

## **A Differential View on the Credit Channel of Monetary Policy Transmission**

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### **I. Introduction**

The textbook version of the monetary transmission mechanism usually considers only two assets, money and one interest-bearing paper such as a bond. Monetary policy may be effective if it impacts the interest rate on the bond as the sole relative price in such a model. This money view of the transmission process has long been challenged by the credit view associated with more elaborate multi-asset models. These models are characterized by imperfect substitutability among the various assets and a multitude of relative prices functioning as potential transmission mechanisms for monetary policy.<sup>1</sup> As a special case of such a multi-asset model, the lending view introduces bank loans as a distinct third asset beside money and bonds (Bernanke and Blinder (1988)). Monetary policy then impacts not only the interest rate on bonds but may work through an independent bank lending channel affecting the spread between loans and bonds or the quantity of bank loans available. A more general definition of the credit view contemplates the whole range of financial intermediaries, identifying a broad credit channel with no special role for the banking sector (e. g. Bernanke (1993)).

The credit channel emphasizes the role of the external finance premium as the wedge between the cost of internal and imperfectly collateralized external finance. This premium is influenced by two factors. First, informational asymmetries between borrowers and lenders require a compensation to lenders for the expected cost of monitoring, evaluation and contract enforcement. Second, any rise in the riskless interest rate lowers the discounted value of borrowers' net wealth and curtails their

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<sup>1</sup> The most influential early contributions include *Tobin* and *Brainard* (1963), *Brunner and Meltzer* (1963, 1972) and *Tobin* (1970).

ability to offer collateral. This further raises the external finance premium and the cost of capital in financial markets through an independent balance sheet channel.

Any attempt to assess the empirical relevance of the credit view encounters an identification problem of distinguishing between shifts in loan supply and shifts in loan demand. The money view implies that tight money causes a drop in output, entailing in its wake a decline in the demand for credit. In contrast, the credit view implies that financial intermediaries react to tight money by curtailing the supply of credit, thereby reducing the availability of external finance. In both cases tight money induces a tendency for disintermediation in financial markets. Kashyap, Stein and Wilcox (1993) address the identification problem by investigating the financing mix between bank credit and commercial paper. According to the money view, the decline in the demand for credit following a monetary contraction should cause the demand for bank credit and the issuance of commercial paper to fall simultaneously. In contrast, the credit view predicts that banks react to tight money by reducing bank credit. In this case, and with no overall decline in the demand for external finance, borrowers may simply substitute out of bank credit and into commercial paper. Kashyap, Stein and Wilcox provide evidence in favor of the credit view by demonstrating that tight money causes a reduction in bank loans but leads to an actual increase in the supply of commercial paper.

According to the credit channel, small firms with weak balance sheets should be more strongly affected by the rising cost of capital than large firms. An alternative approach to avoiding the identification problem thus lies in investigating the mix of bank and nonbank debt separately for small and large firms. Gertler and Gilchrist (1993, 1994) and Oliner and Rudebusch (1996a) find that tight money leads to a general shift in the availability of all types of finance from small firms to large firms, and Kashyap, Stein and Wilcox (1996) show that even among large U.S. firms there is considerable substitution away from bank loans towards commercial paper. Similar micro-level evidence in favor of a broad credit channel has been provided for firms (Calomiris, Himmelberg and Wachtel (1995), Chatelain et al. (2001)) as well as for banks (Kashyap and Stein (1995, 2000), Chatelain et al. (2003)).

The evidence from most studies on the lending view points towards the general existence of a credit channel, but its effectiveness seems to depend on a number of different factors. In particular, the leverage of

the credit channel appears to vary throughout and across business cycles (Gertler and Gilchrist (1994)), may be strongly influenced by whether monetary policy is tight or easy (Oliner and Rudebusch (1996b)), and may deteriorate on a secular path as financial innovation increases the substitutability of intermediated and nonintermediated credit (Bernanke and Gertler (1995)). In fact, a growing number of medium-sized firms today are already able to place debt in credit markets by directly issuing bonds or commercial paper, particularly in the U.S. With the ascent of independent rating agencies the risks associated with these debt instruments have become successively more transparent, resulting in a deepening of the commercial paper market.

Bernanke, Gertler and Gilchrist (1999) show that corporate spreads over risk-free government rates increase sharply in response to a contractionary monetary shock and this effect is a key element in their theory of the credit channel. Their approach moves the focus away from identifying the credit channel using quantity data towards a qualitative approach by means of interest rate spreads. Although theoretically appealing, the major drawback of such a qualitative approach is an identification problem similar to the one encountered in the micro-level studies. Tight money may widen the spreads either due to a genuine credit channel effect as firms substitute out of credit and into commercial paper, or because the receding credit demand reduces the demand for commercial paper. Both the credit supply and credit demand effects would thus raise the returns on commercial paper relative to the risk-free rate.

