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Abstract

In this paper, we estimate a credit market disequilibrium model in order to establish specific determinants of credit supply and demand and to identify credit market disequilibrium periods. The model estimation results indicate three characteristic sub-periods, differentiated by sources of bank credit activity dynamics. The first period, from 2000 to 2002, was marked by equilibrium between credit supply and demand and gradual stabilisation of global financial markets and the domestic banking sector after the crisis in the late 1990s. In the second period, from end-2002 to the middle of 2009, encouraged by strong foreign capital inflows, banks were ready to supply more credit than demanded. The third period, marked by an abrupt halt in credit activity, started with an escalation of the world financial crisis during the third quarter of 2008 and lasted until end-2009. According to the model estimation results, such movements were the consequence of a credit supply shortage, i.e. a credit crunch.

JEL:
E44, G21, G28

Keywords:
credit crunch, credit rationing, credit market disequilibrium model

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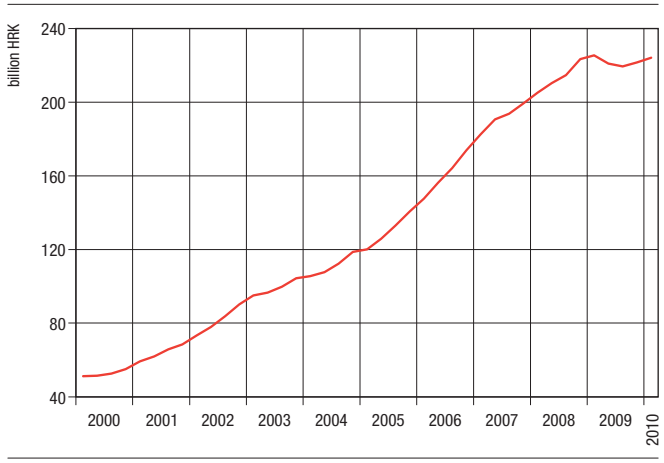
Contents

1 Introduction

After several years of strong bank credit growth, the beginning of 2009 saw an abrupt halt in credit activity in Croatia (*Figure 1*), which stirred up a discussion about its sources and determinants. Under such circumstances, questions arise about how strongly the credit dynamics are influenced by supply-side factors, such as the tightening of banks' credit policy or a possible liquidity shortage, and to what extent credit movements are due to a fall in demand for loans caused by investment stoppage and a drop in personal consumption as a result of unemployment growth, wage stagnation and pessimistic expectations about future growth and profits. In other words, a fall and stagnation in credit activity in 2009 may have been the result of either a credit supply shortage, i.e. a credit crunch, or a credit demand shortage. Therefore, this research is primarily aimed at estimating a model capable of enabling a differentiation between the effects of supply and demand on the credit activity movements in Croatia in the post 2000-period, with a special emphasis on events during 2009. A separation of credit supply from credit demand is particularly important in the light of recent financial market developments in the aftermath of the global financial crisis, and when considering the possibilities of and constraints on the influence of monetary and fiscal policies on credit activity.

Figure 1 Loans to households and enterprises



Source: CNB.

In order to identify specific determinants of supply and demand and periods of credit market (dis)equilibrium, a switching regression model has been estimated, with the credit market disequilibrium being defined as the difference between estimated credit supply and estimated credit demand that occurs when interest rates,

due to their inflexibility, do not maintain equilibrium between the supply of and demand for loans, so that total credit activity is limited on either the supply or demand side. A credit crunch occurs in a situation of excess demand for loans, when loans cannot be obtained at current interest rates, regardless of whether the demand for loans has abruptly increased or the supply decreased. Reduced loan supply can be due to a lack of funds for granting loans, or the fact that banks are less willing to extend loans, which does not necessarily result in higher interest rates. Specifically, banks do not choose to raise interest rates (additionally) in order to eliminate the excess demand (despite the possible preparedness of clients to take on more expensive loans) because they do not believe this would eliminate the risk of a wrong choice of client, which arises from asymmetric information, and decide rather to ration the credit supply.

The model estimation results point to three characteristic periods with respect to the sources of the banks' credit activity dynamics. The first period, from 2000 to 2002, was marked by equilibrium between credit supply and demand, and a gradual stabilisation of global financial markets and the domestic banking sector after the crisis during the late 1990s. In the second period, from end-2002 to the middle of 2008, encouraged by strong foreign capital inflows, banks were prepared to supply more loans than demanded. The third period that saw an abrupt halt in credit activity started with the escalation of the global financial crisis over the third quarter of 2008, and lasted until the end of 2009; according to the model estimation results, such movements arose from a shortage of credit supply, i.e. a credit crunch.

The paper is organised as follows: Chapter 2 gives a summary of an extensive body of literature identifying the determinants of credit supply and demand. Chapter 3 is a presentation of a switching regression model of credit market disequilibrium, including a description of variables that the authors consider to be determinants of credit demand and credit supply. Chapter 4 gives an interpretation of the estimated model results, and the last chapter summarises the conclusions of the analysis conducted.

2 A literature review

There are several different approaches in the literature to identifying periods of credit crunch and determinants of credit supply and demand, all of them aimed at assessing the relative importance of credit supply and demand for credit activity dynamics and identifying the factors that have a dominant influence on the total lending volume at a given point in time. For this purpose, various methods are used – from descriptive analyses or surveys among banks and credit users to more simple time series regressions, panel regressions and disequilibrium models. Research works dealing with credit crunch differ not only in the definition but also in the independent variables used for determining credit supply and demand.

Kanoh and Pumpaisanchai (2006) define a credit crunch as a situation when the supply of credit is restricted below the range usually identified with prevailing market interest rates and the profitability of investment projects. In order to identify the causes of credit activity contraction in Japan, they used not only the official statistical data, but also information from surveys conducted among banks and enterprises showing the respondents' views of credit activity and lending terms. As the main advantage of the survey-based method, they emphasize qualitative information not included in the available quantitative data, which is particularly important if the market is inefficient. Given the nature of the qualitative information, they used a logistic regression to estimate the credit supply and credit demand functions, and they calculated the level of mismatch in the credit market as the smallest quantity between the credit supply and the demand minus the actual lending amount. As the difference was positive in most of the observed periods, they proved the existence of mismatch, which they partly accounted for by the inefficiency of the Japanese banking system.

In order to establish whether the credit activity slowdown in East Asian countries was due to restrictions on the supply side or the demand side, Agénor et al. (2000) used a two-step approach. Step 1 consisted of estimating the function of commercial banks' demand for excess liquidity reserves with negligible or no return.

