Oesterreichische Nationalbank

Working Paper 90

Modeling Credit Aggregates

Sylvia Kaufmann and Maria-Teresa Valderrama

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.co.at/workpaper/pubwork.htm

Editorial

In this paper, the authors model loans to households and to non-financial corporations as well as their relation to interest rates and demand variables for Austria, Germany, the Netherlands and the United Kingdom. Credit aggregates are modeled using a Markov-switching vector autoregressive model, which allows testing as to whether shocks to the economy have stronger effects during tight credit regimes or economic downturns. The analysis of the above-mentioned countries makes it possible to assess the differences in the amplifying and asymmetric effects of credit aggregates between market-based and bank-based financial systems.

September 20, 2004

Modeling Credit Aggregates[1]

***Sylvia Kaufmann*[2]**

and

***Maria Teresa Valderrama*[3]**

September 2004

Abstract

The purpose of this paper is to model both loans to households and to non-financial corporations as well as their relation to interest rates and demand variables for Austria, Germany, the Netherlands and the United Kingdom. Credit aggregates are modeled using a Markov-switching vector autoregressive model, which allows testing as to whether shocks to the economy have stronger effects during tight credit regimes or economic downturns. The analysis of the above-mentioned countries makes it possible to assess the differences in the amplifying and asymmetric effects of credit aggregates between market-based and bank-based financial systems.

Keywords Asymmetry and amplification, credit aggregates, market-based and bank-based financial systems

JEL classification C32, E44, E51

The views presented here do not necessarily reflect those of the OeNB.

[1] We would like to thank Leo de Haan, Elmar Stoess and Andreas Worms for providing us with Dutch and German series. We also thank participants for comments on an earlier version of this paper presented in seminars at the ECB, the Bank of Canada, the Bundesbank and the Annual Meeting of the Austrian Economic Association. Moreover, we thank an anonymous referee for his/her feedback. We would also like to thank participants at the DNB Seminar, at the 21st Symposium on Banking and Monetary Economics and at ECOMOD 2004 for their comments. All remaining errors are ours.

[2] Oesterreichische Nationalbank, Economic Studies Division, Otto-Wagner-Platz 3, 1090 Vienna, Austria, Phone: +43 1 40420 7222, Fax: +43 1 40420 7299; E-mail: Sylvia.Kaufmann@oenb.at.

[3] Oesterreichische Nationalbank, Economic Analysis Division, Otto-Wagner-Platz 3, 1090 Vienna, Austria, Phone: +43 1 40420 7412, Fax: +43 1 40420 7499; E-mail: Maria.Valderrama@oenb.at.

1. Introduction

The purpose of this paper is to model credit aggregates for both households and non-financial corporations and their relation to interest rates and demand variables for four member countries of the European Union. Credit aggregates not only play a major role in the transmission mechanism of monetary policy (Bernanke and Blinder, 1988) but may also be important indicators of the monetary stance and liquidity conditions at the national level. This may be especially relevant for countries with an exchange rate peg or for members of a monetary union, for which interest rate levels or “national” monetary aggregates may lose their leading indicator properties, while “national” credit aggregates may still have a more direct impact on national spending and therefore on national inflation. Moreover, as Borio and White (2004) and Borio and Lowe (2004) have shown, credit aggregates can also be useful in identifying the possible buildup of financial imbalances in the economy, which should be taken into account by policymakers. Despite their importance there are very few studies that focus on credit aggregates and even fewer which cover countries like Germany and Austria. This paper fills this gap by presenting evidence for the role of credit aggregates in the transmission mechanism for Austria, Germany, the Netherlands and the United Kingdom (UK).[4]

On the other hand, money and credit and their relation to business cycles have been explored and outlined in a large body of theoretical models (Stiglitz and Weiss, 1981, Scheinkman and Weiss, 1986, Bernanke and Gertler, 1989, Kiyotaki and Moore, 1997a and 1997b, Boissay, 2001). Despite their different approaches, all these models predict that, due to the existence of asymmetric information, credit markets propagate shocks to the economy. Moreover, they show that the procyclicality of bank lending results in an amplification of business cycles that is stronger during recessions and, thus, leads to asymmetric effects of monetary policy.

[4] See Jacobs and Kakes (2000) and Sensier et al. (2002) for similar studies conducted on the Netherlands and the UK.

Thus, the mechanisms described in these theoretical models imply that credit aggregates should be modeled in a nonlinear framework.[5] To capture asymmetries, we introduce a Markov-switching vector autoregressive model (MS-VAR), in which parameters switch according to an unobservable state variable. The state variable is assumed to capture changing credit or economic regimes and is estimated along with the model parameters.

For each country, we analyze two credit systems, one for loans to households and one for loans to firms, as these two aggregates are determined by different spending components and may be differently affected by asymmetric informational problems and financial constraints. The countries we analyze are representative of both large and small countries within the European Union, with either market-based[6] or bank-based[7] financial systems. This allows us to examine whether asymmetries propagated by credit aggregates depend on the type of financial system. For example, credit tightening during an economic downturn may be more severe in market-based than in bank-based systems as in the latter the existence of lending relationships allows borrowers to smooth liquidity shocks over the cycle.

To summarize: The objectives of this paper are, first, to model credit aggregates, which have been rather neglected in the literature, especially as regards European countries; second, to use a nonlinear methodology in order to capture the asymmetric effects predicted by theoretical models and by the evidence at the micro level; third, to separate lending to households from lending to non-financial corporations; and finally, to draw up models for four countries with different financial systems, which will allow us to investigate asymmetric effects related to differences between market-based and bank-based financial systems.

[5] See below for a detailed account of these models.
[6] The UK and the Netherlands.
[7] Germany and Austria.

The paper is organized as follows: The next section motivates the use of nonlinear modeling based on theoretical models of credit cycles. Section three describes some stylized facts about the evolution of credit aggregates and the institutional frameworks of the four countries discussed in this study. Section four introduces the MS-VAR model and the estimation method. Section five presents our results. Section six compares the results across countries. Conclusions follow.

2. Nonlinear effects of credit aggregates – Theory and evidence

Models that focus on the credit view of monetary policy transmission (as opposed to the 'money' or monetarist view) were introduced among others by Bernanke and Blinder (1988) and Bernanke and Gertler (1989). In a simple neoclassical framework, these authors describe the financial accelerator effect by showing how business cycles may emerge or may be amplified through borrowers' balance sheets. During business cycle upturns, borrowers' net worth improves and the costs of external finance decrease, which results in higher investment. Empirical evidence for the United States at the aggregate level for this transmission channel is found in Bernanke and Blinder (1989), Kashyap et al. (1993), Bernanke and Gertler (1995) and Christiano et al. (1996). These authors find that credit aggregates and the composition of external funds react to liquidity shocks and in turn affect investment behavior.

Asymmetric effects over time propagated through the credit market were introduced by Kiyotaki and Moore (1997a, 1997b) and Kocherlakota (2000). According to Kiyotaki and Moore (1997a, 1997b) higher debt default during a recession leads to exaggerated responses of the economy to an initial liquidity shock. In a neoclassical framework which uses a tangible asset (land) as a production factor Kocherlakota (2000) demonstrates that credit constraints lead to asymmetric responses in output. Positive or small negative transitory income shocks do not affect output, while large negative shocks lead to a persistent decrease in output. This propagation mechanism is amplified when land is used as collateral.

Models which explicitly switch between equilibria due to borrowing constraints or adverse selection problems in the credit market are presented by Scheinkman and Weiss (1986) and Azariadis and Smith (1998). Borrowing constraints affect economic activity via the distribution of wealth. As this distribution evolves endogenously, exogenous shocks lead to a considerable cyclical economic activity. The model solution in Azariadis and Smith leads to multiple equilibria[8]; whereby the switching between these equilibria can be described as a Markov-switching process.

In summary, these models imply that monetary policy-induced shocks or any other shocks have asymmetric effects on the economy. These effects arise from the fact that although lending is procyclical and therefore renders binding credit constraints during a downturn, it does not have an equally positive symmetric effect during the upturn.

For the countries investigated in this paper, empirical evidence at the individual bank and firm level tends to confirm both the relevance of credit aggregates for the transmission mechanism and the asymmetric propagation of shocks through credit markets to the real economy. Frühwirth-Schnatter and Kaufmann (2004) and Kaufmann (2003) have studied the behavior of bank lending and find that it reacts asymmetrically to interest rate changes over time in Austria. Valderrama (2001 and 2003a) and Wesche (2000) provide evidence for the existence of a financial accelerator effect in Austria using firm-level data. Vermeulen (2002), Chatelain et al. (2003) and von Kalckreuth (2003) show that internal funds are significant determinants of investment in Germany. Similar evidence for the Netherlands is presented by Van Ees and Garretsen (1994) and Van Ees et al. (1998), who find that liquidity and debt constraints have a significant impact on Dutch business investment. Guariglia (1999) uses firm-level data for the UK and shows a significant link between financial variables and inventory investment. Moreover, the effect on investment is more pronounced in the case of firms with weak balance sheets during recessions and

[8] One in which economic activity is slowing, interest rates are falling and credit constraints are binding, and another which is terized by accelerating growth and rising interest rates accompanied

periods of tight monetary policy. Hall (2001) concludes that a business cycle model for the UK incorporating financial accelerator effects is consistent with observed features of corporate real and financial behavior in previous downturns.

3. Credit aggregates in market-based and bank-based financial systems

Our decision to model credit aggregates for four EU countries with different financial systems allows us to investigate whether the role of credit aggregates in the transmission mechanism depends on their institutional framework. We expect that due to the existence of the "house bank" principle found in bank-based systems, credit constraints and asymmetric propagation through credit markets may be less severe than in market-based systems.

The "house bank" principle allows both lenders and borrowers to overcome some of the asymmetric information problems found in imperfect capital markets by building long-standing relationships. These lending relationships allow the borrower to be less dependent on internal funds, since the lending institution will provide its client with liquid funds even during an economic downturn. As a result, the borrower can smooth spending decisions over the cycle, since lending, in this case, is mostly demand driven.[9]

Evidence at the firm level confirms that the advantage of such lending relationships consists in a lower dependence on internal funds and not in lower capital costs.[10] At the aggregate level, the presence of relationship lending should translate into smoother business cycle fluctuations. To test this hypothesis, we compare results for Austria, Germany, the Netherlands and the UK, which are two small and two large countries in the EU, representative of both bank-based and market-based financial systems.

---

by a credit market in Walrasian equilibrium.

[9] See Ongena and Smith (1998) and Boot (2000) for a more detailed account of possible effects of lending relationships.

[10] Petersen (1994, 1995), Ongena and Smith (1998), Houston and James (1999), Boot (2000).

Austria and Germany have very similar banking systems, which are characterized by narrow lending relationships.[11] In Europe, the United Kingdom is widely known to be a market-based financial system with the highest market capitalization in Europe, while the ratio of loans to non-financial corporations to GDP in the UK is low compared to other EU countries. It is not easy to find a small European country that has a market-based system. In this context, the Netherlands, which show a high share of equity issues and a large market capitalization compared to most other countries in Europe, are the most suitable candidate. Ranking behind the UK and Luxembourg, market capitalization in the Netherlands is the third-highest among the former EU-15.[12] Although lending relationships may also be present in the Netherlands and the UK,[13] at the aggregate level the effect of shocks should be smaller than in Austria and Germany, due to the smaller loans-to-GDP ratio in the latter two countries.

Graphs 1 and 2 seem to confirm this perception. Owing to the rapid liberalization of bank lending to consumers in the UK and the Netherlands during the 1990s, the ratio of loans to GDP for the household sector in these two countries is higher than in Austria and Germany. By contrast, the ratio of loans to GDP for non-financial corporations is much higher in Austria and Germany and relatively low for the UK, while the Netherlands rank somewhere in between. This is consistent with the higher market capitalization observed in both the UK and the Netherlands.

4. Econometric model and estimation method

In order to capture the nonlinear dynamics predicted by theoretical models we use a Markov-switching vector autoregressive (MS-VAR) model, which allows for regime-switching coefficients. The advantage of an MS-VAR model is that it enables us to

[11] Evidence for Germany is extensive – see for example Chirinko and Elston (1996), Elsas and Krahnen (1998) and Harhoff and Körting (1998). See Valderrama (2001, 2003a and 2003b) for evidence on Austria.
[12] Data for 2000. See Rajan and Zingales (2003).
[13] See Van Ees and Garretsen (1994), Van Ees et al. (1998) and de Haan and Sterken (2002) for data on the Netherlands.

estimate dates of regime shifts and model parameters simultaneously. Thus, a priori knowledge about the dates at which the economy shifts into e.g. a tight credit regime is not necessary, which is an advantage if we take into account that the variable determining regime shifts and their timing are not observable with certainty.

The most general specification of an MS-VAR model allows all model parameters to depend on the unobservable state s_t:

$$\begin{aligned} y_t &= \upsilon(s_t) + A_1(s_t) y_{t-1} + A_2(s_t) y_{t-2} + \ldots\ldots + A_q(s_t) y_{t-q} + \varepsilon_t, \\ \varepsilon_t &\sim i.i.d.N(0, \Sigma(s_t)), \end{aligned} \tag{1}$$

where s_t takes on one out of K values, $s_t = k, k = 1, \ldots K$, and is assumed to follow a first-order Markov process. The probability that regime j prevails in t depends on the regime prevailing in $t\text{-}1$, $\Pr(s_t = j | s_{t-1} = i) = \eta_{ij}$, and is assumed to be exogenous and constant. In a K-state model there are $K \times K$ of such conditional transition probabilities, which are represented in the transition matrix η:

$$\eta = \begin{bmatrix} \eta_{11} & \eta_{12} & \cdots & \eta_{1K} \\ \eta_{21} & \eta_{22} & \cdots & \eta_{2K} \\ \vdots & \vdots & \ddots & \vdots \\ \eta_{K1} & \eta_{K2} & \cdots & \eta_{KK} \end{bmatrix}, \tag{2}$$

with the obvious restriction $\eta_{iK} = 1 - \sum_{j=1}^{K-1} \eta_{ij}$.

The estimation of model (1) yields an inference on all model parameters and the state variable s_t as well. Here, the estimation is cast into a Bayesian framework and the inference is obtained using Markov chain Monte Carlo (MCMC) simulation methods. Although maximum likelihood is feasible (Krolzig, 1997), MCMC methods circumvent problems that may arise when the likelihood is maximized numerically. In systems involving more than two states and a larger number of variables, for instance, one often encounters boundary problems for the transition probabilities if these approach zero or one. Moreover, the maximization proves to be sensitive to starting values.

The random permutation sampler (Frühwirth-Schnatter, 2001) used here is based on the Gibbs sampler and allows the exploration of the whole unconstrained posterior distribution of the model parameters. If a suitable restriction identifying the states is not known a priori,[14] we may find an adequate one by post-processing and visualizing the output of the sampler. In general, it is sufficient to set reasonable starting values for the sampler to converge to the steady-state posterior distribution of the model parameters and of the state variable (Tierney, 1994).

To briefly describe the estimation procedure, we gather all model parameters into the vector θ for notational convenience, $\theta = (\upsilon(1),...,\upsilon(K), A_1(1),...A_q(K), \Sigma(1),...,\Sigma(K), \eta)$. Conditional on s_t, the likelihood of the data can be factorized as:

$$L(y^T \mid \theta, s_t) = \prod_{t=1}^{T} f(y_t \mid y^{t-1}, \theta, s_t), \tag{3}$$

where the observation density $f(y_t \mid y^{t-1}, \theta, s_t)$ is multivariate normal:

$$f(y_t \mid y^{t-1}, \theta, s_t) = \mid \Sigma(s_t) \mid^{-1/2} (2\pi)^{-p/2} \exp\left\{ -\frac{1}{2}(y_t - \mu(s_t))' \Sigma(s_t)^{-1}(y_t - \mu(s_t)) \right\}, \tag{4}$$

with $\mu(s_t) = \upsilon(s_t) + A_1(s_t)y_{t-1} + A_2(s_t)y_{t-2} + ... + A_q(s_t)y_{t-q}$ and $y^{t-1} = (y_{t-1}, y_{t-2},..., y_1)$.

Further, the prior distribution of $s^T = (s_T, s_{T-1},..., s_0)$ depends only on the relevant transition probabilities and its density is proportional to:

$$\pi(s^T \mid \eta) \propto \prod_{t=1}^{T} \eta_{s_t, s_{t-1}} \pi(s_0) = \prod_{j=1}^{K} \prod_{i=1}^{K} \eta_{ij}^{N_{ij}} \pi(s_0), \text{ with } N_{ij} = \#\{s_t = j \mid s_t = i\}.$$

Finally, the specification of the prior distribution of the model parameters, $\pi(\theta)$, completes the Bayesian setup:

[14] A common restriction which allows to discriminate between the states would be e.g. that $\upsilon_1(1) < \upsilon_1(2)$, meaning that the first regime would relate to below-average growth periods in the first variable of the system, while the second regime would relate to above-average growth rate periods.