This paper utilizes the qualitative approach to empirically test for the existence of a credit channel in U.S. data. To this end, we use the default premium in terms of the difference between yields on BAA and AAA rated corporate bond portfolios as an indicator of the credit channel. Analyzing this default premium, also referred to as the quality spread, avoids the identification problem by allowing for differential impacts of monetary policy on the tendency for disintermediation across these two classes of creditors. In particular, we are concerned with assessing the relative importance of the secular component and other potential latent factors determining the effectiveness of the credit channel in time series data. As these factors are generally unobservable, we allow for discrete shifts in the data generating process (DGP) by employing a Markov switching model. In this class of non-linear models the parameters of the DGP of the observed time series depend on an unobservable state variable which we associate with a genuine credit channel. The remainder of

the paper is structured as follows: Section II. provides technical details on our estimation strategy, Section III. reports on the estimation results and a concluding section summarizes our findings.

## II. An Econometric Model for the Identification of the Credit Channel

The Markov switching model, also referred to as regime switching model, was pioneered by Hamilton (1989, 1990), and has since developed into one of the most popular non-linear time series models. In this model, the nonlinearities are introduced via discrete shifts among any number of regimes. Here we allow for regime switching between two possible states, one state in which the credit channel is absent, denoted by  $S_t = 1$ , and another in which it is operative, denoted by  $S_t = 2$ . The model is estimated without any prior knowledge about possible break points, such that identification of the two states is solely determined by the data.

The model can be written as follows:

$$(1) \quad \rho_t = c_{S_t} + X_t \beta_{S_t} + u_t,$$

where  $\rho_t$  denotes the quality spread in period  $t$ ,  $c_{S_t}$  is a (state-dependent) constant,  $X_t$  is a matrix of conditioning information used to predict  $\rho_t$ ,  $\beta_{S_t}$  is the (state-dependent) vector of coefficients, and  $u$  is the error term with  $u_t \sim NID(0, \sigma_{S_t}^2)$ . Any regime shift between the two states represents a structural break in the data. If the timing of these shifts were known in advance, the approach would degenerate into a simple dummy variable model. However, as the states  $S_t$  are not directly observable, we make the common assumption that these follow a first-order Markov chain. The underlying process can be described by the following transition probabilities governing the switches between the two states:

$$(2) \quad \begin{aligned} p_1 &= P(S_t = 1 \mid S_{t-1} = 1), \\ 1 - p_1 &= P(S_t = 2 \mid S_{t-1} = 1), \\ p_2 &= P(S_t = 2 \mid S_{t-1} = 2), \\ 1 - p_2 &= P(S_t = 1 \mid S_{t-1} = 2), \end{aligned}$$

such that the probability of being in a particular state at time  $t$  depends only on the state the system has been in at time  $t - 1$ . The system may thus prevail in any of the two states for a random period of time, and is

replaced by the other state when switching takes place. The attractive feature of this model is that no extraneous information is needed regarding the dates when the system was in each regime.<sup>2</sup> The probability of the system being in a particular regime is solely inferred from the data. Suppose that the density conditional on being in state  $j$ , is Gaussian:<sup>3</sup>

$$(3) \quad \eta(\rho_t \mid \Omega_{t-1}, S_t = j) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(\frac{-(\rho_t - c_j - X_t\beta_j)^2}{2\sigma^2}\right),$$

for  $j = 1, 2$ , and  $\Omega_{t-1}$  denoting information at time  $t - 1$ . Then the log-likelihood function can be written as

$$(4) \quad l(\rho_t \mid \Omega_{t-1}) = \sum_{t=1}^T \ln(\phi(\rho_t \mid \Omega_{t-1})),$$

where the density  $\phi(\rho_t \mid \Omega_{t-1})$  is the sum of the probability-weighted state densities,  $\eta(\cdot)$ , of the two states

$$(5) \quad \phi(\rho_t \mid \Omega_{t-1}) = \sum_{j=1}^2 \eta(\rho_t \mid \Omega_{t-1}, S_t = j)P(S_t = j \mid \Omega_{t-1}).$$