In the second step, the authors made dynamic projections for the post-crisis period, estimating whether the actual amounts of excess reserves were close to those estimated through the regression model. Where it was established that banks deliberately maintained a higher level of liquidity reserves than was required, this was interpreted as greater caution of banks, i.e. credit rationing. By contrast, great differences between the actual and estimated amounts of reserves were interpreted as the involuntary accumulation of liquid reserves, likely to be connected with lower demand for loans due to a fall in aggregate demand and overall economic activity contraction. Their results for Thailand show that the contraction of bank lending was the result of restrictions on the supply side, especially as concerns small and medium-sized enterprises. In this context, the authors point out that establishing the causes of low credit activity has important implications for both monetary and fiscal policies. For example, if banks are unwilling to lend because of a perceived increase in the default risk that is not reflected in higher interest rates, measures to increase liquidity and reduce interest rates will probably be ineffective. In other words, if a credit crunch is the consequence of restrictions on the supply side, monetary policy will lose some of its efficiency. By contrast, if banks are unable to lend because of reduced demand for credit as a result of enterprises' perception of poor economic growth, a stronger emphasis should be placed on fiscal as well as monetary policy measures.

In econometric analyses of credit crunches, most authors estimate a disequilibrium model by which supply and demand are modelled separately in order to identify periods of excess supply or excess demand[1]. Fair and Jaffee (1972) made the first empirical research into the general market disequilibrium. Fair and Kelejian (1974) and Maddala and Nelson (1974) suggest that such a disequilibrium model be estimated by using the maximum likelihood method, whereas Quandt and Ramsey (1978) analyse the *switching regression model* of disequilibrium in which periods of excess supply and periods of excess demand constitute two regimes with a certain likelihood of occurrence.

Baek (2002) also uses this model for exploring the causes of credit contraction in Korea. Baek defines a credit crunch as an unusually sharp decline on the credit supply side, resulting in unsatisfied demand for credit at the prevailing interest rates. His results suggest that such movements in Korea over 2001 might be largely caused by credit risks of enterprises and high uncertainty due to delayed economic reforms. He concludes that credit expansion should not be forced onto commercial banks; rather, credit activity should be stimulated by measures aimed at reducing these risks and the level of uncertainty.

Pazarbasioglu (1996) also uses the disequilibrium model for identifying a credit crunch episode in Finland in the aftermath of the banking crisis of 1991-92. As bank lending capacity indicators, he uses total deposits and capital; other variables that proved significant in the credit supply function included the price performance of banks' shares, lending interest rates and interest differential as an indicator of alternative investment possibilities for banks, whereas the credit demand side is best described through lending interest rates and expected investment. By analysing monthly data, he shows that the credit activity decline was the consequence of reduced credit demand related to high indebtedness of borrowers. On the other hand, banks' willingness to accept risks was additionally reduced due to deterioration in the quality of assets and banks' need to increase their capital adequacy levels.

In the first part of their work, Barajas and Steiner (2002) explore possible causes of credit stagnation in three Latin American countries. According to the authors, a credit crunch occurs when, at a certain level of deposits, banks refuse to raise interest rates on loans to a level at which credit supply and demand would be equal, which results in partially unsatisfied credit demand and can be the consequence of banks' perception that the risk of enterprise financing is too high, or of a shortage of capital for the financing of risky placements. Apart from usual indicators, such as lending capacity and economic activity, their credit supply function includes credit risk and regulatory variables, as well as the EMBI yield spread, which, for Mexico, accounts for the substitution of domestic loans by borrowing abroad, whereas for Peru, it constitutes an additional macroeconomic environment indicator.

1 This paper sets forth only part of an extensive literature on the credit market disequilibrium model. For other works, see Allain and Oulidi (2009), Bernanke, Lown and Friedman (1991), Catao (1997), Costa and Margani (2009), Ding, Domac and Ferri (1999), Ghosh (2009), Ikhide (2003), Kanoh and Pumpaisanchai (2006), Okurut, Schoombee and van der Berg (2004), Westermann (2003) and Woo (1999).

In the remainder of the paper, Barajas and Steiner (2002) analyse the period from 1980 to 2000, presenting *stylized facts* about credit crunches for most of the Latin American countries, Finland, Indonesia, Thailand, Korea, Japan and USA, which saw a sharp decline in credit activity during the reference period. It has been observed that the consequences of credit crunches[2] are very similar in a number of countries, and they include a strong economic slowdown, the growth of the non-banking institution sector, an increase in financing through the stock exchange as a substitute for bank credit, a fall in deposits and foreign capital flight. These stylized facts about credit crunches are important insomuch as they should certainly be taken into account for the analysis of the consequences of a credit crunch in Croatia.

Nehls and Schmidt (2003) use the credit crunch definition from Kanoh and Pumpaisanchai (2006). They determine the credit supply function by interest rates, commercial banks' lending capacities (deposits plus capital), share price and differences between lending and deposit interest rates, whereas credit demand is determined by interest rates and real GDP. Based on a disequilibrium model, they found out that in Germany during 2002, the estimated credit demand was significantly stronger than the estimated credit supply. They cite a drop in earnings in the banking sector, coupled with capital market losses, as the main reasons for banks' unwillingness to grant loans. They conclude that such a restrictive lending policy of banks prolongs the unfavourable economic situation, because profitable investment projects are delayed or cancelled, thus directly contributing to GDP contraction.

Our model and the credit supply and demand determinants mostly rely on the work of Ghosh and Ghosh (1999), which analyses credit activity in East Asian countries during the Asian crisis. Ghosh and Ghosh (1999) use a switching regression model to determine whether the limiting factor to total credit activity in a given moment was on the credit supply or credit demand side. They define a credit crunch as a situation in which interest rates do not equilibrate supply and demand for credit, so that the aggregate credit amount is supply-constrained, i.e. there is the quantity rationing of loans. As explanatory variables in the credit supply function they use real interest rate relative to the cost of funds, industrial output as a measure of current economic activity and banks' lending capacities, calculated as a difference between total bank liabilities and required reserves and liquidity requirements, cash in vault and equity capital. Credit demand is defined by means of the real interest rate, industrial output, its deviation from the long-run trend, share price index as a proxy for future economic activity and inflation as an overall macroeconomic environment indicator. Their results show that the credit slowdown in the observed countries was due to a fall in demand caused by growing interest rates and declining economic activity, which means that no quantity rationing has occurred at the aggregate level.

3 An econometric model of credit market disequilibrium

The main assumption of the disequilibrium model is that the credit market does not clear in each time period, i.e. that it can at any time be in equilibrium or disequilibrium due to incomplete adjustment of interest rates to equalize credit demand and supply. Therefore, we distinguish between periods of excess credit demand and periods of excess credit supply. The former represent a situation when, for any reason, banks do not want to or cannot satisfy the demand for loans, which leads to a credit crunch, i.e. when banks assess that their clients are too risky or, simply, when there is a shortage of funds for approving more risky loans.

