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Macro-Financial Linkages: Theory and Applications

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EDITORIAL

The recent financial crisis has challenged the prevailing modelling approaches and empirical frameworks, stressing the importance of closer examination of the interconnections between macroeconomic and financial conditions. This edition of the Research Bulletin presents the results of five selected papers which address various theoretical and empirical aspects of macro-financial linkages.

The first article presents a model that incorporates credit frictions and serves to describe the dynamics of credit spreads in moderate as well as crisis times. The model is then used to evaluate the effects of quantitative easing and credit easing. The second article proposes a model that shows how the conditions of a parent bank might affect the interest rate setting of its subsidiary or branch in a foreign country, and is followed by an empirical assessment of the ten largest banks in the Czech Republic under foreign control. The remaining papers are of an empirical nature. The third article investigates the household credit market in the Czech Republic, proposing a new indicator of default risk and examining its determinants. The fourth article evaluates the extent to which financial variables help predict key Czech macroeconomic indicators. The last article presents evidence on the degree and evolution of financial integration of the Czech Republic and four other EU countries outside the euro area.

Jan Babecký

IN THIS ISSUE

Financial Frictions and Stress in Financial Markets[1]

Ke Pang[a] and Pierre Siklos[a,b]

[a]Wilfrid Laurier University [b]Viessmann European Research Centre
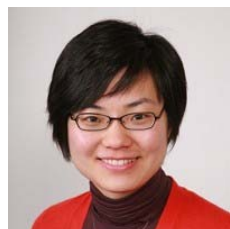
The financial crisis, which began in earnest in the summer of 2007, revealed the need for macroeconomic analysis to more explicitly consider financial market imperfections, generally referred to as financial frictions, into the canonical macro model that many academics and central banks routinely employ in policy analysis. While the weaknesses of the canonical model (Woodford, 2003) are well-known (e.g. Goodhart, 2008, Tovar, 2008, and Chari, Kehoe and McGrattan, 2009), the profession has not yet given up on this approach to the analysis of monetary policy. A key indicator of stress facing financial markets can be seen from the behaviour of credit spreads. Figure 1 illustrates and reveals how typical credit spreads, including the Libor-OIS spread highlighted by Taylor and Williams (2009), rose sharply in the U.S. as the financial crisis deepened. The Baa-Aaa and the prime rate-fed funds spreads are other examples of indicators that have been used to determine the level of financial stress since they tend to rise during recessions.

Goodfriend and McCallum (2007) show that an otherwise standard optimising model, variants of which are now the staple of models used by central banks in policy analysis, is capable of explaining credit spreads. Understanding movements in these spreads, and their behaviour in response both to shocks and to policies, is considered to be a central element for our understanding of the role of financial markets in the macroeconomy. Moreover, it has been known for some time that the credit channel plays a critical role in the monetary policy transmission mechanism (e.g. Bernanke and Gertler, 1989, and Bernanke and Gertler 1995). Consequently, financial frictions, as reflected in interest rate spreads, may potentially have large economic effects.

Walsh (2009) argues that a good understanding of the "factors that generate movements in spreads, or the degree to which these movements reflect inefficient fluctuations that call for policy responses" still eludes us. Our paper attempts to model the behaviour of credit spreads in a dynamic model (more typically known by the acronym DSGE model) with financial frictions. Financial frictions come in many forms. One view is that creditors are reluctant to lend for fear of not being repaid. Another type of friction shows up as spreads remaining high because debt is undervalued. Hence, lenders are not making loans that they would otherwise have made. Hence, the costs associated with initiating and monitoring lending activity are assumed to be reflected in the spread. Why? Siegel (2010), for example, points out that markets were indeed suspicious of the quality of mortgage-backed securities and this was reflected in the behaviour of spreads between high quality mortgage securities and corporate bonds in advance of the outbreak of the

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[1] This article is based on Pang and Siklos (2010).

latest financial crisis. Therefore, while attempts to make the connection between financial frictions and credit spreads are unlikely to be able to capture idiosyncratic elements present in any financial crisis, the stylised model proposed in this paper can replicate the kinds of sharp movements and volatility that were observed in some credit spreads that policy makers have highlighted in describing the global financial crisis.

