Empirical Evidence, *Banca Nazionale del Lavoro Quarterly Review* 52, 149-168.
- Detken, Carsten and Frank Smets (2004). Asset Price Booms and Monetary Policy, *European Central Bank Discussion Paper* 364.
- Deutsche Bundesbank (2002). The Development of Bank Lending to the Private Sector, *Monthly Report*, October, 31-43.
- Deutsche Bundesbank (2003). German Results of Euro-Area Bank Lending Survey. *Monthly Report*, June, 67-76.
- Eichengreen, Barry and Kris Mitchener (2003). The Great Depression as a Credit Boom Gone Wrong, *Bank for International Settlements Working Paper* 137.

- Engle, Robert F. and Clive Granger (1987). Cointegration and Error Correction: Representation, Estimation, and Testing, *Econometrica* 55, 251-276.
- ECB (2006). Monthly Bulletin, May.
- Estrella, Arturo (2004). The Cyclical Behavior of Optimal Bank Capital, *Journal of Banking and Finance* 28, 1469-1498.
- Fase, Martin M. G. (1995). The Demand for Commercial Bank Loans and the Lending Rate, *European Economic Review* 39, 99-115.
- Friedman, Benjamin M. and Kenneth N. Kuttner (1993). Economic Activity and the Short-term Credit Markets: An Analysis of Prices and Quantities, *Brookings Papers on Economic Activity* 2, 193-283.
- Gambacorta, Leonardo (2005). Inside the Bank Lending Channel, *European Economic Review* 49, 1737-1759.
- Ghosh, Swati R. and Atish R. Ghosh (1999), East Asia in the Aftermath: Was there a Crunch?, *IMF Working Papers* 99/38.
- Hall Stephen, Zacharias Psaradakis and Martin Sola (1997). Switching Error-Correction Models of House Prices in the United-Kingdom, *Economic Modelling* 14, 517-527.
- Hamilton, James, D. (1993). Estimation, Inference and Forecasting of Time Series Subject to Changes in Regimes, G.S. Maddala, C.R. Rao and H.D. Vinod (eds.): *Handbook of Statistics*, Vol. 11, Amsterdam: Elsevier, 231-259.
- Higgins, Matthew and Carol Osler (1997). Asset Market Hangovers and Economic Growth: The OECD during 1984-93, *Oxford Review of Economic Policy* 13, 110-134.
- Hofmann, Boris (2004). The Determinants of Bank Credit in Industrialized Countries: Do Property Prices Matter?, *International Finance* 7, 203-234.
- IMF (2006). Germany: Selected Issues, *IMF Country Report* 06/17. Washington
- Jaffee, Dwight and Joseph E. Stiglitz (1990). Credit Rationing, B. Friedman and F. Hahn (eds.): *Handbook of Monetary Economics*, Vol. 2, Amsterdam, 838-888.

- Kakes, Jan and Jan-Egbert Sturm (2002). Monetary Policy and Bank Lending: Evidence from German Banking Groups, *Journal of Banking and Finance* 26, 2077-2092.
- Kashyap, Anil K., Jeremy C. Stein and David W. Wilcox (1993). Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance, *American Economic Review* 83, 8 –98.
- Kim, Sun Bae and Ramon Moreno (1994). Stock Prices and Bank Lending Behavior in Japan, *Federal Reserve Bank of San Francisco Economic Review* 31-42.
- Kiyotaki, Nobuhiro and John Moore (1997). Credit Cycles, *Journal of Political Economy* 105 211-248.
- Kocherlakota, Narayana R. (2000). Creating Business Cycles Through Credit Constraints, *Federal Reserve Bank of Minneapolis Quarterly Review* 24, 2-10.
- McKinnon, James G. (1996). Numerical Distribution Functions for Unit Root and Cointegration Tests, *Journal of Applied Econometrics* 11, 601-618.
- Nehls, Hiltrud and Torsten Schmidt (2004). Credit Crunch in Germany?, *Kredit und Kapital* 37, 479-499.
- Pazarbasioglu, Ceyla (1997). A Credit Crunch? Finland in the Aftermath of the Banking Crisis, *IMF Staff Papers* 44, 315-327.
- Psaradakis, Zacharias, Martin Sola and Fabio Spagnolo (2004). On Markov Error Correction Models, with an Application to Stock Prices and Dividends, *Journal of Applied Econometrics* 19, 69-88.
- Shin, Yongcheol (1994). A Residual-Based Test of the Null of Cointegration against the Alternative of no Cointegration, *Econometric Theory* 10, 91-115.
- Stiglitz, Joseph E. and Bruce C. Greenwald (2003). *Towards a New Paradigm in Monetary Economics*. Cambridge: Cambridge University Press.