As the observed total credit movements do not suggest whether the fall in credit is caused, for example, by a decline in credit supply, a fall in credit demand or both, it is necessary to estimate the supply and demand functions, which we did within a switching regression model with exclusion restrictions. Assuming credit market disequilibrium, credit demand C_t^d need not equal credit supply C_t^s, so that the observed credit must equal

2 Of all analysed countries, the sharpest fall in credit activity was seen in Venezuela and amounted to 56% of the highest value of credit in GDP in 1983. The low credit activity lasted as long as 13 years (from 1983 to 1995.

the lesser of the two quantities[3], i.e.:

$$C_t = \min(C_t^d, C_t^s)$$

Subject to the "minimum" condition, our model consists of a credit demand equation and a credit supply equation

$$C_t^d = \mathbf{X}_{1t}^{'}\boldsymbol{\beta}_1 + \varepsilon_{1t}$$
$$C_t^s = \mathbf{X}_{2t}^{'}\boldsymbol{\beta}_2 + \varepsilon_{2t}$$

where $\mathbf{X}_{1t}^{'}$ represents the determinants of credit demand, $\mathbf{X}_{2t}^{'}$ determinants of credit supply, $\boldsymbol{\beta}_1, \boldsymbol{\beta}_2$ are the parameters to be estimated, and ε_{1t}, ε_{2t} are random errors. Assuming that the errors are independent and normally distributed with variances σ_1^2 and σ_2^2, the following functions are given:

$$f_1(C_t) = \frac{1}{\sqrt{2\pi\sigma_1^2}}\exp\left[-\frac{1}{2\sigma_1^2}(C_t - \mathbf{X}_{1t}^{'}\boldsymbol{\beta}_1)^2\right]$$
$$f_2(C_t) = \frac{1}{\sqrt{2\pi\sigma_1^2}}\exp\left[-\frac{1}{2\sigma_2^2}(C_t - \mathbf{X}_{2t}^{'}\boldsymbol{\beta}_2)^2\right]$$
$$F_1(C_t) = \frac{1}{\sqrt{2\pi\sigma_1^2}}\int_{C_t}^{\infty}\exp\left[-\frac{1}{2\sigma_1^2}(C_t - \mathbf{X}_{1t}^{'}\boldsymbol{\beta}_1)^2\right]dC_t^d$$
$$F_2(C_t) = \frac{1}{\sqrt{2\pi\sigma_2^2}}\int_{C_t}^{\infty}\exp\left[-\frac{1}{2\sigma_2^2}(C_t - \mathbf{X}_{2t}^{'}\boldsymbol{\beta}_2)^2\right]dC_t^s$$
$$f(C_t^d, C_t^s) = f_1(C_t^d)f_2(C_t^s) = \frac{1}{2\pi\sigma_1\sigma_2}\exp\left(\frac{-(C_t^d - \mathbf{X}_{1t}^{'}\boldsymbol{\beta}_1)^2}{2\sigma_1^2}\right)\exp\left(\frac{-(C_t^s - \mathbf{X}_{2t}^{'}\boldsymbol{\beta}_2)^2}{2\sigma_2^2}\right).$$

Then, the likelihood that an observation in a period is determined by demand $C_t = C_t^d < C_t^s$ is given by a conditional density C_t

$$f(C_t \mid C_t = C_t^d < C_t^s) = \frac{\int_{C_t}^{\infty} f(C_t, C_t^s)dC_t^s}{\Pr ob(C_t^d < C_t^s)} = \frac{f_1(C_t)\int_{C_t}^{\infty} f_2(C_t^s)dC_t^s}{\Pr ob(C_t^d < C_t^s)} = \frac{f_1(C_t)\cdot F_2(C_t)}{\Pr ob(C_t^d < C_t^s)}$$

where $f(C_t, C_t^s)$ is the joint density of C_t and C_t^s. Conversely, if in a period t there is a credit crunch $C_t = C_t^s < C_t^d$, then the conditional density C_t is given by

$$f(C_t \mid C_t = C_t^d < C_t^s) = \frac{\int_{C_t}^{\infty} f(C_t, C_t^d)dC_t^d}{1 - \Pr ob(C_t^d < C_t^s)} = \frac{f_2(C_t)\int_{C_t}^{\infty} f_1(C_t^d)dC_t^d}{1 - \Pr ob(C_t^d < C_t^s)} = \frac{f_2(C_t)\cdot F_1(C_t)}{1 - \Pr ob(C_t^d < C_t^s)}.$$

Given that in a period t the observed quantity of credit is determined by either supply or demand, the unconditional density C_t is given by

$$\begin{aligned} f(C_t \mid \mathbf{X}_{1t}, \mathbf{X}_{2t}) &= \Pr ob(C_t^d < C_t^s)f(C_t \mid C_t = C_t^d) + (1 - \Pr ob(C_t^d < C_t^s))f(C_t \mid C_t = C_t^s) \\ &= f_1(C_t)\cdot F_2(C_t) + f_2(C_t)\cdot F_1(C_t) \end{aligned}$$

on the basis of which the *LogLikelihood* of the entire sample is

$$L(\boldsymbol{\beta}_1, \boldsymbol{\beta}_2 \mid \mathbf{X}_{1t}, \mathbf{X}_{2t}) = \sum_{t=1}^{n}\log[f_1(C_t)\cdot F_2(C_t) + f_2(C_t)\cdot F_1(C_t)]$$

The parameter estimations for $\boldsymbol{\beta}_1, \boldsymbol{\beta}_2$ will represent the values maximising the *LogLikelihood*.

3 This condition helps to avoid the usual identification problems in credit market equilibrium models, given that, in each period, the volume of credit is determined by either supply or demand.

The *LogLikelihood* maximisation algorithm has been initiated from the starting point for β_1, β_2 estimated by OLS or 2SLS. Therefore, apart from identifying the periods of credit crunch, the model also establishes key determinants of credit supply and demand. After estimation of the credit demand and supply parameters, the excess supply is calculated as the difference between estimated credit supply and estimated credit demand.

Given that the series are non-stationary, the estimated results are reasonable only if the credit supply and demand determinants are cointegrated, which can be[4] proved by a test of cointegration between the model-estimated credit demand and the observed credit series and, separately, between the estimated credit supply and observed credit.

3.1 Determinants of credit supply and demand

The vector of potential determinants in this model includes variables normally used as determinants of supply and demand. As we are actually dealing with a simultaneous equations system, in choosing variables for a particular equation, we take account of identifying both equations.

Real credit demand depends on the price of credit (nominal interest rate), economic activity (real GDP), GDP gap, EMBI yield spread and EURIBOR. As households have no access to foreign credit markets, the last two variables relate exclusively to credit supply to enterprises.