Figure 1. Selected credit spreads
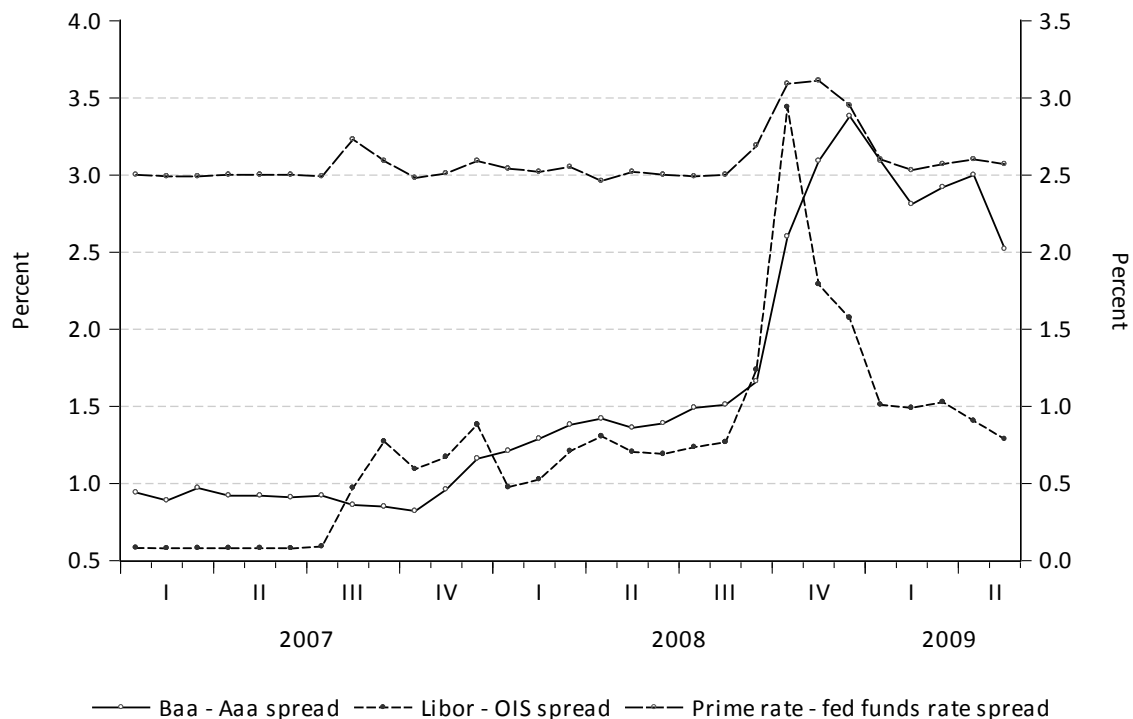
In spite of differences in the behaviour of these spreads they all display certain common features, notably large changes in the levels particularly beginning around 2008, reflecting the rising stress in credit markets, culminating in sudden movements prompted by large shocks to the financial system in the aftermath of the failure of Lehman Brothers.

The model we adapt is the basic credit-friction model developed by Cúrdia and Woodford (2009a, 2009b, 2009c, 2010). However, we assume that the policy authorities use an optimising model where the policy instrument is adjusted so that the central bank effectively hits a desired inflation rate at an appropriate horizon. This is, of course, also consistent with the conduct of monetary policy that aims for an inflation target. As a result, the policy instrument becomes an implicit function of current information. This keeps the model tractable.

The assumption in the Cúrdia and Woodford framework that agents are heterogeneous, that credit frictions exist, and that central bank policies should be identified according to whether or not the composition of its balance sheet is affected, are especially appealing under the current circumstances. Nevertheless, a few other modifications to the Cúrdia and Woodford framework are also introduced to enable us to focus more directly on the question of explaining movements in a credit spread. In particular, we solve the model numerically (using a nonlinear method). Also, actual time series for the exogenous driving forces are used to generate a time series pattern for

the simulated credit spread. More importantly, we add default risk to the model, in recognition of the possibility that the financial market seizes up from time to time because there is a change in loan default rates.

The paper also addresses some important policy questions. The first is: can a simple credit-friction model explain the credit spread observed in the data? We also consider the following policy exercises: how can monetary policy influence such spreads? More precisely, what are the qualitative differences between quantitative easing (QE) and credit easing (CE) policies? According to Bernanke (2009), QE amounts to actions that centre on the liabilities of the central bank. In contrast, CE policies focus on the composition of the asset side of the central bank's balance sheet. In the present context, credit easing takes place through an increase in the central bank's direct lending to households. Insights about the impact of quantitative easing are obtained by considering an injection of bank reserves. The results reveal that the short-run impacts of QE and CE are almost diametrically opposite to each other. In the long run, however, the differences between the two policies, while being more modest, still favour a CE response. While a more conclusive policy assessment awaits further refinements to the model, our results go part way to fulfilling one of the "homework assignments" that Kohn (2010), former Vice-Chair of the Board of Governors of the U.S. Federal Reserve, challenged the profession to tackle in future. Our model also shows that quantitative easing need not be inflationary, though this is likely because the inflation target in our model is always met and, hence, is credible in the steady state.

