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Macroprudential Policy and Its Instruments in a Small EU Economy

Jan Frait and Zlatuše Komárková*

Abstract

This paper focuses on the way the macroprudential policy framework in a small EU economy should be designed. With reference to the experience of the Czech Republic's financial system and the Czech National Bank it provides definitions of financial stability and macroprudential policy as well as of their objectives. It then explains how systemic risk evolves over the financial cycle and outlines approaches to preventing systemic risk in the accumulation stage of the cycle and subsequently mitigating the materialisation of such risk if prevention fails. The paper argues that for the establishment of a macroprudential policy framework in a bank-based economy with a relatively simple and small financial sector, the phenomenon of procyclical behaviour has to stand centrally. Correspondingly, a macroprudential authority in such an economy has to look primarily at cyclically induced sources of systemic risks. Nevertheless, structural sources of systemic risks and associated instruments are discussed as well. The arguments for the recommended arrangements are supported by empirical investigations into the extent of procyclicality in European banks' lending behaviour and the contribution of the regulatory and accounting framework to it.

JEL Codes: E52, E58, E61, G12, G18.

Keywords: Financial stability, macroprudential policy, monetary policy, procyclicality, systemic risk.

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Nontechnical Summary

This paper delineates a framework for macroprudential policy, which is a foundation stone for pursuing the financial stability role of a central bank. The paper attempts to answer how the concept of macroprudential policy and the framework for its conduct should be developed in a country similar to the Czech Republic. This means that solutions are sought for a small open EU economy with a relatively small and simple bank-based financial sector that is controlled by foreign banks, usually from other EU countries. Like macroprudential authorities in other EU member states, the Czech National Bank (CNB) is facing a complex situation, since it has to comply with both international and EU-wide rules.

The key objective of the CNB's financial stability policies is to ensure that the financial system does not become so vulnerable that shocks ultimately cause financial instability and financial distress with significant losses in terms of real output for the economy as a whole. Financial system vulnerability can be brought about by two sources of systemic risk. The cyclical dimension reflects the build-up of systemic risk over time. The source of this dimension is procyclicality in the behaviour of financial institutions. The second dimension of systemic risk is structural and reflects the existence and distribution of systemic risk at any given moment in time. Contagion stands at the centre of the cross-sectional element of systemic risk. Financial institutions or markets are exposed to contagion risk if there are numerous mutual and chained exposures among them that lead to the occurrence of a dense and opaque financial network. The contagion effect within the financial system intensifies with increasing systemic relevance of individual financial institutions and markets. From the general perspective, and given the character of the Czech economy and its financial system, the time dimension of systemic risk can be regarded as more important.

The two main tasks of macroprudential policy are to prevent systemic risk from forming and spreading in the financial sector and, if prevention fails, to mitigate the impacts. These tasks are given by the existence of two phases of its development – first it builds up (accumulates), and then it materialises (de-cumulates), sometimes abruptly. One of the innovations of the CNB's analytical approach is to treat the two stages of systemic risk over the financial cycle as separate analytical concepts. The primary objective must be to act preventively against growth in systemic risk in its accumulation phase, when conditions are being created for future financial instability. It may be rather difficult to distinguish normal cycle fluctuations and long-term trends from a dangerous financial cycle. Nevertheless, as to the build-up of systemic risk, one can be rather sure that if credit and some asset prices are going up quickly and moving away from historical norms, and both the quantitative and qualitative evidence indicates excessive optimism and mispricing of risk, there is a need to send out a clear warning and recommend that decision-making bodies take action.

If prevention is not sufficiently effective and a systemic risk materialisation phase occurs, the macroprudential policy focus must be shifted to mitigating its impact. It will be crucial to assess the financial system's ability to withstand a particular level of tension. Stress tests of the financial system's resilience are a suitable analytical instrument for performing this task. Forward-looking indicators should then ultimately be used again to detect when systemic risk has fallen below the critical level and tell us when we can discontinue the anti-crisis measures and support policies.

The two development phases and two dimensions of systemic risk can necessitate the use of different tools. The authorities can use tools that are being newly developed and implemented as macroprudential instruments or rely on the use of a number of more or less traditional instruments of microprudential policy applied in a macroprudential manner. If necessary, macroprudential authorities can also coordinate with other ones in order to involve the policy tools of the latter in addressing systemic risk. In particular, a capacity to influence the economic cycle makes macroeconomic policies natural candidates for assisting macroprudential tools in coping with extreme occurrences of systemic risk in both its accumulation and materialisation phases.

In the systemic risk accumulation phase, the authorities will primarily attempt to act against the increase in the vulnerability of the system. To the extent they believe in the ability to lean against the cycle, they will also use tools that can affect the behaviour of financial institutions and their clients and thus directly reduce their contributions to the build-up of risks. In this respect they may try to reduce the amplitude of the financial cycle by suppressing credit growth and preventing excessive maturity transformations. In the systemic risk materialisation phase, the macroprudential policy priorities will initially be to prevent the elements of instability from escalating, to reduce the probability of panic adjustment by financial institutions and their clients in response to the revision of expectations, and to mitigate the negative impacts of the significantly worse conditions.