Credit demand is expected to fall if the price of credit goes up. Conversely, stronger economic activity as a relevant measure of the macroeconomic environment should stimulate credit demand from households and enterprises. However, during periods of short-term decline in output, enterprises might increase their credit demand in order to survive or maintain the level of production until the economy recovers, so, besides GDP, the parameters also include GDP gap, which should be negatively correlated with credit demand[5]. The yield spread, as a potential determinant of credit demand from enterprises, has opposite effects on demand. While on the one hand, looking from the perspective of a foreign investor or a bank, an increase/decrease in yield spread constitutes a worsening/improvement of the macroeconomic situation in a country and in the environment, on the other hand, a change in the yield spread influences the price of foreign borrowing, reflecting the possible substitution of domestic for foreign credit. If the substitution effect prevails, the relationship between demand and yield spread should be positive, whereas in the case of prevailing macroeconomic effects, the correlation is expected to be negative. EURIBOR represents the price (or a part of the price) of alternative (foreign) corporate borrowing, so it is expected to have a positive sign.

At the same time, real credit supply depends on the difference between average lending interest rate and average deposit interest rate, lending capacity of the banking system, GDP, volume of non-performing loans, loan-loss provision expenses, ROA and ROE and EURIBOR. Lending capacity and GDP are expected to have positive signs. GDP is a determinant of credit supply, related to the economic situation and the clients' ability to repay loans. It is therefore expected that banks operating in a more favourable economic environment would be more inclined to extend loans due to a lower client risk. The difference between lending and deposit rates reflects a bank's profitability (as do ROA and ROAC) and its client risk. Higher profitability encourages banks to increase lending, which means that the three variables measuring profit are expected to have positive signs. However, if profit making becomes "expensive", i.e. if the difference between interest rates arises from higher client risk premiums, credit supply may fall. The volume of non-performing loans, provision expenses and EURIBOR approximating the price of banks' external borrowing, have negative effects on profitability and their signs are expected to be negative[6].

4 Please, note that the estimated supply and demand series represent a linear combination of their determinants.

5 Similar reasons for including the GDP gap among the credit demand determinants can be given for households.

6 Apart from the aforementioned potential determinants of supply and demand, we included the following variables: the share price index as an indicator of expectations (economic activity dynamics), consumer price index as another indicator of macroeconomic (in)stability, loans to the government as an indicator of crowding the private sector out of the credit market, VIX as an indicator of global risk aversion, immobilised funds of banks as a monetary policy indicator and the difference between interest rate on loans and on the Ministry of Finance treasury bills (with maturity of 91 days) as a measure of opportunity cost or alternative investment. Some of these variables were insignificant, so that the estimated model results were not changed relative to the

In an econometric analysis, the basic model includes all the aforementioned determinants of demand and the first three determinants of supply. Due to the inclusion of all possible determinants of supply and demand, the *LogLikelihood* maximisation algorithm cannot numerically find the global maximum of the objective function, which is the consequence of searching for the maximum in a multidimensional area of model parameters. Therefore, taking into account statistical difficulties with estimators, we estimated a number of models by individually adding the following supply determinants to the basic model: the volume of non-performing loans, loan-loss provision expenses, ROA and ROE and EURIBOR. The excess supply estimates in different models was not significantly different from the basic model specifications

Although potential determinants of supply do not include any variable directly related to the monetary policy measures[7], this by no means implies that measures such as limitation of credit growth or prudential measures have not influenced credit supply. Therefore, we try to find a direct correlation between the estimated excess supply/demand without the monetary policy measures and the CNB measures, primarily those aimed at limiting the banking sector's credit activity.

3.2 Data description

The credit market disequilibrium model has been estimated using quarterly data for the period from the first quarter of 2000 to the first quarter of 2010. This period was delimited by two global financial crises, one of which arose in emerging market countries in the late 1990, and the other came from the most developed world economies at the end of the last decade.

As we analyse a market with real variables, GDP, credit and lending capacity are deflated by the consumer price index. GDP is seasonally adjusted, due to the presence of a strong seasonal component, and the GDP gap represents the difference between the original GDP series and its HP trend. In order to reduce volatility and "standardise" the level of variables, most of them are observed in logs.

Credit includes total loans to enterprises and households. Kuna loans with a currency clause dominate in long-term household and corporate borrowing, so that the nominal interest rate is represented by a quarterly average of the annual interest rate on total kuna loans with a currency clause. Given the negligible role of capital markets in the financing of domestic enterprises, and of corporate borrowing through the issue of debt securities, the satisfaction of financial needs of enterprises and households mostly depends on banks' lending capacities, which was primarily determined by capital inflows during the reference period. Therefore, the banks' lending capacities are approximated by the foreign liabilities of banks increased by foreign direct investment in the banking sector[8]. The difference between lending and deposit interest rates was calculated as the difference between quarterly averages of annual interest rates on total kuna loans with a currency clause and on foreign currency deposits. As the credit demand function uses the nominal interest rate on total kuna loans with a currency clause, in the calculation of the difference between lending and deposit rates, this rate is deducted from the quarterly average of annual interest rate on foreign currency deposits, dominating in both corporate and household savings. As an indicator of commercial banks' credit risk, we use the ratio of non-performing loans to total loans.

The yield spread on Croatian eurobonds is an indicator of the risk premium, which influences the price of external borrowing and reflects the possibility of substituting domestic for foreign credit. It is also an indicator of investors' perception of current and future macroeconomic and fiscal movements in the country and in the environment. The one-year EURIBOR indicates the base price of long-term capital in the eurozone and, in combination with the yield spread, it determines the total cost of external borrowing.

basic model. Another serious concern was the numerical problems with finding the maximum *LogLikelihood*, which is why we had to exclude all variables that had caused the problem. This was also the reason for the omission of insignificant variables from the model.

7 It is impossible to construct any monetary policy indicator to take into account all the measures taken by the CNB since 2000. The estimated correlations between credit supply and the variables, such as immobilised funds of banks due to the CNB measures, proved to be insignificant.

8 The lending capacity measures, which include the components of "domestic" liabilities, are very similar to the lending capacity measures used in this research.