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Funding Costs and Loan Pricing by Multinational Bank Affiliates[2]

Alexis Derviz[a,c] and Marie Raková[a,b]

[a]Czech National Bank [b]Charles University
[c]Institute of Information Theory and Automation, Academy of Sciences of the Czech Republic

The role played by the condition of the parent institution of an international bank group in the interest rate-setting of its affiliate – a subsidiary or branch – in a foreign country is a natural question facing policymakers in financially open economies. The latest global financial crisis has led to the collapse of several multinational banks (MNBs) in industrial countries and has negatively affected most of the surviving ones. The repercussions for financial stability have been tangible both in the countries of incorporation of MNBs and, in some cases, in the host countries of their affiliates. Shock propagation worked in one of two directions. Either the parent's condition deteriorated to the point of inability to maintain the liquidity and/or solvency of its affiliates (e.g. the near-failure and rescue of Fortis Group in the Benelux countries in September 2008), or the affiliate's asset values fell so much that the parent was overburdened with guarantee calls and balance sheet repair needs in them (the case of Scandinavian banks in the Baltic states or Austrian banks in some East European countries in the latest phase of the crisis).

Subsequently, real effects in the form of disrupted credit creation have followed the purely financial ones and contributed to the transition of the financial turmoil into a global recession. Naturally, mechanisms of shock propagation through internationally active banks are now at the centre of policymakers' attention. Indeed, of all the initiatives with regard to financial regulation that have appeared worldwide in reaction to the global crisis, the most radical ones have to do with the regulation of multinational banking activities.

However, the ability of MNBs to transmit positive and negative credit shocks across borders is not limited to periods of financial turmoil. To an extent, excess funds within a bank group are transferred between parent and affiliates on a regular basis. Affiliates in host countries with tight financing constraints (high money market rates, tough competition for deposits, etc.) may take recourse to funds from the parent. The converse situation, of which the Czech banking sector is a good example, obtains when affiliates with an overhang of free liquidity may receive incentives from the parent to divert funds from local lending to preferential alternatives abroad with a higher yield (including lending to the parent itself up to the standing regulatory limit). This has implications for the affiliate's loan pricing and volume, as described by the theory of internal capital markets in complex organisations (see, e.g., Stein, 1997, Scharfstein and Stein, 2000, and extensive related literature). Models developed within this theory explain fund allocation between divisions in a firm, be it financial or non-financial, depending on statistics of future earnings, informational imperfections and manager incentives. The total funding costs of foreign bank

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affiliates is thus a blend of domestic factors (above all, domestic deposits and the interbank money market) and foreign factors. It should then be a matter of empirical analysis to determine the significance of the discussed "parental" cost component in the actual lending rate setting of foreign bank affiliates. So, our research is not narrowly focused on MNB actions in a crisis, but seeks instead to uncover more general behaviour patterns. It can be considered a follow-up to earlier studies of factors driving loan volumes in MNBs (Derviz and Podpiera, 2007, and De Haas and van Lelyveld, 2010).

We are interested in the possible manifestations of MNB-internal capital market functioning in the price of host country credit as a general, not necessarily crisis-related phenomenon. Our conjecture is that, notwithstanding competition between banks for borrowers, funding costs create a first-order effect in the negotiated lending rate. In particular, there must be situations in which foreign bank affiliates optimally adjust their rate-setting policy depending on the incentives provided by their parent bank. This is our motivation to conduct both a theoretical and empirical analysis of lending rate determination in a foreign bank affiliate with alternative sources of funding. The host country under consideration in the empirical part of the study is the Czech Republic, whose banking sector is dominated by institutions under foreign control: more than 80 per cent of banking sector assets, deposits and loans are held by banks with a foreign majority shareholder or by foreign bank branches.

First, a model is developed in which the lending rate charged by an MNB affiliate is an endogenous function of commonly observed characteristics of borrower performance, the degree of borrower informational opacity and, finally, funding costs. The last-mentioned may be influenced by the costliness of funds within the parent bank group. An important caveat is that the influence is only present if, given the frictions in the internal capital market, the net benefit from accessing it by the affiliate is positive. Otherwise, it would be preferable to limit funding to host country sources only. The model predicts that both the equilibrium lending rate and the potential parent influence on it will be different for different groups of borrowers differing in informational opacity.

Second, we apply the empirical implications of the theoretical model to foreign bank affiliates operating in the Czech credit market. The data cover the 3.5 year period preceding the final phase of the latest financial crisis (January 2005–June 2008). Our cross-sectional sample consists of the ten largest foreign-owned commercial banks. For them, we use data on interest rates on new loans at monthly frequency for the period between January 2005 and June 2008 from the internal data base of the Czech National Bank. The data started being collected in the current structure exactly at the start of our sample period. Besides interest rates and loan volumes, they also contain a crude sectoral classification of borrowers. Among the latter, we focus attention on non-financial legal persons, in particular domestically owned firms, foreign-owned firms and self-employed individuals. We use several control variables on the affiliate level plus a "parent bank condition" variable in order to capture the scarcity of funds in the internal capital market at the MNB group level. We then test the presence and significance of this parent effect for monthly volume-weighted averages of interest rates in each of the named borrower categories.