In conducting macroprudential policy, each country has to choose a limited spectrum of tools reflecting the structure and nature of the local financial system as well as the legal and regulatory environment within which it operates. The recommendations of this paper regarding the most promising tools start from the fact that the key to avoiding financial system vulnerability is to ensure that the system is *robust*. For a bank-based system, robustness can be achieved via high loss absorbency, strong liquidity and barriers to excessive credit growth. Loss absorbency concerns the ability to withstand both expected losses thanks to sufficient provisions, and unexpected losses via capital cushions. Some macroprudential tools for creating barriers to credit booms and excessive leverage may be needed, too. The obvious candidates for this part of the toolkit are those which may help in holding back housing debt, which is particularly prone to cyclical upswings. Instruments such as increased sectoral risk weights, ceilings on loan-to-value ratios and ceilings on debt-to-income or payment-to-income ratios have already been used in a number of countries. Certainly, the role of macroprudential policy cannot be to wipe out cyclical fluctuations in credit and asset prices; it can only be to cut off extreme peaks in the cycle that would lead to an untenable level of debt and, with a high probability, to tail events.

As to the structural sources of systemic risk, a system with many irreplaceable systemically important financial institutions or markets is particularly vulnerable to network shocks. For this reason, some space arises for regulations in the form of measures to reduce the size or interconnectedness of the system to make it more resilient to systemic shocks such as network risks or contagion. The CNB has already begun work on identifying the systemic significance of banks in the Czech financial system. This is a necessary step for the implementation of systemic surcharges for individual institutions deemed systemically important. New liquidity requirements for a specific ratio of stable sources of balance sheet liquidity or for coverage of potential outflows by highly liquid assets under Basel III may also change the landscape. The possibility of configuring liquidity risk management tools so that they also have some countercyclical effect is

also worth considering. These tools include maturity transformation limits, intra-group exposures limits and extra capital requirements for large exposures.

Besides the tools embodied in bank regulations, one accounting instrument is addressed as well, namely through-the-cycle provisioning against impaired assets. Provisioning is important not only because the provisions serve as a buffer against expected loan losses, but also because they provide significant information on how banks price credit risk. Since there is limited information on banks' provisioning in European countries in recent years, an empirical investigation was conducted into the level of procyclicality in banks' provisioning in the Czech Republic using supervisory data on the Czech banking sector. The results of the analysis confirmed that the provisioning contains a cyclical component which might be smoothed to some extent by the introduction of through-the-cycle provisioning. However, it is likely that during a strong boom, through-the-cycle provisioning – like any other isolated tool – would not provide a sufficiently strong negative incentive for banks as regards lending.

The important prerequisite for successful macroprudential policy is an operational framework that provides a trigger mechanism for the use of tools in the risk inception and manifestation phase. When implementing such policy, it will be vital to combine a rigorous analytical approach with a large dose of judgement. The experience gained in handling the crisis makes the integration of supervisory structures into a central bank particularly attractive in this respect. Integration of financial market regulation and supervision at the national level in a central bank will create conditions for the effective exchange of truly relevant data, data integration and potential consolidation of analytical work. Only in an integrated institution is it possible to completely avoid the constraint that holds back many financial stability analysts – limited or non-existent access to supervisory data on individual institutions. In a real crisis, a single institution is ideally placed to work with the government and to act expeditiously.

1. Introduction

In reaction to the global financial crisis, international and national authorities have striven to strengthen financial systems and regulatory and supervisory frameworks by introducing a new policy component – usually labelled macroprudential policy. At the international level, the Financial Stability Board (FSB) has been established to coordinate the work of national financial authorities and international standard-setting bodies and to develop and promote the implementation of effective regulatory, supervisory and other financial sector policies in the interests of financial stability. One of the most important tasks of the FSB is to advise on and coordinate the establishment of macroprudential policy frameworks. In the EU, the European Systemic Risk Board (ESRB) has been created as the EU authority for macroprudential oversight. Numerous initiatives have also been set up to produce macroprudential regulations. Some of these have already been incorporated into the "Basel III" accord of the Basel Committee on Banking Supervision (BCBS, 2010a) and into the EU proposal for its transposition, called the CRD IV package.

This paper aims to explain how the concept of macroprudential policy and the framework for its conduct should be developed in the Czech Republic as a small EU economy with a bank-based financial system and autonomous monetary policy, and the Czech Republic's historical experience with regulating and supervising financial institutions over the preceding two decades.[1] The paper includes descriptions and definitions of a whole range of terms and concepts that have started to be used routinely – and often also inaccurately – in the debate on the pursuit of financial stability goals through macroprudential policy. The starting point for realising the aim mentioned above is *the CNB's financial stability concept*, which has been applied since 2004. The original narrowly defined macroprudential policy framework advocated by economists from the Bank for International Settlements (BIS henceforth) is incorporated into this concept and supplemented by information obtained from assessments of the causes of the latest global and euro-area financial crises.

The paper is structured as follows. Section 1 explains the structure of the Czech financial sector and its historical developments deemed important for understanding the CNB's preferences and approaches. Section 3 examines the objective of financial stability and defines macroprudential policy and systemic risk. Section 4 focuses on the time dimension of systemic risk – procyclicality in the behaviour of the financial system and the financial cycle. Section 5 deals with the cross-sectional dimension of systemic risk. Section 6 describes methods for identifying and assessing the magnitude of systemic risk of a cyclical nature, while Section 7 does the same for systemic risk of a structural nature. Section 8 lists and discusses tools for preventing systemic risk and mitigating its impacts, putting them into context with various phases of the financial cycle and different sources of systemic risk. It looks first at tools for increasing resilience and leaning against the financial cycle. A discussion of specific issues related to accounting for potential credit losses and of the proposals for through-the-cycle provisioning follows. The links between macroprudential and macroeconomic policies are also looked at. Section 9 highlights selected

[1] The paper deliberately does not attempt to cover communication aspects of macroprudential policy and touches only lightly on the issue of the organisation and division of work in a macroprudential authority. Considerations of this sort are better addressed in a different kind of a paper.

issues in the operationalisation of national macroprudential frameworks for macroprudential and monetary policy, while Section 10 concludes. Two annexes provide an insight into empirical studies supporting the conclusions of the main text. The first annex demonstrates procyclicality through an empirical analysis of provisioning for impaired assets. The second investigates the evolution of credit risk over the business cycle.