4 Model estimation results

This chapter sets forth the estimation results of a credit market disequilibrium model, obtained by applying the ML method, and shows a number of specifications differing in the number of involved determinants of credit supply. The top of Table 1 shows the estimated parameters of the credit demand function, whereas the bottom shows the estimated parameters of the credit supply function, with their standard errors in brackets. In the basic model (Spec 1), the economic environment measured by GDP expectedly has positive effects on both credit supply and demand. The level of economic activity is the most important determinant of both credit supply, as a measure of risk, and credit demand, as a measure of wealth. As in Barajas and Steiner (2002), as well as in Gosh and Gosh (1999), the GDP gap parameter is negative, suggesting that the economy "overheating" that results in faster-than-potential growth reduces credit demand due to an increase in own sources of finance, i.e. that in bad times, demand from enterprises for external sources of finance is stronger than demand for own sources of finance. Moreover, the above-average growth during the reference period was due to heavy external borrowing by enterprises, as a substitution for a large portion of demand for domestic loans. The correlations between credit price and credit supply vs. demand are expected. Thus, the relationship between interest rate and demand is negative, i.e. higher prices of credit reduce credit demand, but this parameter is insignificant. The estimated yield spread parameter has a positive sign, so in this case, the yield spread apparently reflects the substitution of domestic by external financing, rather than the macroeconomic effects on credit demand. Concurrently, an increase in EURIBOR, as another measure of substituting domestic for foreign loans to enterprises, correlates negatively with credit demand, but is insignificant. The relationship between credit supply and the difference between credit and deposit interest rates is positive, so that a higher price of credit or lower cost of the sources of finance encourages banks to lend more. As in most research works, lending capacity, the second most important determinant of credit supply, is positively correlated with it.

The remaining model specifications show the relationship between some other possible determinants and credit supply. Despite the inclusion of additional regressors in the model, there have been no significant changes in the amounts of estimated coefficients (with the exception of GDP gap in Spec 4 and Spec 5, and the interest rate difference in Spec 2 and Spec 4, which have become insignificant) and the conclusions based on hypothesis tests. For this reason, and because GDP and lending capacity play the main role in determining credit demand and supply, the conclusions relating to excess supply are robust with respect to the model specification. The increases in loan-loss provision expenses (Spec 2) and in EURIBOR (Spec 6) are unexpectedly positively correlated with credit supply. By contrast, the volume of non-performing loans, as a credit risk indicator in Spec 3 expectedly reduces credit supply. Given the high correlation between the provision expenses and the volume of non-performing loans, the estimated parameters for these variables are expected to have the same sign. However, unexpected signs, as well as their insignificance, are probably the result of a strong correlation among regressors in the supply function, and perhaps of the numerical problems with *LogLikelihood* maximisation. The signs of the measures of bank profitability in Spec 4 and Spec 5 are positive, but also insignificant.

Given that we estimate a model with non-stationary data (at log-levels), the parameter estimation results and hypothesis tests only have sense if the estimated supply and demand and realised credit are co-integrated. The *Johansen* co-integration rank test, i.e. the *trace statistics,* shows the presence of one co-integration link between supply and demand in each model specification.

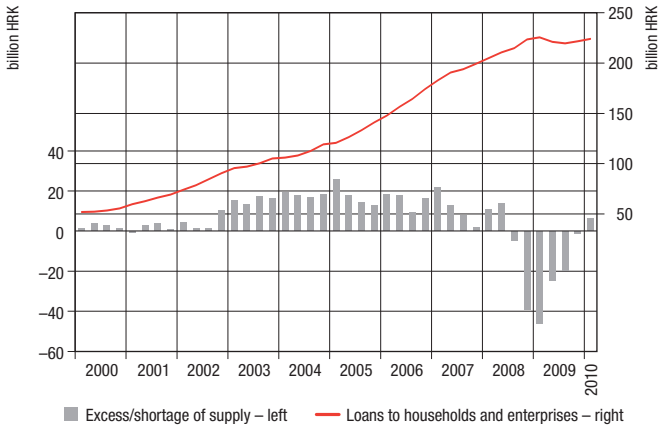
Figures 2 and 3 show the difference between the estimated series of credit supply and demand, calculated under the basic disequilibrium model and on the basis of realised amounts of credit. Given the robustness of parameter estimates in various model specifications, the conclusions about the excess amount of credit supply have remained unchanged. With respect to the difference between credit supply and demand, Figure 1 shows three distinct sub-periods. The first, from 2000 to end-2002, was marked by "equilibrium" between supply and demand and gradual stabilisation of the global financial markets and domestic banking sector after the crisis in the late 1990s. From end-2002 to mid-2008, credit supply exceeded the demand due to strong capital

Table 1 Parameter estimation of a credit market disequilibrium model using the maximum likelihood method

Loans granted (households and enterprises)	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6
Demand						
Constant	–8.81**	–8.94**	–8.73**	–7.82**	–8.82**	–8.67**
	(0.69)	(0.22)	(0.71)	(0.63)	(0.80)	(0.71)
Lending interest rate	–0.03	–0.02**	–0.03	–0.02	–0.03	–0.03
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
GDP	3.46**	3.48**	3.44**	3.15**	3.46**	3.423**
	(0.15)	(0.06)	(0.15)	(0.15)	(0.17)	(0.15)
GDP gap	–2.09**	–2.25**	–2.00**	–3.556	–2.1	–1.91**
	(0.60)	(0.57)	(0.56)	(0.61)	(0.62)	(0.57)
EMBI yield spread	0.08**	0.05**	0.07**	0.08**	0.07**	0.07**
	(0.03)	(0.01)	(0.03)	(0.03)	(0.03)	(0.03)
EURIBOR 1 y.	0	–0.01	0	0.05	0	0
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Standard deviation (σd)	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LogLikelihood	93.86	86.33	94.46	104.66	94.93	93.87
Null hypothesis: no cointegration links						
No. of cointegration links	1	1	1	1	1	1
Trace statistics	28.10**	27.59**	27.93**	25.39**	28.02**	27.59**
Supply						
Constant	–3.98**	–6.09**	–3.10**	–1.34**	–3.59**	–2.68**
	(0.02)	(0.03)	(0.00)	(0.45)	(0.04)	(0.01)
Difference between lending and deposit rates	0.04**	0	0.05**	–0.01	0.04**	0.05**
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
Lending capacity	0.50**	0.32**	0.52**	0.56**	0.54**	0.61**
	(0.01)	(0.01)	(0.00)	(0.03)	(0.01)	(0.00)
GDP	1.65**	2.34**	1.41**	0.99**	1.51**	1.196**
	(0.01)	(0.02)	(0.00)	(0.11)	(0.00)	(0.00)
EURIBOR 1 y.	–	–	–	–	–	0.01**
	(–)	(–)	(–)	(–)	(–)	(0.00)
Provision expenses	–	0.04**	–	–	–	–
	(–)	(0.01)	(–)	(–)	(–)	(–)
Ratio of non-performing loans	–	–	–0.00**	–	–	–
	(–)	(–)	(0.00)	(–)	(–)	(–)
RoE	–	–	–	–	0	–
	(–)	(–)	(–)	(–)	(0.00)	(–)
RoA	–	–	–	0	–	–
	(–)	(–)	(–)	(0.02)	(–)	(–)
Standard deviation (σs)	0.001**	0.000**	0.000**	0.000**	0.000**	0.000**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LogLikelihood	93.86	86.33	94.46	104.66	94.93	93.87
Null hypothesis: no cointegration links						
No. of cointegration links	1	1	1	1	1	1
Trace statistics	20.64**	24.80**	20.83**	20.85**	20.91**	21.39**