The degree of detail of our affiliate-level information is substantially higher than that of the information on parent banks: essentially, the only reliable monthly data on their operation and

condition present in the public domain is that extractable from market prices of the traded liabilities of the parents. Therefore, the exercise we undertake is necessarily crude and cannot guarantee the detection of all subtleties of internal capital market workings in a multinational bank group. Nevertheless, it is possible to set up criteria for both the cases in which the parent effect is unlikely to be important and the cases in which it becomes prominent enough even to surface through all the noise present in our data.

Our empirical findings can be summarised as follows. There is no uniform home country (of the parent bank) effect in the form of a money market rate differential influence on interest rates charged by the affiliate in the host country. That is, the intra-banking group flow of funds seems to be immune to cross-border interbank market shocks. The intra-banking group flow of funds seems to be effectively disconnected from short-term interbank market influences. Apparently, cross-financing between entities in different countries is subject to detailed earmarking and other bank-internal constraints that do not allow for easy interaction with short-term liquidity management. Symptomatically, the parent's stock price, at least at times when it is mirroring its current and prospective earnings correctly, contains more information on the cost of affiliate funding than both the money market rate differences and the bond yield spreads of that bank.

Furthermore, parent bank effects are absent in banks with slack fund flow constraints to/from the parent. The said constraint is usually not uniformly tight across loans to all categories of borrowers, but instead comes about as a consequence of the special importance of a certain segment of clients for the affiliate (and hence for its performance inside the bank group). If these borrowers happen to be more informationally opaque than the average, loans to them are more exposed to the parent effect.

The results tell us about the possibility of host country monetary policy transmission disruptions as a consequence of the large-scale presence of foreign bank affiliates. It seems that parent bank influence does not have to be a dominating factor in interest-rate setting on aggregate, but can influence the cost of credit in those borrower categories that are of major importance for the affiliate. So, whereas monetary policy is targeted at the credit conditions for everyone, foreign-controlled banks are able to interfere with this policy in a particular class of economic agents that are strategically significant for their business. Altogether, the parent influence, although occasionally statistically significant, appears to be of subordinate importance economically, at least in the Czech banking sector in the pre-2008 crisis period.

Neither the banks whose data we analyse nor the economy in which they operate were themselves the sources of financial turmoil. Also, owing to their prevailing deposit-over-loan overhang and adherence to the traditional commercial bank business model at the same time as increasing leverage became "fashionable" around the world, many Czech banks got into the position of net creditors to their parents. Thus, the evidence from the Czech banking sector is not particularly useful for analysing extreme crisis-related events in the banks directly involved. Rather, the Czech experience is useful for assessing the impact of evolving parent bank standing in the market on latent poorly observable components of lending rates (and volumes) in the absence of extreme events. Only then, by extrapolating the assembled experience to "extraordinary" periods, might one be able to make inferences about the impact of shocks originating in the epicentre of the financial turmoil on credit markets lying on its periphery.

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Who Borrows and Who May Not Repay? [3]

Alena Bičáková[a], Zuzana Prelcová[a] and Renata Pašaličová[b]

[a]CERGE-EI [b]Czech National Bank

The build-up of household debt is typically regarded as one of the early signals of financial tension. The recent financial crisis has highlighted the importance of identifying and characterising households that are the most likely to default when affected by an adverse economic event. Household overindebtedness can have important implications for aggregate household spending (via the wealth channel) as well as for the financial system (via the balance sheets of the banking sector). As excessive household indebtedness may represent a financial and macroeconomic risk, analysis of household indebtedness provides important inputs for monetary policy as well as financial stability.

The most frequently used measures of household borrowing are based on aggregate indicators. However, only household-level analysis using micro data can reveal the actual concentration of debt in the population and help identify households that are overindebted and whose repayment ability is the most likely to be affected by negative economic shocks, which is crucial for the evaluation of default risk (Zochowski and Zajaczkowski, 2006, and Faruqui, 2008). Our analysis is based on the Czech Household Budget Survey, which includes detailed information on borrowing over the period 2000–2008. We find that while the share of households that borrow remained stable and below 40%, the average amount of debt outstanding increased over the last decade relative to income. The average size of new loans also increased over the period analysed, with a sharp rise during the housing market boom in 2007 and a drop during the financial crisis in 2008. Estimated regression models show that the typical household that borrows the most has young members who are employees, have higher income, have children, live in a city, and have been married for a shorter period of time. They are less risk averse and have experience with financial products. Having an existing loan is also an important positive determinant of getting a new loan, in particular for the years after the credit bureau was established and information-sharing started to be used in the Czech Republic.