2. The Structure of the Czech Financial Sector and Its Historical Developments

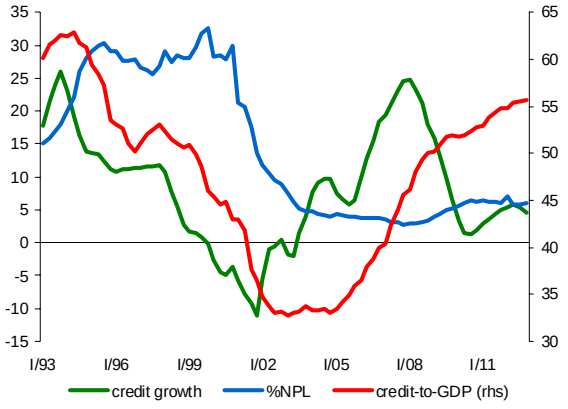
For setting a national macroprudential policy framework, the structure of the local financial sector and the most significant recent experiences are the most important factors. The financial system in the Czech Republic went through a boom and bust in the 1990s, associated with swings in both banking sector structures and macroeconomic developments. The launch of the country's economic transition from socialism in 1991 and the subsequent privatisation of state-owned firms dramatically increased the demand for banking services, credit in particular. The group of four state-owned commercial banks that were built on the basis of the previous "monobank" structure was not able to meet the demand. To address the banking sector's insufficient capacity, a couple of new, private banking institutions were allowed to operate. These institutions began lending to new private firms and traders, and at the same time they played an important part in providing funding for the privatisation of state-owned enterprises. With a loose monetary policy conducted under a regime combining money supply targeting and a fixed exchange rate, the economy became overheated and the quality of the assets of the banking system weakened. The authorities initially resorted to partial solutions. Various forms of government assistance were used to cope with inherited as well as newly created deficiencies (for details, see Bárta and Singer, 2006). The full extent of the problem came to light only in the recession of 1997–1999. Major restructuring and (re)privatisation of banks followed, paving the way for the current structure, in which the sector is controlled almost exclusively by foreign banking groups, usually from other EU countries. In 2011, the direct share of foreign banks in total assets was 80 per cent, but as some banks (mainly specialised building savings societies) are owned by other banks domiciled in the Czech Republic but with foreign owners, the share of the banking sector under (direct and indirect) foreign control is almost 97 per cent (93 per cent under the control of banking groups from other EU countries, mainly Austria, Belgium, France and Italy).[2]

Given the relatively high exposure of the banking sector to the corporate sector associated with legacy loans, loans for financing inventory needs, and new loans associated with privatisation, the credit-to-GDP ratio of the Czech banking sector was rather high in the early stage of the transition – roughly 65 per cent in 1993 (Figure 1). In addition, nearly 90 per cent of loans in credit portfolios were to the non-financial corporate sector. The share of households in the overall credit system stayed below 10 per cent throughout the 1990s (Figure 2). The deep banking crisis that hit the Czech economy from 1997 to 1999 was caused by a mix of flaws in the financial system and suboptimal steps in macroeconomic policies. The share of non-performing loans exceeded 30 per

[2] Foreign banks play a key role in the Czech financial system, and fortunately the ownership is not concentrated in one or two key EU countries. The three biggest state-owned Czech banks were privatised in the early 2000s to three large EU banking groups with origins in different EU countries. This to some extent limits the contagion risk.

cent, and a sharp contraction of credit followed (for a detailed description, see Hampl and Matoušek, 2000). Between 1997 and 2000 the credit-to-GDP ratio declined from more than 60 per cent to less than 40 per cent (Figure 1). Considering the unfavourable situation in major financial institutions, the authorities decided to resume the privatisation process with the goal of finding strong strategic investors. By the end of 2001 the banking sector had been restructured and privatised. Soon these banks started to lend to the segment of households, which had been largely ignored by the pre-crisis, semi-state banks. As the economic recovery accelerated, the performance of the banking sector improved significantly, with the share of non-performing loans decreasing to less than 5 per cent in 2003. The financial system simultaneously regained its momentum, and a strong pick-up in credit growth followed. From the beginning of 2002 until the middle of 2008, credit to the household sector grew by 30 per cent or slightly more on a year-over-year basis (Figure 1), albeit initially from a very low base (Figure 2). Credit to the non-financial corporate sector exhibited much slower dynamics, but between the beginning of 2006 and the middle of 2008 it also rose rather fast (15–20 per cent). Compared to household credit, non-financial corporate credit started from a much higher base, but its absolute level in 2011 was still roughly the same as at the beginning of 2000.