- The VAR parameters $\beta = (\upsilon(1),...,\upsilon(K), A_1(1),...A_q(K))$, the covariance matrices $\Sigma = (\Sigma(1),...,\Sigma(K))$ and the transition probabilities η are independent a priori, $\pi(\theta) = \pi(\beta)\pi(\Sigma)\pi(\eta)$.
- β is assumed multivariate normal $N(b_0, B_0^{-1})$. For the constant terms $(\upsilon(1),...,\upsilon(K))$ we assume a noninformative prior that is independent of the autoregressive parameters; B_0^{-1} is therefore block-diagonal. The prior covariance matrix of the autoregressive parameters $A_1(1),...A_q(K)$ is designed in a way that takes into account the possible different scales of the system variables and tightens the prior for the standard errors of higher order lags (see Litterman, 1986, and Hamilton, 1994, pp.360-362).
- $(\Sigma(1),...,\Sigma(K))$ are independent a priori and each have an inverse Wishart distribution, $\Sigma^{-1}(k) \sim W(\nu_0, S_0)$, $k = 1,...,K$.
- $\eta_{1\cdot},...,\eta_{K\cdot}$ are independent a priori and are assumed to have a Dirichlet prior distribution, $\eta_{k\cdot} \sim D(e_{k1},...,e_{kK})$, $k = 1,...,K$.

The inference on the *joint* posterior distribution of the model parameters and the state variable, $\pi(\theta, s^T \mid y^T)$, is then obtained by successively simulating the parameters and the path of the state variable from their *conditional* posterior distribution. The sampling scheme includes the following steps (see appendix B for details):

Step 1. $\pi(\beta \mid y^T, s^T, \Sigma)$, simulating the VAR parameters given the data, the state variable and the covariance matrices out of a multivariate normal distribution. We check at each iteration whether the simulated parameters define a stationary system. If this is not the case, we reject the draw and retain the current values for the next sampling step.

Step 2. $\pi(\Sigma \mid y^T, s^T, \beta)$, simulating the covariance matrices given the data, the state variable and the VAR parameters out of K independent Wishart distributions.

Step 3. $\pi(s^T \mid y^T, \theta)$, simulating the state variable given the data and all model parameters using the multi-move sampler described in Chib (1996).

Step 4. $\pi(\eta \mid s^T)$, simulating the transition probabilities, which in fact depend only on s^T, from K independent Dirichlet distributions.

A permutation step completes each iteration of the sampler, in which the simulated parameters are permuted randomly to explore the unconstrained posterior distribution. In the presence of two states, this amounts to an interchange of all state-specific parameters and the state variable with a probability of 0.5, leaving them unchanged otherwise: $(\beta(1), \beta(2)) := (\beta(2), \beta(1))$, $(\Sigma(1), \Sigma(2)) := (\Sigma(2), \Sigma(1))$, $s^T = 3 - s^T$, $\eta_{ij} := \eta_{3-i,3-j}, i, j = 1,2$, if $U \leq 0.5$, where U is drawn from the uniform distribution.

Based on explorative tools like scatter plots and marginal posterior distributions of the simulated values of the state-specific parameters, we can then find a restriction that identifies the states[15] and according to which we reorder all simulated values to obtain the posterior inference on the model. With these tools, we also find a parsimonious representation of the system, in which parameters that are not switching or which are insignificant are restricted to zero (see appendix C).

To assess our model specification, we estimate the marginal likelihoods, with which we also can test the switching specification against a linear alternative by means of the Bayes factor. The marginal likelihood is estimated using the optimal bridge sampler proposed by Frühwirth-Schnatter (2004; see also appendix C for technical details).

[15] In our empirical investigation, it turned out that for some systems one of the constants, in particular the growth rate of consumption or the growth rate of investment, could be used to identify the states. In these cases, the states relate primarily to periods of above- and below-average growth in one variable. In other systems, the states can be discriminated on the basis of an autoregressive coefficient (see appendix D).

The appropriate parsimonious and identified model is then used to compute state-dependent impulse response functions, the structural model being identified by means of a Cholesky decomposition of the state-specific covariance matrix. We obtain the distribution (mean and confidence interval) of the impulse responses by using draws of the MCMC simulations of the model parameters and by computing the respective impulse responses.

5. Results

(a) Data and model selection

The model outlined in section 4 is used to build five-variable systems for loans to non-financial corporations and for loans to households. We use seasonally adjusted quarterly data covering the period from the first quarter of 1980 up to the last quarter of 2002. The effective sample period is adjusted to the country-specific data length (see graphs 3 to 10 in appendix A). Because of the well-known identification problem, we do not distinguish between credit demand and supply. The system which describes loans to non-financial corporations includes (in the following order): investment, imports, consumer price index (CPI), loans to non-financial corporations and the three-month interest rate.[16] Household consumption, net disposable income, CPI, loans to households and the short-term interest rate form the second system. All variables are expressed in real terms (except for the CPI and the short-term interest rate) and in quarterly percentage growth rates. Interest rate changes are expressed in basis points (the first difference of the level times 100). The data is demeaned for computational purposes and we include dummy variables where required.[17]

First we estimate an unrestricted version of each model with two lags in which all parameters are switching. Based on this benchmark estimation, we restrict those

[16] The choice of the short-term interest rate is driven by our interest in studying the effects of monetary policy and also by the fact that a substantial share of loans are extended with a variable interest rate clause. In particular for Austria, the data show that lending rates (unfortunately only available from 1995 onward) follow the short-term interest rate more closely than the long-term interest rate.

parameters that are not switching to be equal across regimes and those that are insignificant to be zero (see appendix C for the model selection procedure). The unrestricted and the final specifications (see appendix D) are also tested against a non-switching specification by means of marginal likelihoods, i.e. by using the Bayes factor.[18] Table 1 also shows results for the case of an unrestricted switching and a non-switching (linear) specification of the VAR model with one lag. In all cases, the final specification is preferred to all others.

In the following, we discuss the results for each country. We expect to relate the posterior state probabilities to specific economic periods and/or to specific credit regimes. In addition, we expect to observe asymmetric responses to shocks between regimes. The difference in responses should be smaller for countries with bank-based financial systems (Austria and Germany).

Table 1: Log of the marginal likelihoods of various model specifications

	Austria	**Germany**	**Netherlands**	**United Kingdom**
Loans to non-financial corporations				
Non-switching 2 lags	-1334.37	-1384.90	-1295.41	-1757.52
Unrestricted 2 lags	-1321.79	-1383.04	-1264.11	-1736.24
Non-switching 1 lag	-1308.32	-1369.76	-1284.32	-1816.69
Unrestricted 1 lag	-1326.08	-1371.36	-1267.53	-1768.60
Final specification	**-1291.24**	**-1351.26**	**-1230.40**	**-1724.98**
Loans to households				
Non-switching 2 lags	-813.69	-882.97	-769.35	-1580.96
Unrestricted 2 lags	-734.21	-1027.06	-726.25	-1438.77
Non-switching 1 lag	-797.36	-853.27	-748.02	-1539.65
Unrestricted 1 lag	-762.64	-1051.17	-743.26	-1434.37
Final specification	**-715.85**	**-799.92**	**-708.31**	**-1409.40**

[17] See the graphs in appendix A.
[18] Twice the difference of the log of the marginal likelihood is interpretable on the same scale as the well-known likelihood ratio test with X^2 distribution.

(b) Austria

The posterior state probabilities obtained from the system for loans to non-financial corporations are depicted in graph 11. Regime 1, depicted in the upper panel, can be broadly related to economic conditions. It prevails during the periods of 1982–1983, 1986–1987, 1992–1993, 1995–1997, 1998–1999 and from mid-2001 until the end of 2002. These correspond to the periods of below-average growth for Austria and other European countries identified by Kaufmann (2001, 2004) and are broadly consistent with the dating by the Centre for Economic Policy Research (CEPR) and that by Artis et al. (2003) for the euro area. The impulse responses shown in graph 12 (along with a 95% confidence interval) illustrate that lending is not a significant determinant of investment since in both regimes the response of investment to loan shocks is insignificant. The reaction of investment to interest rate shocks is almost identical in both regimes, but is somewhat more pronounced when economic growth is below average (regime 1). Loans react significantly positively to both investment and interest rate shocks in both regimes, responses once more being stronger in periods of below-average economic growth (regime 1). These results suggest that lending is demand driven rather than supply driven,[19] which is consistent with the weak microeconomic evidence for a bank lending channel in Austria (Frühwirth-Schnatter and Kaufmann, 2004, and Kaufmann, 2003). Moreover, the much weaker response of loans to investment in periods of normal growth (regime 2) reflects the fact that substitutes to bank loans such as retained earnings are preferred during an economic upturn, which is also consistent with previous evidence of a balance sheet channel in Austria (Valderrama 2001, 2003a, 2003b). Since investment does not seem to react to lending in any regime, there is no evidence that credit aggregates amplify business cycles. These results reflect the fact that due to the “house bank” principle, investment does not face credit constraints in any regime.

The posterior state probabilities for the system of loans to households (see graph 13) are not obviously related to economic conditions as is the case for loans to firms. Regime 1 prevails during the periods of 1987–1988 and 1995–1996. The period of 1987–1988 corresponds to the beginning of the Austrian financial market's liberalization and to an increase in real estate prices (Braumann, 2002). The period of 1995–1996 coincides with a strong increase in consumer credit as commercial banks were trying to compensate for the decrease in public debt-financed deficits. Regime 1 is thus characterized by periods of rapid loan growth. The impulse response functions (see graph 14) are very different from those of the firms' loans system. In periods of normal loan growth (regime 2), consumption, as expected, reacts significantly positively to loan shocks. If credit conditions are lax (regime 1), however, the reaction is insignificant, which implies that consumption is not constrained by lack of financing during periods of lower lending growth. Consumption does not react significantly to interest rate shocks in any regime. Loans do not react significantly to consumption shocks or interest rate shocks in any regime. This could be explained by the fact that a large percentage of lending to households is used for residential investment.[20]

(c) Germany

The posterior probabilities of regime 1 (graph 15) are indicative of economic slowdowns (1980–1982, 1984–1985, 1992–1993, 1995, 1997–1998, 2000–2002). The impulse responses in graph 16 show that investment does not react significantly to loans in either regime. Responses, however, tend to be more pronounced during a slowdown (regime 1). Thus, credit aggregates do not amplify negative shocks during the downturn. During periods of normal growth (regime 2), investment does react positively and marginally significant to interest rate shocks, while there is no significant response in

[19] We define demand-driven lending as a situation in which lending reacts to spending and the reaction to an interest rate shock is not negative. When lending is supply driven, there is no reaction to spending and the reaction to an interest rate shock is negative.

regime 1. Loans, by contrast, respond positively to shocks to investment in both regimes, while their response to interest rate shocks is significant but differs between regimes: It is positive in regime 2 and negative in regime 1, indicating that bank lending is demand driven in periods of normal growth , which confirms the expected effect of the "house bank" principle.

The posterior state probabilities estimated for the system of loans to households (graph 17) reveal that regime 2 prevails most of the time until 1995 and, thus, a meaningful relation to economic conditions cannot be established. After 1995, however, the posterior state probabilities are similar to those found for non-financial corporations. Given the high growth in lending to households observed since 1995, regime 1 can be characterized as a state in which access to credit was not constrained for households. The response of consumption to lending (see graph 18), however, is insignificant in this regime, while it is negative and significant in periods in which credit seems to have been more restricted (regime 2). This result appears counterintuitive, but as the examined data includes mortgage loans, it may reflect the cautious behavior of German households, which tend to restrict consumption as their residential debt increases. Another reason for this result might be that consumer credit was not widely used until the mid-1990s. Consumption does not react significantly to shocks in the short-term interest rate in any regime. The responses of lending to consumption and to interest rate shocks are always insignificant in regime 1, while in times of credit restrictions (regime 2) lending reacts positively to consumption shocks and negatively to interest rate shocks. These responses correspond to the expected reaction of credit markets under the bank lending channel. However, we cannot observe the expected amplifying effect of lending on consumption.

---

[20] Unfortunately, it is not possible to extract consumer credit from this data.

(d) Netherlands

The posterior state probabilities for non-financial corporations reveal that one state prevails most of the time. It is therefore difficult to relate the states to business cycles in the Netherlands[21] (graph 19). Regime 2, nevertheless, captures periods in which loan growth relative to investment growth was low (see graph 7) – which is characteristic of a state in which access to credit is constrained –, accompanied by falling interest rates.

An analysis of the impulse responses (graph 20) shows some asymmetries between regimes. Although investment always reacts positively and significantly to both loan and interest rate shocks, responses are significantly stronger in periods of restricted credit (regime 2). This indicates that credit markets may amplify shocks during regime 2, which is consistent with the financial accelerator view of the credit channel. Moreover, we observe that lending does not react significantly to investment shocks in periods of credit tightening (regime 2), whereas it reacts negatively to them in regime 1. When credit access is not constrained (regime 1), these findings are consistent with firms' behavior in a market-based financial system, in which firms prefer to finance themselves by retained earnings or other sources of external funds.[22] Although credit growth does not react to investment in regime 2, it cannot be classified as supply driven since lending reacts positively to interest rate shocks.[23] The posterior state probabilities for loans to households depicted in graph 21 show that regime 1 can be related to the troughs of the business cycle as dated by the Dutch central bank (DNB 2002). Although most impulse responses are insignificant, we can observe some asymmetries across regimes (see graph 22). The reaction of consumption to loan shocks is insignificant in both regimes, but at the trough of the economic downturn (regime 1) the response is more pronounced and positive, indicating

[21] See for example, DNB Quarterly Bulletin, December 2002.

[22] See de Haan and Hinloopen (2003), who show that the most preferred financing form of Dutch firms is internal financing.

[23] This is consistent with other evidence on the Netherlands, in which the bank lending channel is weakened due to customer relationships and banks' possibility of isolating monetary shocks. See Kakes (1998), Jacobs and Kakes (2000) and de Haan (2003).

that credit aggregates on average have positive effects. This is confirmed by the insignificant reaction of loans to consumption and to interest rate shocks in regime 1. In regime 2, lending reacts positively to consumption shocks and negatively, to interest rate shocks. Overall, however, these responses are insignificant, which may be explained by the large share of mortgage loans in the credit series and by the fact that growth in household lending has been accompanied by a housing market boom, which is not captured in our model and does not have a direct effect on consumption.[24]

(e) United Kingdom

The posterior state probabilities obtained from the system for loans to non-financial corporations (graph 23) are closely correlated to economic conditions in the UK. Regime 1 nicely captures the recessions at the beginning of the 1980s and during the years from 1990 to 1993, as well as the most recent recession in 2001. Regime 2 consequently represents periods of "normal" economic conditions.

The response of investment (graph 24) to shocks in loans is positive and significant under normal economic conditions and insignificant during periods of economic slowdown. As in the case of bank-based systems, this implies, that lending does not amplify shocks during downturns. In periods of normal growth (regime 2), however, investment reacts significantly negatively to interest rate shocks, while its response is insignificant during times of economic slowdown (regime 1). Lending to non-financial corporations reacts significantly positively to investment and interest rate shocks in periods of normal growth, but insignificantly, during downturns. Finally, it is worth mentioning that in times of normal economic growth, the interest rate reacts positively to inflation shocks, while its response is insignificant during periods of ecomomic slowdown. Overall, these results document the procyclicality of credit markets during normal economic conditions and a rather limited effect of both lending and monetary policy during downturns.

[24] See DNB, 2000.

The regimes identified for the system of loans to households are not as clearly correlated to the business cycle as the model discussed earlier. Nevertheless, the posterior state probabilities of regime 1 (graph 25) can be described as weakly correlated to economic conditions until 1992. Regime 2 prevails most of the time after 1992, which coincides with periods of rapid credit growth relative to GDP (see graph 1).

Although the signs of responses differ across regimes, the response of consumption to both lending and interest rate shocks is insignificant in both regimes (graph 26). The response of loans to consumption shocks, however, is only insignificant during periods of low credit growth and positively significant in times of above-average credit growth (regime 2). While, as long as credit growth is moderate, lending reacts positively to interest rate shocks, it does not do so in periods of rapid credit growth. This is consistent with the rapid liberalization of the consumer credit market in an environment of falling interest rates, which implies that lending is demand driven in this regime (regime 2). The finding that consumption does not react significantly to loan shocks may reflect the fact that the increased lending observed since the mid-1990s have not been used to finance consumption but rather residential and financial investment.

6. Rounding up: country comparisons

In a set of tables, we now summarize our main findings and compare the results across countries. In table 2, we relate the estimated state probabilities to either economic or credit market conditions. In all countries except the Netherlands regime-switching in the system of non-financial corporations is driven by economic conditions, while for loans to households it can be related to credit market conditions. These results are consistent with the hypothesis that market imperfections, such as asymmetric information and moral hazard, affect households and firms in different ways. Lending to households is expected to be more strongly supply-side driven and therefore lending relationships matter less in this context. During the period under study, all countries experienced a process of financial liberalization, which was accompanied by a rapid growth of consumer credit. Presumably this effect dominated bank lending during this period, which explains our findings that lending to households is not correlated to business cycles (except for the Netherlands). As Dutch firms can access capital markets more easily and prefer internal financing, lending is not a prime determinant of investment in the Netherlands.[25]

Table 2: Regime-switching driven by:

	Firms	Households
AT	economic conditions	credit market conditions
DE	economic conditions	credit market conditions
NL	credit market conditions	economic conditions
UK	economic conditions	credit market conditions

The effects of lending on spending variables depend on the country-specific financial system (see table 3). As one would expect for bank-based systems, in which the house bank principle prevails, lending to non-financial corporations does not influence investment in either regime. Its effect is, however, asymmetric in market-based financial systems. In the systems for loans to households, we find exactly the opposite to be the case. Thus, as expected for bank-based financial systems, lending to non-financial corporations neither propagates nor amplifies shocks, while lending to households affects consumption. In particular for Austria, we observe that lending amplifies shocks in times of rapid credit growth, while it does not do so in the regime in which credit growth is subdued. The results for market-based financial systems show exactly the opposite situation. We find that lending to non-financial corporations has procyclical effects during "normal" economic conditions, whereas it has an insignificant effect on investment during downturns. Thus, even in market-based financial systems, bank lending shields businesses from tight liquidity conditions during an economic slowdown. The fact that consumption is not affected by credit markets in market-based systems may be due to our inclusion of mortgage loans and to the increase in private households' financial investments. In bank-

[25] See De Haan and Hinloopen (2003).

based systems, we find that lending to households also increased in the second half of our sample in the wake of financial liberalization.