The debt burden – the ratio of annual loan repayments to annual net income – reached an average level of 10.5% among households with outstanding debt in 2008. The distribution of the debt burden among households that borrow moved towards higher levels over the analysed period. The level rose in particular among households with higher income levels, pointing to expansion of the housing loan market. Default in the household credit market is typically a consequence of negative macroeconomic shocks, such as job loss or reduction in income (Jappali et al., 2008, Girouard et al., 2006, and Garner, 1996). We test the predictive power of the standard debt burden definition for default risk. Information on repayment behaviour was taken from the Statistics on Income and Living Conditions in 2005–2008. The percentage of households with

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[3] This article is based on Bičáková, Prelcová and Pašaličová (2010).

any delayed payments on their loans in the given year decreased substantially over time, starting at almost 11% in 2005 and reaching about 5% in 2008. We define default as the inability to make loan repayments on time. While this is a very conservative and rather broad concept of default, it is the best information available in the data. As only a fraction of loans with delayed payments become truly non-performing loans, both the default risk measures and the presented default rates should only serve as a signal of potential future default.

As part of our research, we propose a new measure of debt burden, the so-called adjusted debt burden (ADB), which proves to be superior in its capacity to predict default to the standard definition of debt burden. The ADB is defined as the ratio of annual loan repayments to annual disposable income, where the latter is constructed as annual net income minus the living minimum corresponding to the household's size and composition. The ADB is twice as strongly correlated with default as the standard debt burden (SDB, see Table 1). The default rate in the Czech Republic has declined since 2005, in contrast to the slightly rising SDB measure, but in line with a similar decrease in the ADB indicator.

Table 1. Correlations of the SDB and ADB with default

	2005	2006	2007	2008
SDB	0.03	0,09**	0.13**	0.09**
ADB	0.12**	0.19**	0.17**	0.17**

Note: ** means significant at the 5% level.

The results suggest that the adjusted debt burden rather than the debt burden should be used as a measure of default risk. In addition, our analysis identifies an ADB cut-off point of above 30% as the threshold above which the risk of default sharply rises (similarly to Willeke, 2009). An ADB above the 30% level was proposed as the definition of overindebtedness when assessing potential threats to the financial stability of the household credit market. According to the analysis, households with an SDB above 15% and with an ADB above 30% are substantially more likely to have repayment difficulties and to default on their payments (implying an average default risk of 11% and 15% respectively – see Table 2).

Table 2. The SDB and ADB as a signal of default

Debt burden	Default in 2008	Adjusted debt burden	Default in 2008
<=7%	1.79%	<=9%	0.74%
<=11%	2.84%	<=19%	3.42%
<=15%	4.08%	<=31%	4.13%
>15%	10.45%	>31%	14.51%

While the ADB turns out to be a superior predictor of the risk of default, the proposed measure has two potential drawbacks. First, the living minimum used to calculate disposable income in the ADB does not vary across regions, whereas there clearly are regional differences in the cost of living in the Czech Republic. Second, an internationally comparable definition of the living minimum would be necessary for cross-country comparisons. These two issues remain for future research. We emphasise our general conclusion that the variation in the costs of living of households of different size and composition must be taken into account together with income when compared to the amount of repayments in order to assess households' default risk.

Based on the presented definition of overindebtedness, and extrapolating the micro data to the whole economy, we estimate that overindebted households accounted for about 40% of repayments made and 33% (19%) of new loans taken out in 2007 (2008). This corresponds to about 7.3% of annual repayments and 6.1% (3.8%) of total new loans being at risk of default.

As one of the first papers on the household credit market to do so, our analysis also explores the regional variation in households' borrowing and repayment behaviour. We show that there are substantial differences in overindebtedness and default across regions, which in turn are closely related to local economic conditions. There is a strong positive correlation between the degree of indebtedness and default across regions, which further confirms the validity of the ADB as a signal of default also at the regional level. The negative impact of the 2008 financial crisis in 2009 was greater in regions with a higher initial share of overindebted households in 2008. We conclude that the financial stability of the whole economy is predominantly affected by regions with the highest overindebtedness and that their contribution to financial instability is likely to be augmented by the fact that these are also regions with an above-average risk of negative economic shocks (see Figure 1).

Figure 1. Household overindebtedness and unexpected negative economic shocks
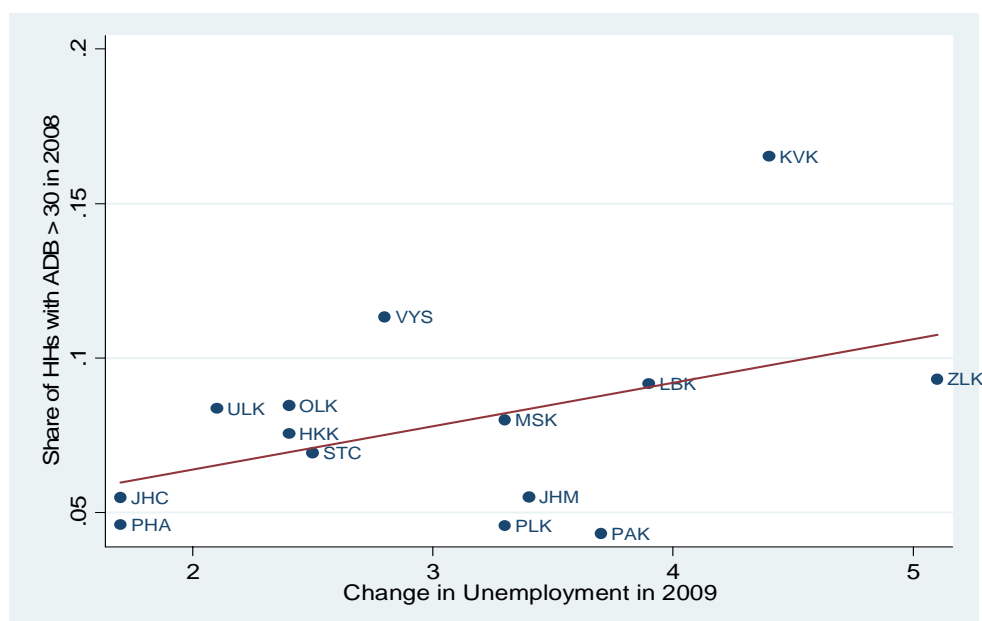
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Do Financial Variables Help Predict the Macroeconomic Environment?[4]