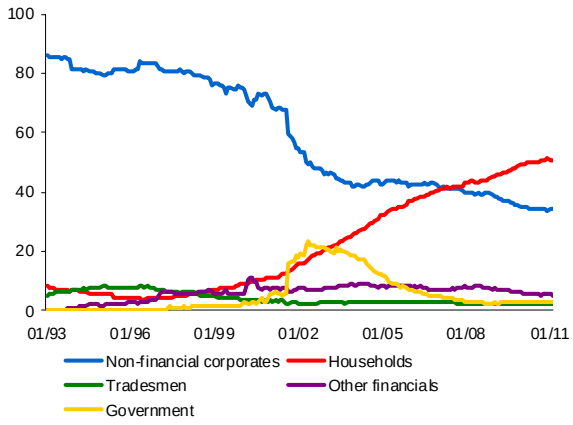
Figure 1: Credit and Its Quality in the Czech Republic (1993–2011, in %)



Note: Credit growth is year-on-year increase in total bank credit. % NPL is the share of non-performing loans on total bank credit. Data from the beginning of 1990s are based on authors'estimates.

Source: CNB

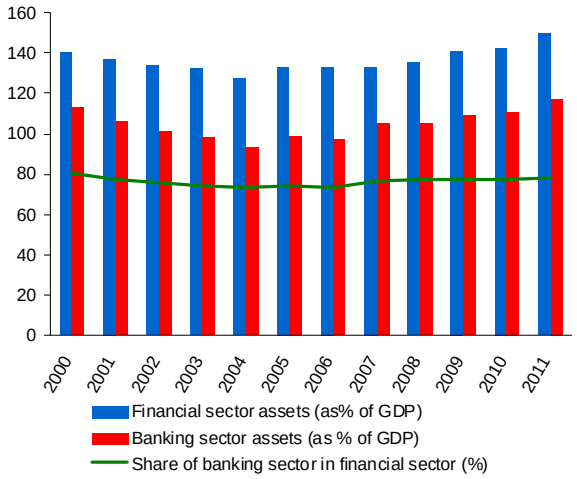
Figure 2: Sectoral Structure of Credit in the Czech Republic (1993–2011, in %)



Source: CNB

The Czech financial system is bank-based, similar to those in many other European countries. While the depth of financial intermediation measured by the total assets of the financial sector in per cent of GDP is steadily increasing, reaching 150 per cent in 2011, the share of banks in the financial sector remains remarkably stable at around 78 per cent (Figure 3). While the majority of loans to the private sector come from local credit institutions (the term banks covers banks, credit unions and building societies throughout this paper), non-bank financial intermediaries (such as other companies engaged in lending and leasing companies) also play some role. In 2011, their share in loans to the non-financial private sector was only slightly above 10 per cent.

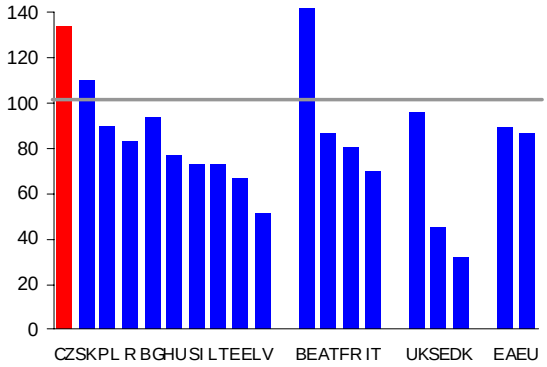
Figure 3: Financial and Banking Sector Assets



Source: CNB

Figure 4: Ratio of Deposits to Loans in EU Countries

(%; end of 2011; residents only)



Note: EA = euro area; EU = average for all EU countries.

Source: ECB

Thanks to the lessons learned from the crisis of the 1990s, the CNB entered the new century with an explicit, history-based, macroprudential mandate in the minds of central bankers. Nevertheless, the Czech economy also experienced a credit boom in the pre-crisis years. The features and quality of the boom, however, were quite different from those in other converging economies. First, the fast credit growth was concentrated in the household sector, while the developments in corporate sector lending were rather smooth. Second, the increase in lending was accompanied by an increase in the base of local deposits and was thus financed from domestic savings, not foreign sources (Figure 4). Despite its high foreign ownership, the Czech banking sector as a whole has a positive net external position vis-à-vis non-residents and its net external position vis-à-vis non-resident banks is also slightly positive. This suggests that the Czech subsidiaries of foreign banks lend to the parent groups they belong to. Moreover, the local deposit base is predominantly in domestic currency, so there was no incentive for banks to offer foreign currency loans to minimise possible currency mismatches on their balance sheets. Third, lending to the household sector was done in domestic currency only, and there was no additional risk except for the credit risk associated with the growing housing loan portfolio of the Czech banking sector.[3] Thanks to the above-mentioned features of the Czech banking sector, the consequences of the crisis in 2008–2009 were relatively contained, and the banking sector was able to provide credit throughout without major disturbances. The tranquil developments in the Czech banking sector relative to some other converging economies were to a large extent associated with the specific macroeconomic environment in which the Czech economy has been operating. Prudent macroeconomic policies and tough monetary conditions were the key ingredients of the macroprudential policy toolkit. At the same time, the fact that both monetary policy and banking

[3] The boom in housing loans may not have been as fast as it seems. The increased demand for these loans in 2006–2007 was also due to an expected increase in value-added tax (VAT) on construction work from 5 per cent to 19 per cent as of 1 January 2008, as announced in 2005. Due to this factor, a number of creditworthy households shifted their plans regarding the purchase or building of housing and frontloaded the loans much earlier to take advantage of the still lower taxation.

supervision have always been the responsibilities of the central bank proved to be rather important.