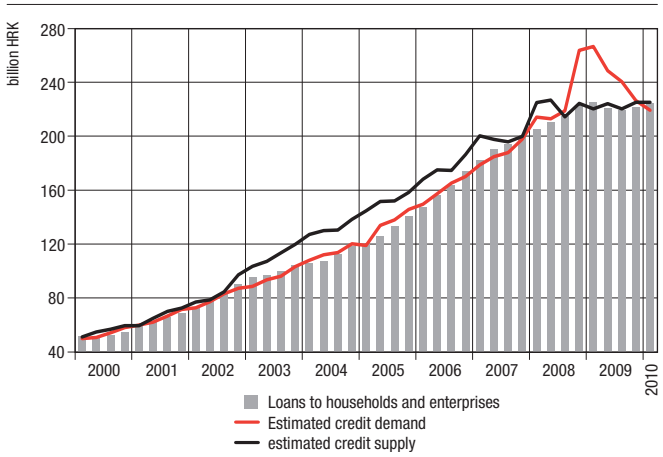
Note: ** 5% significance level, * 10% significance level.
Standard errors are shown in brackets.

Figure 2 Loans to households and enterprises and estimated excess/shortage of credit supply



Source: CNB.

Figure 3 Loans to households and enterprises and estimated credit demand/supply



Source: CNB.

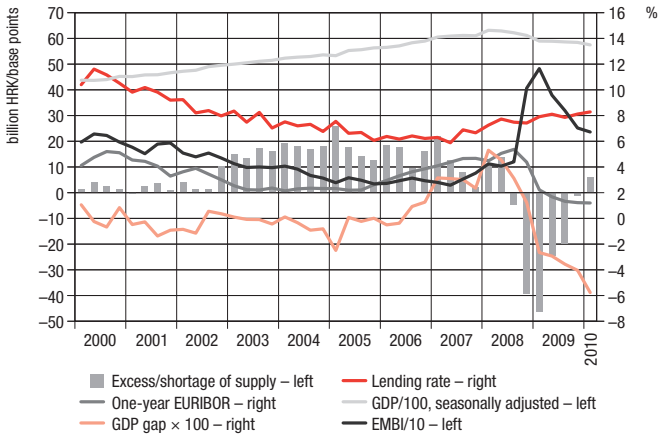
inflows observed in emerging market countries during this period. The last period started with the collapse of Lehman Brothers and an escalation of the global financial crisis in the third quarter of 2008, and lasted until end-2009. During this period, credit demand was not satisfied and a credit crunch arose. The first quarter of 2010 announced the end of the period of credit crunch, primarily due to a fall in demand for loans.

In the first period, domestic credit supply and demand were generally balanced, with the growth in demand determining the economic recovery, accompanied by a gradual decline in (relatively high) domestic and foreign interest rates. As well as by the economic recovery that helped reduce the credit risk, the growth in credit supply over this period was spurred by a moderate increase in capital inflows after their decline during the crisis at the end of the 1990s[9]. Due to a slight recovery of aggregate demand during 2000 and 2001, coupled with higher uncertainty and client risk, banks have built up their foreign exchange assets instead of extending domestic loans (Figures 4 and 5).

The banking system restructuring, primarily through the sales and mergers of banks from 2000 to 2002, led to an excess supply of credit over the second characteristic period, which lasted for the next six years. This period was marked by high global liquidity and a drop in external borrowing prices, resulting in a surge in

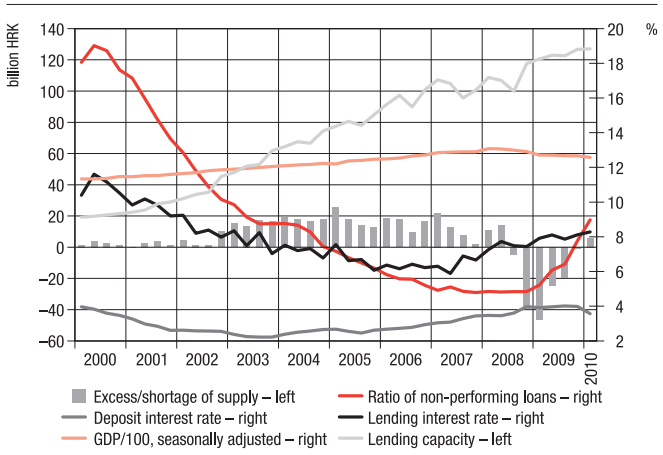
9 Also worth noting was the significant influx of foreign currency deposits at the end of 2001, caused by the conversion of German marks into euros.

Figure 4 Estimated excess/shortage of credit supply and determinants of credit demand



Source: CNB.

Figure 5 Estimated excess/shortage of credit supply and determinants of credit supply



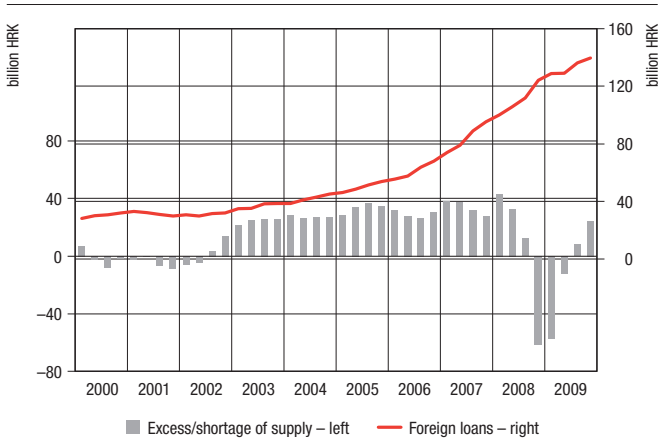
Source: CNB.

capital inflows into the domestic banking sector, coming particularly from parent banks of domestic banks, which resulted in pronounced lending capacity growth. Along with the continuation of a dynamic economic recovery, this led to a strong acceleration of the total domestic credit supply relative to demand, generating a continued excess supply and a noticeable drop in lending interest rates. However, foreign capital inflows and, consequently, credit supply, started to slow down as early as 2007, gradually reducing the excess supply on the credit market.

The last period started with a sharp deepening of the global financial crisis over the third quarter of 2008, as capital inflows slumped, followed by a decline in the banking system's lending capacity. A sharp fall in economic activity additionally reduced credit supply, which stagnated at a lower level in the following period. Concurrently, despite the economic slump and a rise in interest rates, domestic credit demand from enterprises grew strongly, spurred by a pronounced increase in global risk aversion and a limited access to foreign capital markets. Figure 6, showing the estimation results for a model of foreign credit supply and demand, corroborates the fact that domestic business entities have temporarily lost access to foreign credit markets[10]. The

10 Determinants of foreign credit demand include domestic GDP, GDP gap and EURIBOR + yield spread as the price of external borrowing. Determinants of foreign credit supply include EURIBOR + yield spread as the price of supplied foreign credit, external lending capacities of foreign creditors and real

Figure 6 Foreign loans and estimated excess/shortage of foreign credit supply



Source: CNB.

results of the estimated excess demand for foreign credit suggest that the onset of the credit crunch in the foreign credit markets coincided with the beginning of the period of excess credit demand on the domestic credit market. This, among other things, resulted in considerable excess demand for domestic loans relative to their supply at the end of 2008 and early in 2009.