Here  $P(S_t = j \mid \Omega_{t-1})$  denotes the conditional probability of being in state  $j$  at time  $t$  given information at time  $t - 1$ . The conditional state probabilities are obtained recursively:

$$(6) \quad P(S_t = j \mid \Omega_{t-1}) = \sum_{k=1}^2 P(S_t = j \mid S_{t-1} = k)P(S_{t-1} = k \mid \Omega_{t-1}),$$

where  $P(S_t = j \mid S_{t-1} = k)$  are the state transition probabilities of Eq. (2). Finally, the conditional state probabilities are updated according to Bayes' rule using the new information about the state of the economy,  $S_t$ , contained in the  $t^{\text{th}}$  observation of the dependent variable,  $\rho_t$ :

$$(7) \quad \begin{aligned} P(S_t = j \mid \Omega_t) &= P(S_t = j \mid \Omega_{t-1}; \rho_t) \\ &= \frac{\eta(\rho_t \mid S_t = j; \Omega_{t-1})P(S_t = j \mid \Omega_{t-1})}{\sum_{j=1}^2 \eta(\rho_t \mid S_t = j; \Omega_{t-1})P(S_t = j \mid \Omega_{t-1})}. \end{aligned}$$

<sup>2</sup> The properties of Markov chains are extensively discussed in *Hamilton (1994)*.

<sup>3</sup> This is not a particularly strong assumption since combinations of normals can accommodate densities with nonzero skewness and fat tails.

Eqs. (6) and (7) can be iterated on recursively to derive the state probabilities  $P(S_t = j | \Omega_{t-1})$  and to obtain the parameters of the likelihood function. There are various ways of estimating the Markov-switching model (see Hamilton (1990), or Kim and Nelson (1999)). Here we use the Expectation Maximization (EM) algorithm discussed by Hamilton (1994) and Krolzig (1997), and drawing on the software provided by Hans-Martin Krolzig, to perform the iterations.<sup>4</sup>

### III. Empirical Evidence on the Credit Channel

We apply the regime switching approach on the default premium, represented here by the quality spread between yields on Moody's BAA- and AAA-rated U.S. corporate bond portfolios, as the dependent variable. Estimation is performed by means of a *Markov switching intercept heteroscedasticity* (MSIH) model. The vector of conditioning information contains the stance of Federal Reserve monetary policy, the state of the U.S. business cycle and a latent factor associated most broadly with developments in financial markets. We use the spread between the Federal Funds rate and the 10-year Treasury bond rate (FFB) as an indicator of monetary policy because the long bond is relatively insensitive to short-run variations in monetary tightness or ease (Bernanke and Blinder (1992)). Business cycle conditions are proxied by monthly (DIP) and quarterly (DIP3) rates of change of the industrial production index. All data are from the Federal Reserve Bank except for the series on U.S. industrial production, which were obtained from the IMF International Financial Statistics. Our sample consists of monthly data for the time period 1957(1)–2004(12), where the choice of the sample period is dictated by data availability.

All variables were found to be stationary using standard ADF and Phillips-Perron tests. The results of the estimation are presented in Tables 1 and 2. The lower portion of Table 1 shows the log likelihood of the Markov-switching model to be significantly above the corresponding value for the linear system, implying that the regime-switching model performs significantly better than the linear alternative. Moreover, the two regimes identified by the model are both highly persistent, evidenced in Table 2 by transition probabilities close to unity of remaining

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<sup>4</sup> Performing the iteration using data only up to period  $t$  results in the filter probability, whereas utilizing the information in the whole data set yields the smoothed probability (Kim (1994)).

*Table 1*  
**Estimation Results**

	Coefficient	Standard error	t-value
<i>Regime 1</i>			
constant	0.7639	0.0105	72.5242
FFB	-0.0055	0.0057	-0.9625
DIP	0.0061	0.0298	0.2045
DIP3	-0.0696	0.0145	-4.8096
<i>Regime 2</i>			
constant	1.5159	0.0316	47.9983
FFB	0.0507	0.0131	3.8621
DIP	0.0031	0.0817	0.0379
DIP3	-0.1289	0.0349	-3.6912
Log-likelihood (MSIH)	80.9709		
Log-likelihood (linear)	-280.3950		
LR linearity test	722.7318		
p-value	0.0000		

*Table 2*  
**Regime Transition Probabilities**

	Regime 1	Regime 2
Regime 1	0.9863	0.0137
Regime 2	0.0249	0.9751

in either one of the two regimes. Correspondingly, the probabilities of regime switches from Regime 1 to Regime 2 and vice versa in any given month are just 1.37% and 2.49%, respectively.