Table 3: Effects of lending on spending variables

	Firms	Households
AT	insignificant (slightly negative in periods of subdued growth)	positive in periods of rapid loan growth, otherwise insignificant
DE	insignificant (positive and slightly stronger during economic slowdowns)	insignificant in periods of rapid loan growth, otherwise negative
NL	both positive but stronger during periods of constrained credit	insignificant (near troughs of the business cycles the response is stronger and positive)
UK	insignificant during recessions, otherwise positive	insignificant (stronger and positive during periods of normal loan growth)

Table 4 summarizes the responses of lending to shocks in the spending variables. The response of lending to non-financial corporations again depends on the country-specific financial system and corroborates the hypothesis that lending is mainly demand driven in bank-based systems. In the case of loans to households, it is not possible to draw a clear conclusion.

Table 4: Effects of spending variables on lending

	Firms	Households
AT	positive, slightly stronger during periods of subdued economic growth	insignificant (equal across regimes)
DE	positive and equal across regimes	insignificant in periods of rapid loan growth, otherwise positive
NL	insignificant when credit is constrained, otherwise negative	insignificant near the troughs of the business cycle, otherwise positive
UK	insignificant during recessions, otherwise positive	positively significant during rapid loan growth, otherwise insignificant

We can also draw some conclusions on the relevance of the interest rate channel. In accordance with the credit view, the effect of interest rate changes on investment and consumption is in many cases insignificant (see table 5). We find, however, that the effects of interest rates differ between regimes. Thus, both credit aggregates and the interest rate have asymmetric effects on lending and on spending variables.

Table 5: Effects of interest rates on spending variables

	Firms	Households
AT	slightly stronger during periods of subdued economic growth (positive)	insignificant (slightly positive during periods of rapid loan growth)
DE	positive and marginally significant under normal conditions, insignificant during slowdowns	insignificant (positive, slightly stronger during periods of rapid loan growth)
NL	both positive, but stronger during periods of constrained credit	insignificant (positive and stronger during troughs of the business cycles)
UK	negative under normal economic conditions, insignificant during recessions	insignificant (slightly negative during rapid loan growth)

While we can relate the effect on spending variables to the country-specific financial system, this is not possible for the reaction of lending to interest rate shocks. We obtain asymmetric responses of lending to households for all countries, while asymmetric effects in lending to non-financial corporations are only found for the two larger countries.

Table 6: Effects of interest rates on lending

	Firms	Households
AT	positive, slightly stronger in periods of subdued economic growth	insignificant (slightly positive under normal conditions)
DE	positive under normal conditions, negative during slowdowns	insignificant in periods of rapid loan growth, otherwise negative
NL	positive and equal	insignificant at the troughs of the business cycle, otherwise negative
UK	significant, positive under normal conditions, insignificant during recessions	insignificant in periods of rapid loan growth, otherwise positive

7. Conclusions and policy implications

In this paper, we use a Markov-switching VAR model to test the following hypotheses, which were derived from theoretical models that relate credit aggregates to economic activity. First, due to market imperfections arising from asymmetric information, credit aggregates propagate or amplify shocks to the economy. Second, these imperfections become more stringent under certain economic conditions, e.g. during a recession or in periods of credit tightening. By comparing results for different countries, we are able to test whether these effects are stronger in market-based than in bank-based financial systems.

By analyzing households and non-financial corporations we are also in the position to assess the macroeconomic implications of our results.

We obtain evidence for two regimes in each of four countries, which, in countries where lending tends to be procyclical, can be related to periods of different economic conditions; in countries where lending is, for various reasons, unrelated to the business cycle, these regimes can be related to periods of different credit market conditions.

Moreoever, we investigate whether shocks are propagated more strongly in one of the regimes. This is of particular interest as a stronger procyclical response during a downturn or during a period of tight credit conditions could have destabilizing effects on the economy.

For Austria and Germany, the two countries under review that represent bank-based financial systems, we find that lending to non-financial corporations propagates shocks to the economy, but does neither amplify them nor constrain economic activity in periods of subdued growth or tight liquidity conditions. This confirms the stabilizing role of the “house bank” principle. In the case of households, we find that lending is not binding. Here, evidence is not as clear-cut as mortgage loans are included in lending to households.

In the two countries representing market-based financial systems, namely the Netherlands and the UK, we find evidence for a financial accelerator effect in the firm sector and, particularly for the UK, a strong procyclical effect of credit markets during periods of economic recovery. The evidence in the household sector is less significant, as the increased lending level of the 1990s has been used to finance residential and financial investment rather than consumption.

In summary, the initial hypotheses are partially confirmed: Credit aggregates act as propagators and have nonlinear effects on the real economy. In bank-based systems the effects of shocks are smoothed, while in market-based systems we can observe an amplifying effect during periods of good economic conditions. However, the destabilizing effects of procyclical lending during recessions are not found in the UK, while in the case of the Netherlands the evidence suggests that the slowdown in bank lending observed in the last two years may have contributed to an even stronger slowdown in economic activity.

These results have several interesting policy implications: The finding that lending is mostly demand driven may throw some light on the procyclicality of lending and its macroeconomic implications. The evidence of procyclicality during economic upturns suggests that positive economic expectations (whether well-founded or not) may contribute to a dangerous buildup of debt. However, the stronger procyclicality and implied instability of market-based systems in comparison with bank-based systems predicted by theoretical models is not confirmed in the case of the UK. It remains to be seen whether the fall in lending experienced in the Netherlands during recent years will constrain investments of non-financial corporations.

References

Artis, M. J., M. Marcellino, and T. Proietti, 2003, Dating the euro area cycle, CEPR Discussion Paper No. 3696.

Azariadis, C. and B. Smith, 1998, Financial intermediation and regime switching in business cycles, The American Economic Review 88, 516-536.

Bernanke, B.S. and A.S. Blinder, 1988, Credit, money, and aggregate demand, American Economic Review 78, 2, 435-439.

Bernanke, B.S. and A.S. Blinder, 1989, The Federal funds rate and the channels of monetary transmission, American Economic Review 82, 901-921.

Bernanke, B.S. and M. Gertler, 1989, Agency costs, net worth, and business fluctuations, American Economic Review 79, 1, 14-31.

Bernanke, B.S. and M. Gertler, 1995, Inside the black box: the credit channel of monetary policy transmission, Journal of Economic Perspectives 9, 1, 27-48.

Boissay, F., 2001, Credit rationing, output gap, and business cycles, European Central Bank, Working Paper No. 87.

Boot, A.W.A, 2000, Relationship banking: What do we know?, Journal of Financial Intermediation, 9, 7-25.

Borio, C. and P. Lowe, 2004, Securing sustainable price stability: should credit come back from the wilderness, paper presented at the ECB Workshop on “Asset Prices and Monetary Policy”

Borio, C. and W. White, 2004, Whither monetary and financial stability? The implications of evolving policy regimes, BIS Working Paper No. 147.

Braumann, B., 2002, Financial Liberalization in Austria, mimeo, Oesterreichische Nationalbank

Chatelain, J. B., A. Generale, I. Hernando, U. von Kalckreuth and P. Vermeulen, 2003, Firm investment and monetary transmission in the euro area, in: Monetary Policy transmission in the Euro Area, I Angeloni, A Kashyap and B Mojon (eds), Cambridge University Press (forthcoming) and also in Oxford Review of Economic Policy 2003.

Chib, S., 1996, Calculating posterior distributions and modal estimates in Markov mixture models, Journal of Econometrics 75, 79-97.

Chirinko, R. S. and J. A. Elston. 1996. Banking Relationships in Germany: Empirical Results and Policy Implications. Federal Reserve Bank of Kansas City. Research Working Paper 5.

Christiano, L.J., M. Eichenbaum, and C. Evans, 1996, The effects of monetary policy shocks: Evidence from the flow of funds, The Review of Economics and Statistics, 16-34.

DNB, 2000, Survey among Dutch mortgage-holders on the use of mortgage credit, Quarterly Bulletin, June.

DNB, 2002, Just a normal cyclical downturn in the Netherlands, Quarterly Bulletin, December.

Elsas, R. and J. P. Krahnen, 1998, Is Relationship Lending Special? Evidence from Credit-File Data in Germany, Journal of Banking and Finance 22, 1283–1316.

van Ees, H and H. Garretsen (1994), Liquidity and Business Investment: Evidence from Dutch Panel Data, Journal of Macroeconomics, 16:613-627.

van Ees, H., H. Garretsen, L. de Haan and E. Sterken (1998), Investment and Debt Constraints: Evidence from Dutch Panel Data, in S. Brakman, H. van Ees and S.K. Kuipers (editors), Market Behavior and Macroeconomic Modelling, London: MacMillan,159-179.

Frühwirth-Schnatter, S., 2001, MCMC estimation of classical and dynamic switching and mixture models. Journal of the American Statistical Association 96, 194-209.

Frühwirth-Schnatter, S., 2004, Estimating marginal likelihoods for mixture and Markov switching models using bridge sampling techniques. The Econometrics Journal 7, 143-167.

Frühwirth-Schnatter, S. and S. Kaufmann, 2004, How do changes in monetary policy affect bank lending. An analysis of Austrian bank data, Journal of Applied Econometrics, forthcoming.

Guariglia, A. 1999, The effects of financial constraints on inventory investment: evidence from a panel from UK firms, Economica, 66, pp.43-62.

de Haan, L. de, 2003, The credit channel in the Netherlands: evidence from bank balance sheets, in: Monetary Policy Transmission in the Euro Area", I Angeloni, A Kashyap and B Mojon (eds), 2003, Cambridge University Press (forthcoming).

de Haan, L. and J. Hinloopen 2003 Preference hierarchies for internal finance, bank loans, bond and share issues: evidence for Dutch firms, Journal of Empirical Finance, 10:661-681

de Haan, L. de and E. Sterken, 2002, Corporate governance, relationship lending and monetary policy: firm-level evidence for the Euro area, University of Groningen CCSO Working Paper No. 12.

Hamilton, J. D., 1994, Time Series Analysis, Princeton University Press.

Harhoff, D. and T. Körting, 1998 Lending Relationships in Germany: Empirical Results from Survey Data, Journal of Banking and Finance, Vol. 22, S. 1317-1353.

Hall, S. 2001 Financial accelerator effects in UK business cycle, Bank of England Working Paper. No. 150

Houston, J., and C.M. James, 1999. Do Relationships have Limits? Banking Relationships, Financial Constraints and Investment, Working Paper, University of Florida.

Jacobs, J. and J. Kakes, 2000, Credit demand asymmetry in the Netherlands, Mimeo

Kakes, J. 1998, Monetary transmission and bank lending in the Netherlands, Mimeo

von Kalckreuth, U., 2003, Monetary transmission in Germany: new perspectives on financial constraints and investment spending, in: Monetary Policy Transmission in the Euro Area, I Angeloni, A Kashyap and B Mojon (eds), Cambridge University Press.

Kashyap, A.K., J.C. Stein and D.W. Wilcox, 1993, Monetary policy and credit conditions: Evidence from the composition of external finance, The American Economic Review 83, 78-98.

Kaufmann, S., 2001, Asymmetries in bank lending behaviour. Austria during the 1990s. Oesterreichische Nationalbank, Working Paper 56.

Kaufmann, S., 2003, The cross-sectional and the time dimension of the bank lending channel: The Austrian case, in Monetary Policy Transmission in the Euro Area, I Angeloni, A Kashyap and B Mojon (eds), Cambridge University Press, pp 347-358.

Kaufmann, S., 2004, Business cycle synchronization of European countries. Evidence from a panel of GDP series, Oesterreichische Nationalbank, mimeo.

Kiyotaki, N. and J. Moore, 1997a, Credit cycles, Journal of Political Economy, 105, 2, 211-248.

Kiyotaki, N. and J. Moore, 1997b, Credit chains, mimeo, London School of Economics.

Kocherlakota, N.R., 2000, Creating business cycles through credit constraints, Federal Reserve Bank of Minneapolis Quarterly Review 24, 2-10.

Krolzig, H.M., 1997, Markov-Switching Vector Autoregressions (Springer, Berlin).

Litterman, R.B., 1986, Forecasting with Bayesian vector autoregressions – Five years of experience, Journal of Business & Economic Statistics 4, 25-38.

Meng, X.-L. and W.H. Wong, 1996, Simulating ratios of normalising constants via a simple identity, Statistica Sinica 6, 831-860.

Ongena, S., and Smith, D.C., 1998, Bank Relationships: A Review, in "The performance of financial institutions, eds. P. Harker and S. Zenios, Cambridge University Press.

Petersen, M., and R. Rajan, 1994,. The Benefits of Lending Relationships: Evidence from Small Business Data, Journal of Finance 49, 1367-1400.

Petersen, M., and R. Rajan, 1995, The Effect of Credit Market Competition on Lending Relationships, Quarterly Journal of Economics 110, 406-443.

Rajan, R. and L. Zingales, 2003, Banks and Markets: The Changing Character of European Finance, NBER Working Paper No. 9595.

Scheinkman, J.A. and L. Weiss, 1986, Borrowing constraints and aggregate economic activity, Econometrica 54, 23-45.

Sensier, M., D. R. Osborn and N. Öcal, 2002, Asymmetric Interest Rate Effects for the UK Real Economy, Centre for Growth & Business Cycle Research, University of Manchester, Discussion Paper No. 010.

Stiglitz, J.E. and A. Weiss, 1981, Credit rationing in markets with imperfect information, The American Economic Review 71, 393-410.

Tierney, L., 1994, Markov chains for exploring posterior distributions (with discussion), Annals of Statistics 22, 1701-1762.

Valderrama M.T., 2001, Balance Sheet and Bank Lending Channels: some evidence from Austrian firms, Oesterreichische Nationalbank, Focus on Austria, 3-4.

Valderrama M.T., 2003a, Credit Channel and Investment Behavior in Austria: a Micro-Econometric Approach, in Monetary Policy Transmission in the Euro Area, I Angeloni, A Kashyap and B Mojon (eds), Cambridge University Press, 221-232.

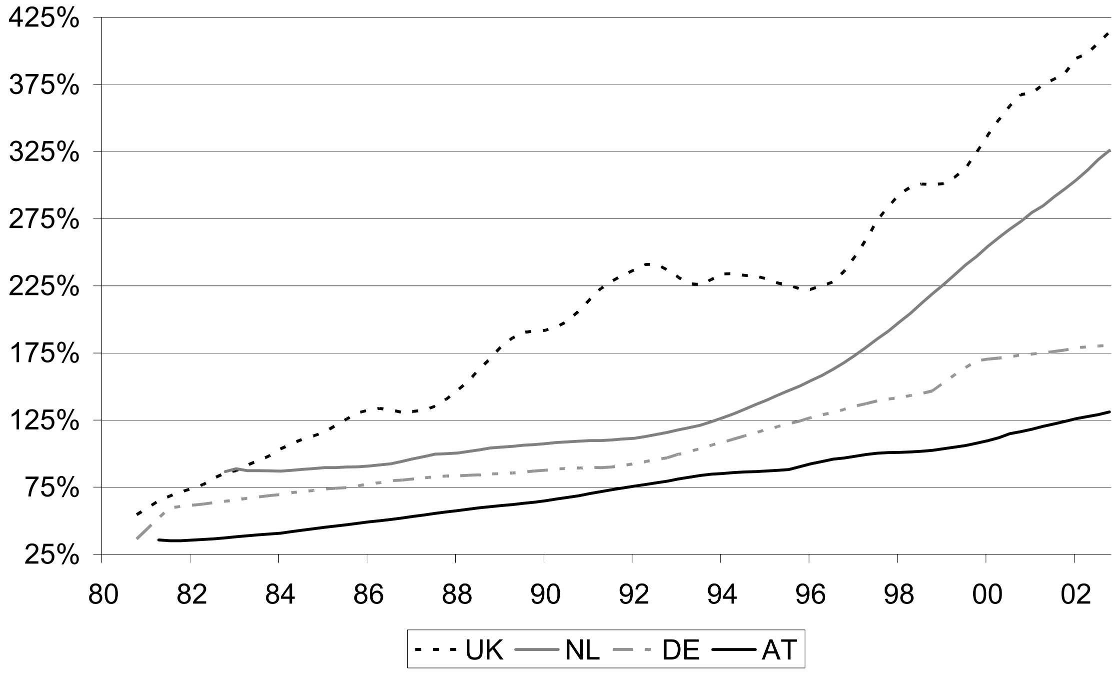
Valderrama, M.T., 2003b, Banking Structure and Investment in Austria: Some Empirical Evidence, Focus on Austria, 1.