Tomáš Havránek[a,b], Roman Horváth[b] and Jakub Matějů[a,c]

[a]Czech National Bank [b]Charles University [c]CERGE-EI

The financial crisis in 2007–2010 has renewed the interest in exploring the linkages between financial variables and the macroeconomic environment. Specifically, central bankers are now facing obvious policy challenges in conducting monetary policy in a world where financial developments seemingly matter for their target variables of inflation and the output gap. But how exactly do these macro-financial linkages work? An academic consensus has not yet been reached. Many commentators in the economic profession have called for the inclusion of financial variables in the core forecasting models, such as those used in central banks. However, it is not yet clear which financial variables are supposed to matter the most, and consequently which factors should the forecasters focus on while extending the modelling framework.

Our research examines the forecasting performance of individual financial time series in a simple empirical framework of vector autoregressions. Specifically, we test whether the inclusion of individual financial variables in a parsimonious macroeconomic model improves its forecasting performance. While some previous research examined the predictive power of asset prices for the forecasting of inflation and real activity, it typically focused on a particular set of financial variables such as term spread (Estrella et al., 2003), various short-term interest rates (Forni et al., 2003), housing prices (Goodhart and Hoffman, 2000), or the default rate (Jacobson et al., 2005). Our research evaluates the predictive power of a different set of financial variables, especially of those related to credit and liquidity risk. These include bank liquidity, loan loss provisions and the share of non-performing loans (together with some more widely applied variables such as equity prices). In addition, we investigate the predictive content of financial variables during the recent 2007–2009 financial and economic crisis in order to assess which financial variables play a prominent role in turbulent periods.

We believe that one of the preconditions for building large structural macroeconomic models with a financial sector that would be of some guidance for monetary policy decision-making is first to verify empirically whether financial variables convey any useful additional information. To shed light on this issue, we compare the forecasting performance of two empirical models. The first forecasting model consists of macroeconomic variables only (hereinafter referred to for convenience as the macroeconomic model), while the second model in addition includes financial variables (hereinafter referred to for convenience as the macro-finance model). The empirical framework we apply is a two-country vector autoregression model consisting of two economies – the Czech Republic and the euro area. We impose the realistic assumption that the

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[4] This article is based on Havránek, Horváth and Matějů (2010).

euro area variables can influence the Czech variables, but not vice versa. In addition to examining whether the financial sector helps to predict the macroeconomic environment, our framework allows us to assess the transmission and relative importance of euro area developments for the Czech economy.

Figure 1. Do financial variables improve the forecast of GDP?