3. The CNB's Approach to Financial Stability and Macroprudential Policy

There is currently a consensus in the central bank community that the *financial stability objective* is to achieve continuously a level of stability in the provision of financial services (i.e. lending, insurance, execution of payments, etc.) which will support the economy in attaining maximum sustainable economic growth. The CNB adopted a definition consistent with this way of thinking about the financial stability objective back in 2004. It defines *financial stability* as a situation where the financial system operates with no serious failures or undesirable impacts on the present and future development of the economy as a whole, while showing a high degree of resilience to shocks. Another core element of the CNB's financial stability framework is its conception of *financial stability analysis* as the study of potential sources of systemic risk arising from the links between vulnerabilities in the financial system and potential shocks coming from various sectors of the economy, the financial markets and macroeconomic developments. The sources of systemic risks can be viewed as externalities associated with the behaviour of financial institutions (for details of this approach, see Nicolò et al., 2012) and financial markets (short-termism, myopia, risk ignorance, herding).

The aforementioned definitions explicitly emphasise the *macroprudential orientation of the CNB's financial stability policies*. The job of these policies is to ensure that the financial system does not become so vulnerable that shocks ultimately cause financial instability in the form of a crisis. The CNB's financial stability analyses contained in its Financial Stability Reports are therefore primarily focused on determining whether weak spots are forming in the financial system which might reduce its resilience to shocks and whether conditions are being created in which the interaction of macroeconomic factors and policies, excessive household, corporate, government or financial institution debt, and financial market volatility could cause a financial crisis. As explained in Section 3, the CNB's financial stability analyses are focused predominantly, although not exclusively, on developments in the sector of credit institutions. The links between credit institutions and institutions in other sectors as well as potential providers of shadow banking services are covered too.

An important, although not the only, element of financial stability policy is thus *macroprudential policy*. Until the crisis, the concept of macroprudential policy was discussed primarily within the central banking community under the leadership of the BIS. The interest of the academic community in the issue was rather limited. Soon after the crisis started, a "macroprudential revolution" emerged. Various issues related to macroprudential considerations have become the centre of attention of researchers and policy-makers from multinational institutions, central banks, supervisory authorities and academia. Unfortunately, in this process the multi-dimensional concept of macroprudential policy has become rather blurred. Until 2008, the term "macroprudential" was used almost exclusively in the context of BIS analyses focused primarily on risks associated with the financial cycle.[4] Since then, it has become a highly fashionable expression used in an increasingly wide context moving further and further away from its original

[4] Our view is that the seminal papers by BIS economists which defined the original concept of macroprudential policy are Borio (2003), Borio and White (2004) and White (2006).

meaning (see the discussion in Clement, 2010; Borio, 2010). There is not (and potentially there never will be) full agreement in the central banking community regarding the definition, width, effectiveness or even meaningfulness of macroprudential policy. The objective of this paper is not to provide the reader with an unequivocal and universal conclusion on the ongoing debate. Instead, we strive to explain what might be a reasonable and practical approach for a small EU economy. At the same time, we apply a healthy dose of scepticism regarding the effectiveness and power of the isolated use of macroprudential tools, putting the financial stability objective of a central bank into the context of all the policies it may have at its disposal.

The objective of a macroprudential approach in the BIS tradition is to limit *systemic risk*, i.e. the risk of episodes of financial distress with significant losses in terms of real output for the economy as a whole. This definition falls within the macroeconomic tradition and implicitly involves monetary and fiscal policies as drivers of the financial cycle (Borio and Shim, 2007; White, 2009; Borio, 2011). In the BIS tradition, the phenomenon of financial market procyclicality stands centrally (Borio et al., 2001). Financial system procyclicality means the ability of the financial system to amplify fluctuations in economic activity over the business cycle via procyclicality in financial institutions' lending and other activities. The procyclical behaviour of financial markets transmits to the real economy in amplified form through easy funding of expenditure and investment in good times and financial restrictions leading to declining demand in bad times. Financial stability research in the CNB has always been conducted with the central role of procyclicality in mind (e.g. Frait and Komárek, 2007). There is no doubt that financial market structures matter as well. This is reflected in the other stream of macroprudential thinking, which is more micro-oriented and focused on individual institutions and their interactions. In contrast to the BIS logic, systemic risk in this approach arises primarily through common exposures to macroeconomic risk factors across institutions, as in canonical models of financial instability such as Diamond and Dybvig (1983) emphasising interlinkages and common exposures among institutions. The sources of systemic risk of this sort (common exposures among institutions, network risks, infrastructure risks, contagion, etc.) have been intensively studied, for example, by the International Monetary Fund. The ESRB is also looking at these issues quite a lot.

The primary distinguishing feature of macroprudential policy is that unlike traditional microprudential regulation and supervision (focused on the resilience of *individual* financial institutions to mostly *exogenous* events) it focuses on the stability of the system as a *whole*. It primarily monitors *endogenous processes* in which financial institutions that may seem individually sound[5] (or that may take individually sound actions[6]) can get into a situation of systemic instability through common behaviour and mutual interaction. Even if all banks are individually reasonably diversified, their balance sheets can be highly exposed to the same sources of risk, associated usually with macroeconomic developments. This calls for looking at the system from a systemic perspective, not from the perspective of its isolated parts. Hanson et

[5] The job of financial stability analysts is to avoid risks due to the fallacy of composition, which arises when the whole is wrongly assessed only as the sum of mutually independent parts (not seeing the wood for the trees).