Vermeulen, P. 2002. Business fixed investment: evidence of a financial accelerator in Europe, Oxford Bulletin of Economics and Statistics, Vol. 64, No 3, pp 213 – 231.

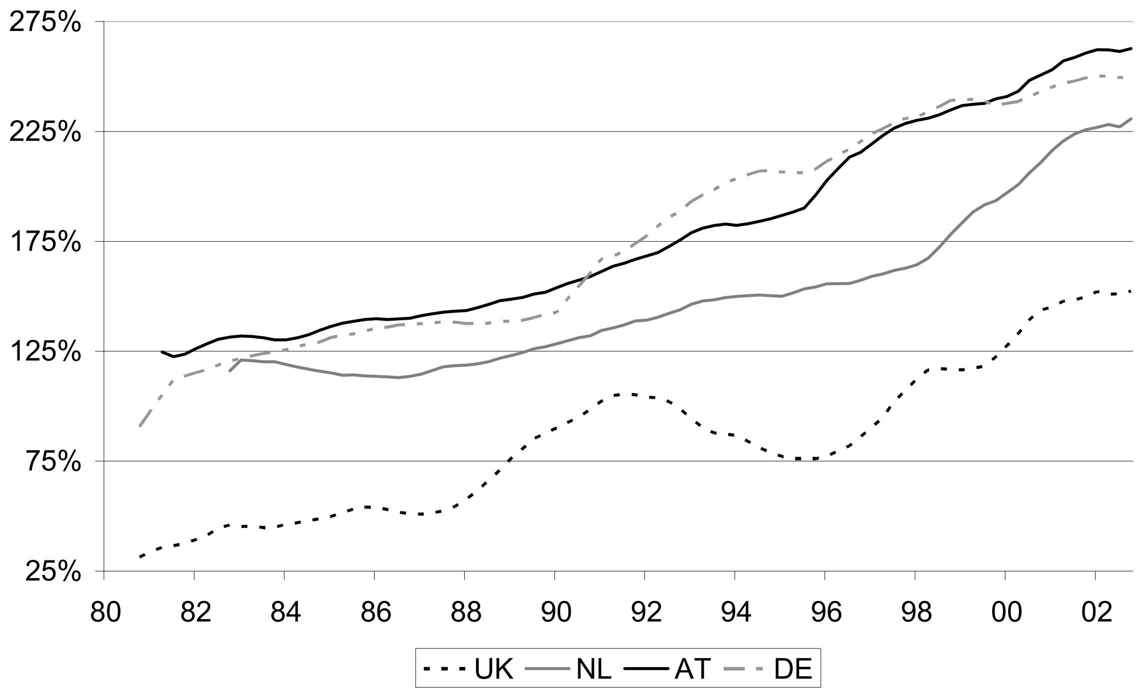
Wesche, K., 2000, Is there a Credit Channel in Austria? The Impact of Monetary Policy on Firms' Investment Decisions, Oesterreichische Nationalbank Working Papers No. 41.

8. Appendix A: Graphs

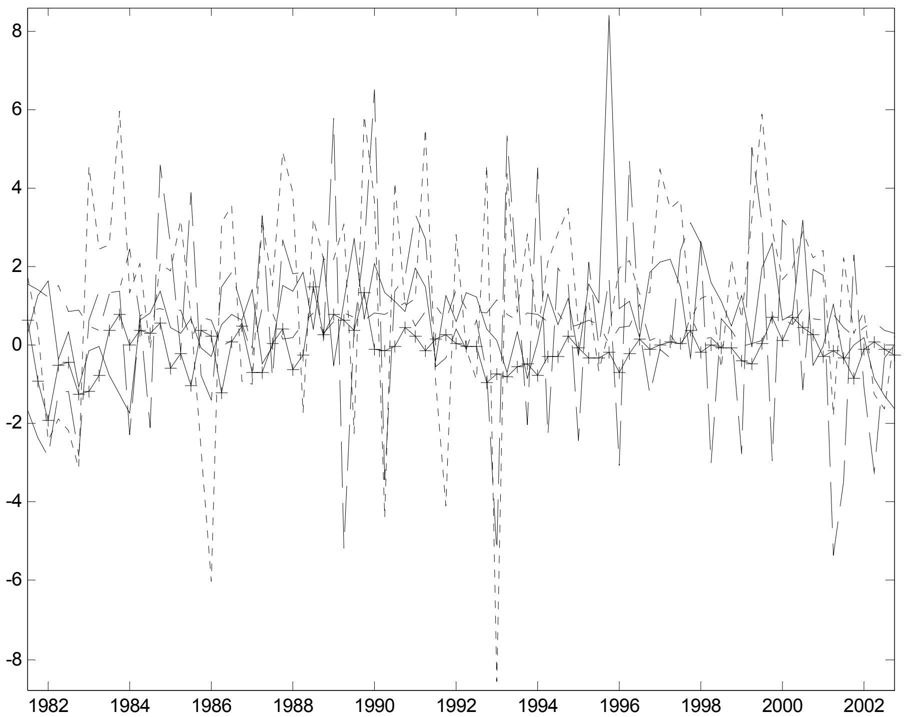
Graph 1. Ratio of loans to households to GDP



Graph 2. Ratio of loans to non-financial corporations to GDP

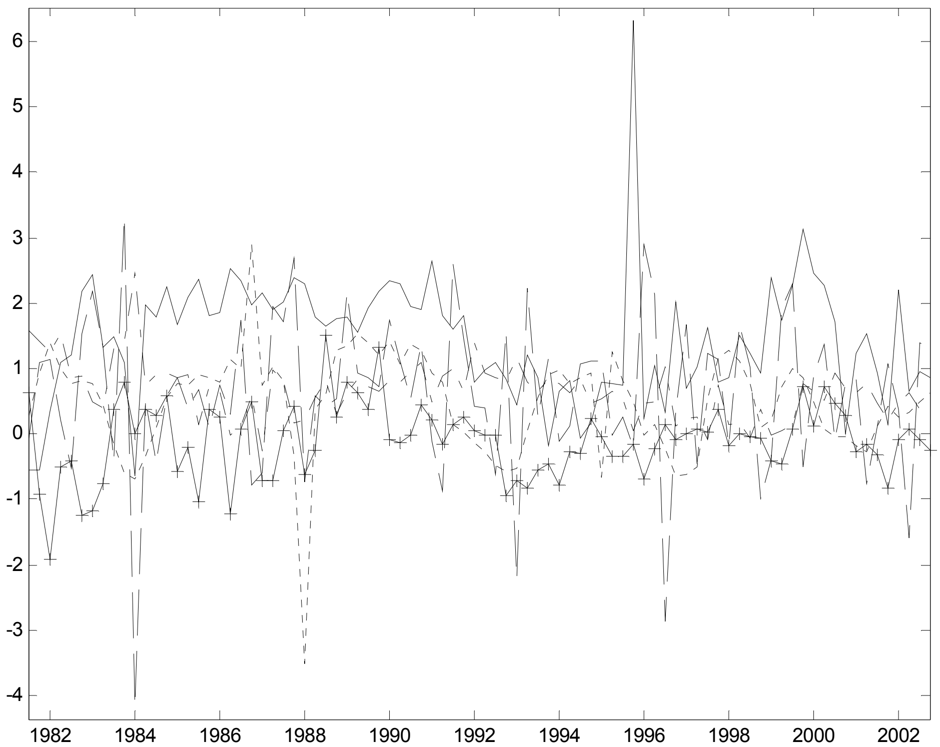


Graph 3. Austria. Loans to non-financial corporations



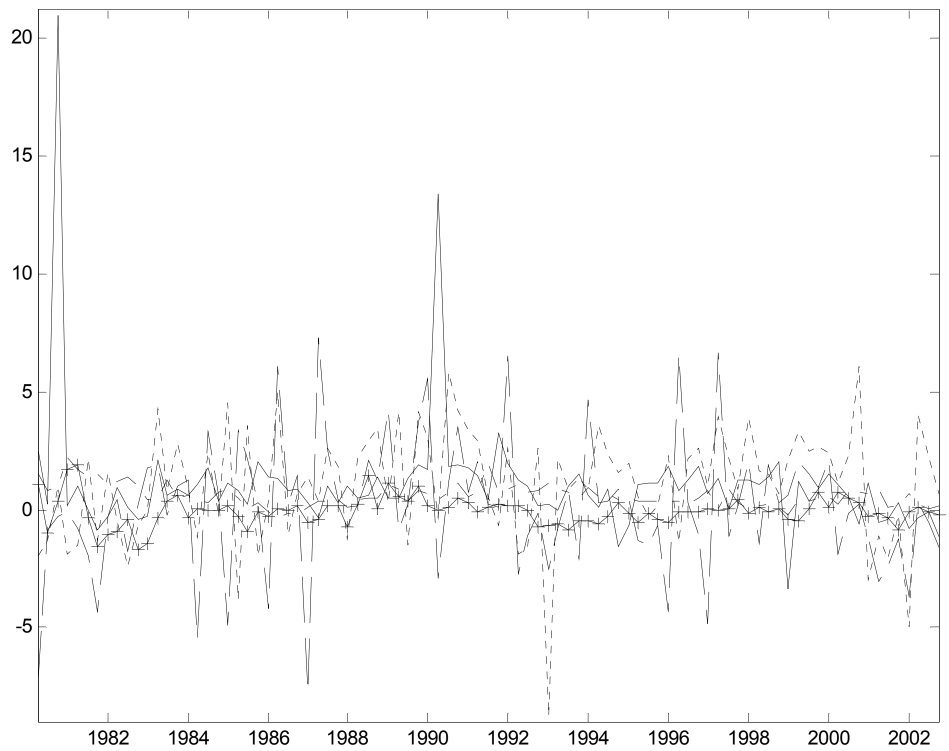
Investment (dashed), Imports (dotted), CPI (dash-dotted), Loans to firms (solid), Interest rate (solid +). Dummy variables: Loans (1995Q4) and CPI (1984Q1, VAT increase).

Graph 4. Austria. Loans to households



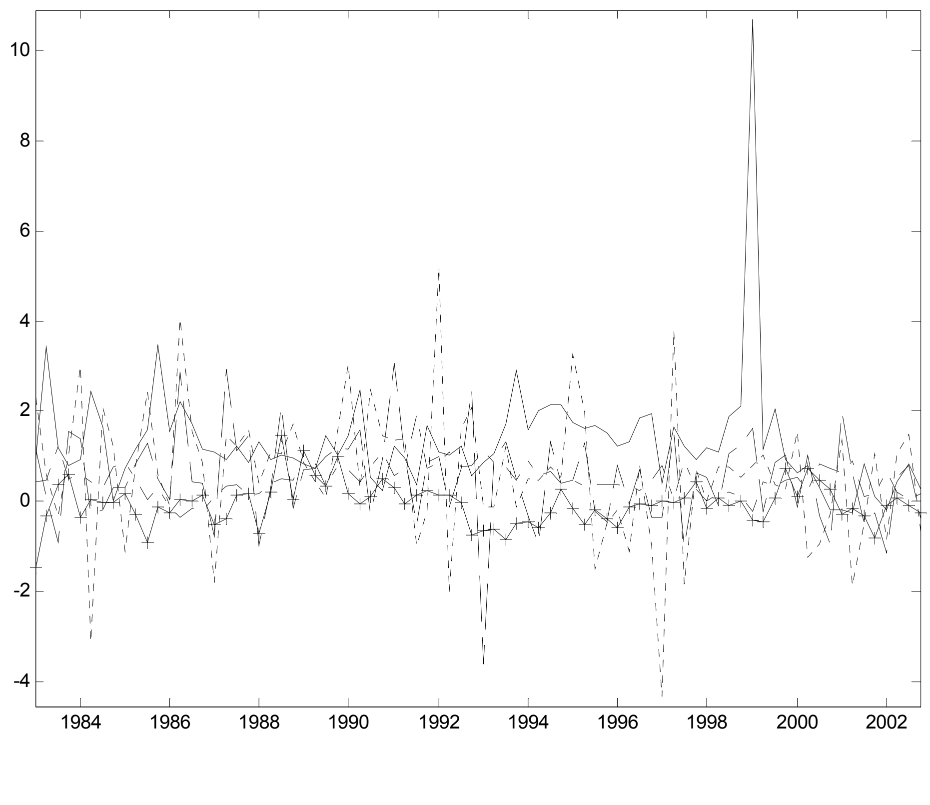
Households' consumption (dashed), Net disposable income (dotted), CPI (dash-dotted), Loans to households (solid), Interest rate (solid +). Dummy variables: Loans (1995Q4), CPI (1984Q1, VAT increase), Consumption (1983Q4, 1984Q1, anticipated and actual effect of VAT increase), Net disposable income (1987Q4, 1988Q1).

Graph 5. Germany. Loans to non-financial corporations



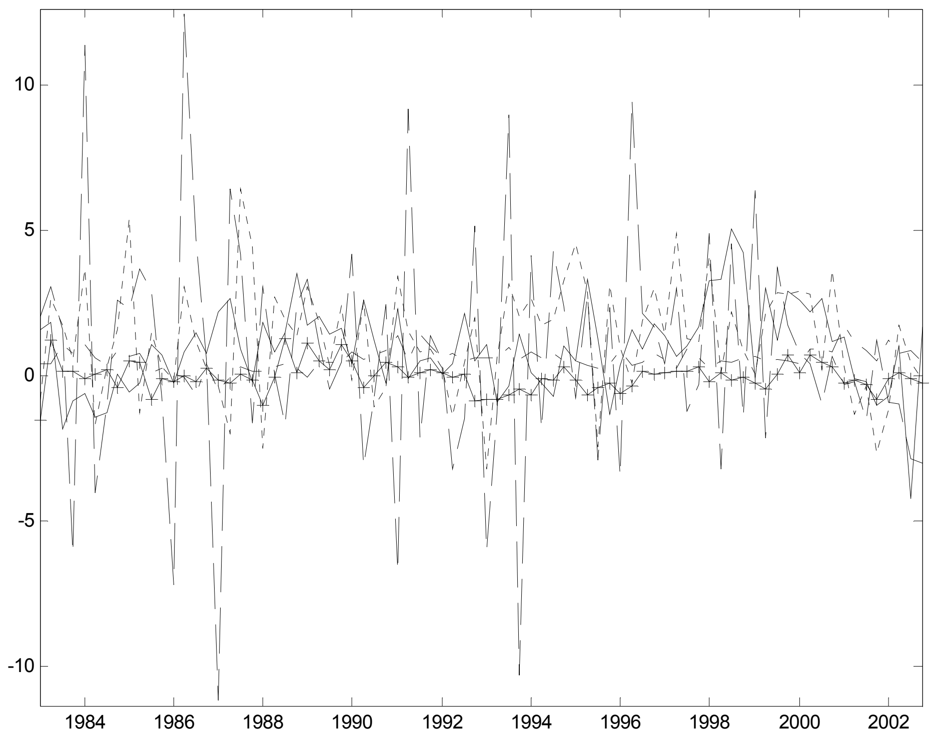
Investment (dashed), Imports (dotted), CPI (dash-dotted), Loans to firms (solid), Interest rate (solid +). Dummy variables: Loans (1980Q4, 1990Q2, 1999Q1).

Graph 6. Germany. Loans to households



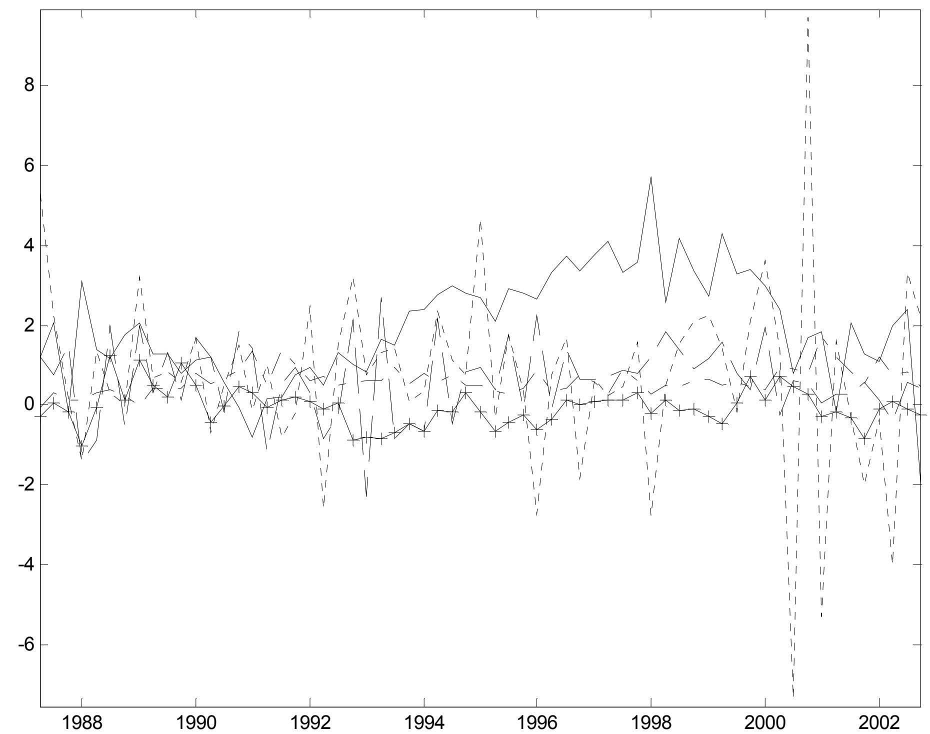
Households' consumption (dashed), Net disposable income (dotted), CPI (dash-dotted), Loans to households (solid), Interest rate (solid +). Dummy variables: Loans (1980Q4, 1999Q1).