It can be seen that the CNB measure aimed at limiting banking sector lending growth, introduced early in 2007 and lifted in January 2010[11], had no influence on the creation of the credit crunch, because household and corporate loans, i.e. credit supply, rose at a rate lower than the allowed rate as early as from the second quarter of 2008 (except in the last quarter of 2008, which was due to loans extended to state-owned enterprises). However, it should be noted that in a scenario that excludes this measure, credit supply would certainly be higher, as would credit demand, because interest rates would probably be somewhat lower. Consequently, these facts provide no basis for a conclusion what the excess supply would have been, had the CNB not taken steps towards slowing down the lending growth.

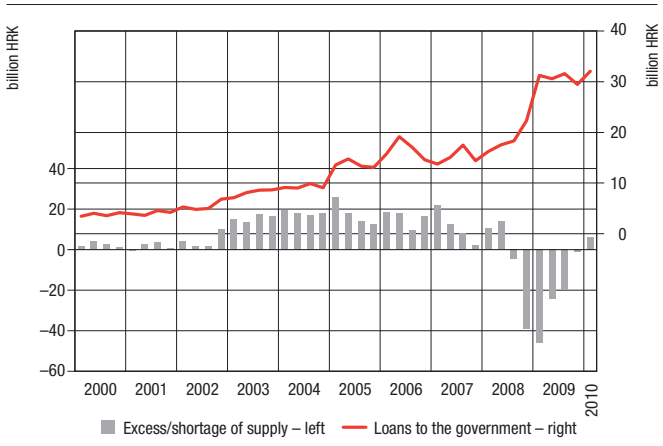
In the rest of 2009 and early in 2010, credit markets stabilized gradually, mainly due to a fall in credit demand in response to low economic activity, an increase in interest rates, and partly as a result of relatively easier access to foreign capital, due to a fall in country risk premiums and relative stabilisation of the global financial markets. All this together led to the pressures on domestic credit supply being relieved.

How can banking sector developments during a period of credit crunch be explained? Generally, during a period of excess demand for credit, banks have at least two reasons for not wanting or being unable to increase (additionally) interest rates in order to discourage credit demand and for deciding instead in favour of credit supply rationing. Firstly, for various reasons, the interest rate adjustment may be slow or "expensive". Besides, the perception of excessive client risk that has not been incorporated into the interest rates (due to the adverse selection risk), or insufficient buffer capital for protection against losses in a situation of quality "deterioration" of loans to risky clients motivates banks to ration the credit supply. In our case, it is very likely that, despite the noticeable interest rate growth in this period, it is exactly the perception of enhanced credit default risk that cannot be covered by higher interest rates that reduced banks' willingness to lend, so, instead of further raising interest rates, the banks tightened other credit conditions and rationed credit supply. This, in turn,

GDP of the EU, as a risk indicator in the EU credit market. The estimation results for a foreign credit market disequilibrium model are given in the Appendix. For the calculation of the amount of credit received by the corporate sector from abroad, loans by non-residents to associated enterprises were added together with loans by non-residents to enterprises from the CNB's external debt statistics, with loans to the HAC (Croatian Motor roads) being excluded for the entire reference period. The foreign lending capacity was calculated using the Bank for International Settlements data on the claims of BIS reporting banks against the non-banking sector in European growing markets, by adding the estimated changes in these claims, adjusted for exchange rate, to their balance as at the end of the first quarter of 2000.

11 See the Decision on the Subscription of Compulsory CNB Bills.

Figure 7 Loans to the government and estimated excess/ shortage of credit supply to households and enterprises



Source: CNB.

impaired the efficiency of the monetary policy measures aimed at boosting liquidity and cutting interest rates. In view of this, the funding models within the economic recovery and development measures of the Croatian Government[12] might be a major step towards resolving the credit-rationing problem, because they are clearly focused on reducing the banks' client risks[13]. However, their practical effects are still questionable, given the currently negligible utilisation of funds under these models.

It should further be noted that, in estimating the credit market disequilibrium model, we analysed loans excluding the loans to the government. According to Figure 7, the onset of the period of credit crunch on the household and corporate loan markets was marked by a sharp increase in loans to the government. This substitution of private sector loans by loans to the government in a situation of credit supply rationing and high client riskiness represents an optimal decision of banks to increase the supply of credit to the most reliable client[14]. Therefore, such a credit substitution cannot be considered an instance of crowding the private sector out of the credit market, given that, in a situation of credit rationing, the supply of credit to the private sector would probably not have grown even if there had been no demand for loans from the government.

12 This relates to two documents, namely the "Economic Recovery and Development Measures - Funding Models" and "Draft Proposal for an Act on a Guarantee Fund for Economic Recovery and Development with a Final Act Proposal" (adopted at the Parliament session on 5 February 2010).

13 This particularly relates to Model B, in which the government undertakes to cover some of the risks associated with new bank loans by establishing a guarantee fund. Within this model, guarantees (in the total value of HRK 2bn) are issued by the CBRD in the name and for the account of the Republic of Croatia, under clearly defined guarantee quotas and with an acceptable level of risk. The entities guaranteed under this model include commercial banks that bid at auctions for available guarantee quotas, which the CBRD then assigns to the best bidders (banks ready to take on a higher percentage of risk). Guarantees are given for the liabilities of final loan users; the amount of an individual guarantee may not exceed HRK 60m and must cover up to 50% of the loan amount (except in special cases for which criteria are still to be set).

14 In the estimated model, i.e. estimated credit supply, loans to the government proved to be insignificant, given that the impact of government loans on credit supply was only significant at end-2008.