[6] Hanson et al. (2011) explain the difference between the micro view and the macro view by pointing out that asset shrinkage can be a sound method of adjustment for a bank that is weak for idiosyncratic reasons. By shrinking its assets, the bank transfers its business to stronger players in the market. However, if the whole banking sector is weak for systemic reasons, collective attempts to shed assets will damage not only the sector itself, but also the real economy via credit-crunch and fire-sale effects on asset prices.

al. (2011) describe a microprudential approach as one which is partial-equilibrium in its conception, while a macroprudential approach is one in which general-equilibrium effects are recognised. Therefore, "true" macroprudential policy instruments are those which are explicitly focused on the financial system as a whole and on the endogenous processes going on within it. Other measures that can be used to a certain extent to support financial stability and can also have macroprudential aspects include microprudential regulatory and supervisory instruments and monetary, fiscal and tax policy tools (for more details see Table 5). The two perspectives are complementary.

The *macroprudential policy objective* is to prevent systemic risk from forming and spreading in the financial system and thereby reduce the probability of occurrence of financial crises with large real output losses for the entire economy.[7] By suppressing channels of formation and spread of systemic risk, macroprudential policy should therefore act primarily preventively against signs of financial instability in the future and secondarily at least to mitigate their impacts if prevention does not succeed.

The object of macroprudential policy is systemic risk, which has two main dimensions. The *time* (cyclical, conjunctural, dynamic) *dimension* reflects the build-up and manifestation of systemic risk over time. The source of this dimension is *procyclicality* in the behaviour of financial institutions contributing to the formation of unbalanced financial trends, which sometimes slip out of the control of institutions themselves or their regulators (see, for example, Brunnermeier et al., 2009 or Borio and Drehmann, 2009a). Systemic risk of this type manifests itself primarily as correlated exposures to the same macroeconomic factors across financial institutions (Section 4). The second dimension of systemic risk is *cross-sectional* (structural) and reflects the existence and distribution of systemic risk at any given moment in time. The source of this dimension is mutual and chained exposures among financial institutions (Section 5). Such institutions can underestimate the potential impact of their own activities on the risk of the financial network as a whole, thereby creating negative externalities for other parts of the system.

The time and cross-sectional dimensions to a large extent evolve jointly and so cannot be strictly separated. Shin (2010) argues that increased systemic risk from interconnectedness of banks is a corollary of excessive asset growth and a macroprudential policy framework must therefore address excessive asset dynamics and fragility of bank liabilities. In a growth phase of the financial cycle, rapid credit growth is accompanied by a growing exposure of a large number of banks to the same sectors (usually the property market) and by increasing interconnectedness in meeting the growing need for balance sheet liquidity. Financial institutions become exposed to the same concentration risk on both the asset and liability side. This makes them vulnerable to the same types of shocks and makes the system as a whole fragile. When a shock comes, banks face problems with funding, their lending is tightened and all market participants try to sell their assets at the same time, which creates a downward spiral in both the financial and the real sectors. The time dimension shows up in the degree of solvency, while the cross-sectional dimension manifests itself in the quality of financial institutions' balance sheet liquidity. However, solvency and liquidity are also interconnected, as liquidity problems often transform quite quickly into insolvency.

[7] Reinhart and Rogoff (2009) document that systemic crises have a long-term negative impact on economic activity. In such crises, GDP contracts for a period of around two years on average and returns to its original trend only after four years.

From the general perspective, and given the character of the Czech economy and its financial system as mentioned in Section 2, the time dimension of systemic risk can be regarded as more important. Empirical analysis of the history of financial crises reveals that the credit cycle – whose primary features are changes in credit growth and in the level of debt of economic agents – usually lies at the heart of systemic financial crises with strong negative impacts on output. The 1997–1999 crisis in the Czech Republic, the 2007–2009 global crisis and the subsequent euro-area crisis were all of this nature. However, the cross-sectional dimension and the role of sectors other than banks should not be underestimated either. Especially in a small open economy, connections between institutions in the domestic economy and their links with the international economy can both be sources of contagion. While acknowledging the greater importance of the time dimension, the approach to macroprudential policy must therefore cover both dimensions.

Given the aforementioned characteristics of systemic risk, *macroprudential policy* can be defined as the application of a set of prudential tools that are calibrated and assigned to target sources of systemic risk. These are tools that have the potential to (i) increase preventively the resilience of the system, in the systemic risk accumulation phase, against the risk of emergence of financial instability in the future by creating capital and liquidity buffers, by limiting procyclicality[8] in the behaviour of the financial system or by containing risks that individual financial institutions may create for the system as a whole, (ii) mitigate the impacts, in the systemic risk materialisation phase, of previously accumulated risks if prevention fails.

4. Procyclicality, the Financial Cycle and Systemic Risk

The writings of BIS economists explain that the combination of liberalised financial markets and their increased procyclicality since the 1990s has made economies prone to *endogenous boom and bust cycles* (the logic of these cycles was previously described by Minsky, 1986 and 1992). In good times, financial institutions and their clients can start to underestimate the risks associated with their economic decisions or, in an environment of increased competition, can even be exposed to strong incentives to take on bigger risks. A major lubricant for such behaviour is easier access to external financing, which is strongly dependent on current risk perceptions reflecting the currently high economic activity. If economic agents start to misconstrue a temporary cyclical improvement in the economy as a long-term increase in productivity, a "virtuous" cycle can start to develop, supported by an increased willingness of households, firms and government to accept a higher level of debt and use it to buy risky assets. Such cycles are common in converging economies, where it can be particularly difficult to distinguish between long-term productivity gains (due, for example, to the positive effects of foreign direct investment) and cyclical improvements.