Graph 7. Netherlands. Loans to non-financial corporations



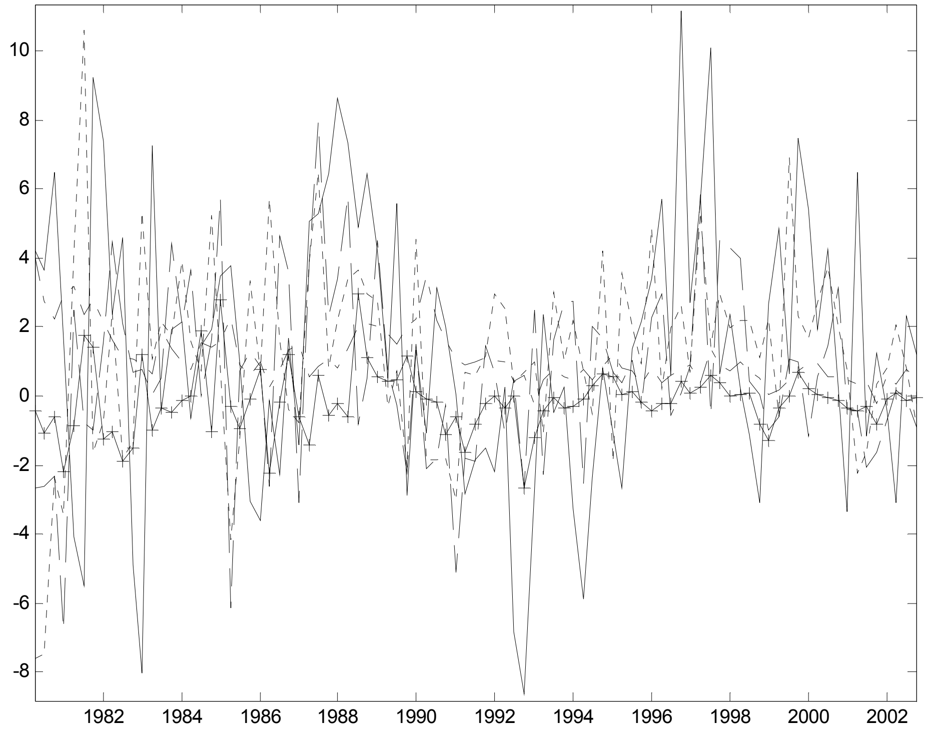
Investment (dashed), Imports (dotted), CPI (dash-dotted), Loans to firms (solid), Interest rate (solid +). Dummy variables: Loans (1995Q4) and CPI (1984Q1, VAT increase).

Graph 8. Netherlands. Loans to households



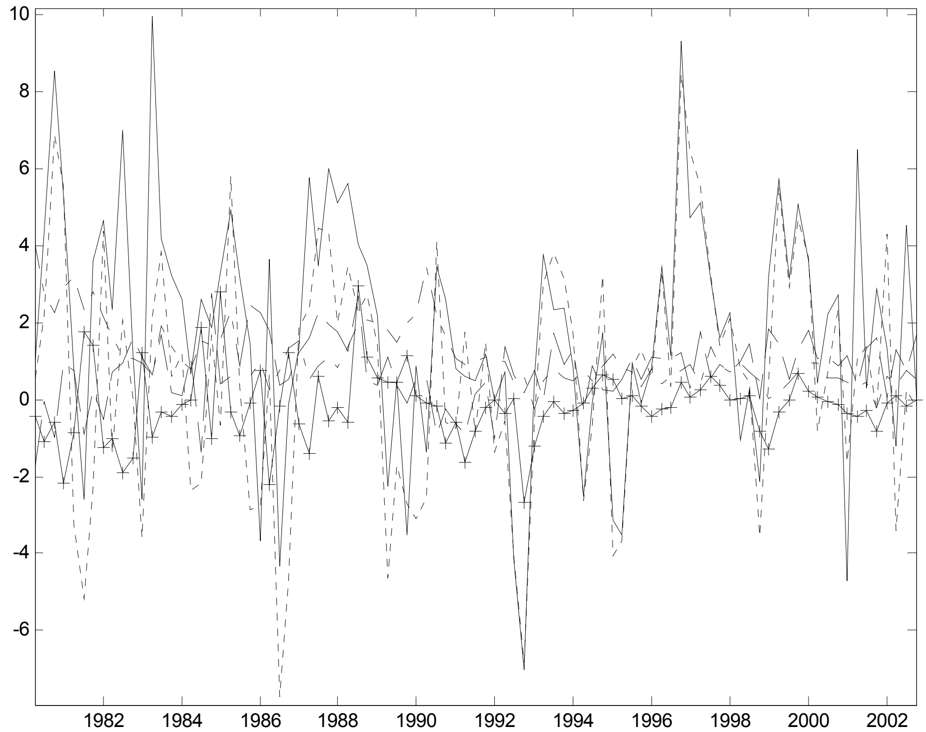
Households' consumption (dashed), Net disposable income (dotted), CPI (dash-dotted), Loans to households (solid), Interest rate (solid +). Dummy variables: Net disposable income (2000Q3, 2000Q4, 2001Q1).

Graph 9. United Kingdom. Loans to non-financial corporations



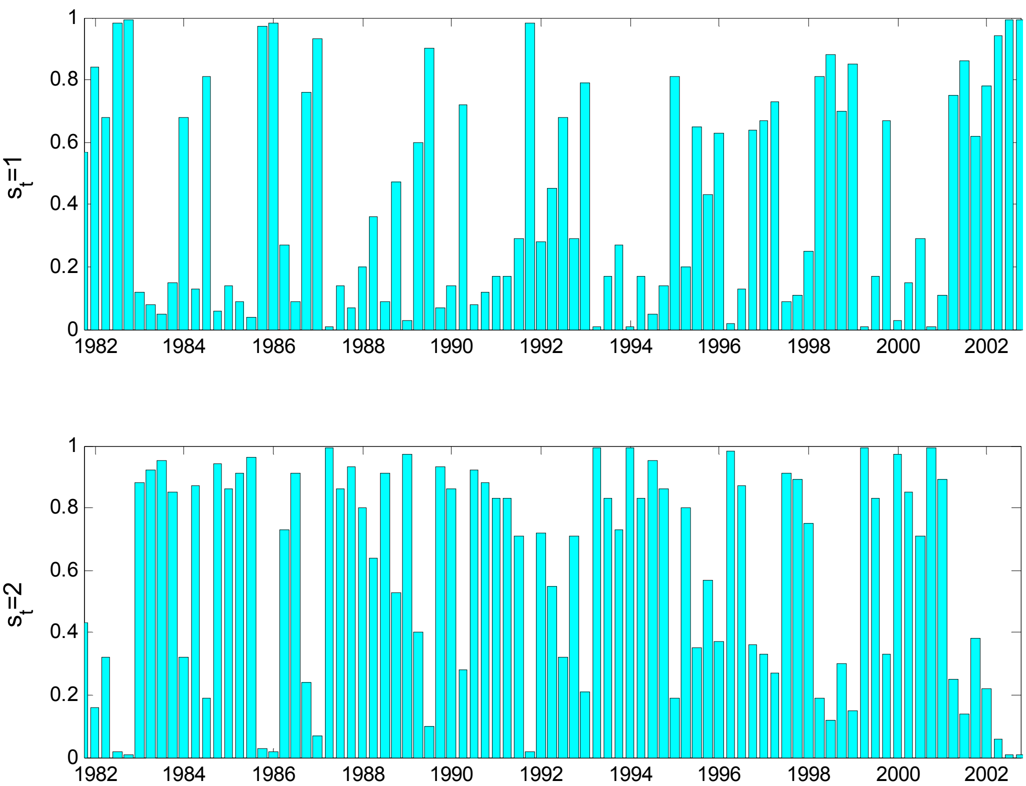
Investment (dashed), Imports (dotted), CPI (dash-dotted), Loans to firms (solid), Interest rate (solid +). Dummy variables: Loans (1995Q4) and CPI (1984Q1, VAT increase).

Graph 10. United Kingdom. Loans to households

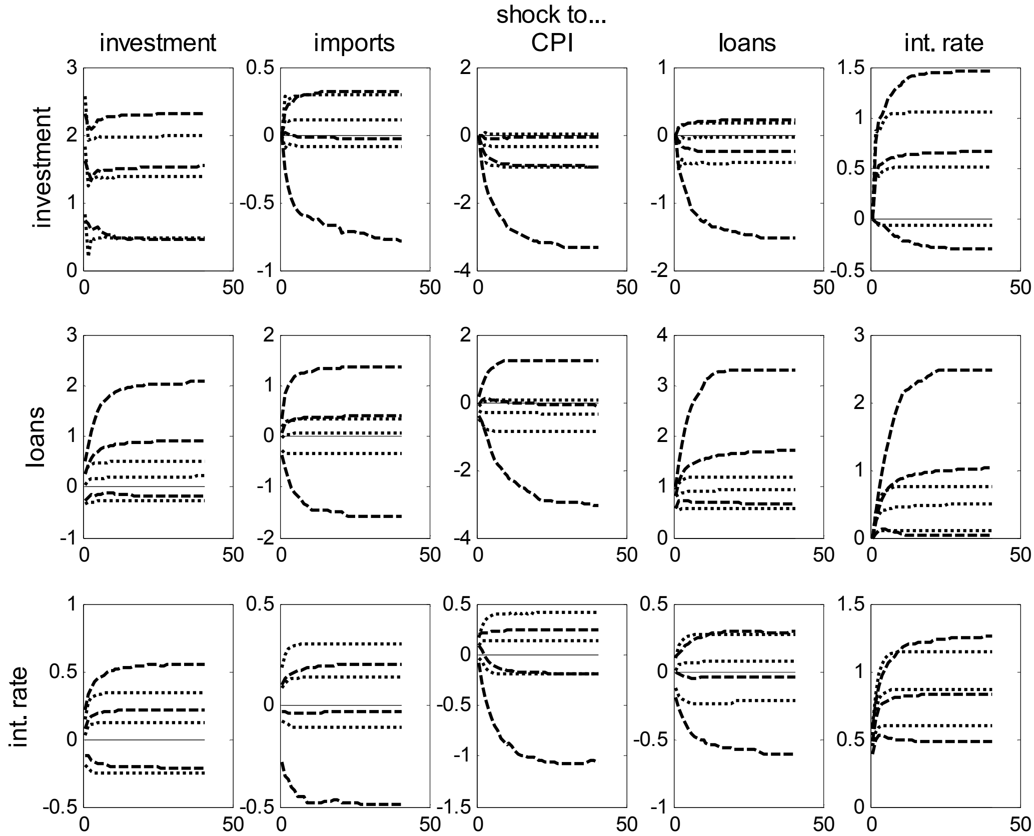


Households' consumption (dashed), Net disposable income (dotted), CPI (dash-dotted), Loans to households (solid), Interest rate (solid +).

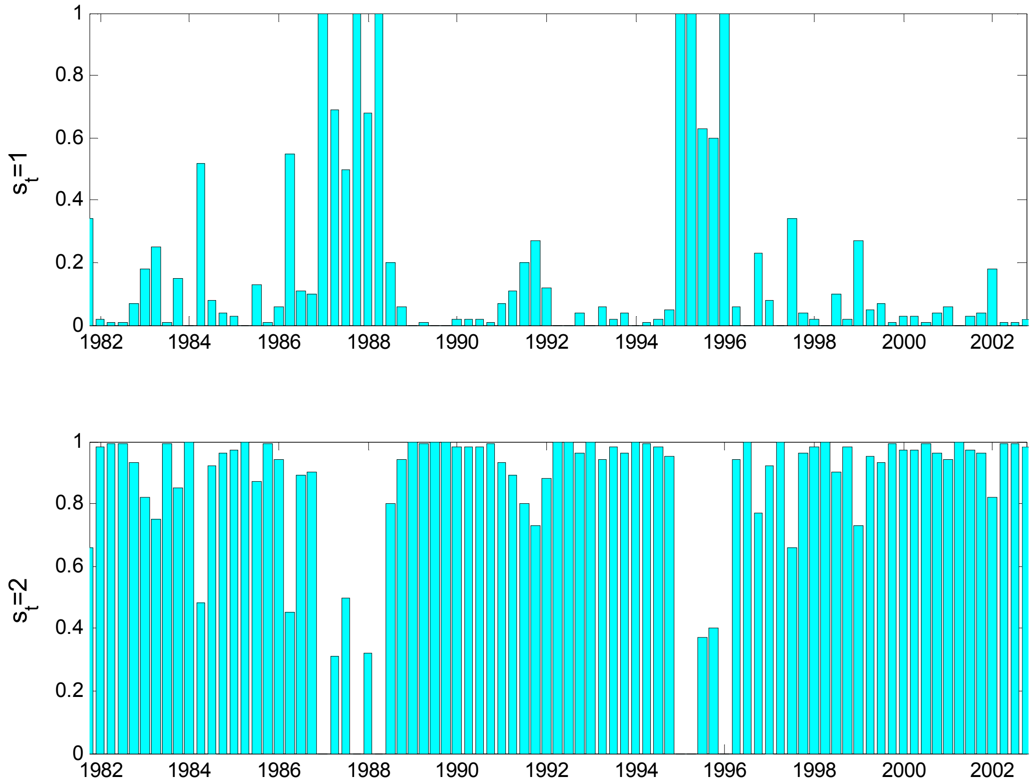
Graph 11. Austria. Loans to firms, posterior state probabilities.



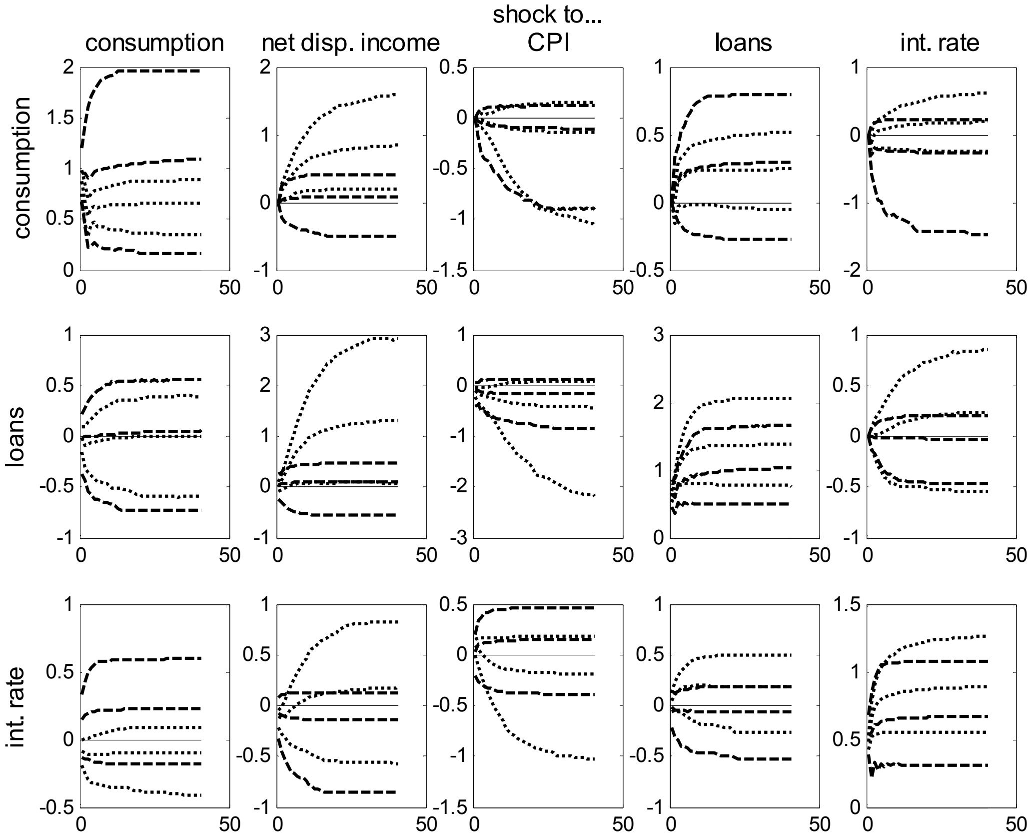
Graph 12. Austria. Loans to firms, IRF, regime 1 (dashed) and regime 2 (dotted).