5 Conclusion

In this paper, we estimated credit supply and demand in order to identify periods of credit market disequilibrium. The results of the estimated model, which is based on the possibility that interest rates do not clear the credit market, suggest three distinct sub-periods of banks' credit activity. The first period from 2000 to 2002, marked by equilibrium between credit supply and demand, saw gradual stabilisation of global financial markets and the restructuring of the domestic banking sector after the crisis in the late 1990s. In the period from end-2002 to the middle of 2008, there was excess supply in the credit market, spurred by strong capital inflows into the banking sector. The model estimation results show that the abrupt halt in lending activity from end-2008 to end-2009 can be accounted for by credit crunch-related reasons, rather than by a credit demand shortage. The credit crunch was mostly due to a surge in demand for loans, and only to a lesser extent due to reduced supply of loans. A rise in demand for domestic loans in the second half of 2008 was mainly the consequence of briefly impeded access to foreign credit markets caused by the escalation of the global financial crisis, regardless of higher interest rates and a fall in total income. Concurrently, as Croatia fell into recession, the credit default risk grew, so that banks started to refrain from lending. Reduced supply did not lead to a further increase in interest rates, as banks started to ration credit. The end of 2009 and the beginning of 2010 saw gradual stabilisation of the credit market due to reduced credit demand caused by low economic activity, a rise in interest rates and, to some extent, by relatively easier access to foreign loans. Moreover, country risk premiums decreased, which, coupled with relatively more stable financial markets, facilitated access to foreign capital and relieved pressure on foreign supply.

The analysis results of the lending activity dynamics point to the economic activity level as the key determinant of both credit supply, as a measure of risk, and credit demand, as a measure of wealth. In addition to this, important determinants of credit supply and demand include the lending capacities of banks, which heavily depends on foreign capital inflows and the price of foreign credit. Viewed in combination with findings by Krznar and Kunovac (2010), showing that the movements and volatility of domestic GDP can be primarily accounted for by the EU economy dynamics, it is obvious that the main determinants of credit supply and demand primarily relate to the external environment. All this points to a limited range of monetary policy measures, aimed at stimulating lending activity, especially in an environment of credit supply rationing and a high client risk, when monetary policy is ineffective.

Assuming the normalization of foreign financial markets, the growth in demand for domestic loans in the coming period will mostly depend on the strengthening of export demand, which is expected to provide the strongest impetus to economic growth. A possible economic recovery will also be spurred by capital inflows into the domestic banking sector, and will contribute to reducing the riskiness of placements. As a result, demand will grow and interest rates will ultimately go down.

6 References

Agénor, P.R., Aizeman, J. and Hoffmaister, A. (2000): *The Credit Crunch in East Asia: What Can Bank Excess Liquid Assets Tell Us?*, NBER Working Paper 7951.

Allain, L. and Oulidi, N. (2009): *Credit Market in Morocco: A Disequilibrium Approach*, IMF Working Paper 09/53.

Baek, E. G. (2002): *A Disequilibrium Model of the Korean Credit Crunch*, The Journal of the Korean Economy, Vol. 6, No. 2, pp. 313-336.

Barajas, A. and Steiner, R. (2002): *Why Don't They Lend? Credit Stagnation in Latin America*, IMF Staff Papers 49, pp. 156-184.

Bernanke, B., Lown, C. and Friedman, B. (1991): *The Credit Crunch*, Brookings Papers on Economic Activity, Vol. 1991, No. 2, pp. 205-47.

Catao, L. (1997): *Bank Credit in Argentina in the Aftermath of the Mexican Crisis: Supply or Demand Constrained?*, IMF Working Paper 97/32.

Costa, S. and Margani, P. (2009): *Credit crunch in Italy: Evidence on new ISAE survey data*, Fourth joint EU-OECD Workshop on Business and Consumer Opinion Surveys, Bruxelles.

Ding, W., Domac, I. and Ferri, G. (1999): *Is There a Credit Crunch in East Asia*? Working Paper, World Bank.

Fair, R.C. and Jaffee, D.M. (1972): *Methods of Estimation for Markets in Disequilibrium*, Econometrica 45(7), pp. 1723-7.

Fair, R.C. and Kelejian, H.H., (1974): *Methods of Estimation for Markets in Disequilibrium: A Further Study*, Econometrica 42(7), pp. 177-99.

Ghosh, S. and Ghosh, A. (1999): *East Asia in the Aftermath: Was There a Crunch*? IMF Working Paper 99/38.

Ghosh, S. (2009): *In Focus: Credit crunch or weak demand for credit*, EU10 Regular Economic Report, October, pp. 37-44.

Ikhide, S. (2003): *Was There a Credit Crunch in Namibia between 1996-2000*?, Journal of Applied Economics, Vol. VI, No. 2, pp. 269-90.

Kanoh, S. and Pumpaisanchai, C. (2006): *Listening to the Market: Estimating Credit Demand and Supply from Survey Data*, Hi-Stat, Discussion Paper Series, No. 137, February.

Krznar, I. and Kunovac, D. (2010): Impact of External Shocks on Domestic Inflation and GDP, CNB Working Papers, I-28, Zagreb, November 2010.

Maddala, G.S. and Nelson, F. (1974): *Maximum Likelihood Methods for Markets in Disequilibrium*, Econometrica 42, pp. 1013-1030.

Nehls, H. and Schmidt, T. (2003): *Credit Crunch in Germany*? RWI: Discussion Papers, No.6.

Okurut, N., Schoombee, A. and van der Berg, S. (2004): *Credit demand and credit rationing in the informal financial sector in Uganda*, DPRU/Tips/Cornell Conference on Affrican Development and Poverty Reduction: The Macro-Micro Linkage, Forum Paper, 2004.

Quandt, R.E. and Ramsey, J.B. (1978): *Estimation Mixtures of Normal Distributions and Switching Regressions*. Journal of the American Statistical Association 73, pp. 730-752.

Pazarbasioglu, C. (1996): *A Credit Crunch? A Case Study of Finland in the Aftermath of the Banking Crisis*, IMF Working Paper 96/135.

Westermann, F. (2003): *The Credit Crunch: A Comparison of Germany and Japan*, CESifo Forum, 2003, No. 1.

Woo, D. (1999): *In Search of "Capital Crunch" Supply Factors Behind the Credit Slowdown in Japan*, IMF Working Paper 99/3.

7 Appendix: An estimated model of foreign credit market disequilibrium

Table 2: Parameter estimation of a model of foreign credit market disequilibrium using the maximum likelihood method

Loans granted (households and enterprises)	Spec 1
Demand	
Constant	–13.21**
	(0.75)
GDP	4.14**
	(0.17)
GDP gap	–0.09**
	(0.01)
EURIBOR 1 y. + EMBI yield spread	0.17**
	(0.03)
Standard deviation (σ_{d})	0.009**
	(0.01)
LogLikelihood	45.94
Null hypothesis: no cointegration links	
No. of cointegration links	1
Trace statistics	27.98**
Supply	
Constant	–9.86**
	(0.47)
EURIBOR 1 y. + EMBI yield spread	–0.03*
	(0.02)
Lending potential	0.27**
	(0.03)
GDP EA	1.76**
	(0.07)
Standard deviation (σ_{s})	0.005**
	(0.00)
LogLikelihood	45.94
Null hypothesis: no cointegration links	
No. of cointegration links	1
Trace statistics	26.73**

Note: ** 5% significance level, * 10% significance level.
Standard errors are shown in brackets.

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