This sets off a spiral (positive feedback loop) manifesting itself as a decreasing ability to recognise risk, trend growth in asset prices, weakened external financial constraints and high investment activity supported by output growth, increased revenue growth and improved profitability. In the background of this cycle, financial imbalances grow and systemic risk builds up unobserved. This often shows up openly later on, when economic starts to weaken as a result

[8] Procyclicality of the financial system means its ability to magnify swings in the economic cycle through lending and other activities of financial institutions as a result of feedback between macroeconomic developments and the financial system.

of a negative stimulus. Recession subsequently sets in and the spiral turns around. Economic agents realise that their income has been rising at an unsustainably high rate, they are burdened with too much debt, their asset holdings have fallen in value and so they need to restructure their balance sheets. In this situation, banks and their clients can, by contrast, start to display excessive risk aversion.

To a large extent, the processes described above are as natural as the business cycle itself. However, the financial imbalances can sometimes get too big and, as a result, a dangerous vicious cycle can arise in the contraction phase. If the desirable adjustment is combined with a strong increase in general uncertainty, a sharp fall in access to external financing due to capital or balance sheet liquidity problems in banks, and with panic selling of overvalued assets, the downward movement can become very rapid and destabilising. The most recent episode of financial instability, which started in 2007, was largely global in nature and entailed huge macroeconomic costs. Even though the Czech financial system remained stable during the crisis and was exposed only to its indirect effects, it will take the Czech economy a few years to return to its pre-crisis output level. For the hardest-hit countries, this process will take much longer.[9]

All this implies that the main source of the time element of systemic risk is the *financial cycle*[10] and one of the primary objectives of macroprudential policy must therefore be to create incentives for financial institutions to behave less procyclically. Conceptually, the evolution of the financial cycle over time can be described as a movement of *leverage*. In its narrower sense, this term[11] concerns the relation between the assets of an economic agent and the debt that was used to acquire them. In its increasingly used broader sense, it approximates the overall nature of the financial cycle and the position of a given economy within it (the indebtedness of economic agents, stocks and dynamics of loans, the size and conditions of the shadow banking credit, the ease of obtaining external financing, the size of interest rate margins and credit spreads, the ratio of assets and capital in financial institutions, the length of lever of financial market investors, etc.). The leverage can be, and often is, approximated by the credit-to-GDP ratio or its deviation from the long-term trend. This approach was embodied in the Basel III concept of countercyclical capital buffers. Although this approach is rather narrow, it can be regarded as a reasonable approximation thanks to its empirically proved capacity to signal the occurences of financial instability (Babecký et al., 2011; Borio and Drehmann, 2009a).

[9] Another danger of such crises is that they can give rise not only to output losses, but also to other long-term economic efficiency losses as a result of a potentially incorrect economic policy response, including in terms of financial market regulation. Significant efficiency losses may also arise in response to the current crisis owing to the introduction of ill-conceived measures adopted under political and time pressure.

[10] We can define the financial cycle as a process in which mutually strengthening credit creation and asset price behaviour amplifies the business cycle, resulting, under certain conditions, in a financial crisis due to excessive debt manifesting itself as financial stress and major macroeconomic disturbances. The credit expansion and subsequent credit contraction in this process have a strong effect on the volatility of real economic activity and in particular on the allocation of capital, with excess capacity first being created and then being liquidated (usually most visibly in the construction sector). Moreover, the financial cycle precedes and to a large extent causes the risks that are characteristic of the cross-sectional dimension.

[11] The term leverage is used in number of areas and therefore has number of different definitions. In the financial market area it generally describes the ratio between the total investments and own funds of an investor and indicates the degree of use of borrowed external funds. In the case of banks, it refers, for example, to the assets-to-equity ratio.

Figure 5: The Evolution of Systemic Risk and Conduct of Macroprudential Policy Over the Financial Cycle