Forecast performance compared to the purely macroeconomic model
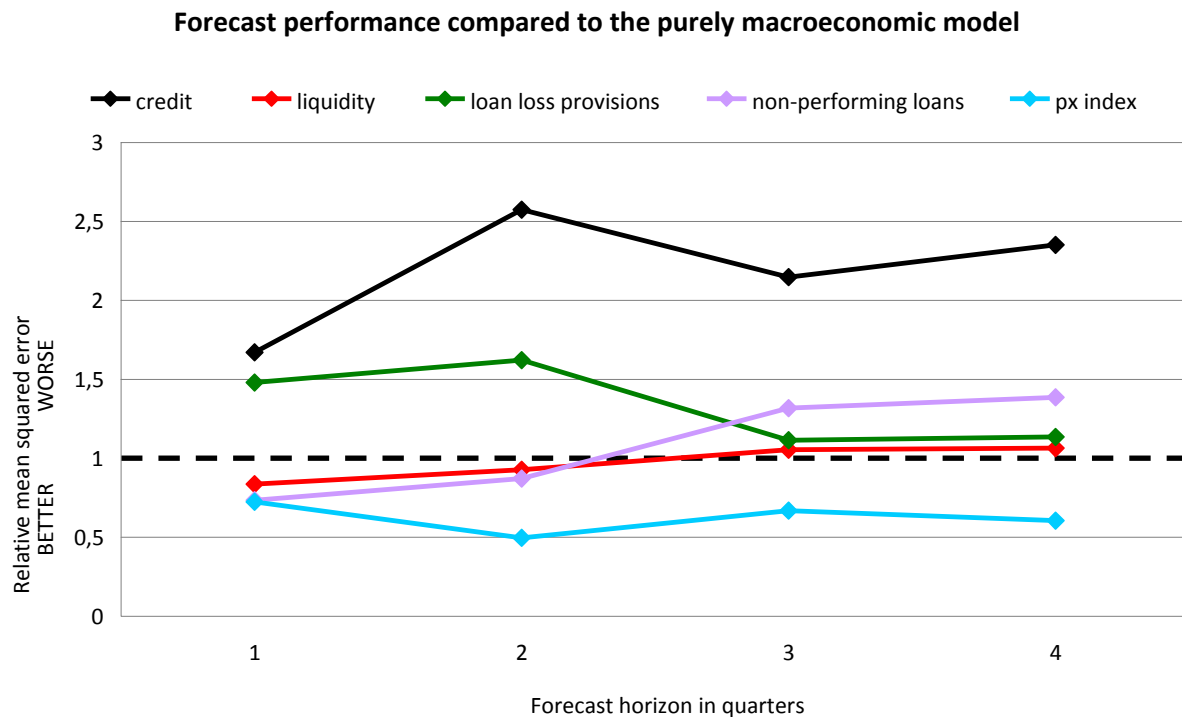
Note: The forecasting performance of the VAR models with individual financial variables is compared to that of the VAR model with macroeconomic variables only. We use data from 1999 to 2009. Values of the relative mean square error below one indicate that the financial variable improves the forecast of GDP.

Our results suggest that financial variables have a systematic and statistically significant effect on the domestic economy. In the terms of forecast evaluation, some financial variables seem to improve the forecast of macroeconomic variables, but the predictive performance of the individual financial variables varies over time, and good performance in one period does not necessarily guarantee good performance in the following period. The results showing the forecasting performance of the GDP prediction are depicted in Figure 1: on the horizontal axis we show the forecast horizon (that is, for how many quarters ahead GDP is forecasted) and on the vertical axis we show how the macro-finance model with the particular financial variable performs in comparison to the purely macroeconomic model – if the value is below (above) one, the macro-finance model performs better (worse) than the macroeconomic model.

For example, neither the amount of credit to the private sector nor the ratio of loan loss provisions helps predict GDP when included in the simple model. The share of non-performing loans and the liquidity ratio improve the forecast of GDP in the short run, but not in the long run. In other words, the results broadly confirm the findings of Stock and Watson (2003) in the sense that some financial variables predict well either inflation or output growth in some periods, but

do not predict them in other periods. An exception to this empirical regularity is the stock market (PX) index, which seems to consistently improve the forecast of both GDP and prices.

In addition, our results document a well-functioning monetary transmission mechanism in the Czech Republic. A monetary contraction results in a decrease in GDP and inflation, with the maximum effect occurring approximately after 12 and 18 months respectively. Moreover, euro area shocks are important for the Czech economy. For example, Czech GDP is found to follow the developments in the euro area with a lag of approximately 5–15 months.

Table 1. How does monetary policy affect the financial sector?

	Response to monetary restriction	Lag of the peak response
Credit	**negative**	10 months
Bank Liquidity	**negative**	3 months
Loan Loss Provisions	**positive**	6 months
Non-performing Loans	insignificant	n.a.

Table 1 illustrates the interactions identified between the macroeconomy and the financial sector. A monetary tightening contributes to a contraction of the volume of credit to the private sector, with the strongest effect after about 10 months. A monetary restriction also leads to a fall in the share of liquid assets held by domestic banks, as a result of the rising opportunity cost of holding money and other liquid assets (Lucchetta, 2007). On the other hand, the effect of monetary tightening on the share of non-performing loans is not statistically significant. Our results indicate that tighter monetary policy is associated with more cautious behaviour of commercial banks, as the banks react by increasing their provisions for loan losses. Generally, the results suggest that a monetary contraction induces more prudent bank behaviour.

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Financial Integration at Times of Financial Instability[5]

Jan Babecký[a], Luboš Komárek[a,b,c] and Zlatuše Komárková[a]

[a]Czech National Bank [b]Technical University of Ostrava
[c]University of Finance and Administration in Prague

Knowledge of the degree of financial integration is important for central banks, since financial markets play the key role in the transmission of monetary policy. The recent economic and financial crisis has challenged the assessment of the costs and benefits associated with financial integration. Whether the benefits of deepening financial integration outweigh the risks associated with contagion effects, and whether rising financial integration will lead to increasing financial stability, depends largely on the resilience and flexibility of the financial system itself, which national and international authorities should be working to enhance.