In order to classify the two regimes with respect to the presence or absence of a credit channel, the upper portion of Table 1 reports the regression results for each of the two regimes identified by the Markov-switching model. It turns out that the influence of monetary policy has a signif-

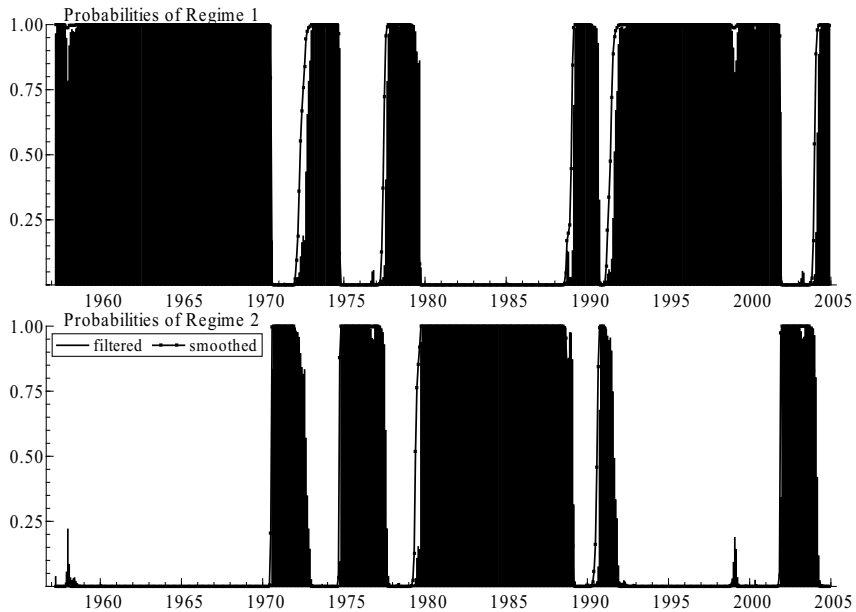


Figure 1: Regime Probabilities

icant impact on the default premium only in Regime 2. There an increase in the Federal Funds rate relative to the long bond (FFB) leads to a significant rise in the quality spread. The evidence is somewhat less clear-cut with respect to the influence of the business cycle. In both regimes, the monthly growth rates in industrial production (DIP) do not significantly affect the default premium. In contrast, the corresponding quarterly figures (DIP3) are significantly negative in either regime, implying that positive (negative) output growth is associated with lower (higher) levels of the quality spread. However, the coefficient on the business cycle variable is twice as high in Regime 2. Taken together, the results thus clearly point towards associating Regime 2 with the credit channel scenario.

We can now turn to Figure 1 to identify along the time axis the relative likelihoods of being in either of the two regimes. In the figure, the regime probabilities are specified separately for Regime 1 (upper panel) and Regime 2 (lower panel). The results show that the model identifies the individual regimes with a very high level of confidence as the prob-



abilities mostly assume values close to 1.0. Due to the high persistence of the individual regimes, there are only very few regime switches over the course of the sample period, and each of the switches can be related to particular historic circumstances surrounding these events. This way we can offer an economic interpretation of the latent factor identified by the regime switching model.

The system remains in Regime 1 (associated with the absence of the credit channel) throughout all of the 1960s, before the first switch into the credit channel regime takes place towards the end of the year 1970. This switch coincides with the trough of the U.S. recession of 1970–71<sup>5</sup> and is followed by a reversal into Regime 1 towards the end of 1972. The next switch occurs in 1974 and can be associated with the onset of the first oil price shock and the concomitant U.S. recession of 1974–75. After reverting to Regime 1 towards the end of the 1970s, the third switch into the credit channel regime takes place in 1980, a period characterized by a sharp business cycle slowdown in the wake of the second oil price shock. During that period, the Federal Reserve under the aegis of Chairman Paul Volcker tightened the money supply in an attempt to defeat rising inflation. After a brief recovery in 1981, and with inflation still high, the Fed tightened once again, and the U.S. economy experienced the severe 1982 recession. Unlike the two previous credit channel periods, however, this third one is not reversed in the wake of the subsequent recovery, but continues to be active right until the end of the 1980s.

During the 1980s, the United States experienced a prolonged bout of distress in financial markets. The Latin America debt crisis, originating with the Mexican debt default of August 1982, plunged a range of private international banks in New York City, which held the bulk of Mexican loans, into severe financial difficulties. As other developing nations struggled to pay the interest on their loans, U.S. banks had to reschedule the debt and reduce additional lending. Only by forcing developing countries to maintain their interest payments, a major banking collapse was averted. However, the difficulties in U.S. financial markets did not abate but were even further aggravated by the savings and loan debacle which became the nation's largest-ever financial scandal. Triggered by the bursting of the U.S. real-estate bubble in 1986, the crisis affected com-

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<sup>5</sup> The exact timing of the peaks and troughs of the U.S. business cycle are documented by the NBER Business Cycle Expansions and Contractions, available at <http://www.nber.org/cycles.html>.

mercial banks, savings banks, and savings and loan associations (S&Ls). In its wake, some 1500 commercial and savings banks and 1200 savings and loan associations failed. In addition, an even larger number of institutions were in precarious financial condition at some time during that period (Kaufman (1994)).