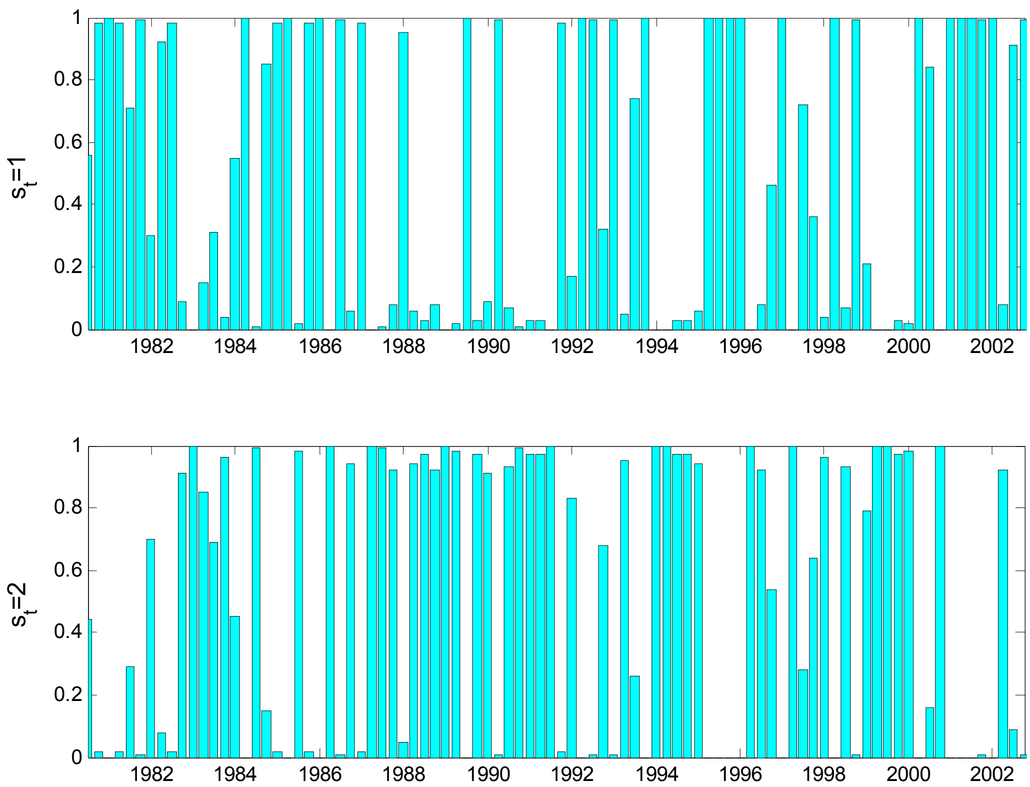
Graph 13. Austria. Loans to households, posterior state probabilities.



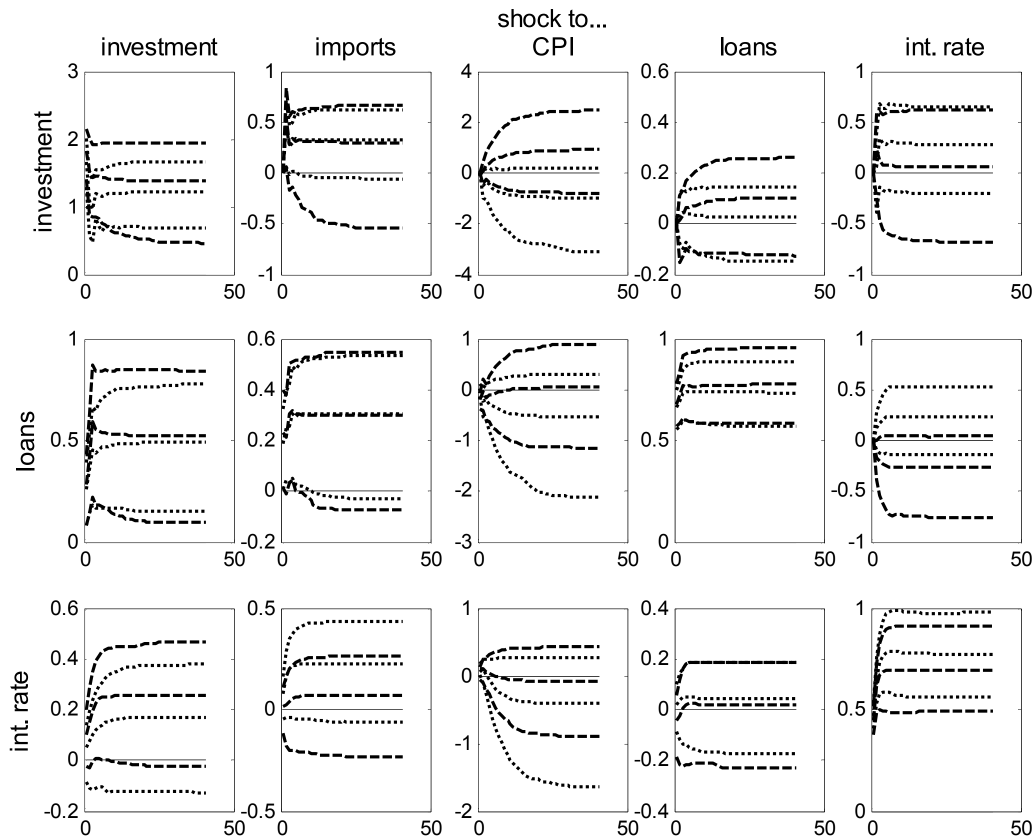
Graph 14. Austria. Loans to households, IRF, regime 1 (dashed) and regime 2 (dotted).



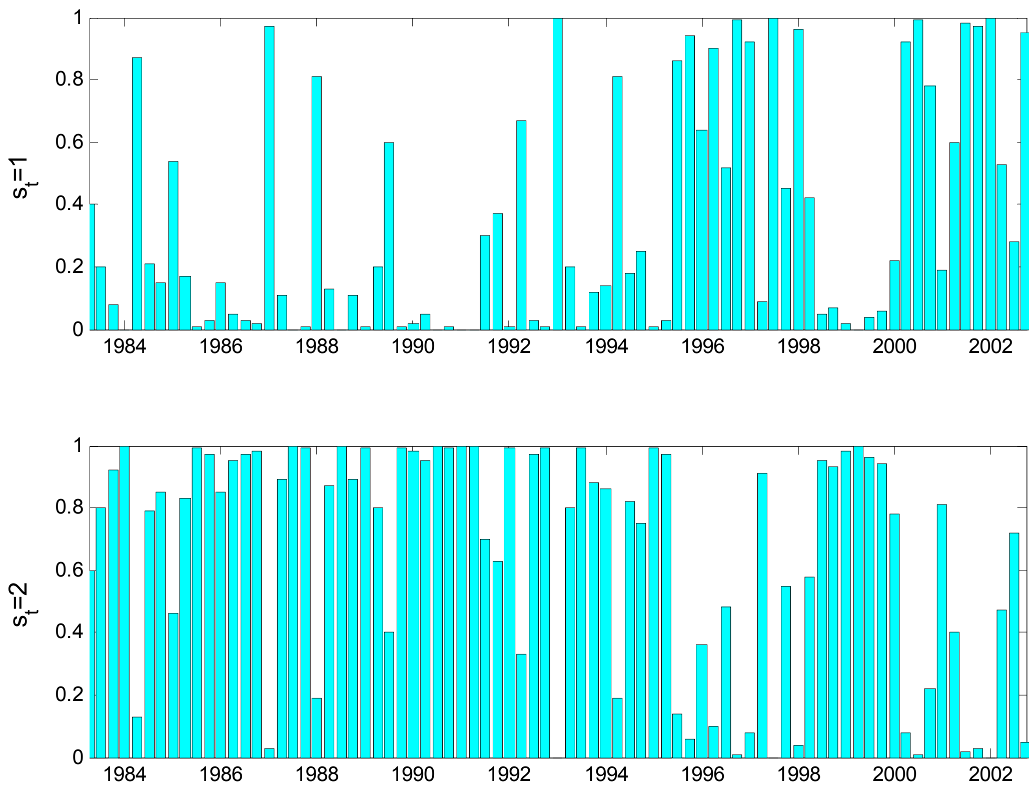
Graph 15. Germany. Loans to firms, posterior state probabilities.



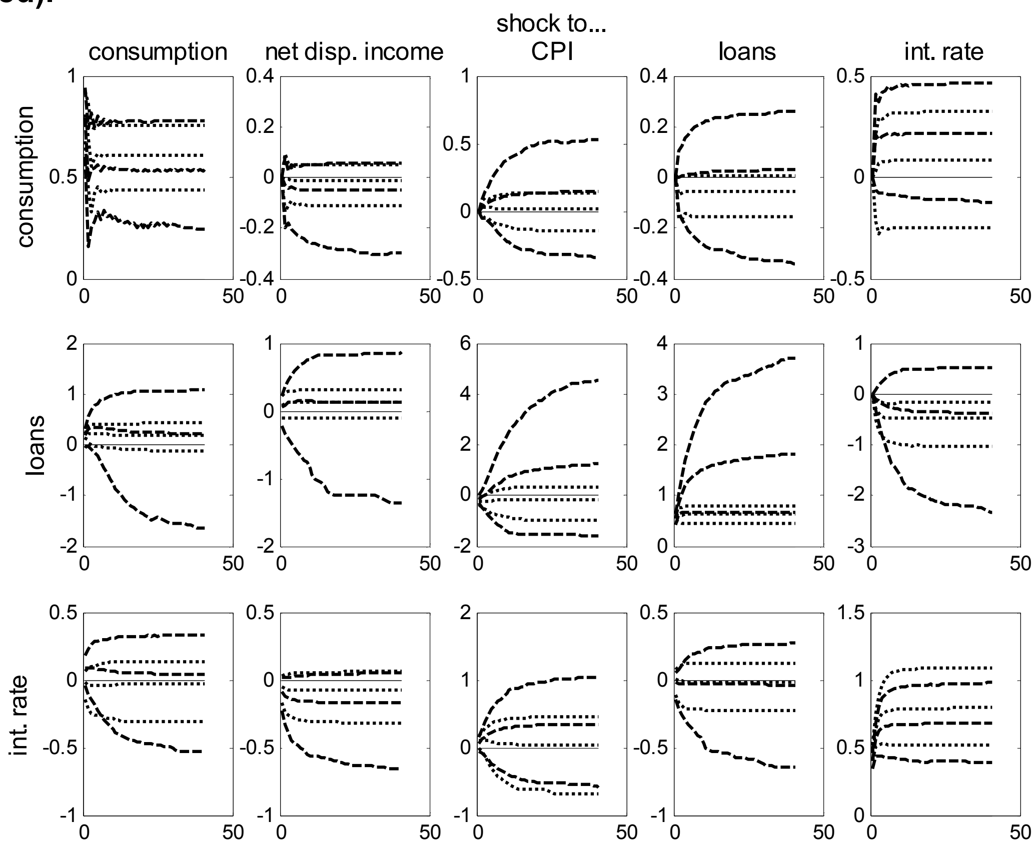
Graph 16. Germany. Loans to firms, IRF, regime 1 (dashed) and regime 2 (dotted).



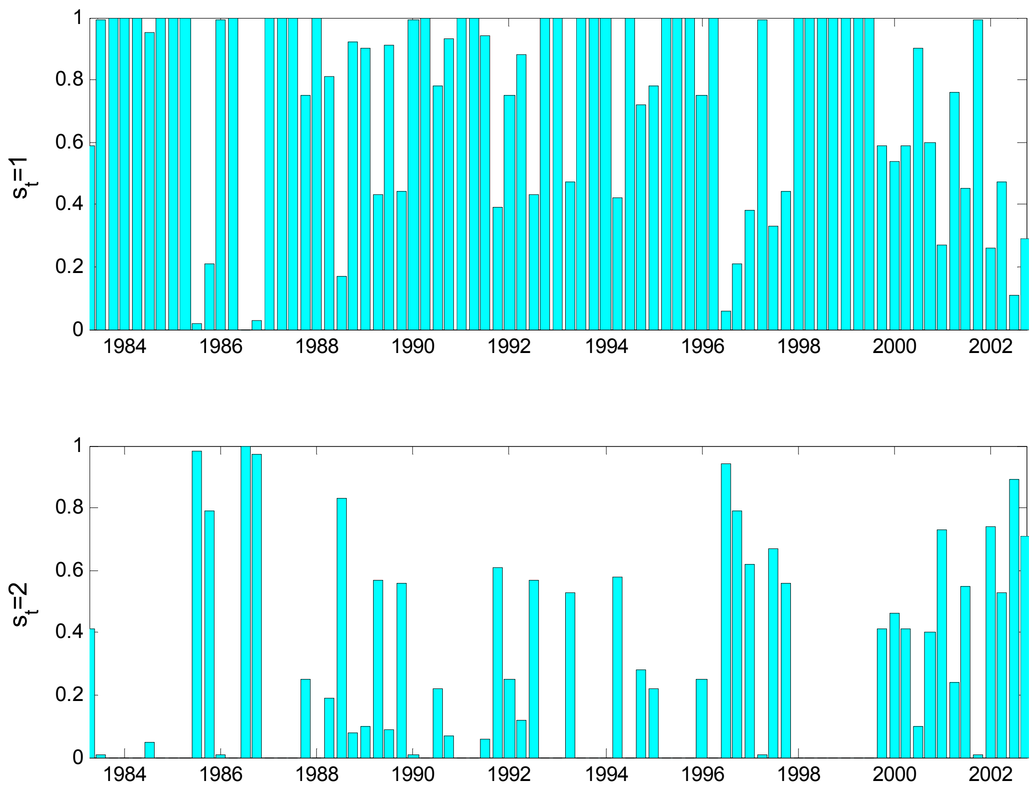
Graph 17. Germany. Loans to households, posterior state probabilities.



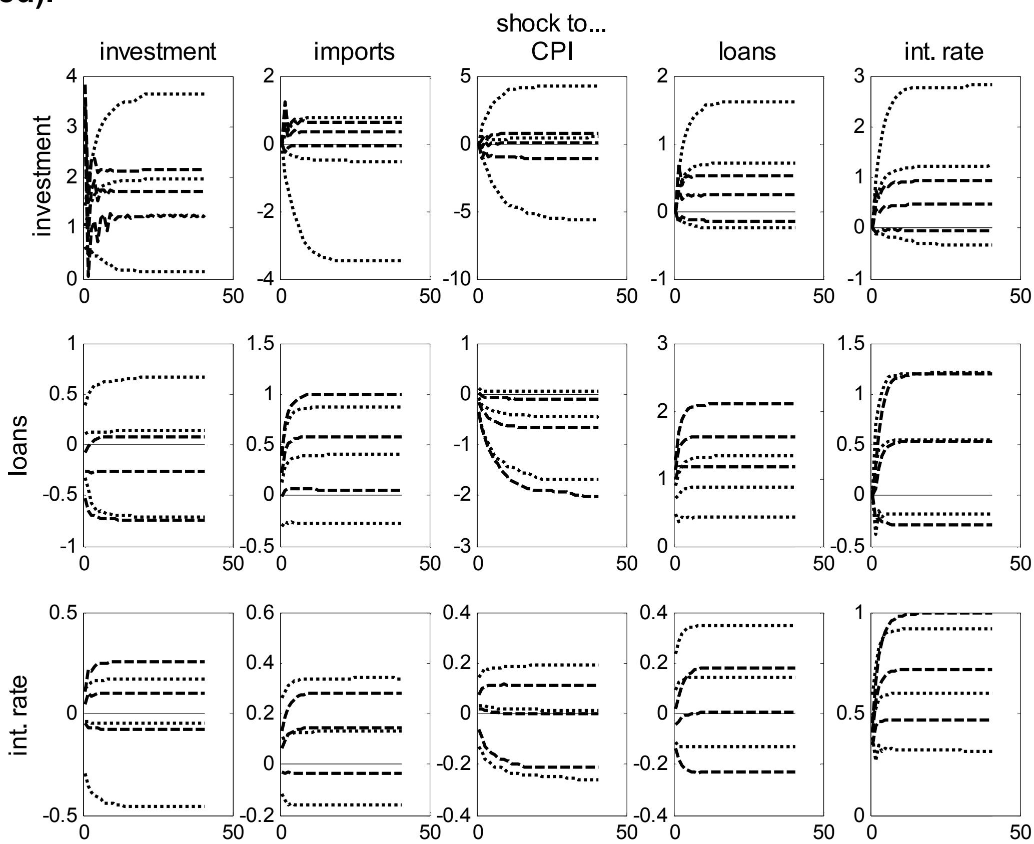
Graph 18. Germany. Loans to households, IRF, regime 1 (dashed) and regime 2 (dotted).