Financial stability and financial integration might influence each other via different channels. On the one hand, there is a financially stable system (i.e. financial institutions, markets and infrastructures), which is part and parcel of effective allocation of capital, and on the other hand, there is the financial integration process, which leads to the efficient allocation capital. It appears from this that the effects of financial market integration promote financial stability. The elimination of barriers to entry and the harmonisation of regulations (within the EU, for example) intensify competition and the pressure on financial intermediaries to offer price concessions to their customers. This, in turn, reduces transaction costs and consequently facilitates more efficient allocation of financial resources.

Financial stability can be defined as the condition where the financial system is able to direct capital to its most profitable investment opportunities without major disturbances (ECB, 2007). In other words, the financial system is stable if it is capable of absorbing shocks without disruptions to the financial intermediation process. Otherwise, it can collapse, with a related detrimental impact on the real economy. It follows that the financial system does not meet the stability definition when it is stable but does not have the capability of efficiently allocating capital (Pauer, 2005).

A commonly used definition for "financially integrated market" is that of Baele et al. (2004) and Weber (2006), i.e. the market for a given set of financial instruments and/or services is fully integrated if all potential market participants with the same relevant characteristics (1) face a single set of rules when they decide to deal with those financial instruments and/or services; (2) have equal access to the above-mentioned set of financial instruments and/or services; and (3) are treated equally when they are active in the market. Most definitions of financial integration are

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[5] This article is based on Babecký, Komárek and Komárková (2010).

closely linked to the law of one price (i.e. assets having identical risks and returns should be priced identically regardless of where they are transacted).

In this article we analyse how financial integration has evolved at times of financial instability. Our assessment is focused on the financial integration of the Czech financial markets (the money, foreign exchange, government bond and equity markets) with the financial markets of the euro area (or Germany for the government bond market) during the past decade. We also examine financial integration for selected inflation-targeting EU member states (Hungary and Poland) and advanced EU economies outside the euro area (Sweden and the UK).

Our empirical analysis is based on the price-based and news-based methods. Price-based measures are applied in accordance with Adam et al. (2002), who used the concepts of beta-convergence and sigma-convergence. The terms beta-convergence and sigma-convergence originate in the economic growth literature; see, for example, Barro and Sala-i-Martin (1992). The concept of beta-convergence enables identification of the speed at which differences in yields are eliminated on individual financial markets. The concept of sigma-convergence captures the dispersion of the differences between the yields on identical assets in different countries at a given moment in time and thus identifies the degree of integration vis-à-vis the euro area achieved at that moment by the individual financial market segments in the countries under review. Beta-convergence may, but need not, be accompanied by sigma-convergence. In fact, sigma-divergence may occur. Both concepts must therefore be tracked concurrently in order to assess financial integration.

News-based measures originate in Baele et al. (2004) and simply monitor the sensitivity of asset prices to local and global news. The technique is based on the assumptions that in a fully financially integrated area portfolios are perfectly diversified and the degree of systematic risk is identical across assets in different geographical parts of the integrated area and so local factors are not significant. For individual countries, sensitivity is measured by gamma, which expresses the degree of sameness of reaction to news between prices of domestic assets and prices of foreign (benchmark) assets. Asset prices are monitored at the aggregate level. It is assumed that the benchmark asset reacts only to global news. Put differently, gamma represents the proportion of the change in asset prices which can be explained by common factors.

The calculations for all measures of financial integration were carried out using weekly data (daily data averages) from Thomson Reuters covering the period January 1999 to July 2010. Three-month interbank rates were used for the money market, national currencies quoted against the US dollar for the foreign exchange market, five-year government bonds for the bond market, and national stock indices for the equity market.

Our results show that: (i) a process of increasing financial integration has been going on steadily in the Czech Republic since the end of the 1990s; (ii) the financial crisis of 2007–2009 caused temporary price divergence of the Czech financial market from the markets of the euro area (in the cases of the equity, money and foreign exchange markets) and Germany (in the case of the government bond market); (iii) results similar to those for the Czech Republic were generally obtained for the other selected inflation-targeting countries; (iv) the overall consequences of the financial crisis for financial stability were not significant in the Czech Republic, thanks mainly to

restraint in the use of financial innovations and to the general soundness and prudent behaviour of Czech financial institutions.

Overall, our results suggest that increasing financial integration does not necessarily lead to financial instability and financial instability does not necessarily lead in the long term to financial market segmentation. In the past few years, financial integration has been stimulated by the development and implementation of financial innovations, whose incautious use – especially in the developed nations – contributed to the recent financial crisis. Assessments of the experience of the ongoing financial crisis have further modified perceptions about the integrated markets. In particular, research and policy interests have started shifting from the formerly separate examination of integration from the geographical perspective in the national market (e.g. the relationship between the Czech and European equity markets) towards joint assessment of integration across segments of the financial market (integration between the foreign exchange, money, bond and equity markets).

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