With the resolution of the turmoil in financial markets a short switch to the inactive Regime 1 occurs in 1989, but the “credit crunch” episode of 1990–91 brings the credit channel briefly back into operation. The “credit crunch” episode was a period of excessive corporate leverage and bank capitalization problems (see Bernanke and Lown (1991) and Bernanke and Gertler (1999), p. 41). For the remainder of the 1990s the system reverts to Regime 1 with only an inkling of a switch around the time of the LTCM crisis in 1998. Following the bursting of the internet bubble, the 9/11 terror attacks and the recession of 2001, the credit channel regime returns in 2002 in the midst of the U.S. accounting scandals, before it again tapers off during 2004.<sup>6</sup>

The empirical evidence from the Markov-switching model holds a number of lessons with respect to the dynamics of the credit channel. First, the strength of the credit channel is affected not only by the state of the business cycle and the stance of monetary policy, but is also influenced by conditions in financial markets. The latter effect, not previously detected in empirical analyses of the credit channel, is identified as the latent factor in the regime-switching model. Second, there is no compelling evidence of a secular decline regarding the effectiveness of the credit channel, which could possibly be related to the global process of financial liberalization and the deepening of financial markets in general. Quite to the contrary, the credit channel re-emerges during the 2002–04 period after having been dormant throughout most of the 1990s.

#### IV. Conclusion

This paper has analyzed the effectiveness of the credit channel as a transmission mechanism of monetary policy by applying a Markov switching approach on the default premium of U.S. corporate bond port-

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<sup>6</sup> The episodes thus identified vary only marginally when the smoothed rather than the filtered probabilities are used (compare footnote 4), with the only difference being that in some instances the smoothed probabilities date the onset of the regime switches a few months prior to those identified by the filtered probabilities.

folios. We identify two regimes, one in which the credit channel is active and one in which it is absent. The two regimes are found to be highly significant and persistent, and we are able to relate the switches between the regimes to particular episodes in recent U.S. economic history. We find that the credit channel is influenced not only by the stance of monetary policy and the state of the business cycle, but also by a latent factor. The latter is closely associated with periods of financial distress, such as the Latin American debt crisis of the early 1980s, the savings and loan debacle, as well as the events surrounding the 9/11 terror attacks and the subsequent accounting scandals. We conclude that the credit channel is still a periodic phenomenon to be reckoned with, thus rendering monetary policy an effective stabilization tool, particularly in times of financial distress.

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## Summary

### A Differential View on the Credit Channel of Monetary Policy Transmission

This paper analyzes the effectiveness of the credit channel as a transmission mechanism of monetary policy by applying a Markov switching approach on the default premium of U.S. corporate bond portfolios. Beside the stance of monetary policy and the state of the business cycle, we identify a latent factor determining the quality spread of the bond portfolios and the strength of the credit channel. In particular, the credit channel appears to be active only in periods of financial distress, such as the Latin American debt crisis of the early 1980s, the savings and loan debacle, as well as the events surrounding the 9/11 terror attacks and the subsequent accounting scandals. (JEL C22, E51)

## **Zusammenfassung**

### **Ein alternativer Ansatz zur Identifikation des Kreditkanals der monetären Transmission**

In diesem Aufsatz wird der Kreditkanal der monetären Transmission auf der Basis eines Markov-Switching-Modells anhand von Risikoprämien von US-amerikanischen Unternehmensanleihen analysiert. Es zeigt sich, dass die Wirksamkeit des Kreditkanals nicht nur durch die Ausrichtung der Geldpolitik sowie die jeweilige Konjunkturlage, sondern zusätzlich durch einen latenten Faktor bestimmt wird, der die Situation auf den amerikanischen Finanzmärkten widerspiegelt. Der Kreditkanal tritt dabei in Phasen turbulenter Finanzmärkte wie der lateinamerikanischen Verschuldungskrise der frühen 1980er-Jahre, der amerikanischen Sparkassenkrise (Savings & Loan) sowie in letzter Zeit im Gefolge der Terrorattacken sowie der Bilanzskandale verstärkt in den Vordergrund.