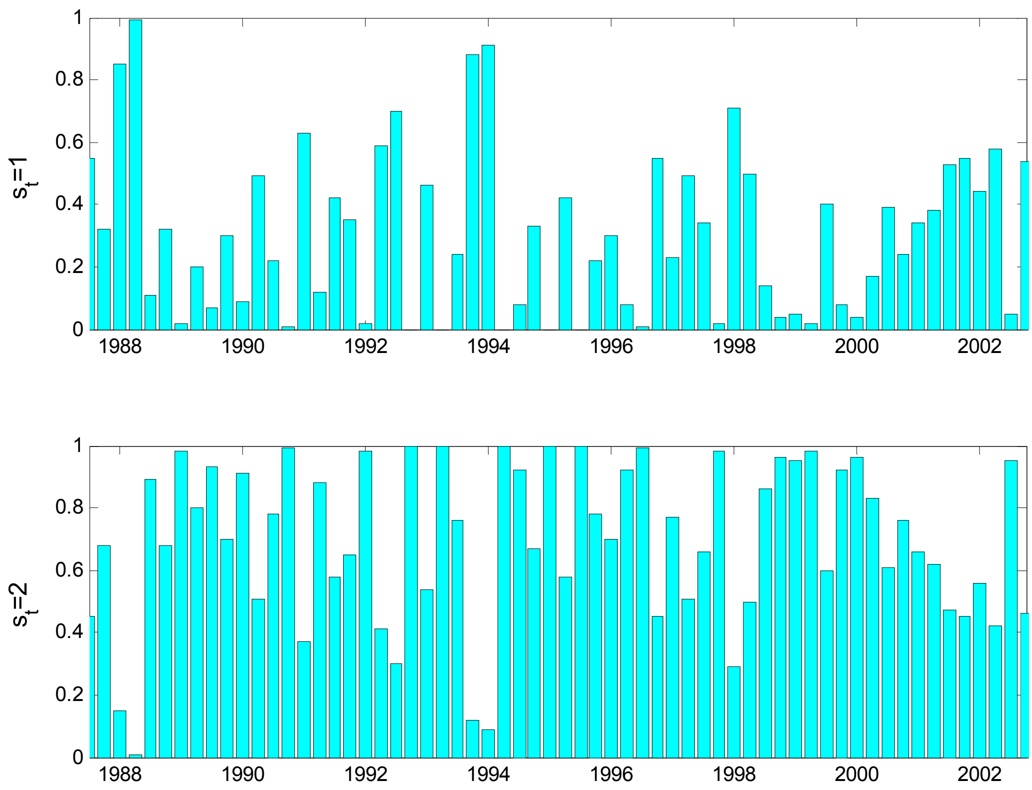
Graph 19. Netherlands. Loans to firms, posterior state probabilities.



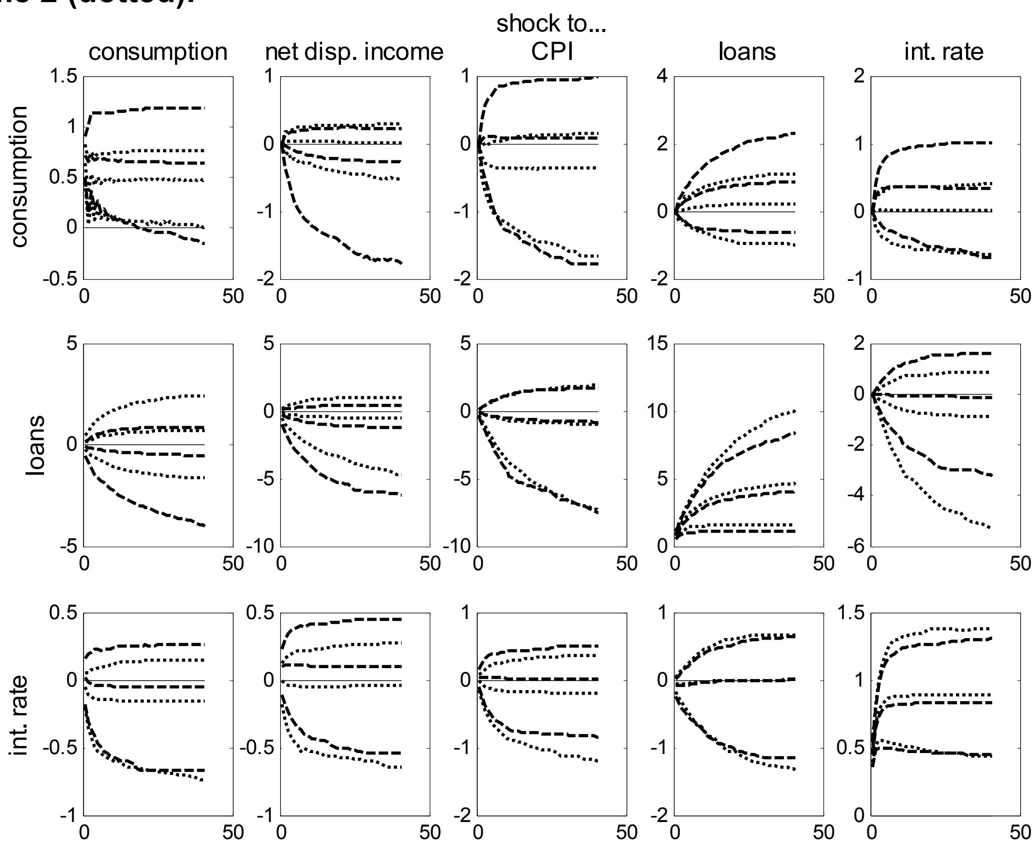
Graph 20. Netherlands. Loans to firms, IRF, regime 1 (dashed) and regime 2 (dotted).



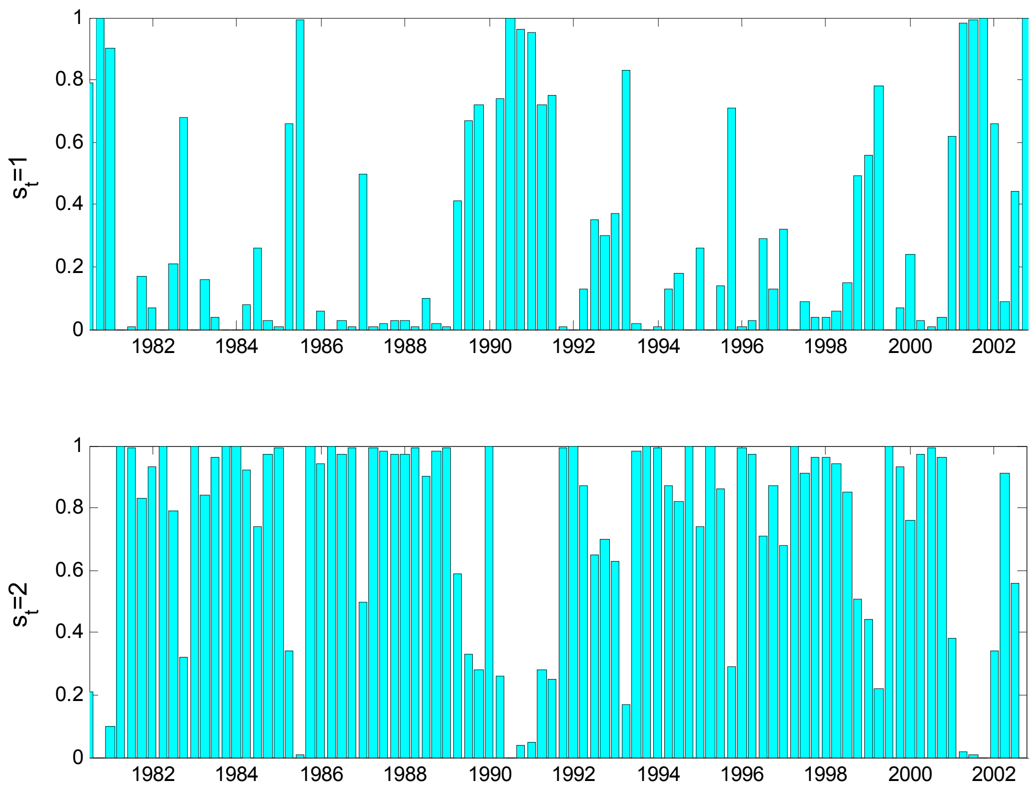
Graph 21. Netherlands. Loans to households, posterior state probabilities.



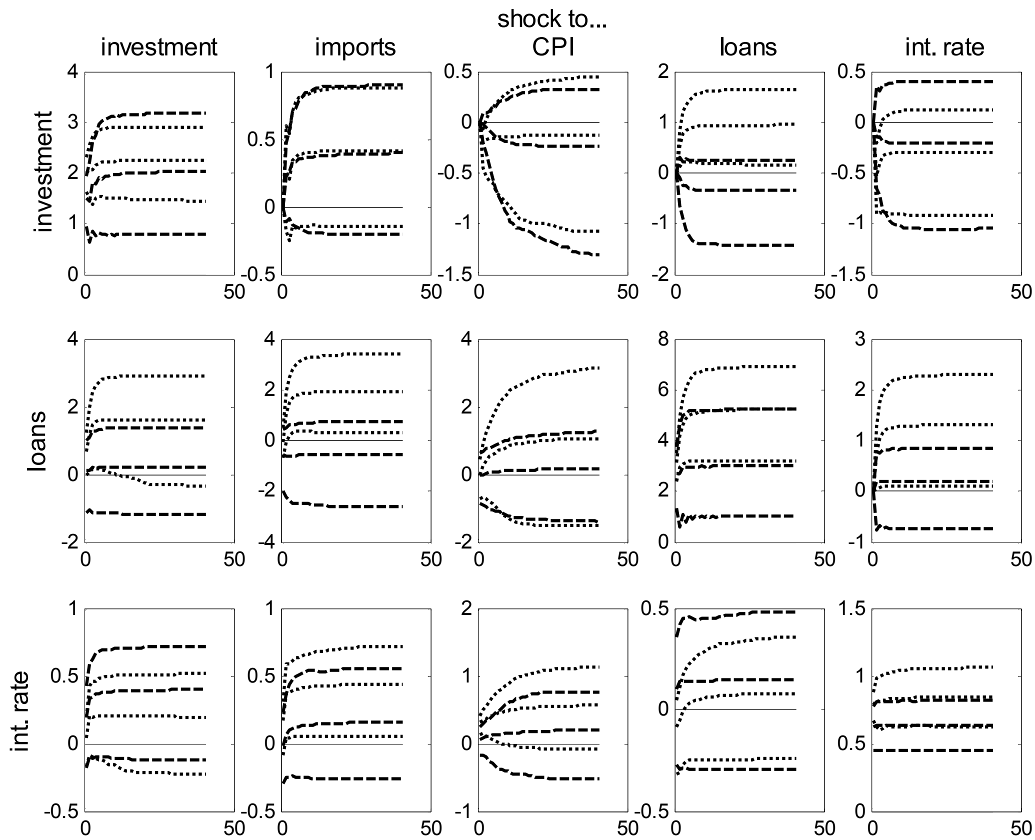
Graph 22. Netherlands. Loans to households, IRF, regime 1 (dashed) and regime 2 (dotted).



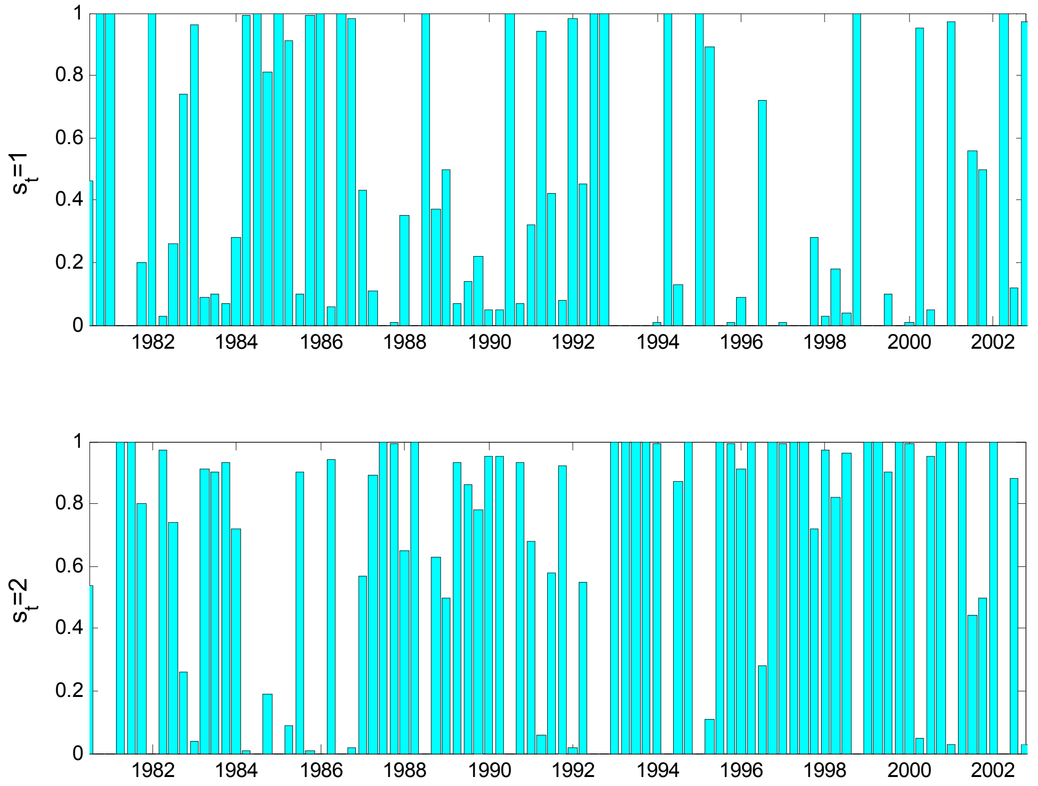
Graph 23. United Kingdom. Loans to firms, posterior state probabilities.



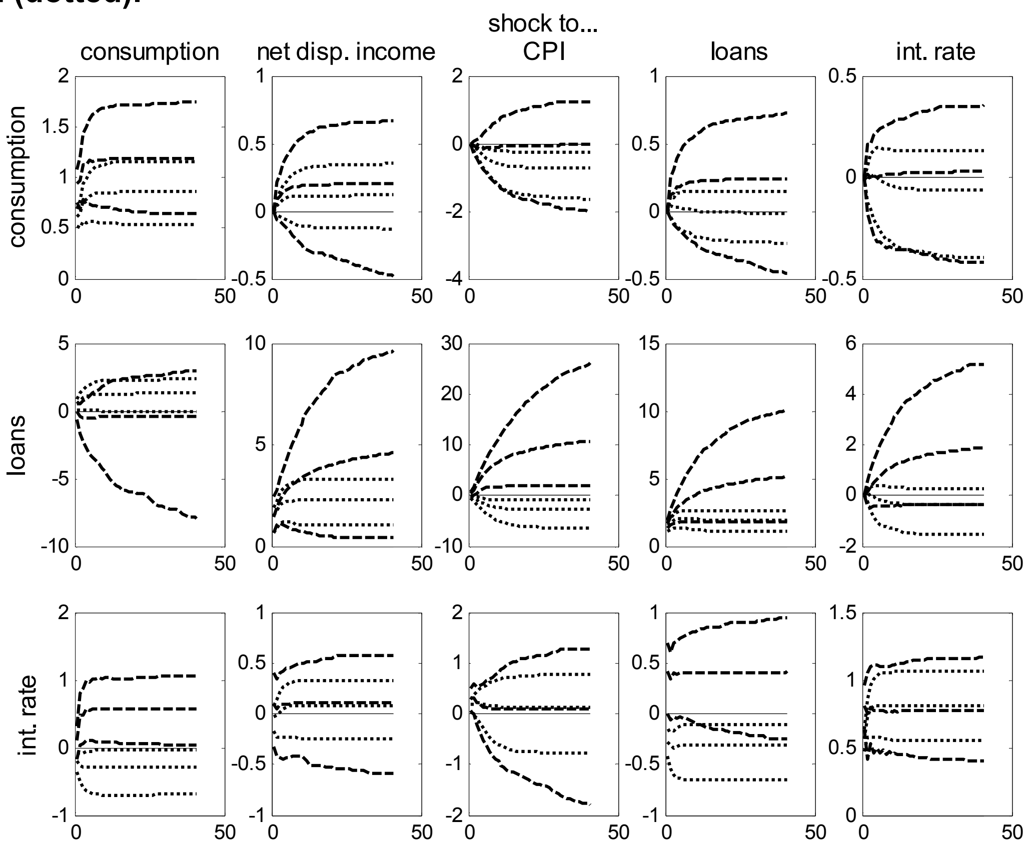
Graph 24. United Kingdom. Loans to firms, IRF, regime 1 (dashed) and regime 2 (dotted).



Graph 25. United Kingdom. Loans to households, posterior state probabilities.



Graph 26. United Kingdom. Loans to households, IRF, regime 1 (dashed) and regime 2 (dotted).



Appendix B: Sampling scheme

This appendix derives the moments of the conditional posterior distributions of the model parameters and the state variables. To simplify notation, the MS-VAR in equation (1) is assumed to be of order one. The extension to higher order lags is straightforward. Equation (1) thus reads as:

$$y_t = \upsilon(s_t) + A(s_t) y_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim i.i.d.N\big(0, \Sigma(s_t)\big). \tag{1'}$$

To derive the posterior distribution of the model parameters, it is helpful to rewrite the model as:

$$y_t = y^*_{t-1} \beta(s_t) + \varepsilon_t, \tag{2'}$$

where $y^*_{t-1} = \big(I_p \otimes [1\ y'_{t-1}]\big)$ and $\beta(s_t) = vec\big([\iota_p\ A(s_t)]'\big)$ with ι_p being a $p \times 1$ vector of ones.

Step 1. Simulate $\beta = vec(\beta(1),...,\beta(K))$ *from* $\pi(\beta \mid y^T, s^T, \Sigma)$. Given s^T, the posterior distribution is normally distributed $N(b, B^{-1})$, with $B = Y'WY + B_0$ and $b = B^{-1}(Y'Wy + B_0 b_0)$ and $y = vec(y_2, \ldots, y_T)$. The matrices Y and W are the predictor and the weighting matrices of model (2'), respectively:

$$Y = \begin{bmatrix} y_1^* D_2^1 & \cdots & y_1^* D_2^K \\ \vdots & \ddots & \vdots \\ y_{T-1}^* D_T^1 & \cdots & y_{T-1}^* D_T^K \end{bmatrix}, \quad W = diag\big(\Sigma(s_2)^{-1}, \ldots, \Sigma(s_T)^{-1}\big),$$

where $D_t^k = 1$ if $s_t = k$ and 0 otherwise. The draw is accepted, if the simulated parameter values define a stationary system; if this is not the case, we reject the draw and retain the current values to continue with the next sampling step.

Step 2. Simulate $\Sigma = (\Sigma(1),...,\Sigma(K))$ from independent Wishart distributions, $\Sigma^{-1}(k) \sim W(\nu_k, S_k)$, where $\nu_k = \nu_0 + N_k$ and $S_k = S_0 + \sum_{s_t = k} \varepsilon_t' \varepsilon_t$ with $N_k = \#\{s_t = k\}$.

Step 3. Simulate the state variable from the joint posterior distribution $\pi(s^T \mid y^T, \theta)$ with the multi-move sampler described in detail by Chib (1996). This involves two steps. In a first, forward-filtering step, we compute the filter distributions $\pi(s_t \mid y^t, \theta)$, $t = 1, \ldots, T$, which can be factored as:

$$\pi(s_t \mid y^t, \theta) \propto f(y_t \mid y^{t-1}, s_t, \beta, \Sigma)\pi(s_t \mid y^{t-1}, \theta),$$

where the observation density $f(y_t \mid y^{t-1}, s_t, \beta, \Sigma)$ is the multivariate normal distribution given in equation (4). The second term is given by extrapolation:

$$\pi(s_t \mid y^{t-1}, \theta) = \sum_{s_{t-1}=1}^{K} \pi(s_{t-1} \mid y^{t-1}, \theta)\eta_{s_{t-1}, s_t},$$

where the starting distribution $\pi(s_0)$, which we set to the unconditional distribution ρ of s_t, is given by the ergodic probabilities of the Markov process.

Then, the backward sampling step begins by sampling s_T from $\pi(s_T \mid y^T \theta)$ and runs backwards to sample from $\pi(s_t \mid y^T, s_{t+1}, \ldots, s_T, \theta)$ for $t = T-1, \ldots, 1$, which is given by

$$\pi(s_t \mid y^T, s_{t+1}, \ldots, s_T, \theta) = \pi(s_t \mid y^T, s_{t+1}, \theta) \propto \pi(s_t \mid y^t, \theta)\eta_{s_t, s_{t+1}}.$$

Step 4. Given s^T, the transition probabilities are simulated from independent Dirichlet distributions, $\pi(\eta \mid s^T) = \prod_{k=1}^{K} D(e_{k1} + N_{k1}, \ldots, e_{kK} + N_{kK})$, where $N_{kj} = \#\{s_t = j \mid s_{t-1} = k\}$.

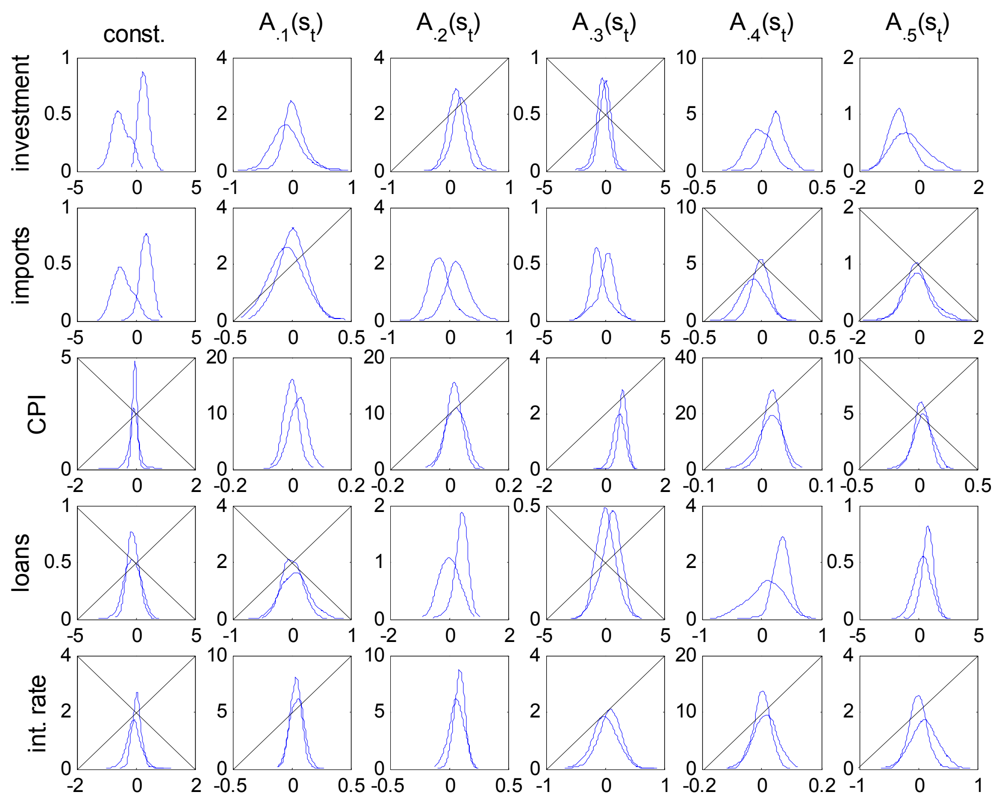
We start the sampler by simulating the VAR parameters and we therefore need a starting value for s^T. We define it to be $s_t = 1$, if y_t is below average, and $s_t = 2$, if y_t is above average.

Appendix C: Parsimonious model specifications and marginal likelihood

To illustrate our model specification procedure, graph 27 reproduces the posterior distribution of the (first-lag) VAR-parameters for the UK system of loans to non-financial corporations. State identification is based on the constant in the investment equation, which means that all simulated state-dependent parameters and the state variable are reordered accordingly to fulfill the restriction $\beta_1(1) < \beta_1(2)$.

To obtain the parsimonious specification, in a first round, we restrict the insignificant parameters on the second lag to zero. Then, we restrict the parameters that are not switching (crossed out once) to be equal across regimes. And finally, insignificant parameters on the first lag are restricted to zero (crossed out twice). In graph 27, we reproduce the marginal distributions, which we obtain after restricting the insignificant parameters on the second lag to zero (see the final specification in appendix D).

Graph 27: Posterior distributions of the system of loans to firms for the UK



To test the parsimonious switching specification against the unrestricted and the linear alternatives, we compare the marginal likelihoods of the respective models, i.e. we compute Bayes factors. To estimate the marginal likelihood, first note that the model likelihood can be obtained by rearranging the following identity (see also Frühwirth-Schnatter, 2004):

$$1 = \frac{\int \alpha(\theta)\pi(\theta \mid y^T)q(\theta)d(\theta)}{\int \alpha(\theta)q(\theta)\pi(\theta \mid y^T)d(\theta)} = \frac{\int \alpha(\theta)\pi^*(\theta \mid y^T)q(\theta)d(\theta)}{L(y^T)\int \alpha(\theta)q(\theta)\pi(\theta \mid y^T)d(\theta)},$$

where $\pi^*(\theta \mid y^T)$ is the unnormalized posterior of the model parameters, $\pi(\theta \mid y^T) \propto \pi^*(\theta \mid y^T)$, the arbitrary function $\alpha(\theta)$ is set such that $\int \alpha(\theta)\pi(\theta \mid y^T)q(\theta)d(\theta) > 0$, and $q(\theta)$ is a density approximating in a reasonable manner the posterior $\pi(\theta \mid y^T)$. If E_f denotes the expectation with respect to the density *f,* we can express $L(y^T)$ as:

$$L(y^T) = \frac{\int \alpha(\theta)\pi^*(\theta \mid y^T)q(\theta)d(\theta)}{\int \alpha(\theta)q(\theta)\pi(\theta \mid y^T)d(\theta)} = \frac{E_q\left(\alpha(\theta)\pi^*(\theta \mid y^T)\right)}{E_\pi\left(\alpha(\theta)q(\theta)\right)},.$$

Suppose we have a sample of size *M* out of $\pi(\theta \mid y^T)$, $\theta^{(1)},\ldots,\theta^{(M)}$, and of size *L* out of $q(\theta)$, $\tilde{\theta}^{(1)},\ldots,\tilde{\theta}^{(L)}$, then we may estimate the model likelihood by averaging:

$$\hat{L}(y^T) = \frac{\hat{E}_q}{\hat{E}_\pi} = \frac{L^{-1}\sum_{l=1}^{L}\alpha(\tilde{\theta}^{(l)})\pi^*(\tilde{\theta}^{(l)} \mid y^T)}{M^{-1}\sum_{m=1}^{M}\alpha(\theta^{(m)})q(\theta^{(m)})}.$$

Frühwirth-Schnatter (2004) demonstrates that the most accurate result is obtained by using the optimal bridge function (Meng and Wong, 1996) for $\alpha(\theta)$, and by using the mixture of posterior distributions to simulate *L* values from $q(\theta)$:

$$q(\theta) = U^{-1}\sum_{u=1}^{U}\pi(\beta \mid y^T, s^{T(u)}, \Sigma^{(u)})\pi(\Sigma \mid y^T, s^{T(u)}, \beta^{(u)})\pi(\eta \mid s^{T(u)}).$$

The U elements that form the mixture are chosen randomly from the simulations of the MCMC output, whereas the M values out of $\pi(\theta \mid y^T)$ entering $\hat{L}(y^T)$ may directly be chosen (randomly) from the simulated parameter values of the MCMC output.

Appendix D: Parsimonious model specifications

The results discussed in section 5 were obtained by estimating the following parsimonious specifications. The notation $a(s_t)$ indicates that the coefficient is switching, a signals that the coefficient is restricted to be equal across regimes and 0 denotes that coefficients are restricted to zero. Regime identification is based on the coefficients in bold face. The variables in the system for loans to non-financial corporations are ordered as follows: first investment, then imports, inflation, loans to non-financial corporations and finally the three-month interest rate. In the system for loans to households, households' consumption comes first, followed by net disposable income, inflation, loans to households and the three-month interest rate.

Austria

Loans to non-financial corporations:

$$y_t = \begin{bmatrix} \upsilon(s_t) \\ \upsilon(s_t) \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} a_1(s_t) & 0 & a_1 & a_1 & a_1 \\ 0 & a_1(s_t) & a_1 & a_1(s_t) & a_1 \\ 0 & 0 & a_1(s_t) & 0 & a_1(s_t) \\ a_1 & a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1 \\ a_1 & 0 & a_1(s_t) & a_1(s_t) & a_1 \end{bmatrix} y_{t-1} + \begin{bmatrix} a_2(s_t) & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} y_{t-2} + \varepsilon_t$$

Loans to households:

$$y_t = \begin{bmatrix} \upsilon(s_t) \\ 0 \\ \upsilon(s_t) \\ \upsilon(s_t) \\ \upsilon(s_t) \end{bmatrix} + \begin{bmatrix} a_1(s_t) & a_1(s_t) & 0 & a_1(s_t) & a_1(s_t) \\ 0 & a_1(s_t) & a_1(s_t) & 0 & \mathrm{a}_1(\mathrm{s}_\mathrm{t}) \\ a_1(s_t) & a_1 & a_1(s_t) & a_1(s_t) & a_1 \\ a_1(s_t) & a_1(s_t) & 0 & a_1(s_t) & a_1 \\ 0 & a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1(s_t) \end{bmatrix} y_{t-1} + \begin{bmatrix} a_2(s_t) & 0 & 0 & a_2(s_t) & a_2(s_t) \\ a_2 & a_2(s_t) & 0 & 0 & 0 \\ 0 & 0 & a_2(s_t) & 0 & 0 \\ 0 & 0 & 0 & a_2(s_t) & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} y_{t-2} + \varepsilon_t$$

Germany

Loans to non-financial corporations:

$$y_t = \begin{bmatrix} \upsilon(s_t) \\ \upsilon(s_t) \\ 0 \\ \upsilon(s_t) \\ 0 \end{bmatrix} + \begin{bmatrix} a_1(s_t) & a_1 & a_1(s_t) & a_1 & a_1(s_t) \\ 0 & a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1 \\ 0 & a_1(s_t) & a_1 & a_1(s_t) & 0 \\ a_1(s_t) & 0 & a_1(s_t) & a_1 & a_1(s_t) \\ 0 & a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1 \end{bmatrix} y_{t-1} + \begin{bmatrix} a_2(s_t) & 0 & a_2(s_t) & 0 & a_2(s_t) \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & a_2 & 0 & 0 \\ a_2(s_t) & 0 & a_2(s_t) & a_2 & 0 \\ 0 & 0 & a_2(s_t) & a_2(s_t) & 0 \end{bmatrix} y_{t-2} + \varepsilon_t$$

Loans to households:

$$y_t = \begin{bmatrix} \upsilon(s_t) \\ \upsilon(s_t) \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} a_1(s_t) & a_1 & 0 & a_1(s_t) & a_1(s_t) \\ 0 & a_1 & a_1(s_t) & a_1(s_t) & a_1(s_t) \\ 0 & a & a_1 & a_1(s_t) & a_1 \\ a & 0 & a_1(s_t) & a_1(s_t) & a_1(s_t) \\ a & 0 & a_1(s_t) & a_1(s_t) & a_1 \end{bmatrix} y_{t-1} + \begin{bmatrix} a_2(s_t) & 0 & 0 & 0 & 0 \\ 0 & a_2 & a_2(s_t) & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & a_2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} y_{t-2} + \varepsilon_t$$

Netherlands

Loans to non-financial corporations:

$$y_t = \begin{bmatrix} \upsilon(s_t) \\ 0 \\ 0 \\ 0 \\ \upsilon(s_t) \end{bmatrix} + \begin{bmatrix} a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1 & a_1 \\ 0 & a_1(s_t) & 0 & 0 & a_1 \\ a_1(s_t) & 0 & a_1(s_t) & 0 & a_1 \\ 0 & a_1 & a_1 & a_1(s_t) & a_1(s_t) \\ a_1(s_t) & 0 & 0 & a_1(s_t) & a_1(s_t) \end{bmatrix} y_{t-1} + \begin{bmatrix} a_2(s_t) & 0 & a_2(s_t) & 0 & 0 \\ 0 & a_2(s_t) & 0 & 0 & 0 \\ 0 & 0 & a_2(s_t) & 0 & 0 \\ 0 & 0 & 0 & 0 & a_2(s_t) \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} y_{t-2} + \varepsilon_t$$

Loans to households:

$$y_t = \begin{bmatrix} \upsilon(s_t) \\ \upsilon(s_t) \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1(s_t) \\ a_1(s_t) & a_1 & a_1(s_t) & a_1(s_t) & a_1(s_t) \\ 0 & 0 & a_1(s_t) & a_1 & a_1 \\ 0 & a_1(s_t) & a_1(s_t) & a_1 & a_1(s_t) \\ a_1 & a_1 & a_1(s_t) & a_1(s_t) & a_1 \end{bmatrix} y_{t-1} + \begin{bmatrix} 0 & 0 & a_2(s_t) & 0 & 0 \\ 0 & 0 & a_2(s_t) & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & a_2(s_t) & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} y_{t-2} + \varepsilon_t$$

United Kingdom

Loans to non-financial corporations:

$$y_t = \begin{bmatrix} \upsilon(s_t) \\ \upsilon(s_t) \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} a_1(s_t) & a_1 & 0 & a_1(s_t) & a_1(s_t) \\ a_1 & a_1(s_t) & a_1(s_t) & 0 & 0 \\ a_1(s_t) & a_1 & a_1 & a_1 & 0 \\ 0 & a_1(s_t) & 0 & a_1(s_t) & a_1(s_t) \\ a_1 & a_1(s_t) & a_1 & a_1 & a_1 \end{bmatrix} y_{t-1} + \begin{bmatrix} a_2(s_t) & 0 & 0 & a_2(s_t) & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & a_2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} y_{t-2} + \varepsilon_t$$

Loans to households:

$$y_t = \begin{bmatrix} \upsilon(s_t) \\ \upsilon(s_t) \\ 0 \\ \upsilon(s_t) \\ \upsilon(s_t) \end{bmatrix} + \begin{bmatrix} a_1 & 0 & a_1(s_t) & a_1(s_t) & a_1(s_t) \\ a_1(s_t) & a_1 & a_1(s_t) & a_1 & a_1(s_t) \\ 0 & a_1 & a_1 & a_1(s_t) & a_1 \\ a_1(s_t) & 0 & a_1(s_t) & a_1(s_t) & a_1(s_t) \\ a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1(s_t) & a_1(s_t) \end{bmatrix} y_{t-1} + \begin{bmatrix} a_2 & 0 & a_2(s_t) & 0 & a_2(s_t) \\ 0 & 0 & a_2(s_t) & 0 & a_2(s_t) \\ 0 & 0 & a_2 & 0 & 0 \\ 0 & 0 & a_2(s_t) & a_2(s_t) & a_2(s_t) \\ 0 & a_2(s_t) & a_2(s_t) & 0 & 0 \end{bmatrix} y_{t-2} + \varepsilon_t$$

Index of Working Papers:

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