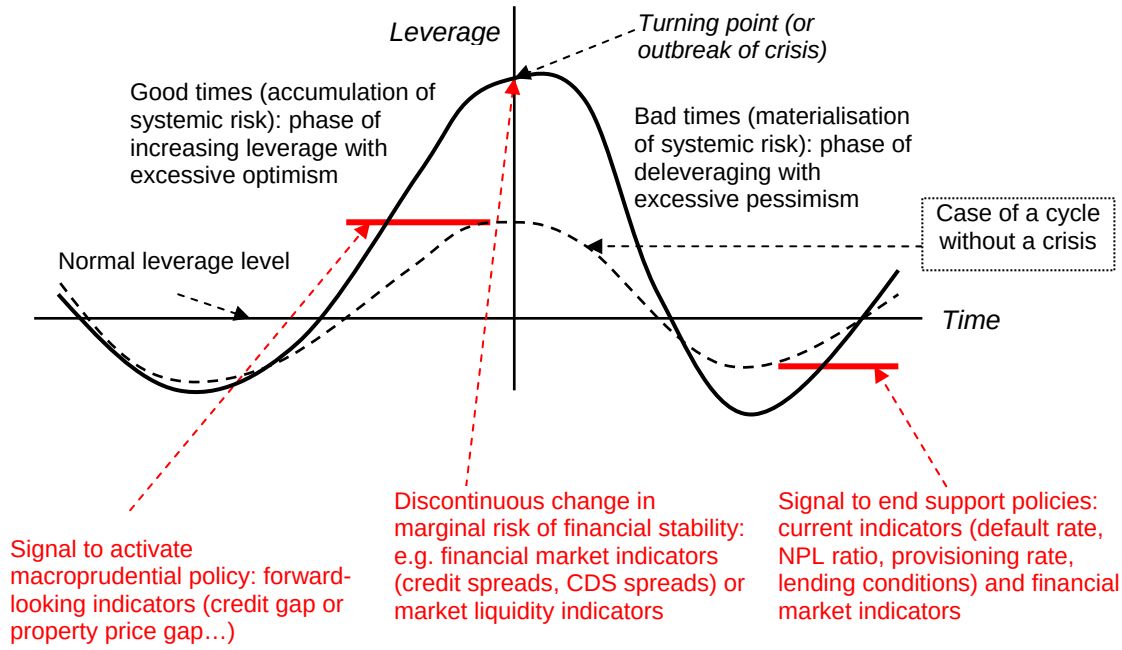


Figure 5 shows the evolution of leverage over the financial cycle, as approximated by the credit-to-GDP ratio gap. The leverage increases until the financial cycle turns over. Normally, the turnover happens in an orderly way (the case of a cycle without a crisis in Figure 5) without the need for any extra policy action. But sometimes the turn is disorderly and presents itself as the eruption of a financial crisis. At a certain point leverage starts to decline, although in the early phase of the crisis it remains high (given falling nominal GDP it can even rise in the initial post-crisis years). The deleveraging phase can therefore last a number of years, and in the event of a deep crisis the leverage can, after a time, fall below its long-term normal value. Although the leverage level is high on both sides of the crisis point, the economic situation is very different on either side. In the pre-crisis optimistic phase there is a financial boom going on, whereas in the post-crisis phase the economy is exposed to financial stress outweighing supportive policy actions. Consequently, the leverage adjusts to economic conditions after a considerable lag, so measures of the stock of some variables may have only a limited information value as a guide for the macroprudential policy response during the financial cycle. For this purpose, in Section 6 we will define forward-looking variables that can be used to identify situations where the tolerable limit for systemic risk has been exceeded. Likewise, we will define indicators of the start and end of the financial instability phase and indicators for determining the scale and seriousness of an ongoing systemic risk materialisation phase. The banking sector in the Czech Republic, despite the country's relatively short existence, has been through both leveraging and deleveraging processes (Figure 1). For a description of these developments see Frait, Geršl and Seidler (2011).

5. The Financial Network and the Risk of Contagion Within the Financial System

To ensure financial stability it is not enough to have financial institutions that are individually sound and resilient to cyclically-induced risks. It is also vital to track and assess the links among them, because efforts to enhance the financial condition of one institution can paradoxically undermine the stability of another institution or of the system as a whole. The links among individual financial institutions can act as channels through which shocks or contagion can propagate. Contagion thus stands at the centre of the cross-sectional element of systemic risk. Owing to a shortage of information, a financial institution is not itself usually capable of judging what effect its behaviour will have on other institutions in the system. For the same reason, it is not capable of defending itself sufficiently against the negative impacts of the behaviour of others. This means that if a financial institution is part of the financial network, it bears network risk, which it cannot effectively defend itself against or otherwise hedge against (Haldane, 2009). However, whether negative shocks are propagated or absorbed within the financial network depends on the phase of the financial cycle (see above).

Contagion channels can be divided into two types (Dijkman, 2010): real and information. The real channel refers to the direct knock-on effects from a stressed institution (or market or infrastructure) to others through direct links (such as existing gross exposures or financial flows through payment systems). Literature from the 1990s (Rochet, 1996) draws attention to the dangers of excessively large exposures between banks, especially in the case of the unsecured money market. It points out that the benefits of interconnectedness in the form of risk-sharing between financial institutions always come at the expense of contagion risk.[12]

The spread of contagion through the information channel is much simpler, but more difficult to predict. Information contagion can be defined as a sudden and sometimes also unexpected change in the behaviour of economic agents, which can take the form of herd behaviour (when diverse investment categories are bucketed together in the same high risk category), information cascades (when every agent chooses the same action, regardless of his own private information), or sudden reappraisals of economic fundamentals (so-called sunspots; Vaugirard, 2007).[13] The current crisis has demonstrated that asymmetric information, which leads to the phenomenon of adverse selection (Kwan et al., 1999), contributed significantly to the spread of the crisis. The inability of banks or other creditors to distinguish between good and bad assets or counterparties led to reduced lending and accumulation of liquidity and caused the money market to stop functioning (Ferguson et al., 2007).

The contagion effect within the financial system can be illustrated with the aid of a contagion matrix composed of the three main parts of the financial system – institutions, markets and infrastructure – and their principal interconnections (see Table 1).

[12] However, the risk of contagion within the financial network depends to a large extent on the network type (complete, random or scale-free; ECB, 2010) and also on the quality of the links.

[13] The type of triggering event can play a significant role in the impact intensity of a negative shock. The triggering event can be an idiosyncratic shock (e.g. problems within a single bank) which then spreads to the financial system through propagation channels, but it can also be a systematic shock (e.g. an unsustainable fixed exchange rate) which hits several institutions at the same time. Several idiosyncratic shocks can exist in the system simultaneously, spreading and escalating inside the system through propagation channels.

Table 1: The Contagion Matrix

		Contagion to		
		Institutions	**Markets**	**Infrastructure**
Contagion from	**Institutions**	credit risk exposures, shareholder links, contingent credit lines, access to key financial infrastructure	market makers for derivatives, provision of credit support through CDSs, fire sales of assets	operational disturbances
	Markets	investment losses in the trading and available-for-sale portfolio, losses through the revenue channel, problems with funding and liquidity management	information channel – sudden loss of confidence	margin calls (financial asset prices may come under pressure)
	Infrastructure	delays in incoming and outgoing payments complicating liquidity management	operational disturbances in system can negatively affect market turnover and distort price formation	supporting services, technical links and connected ICT systems can spread disruptions

Source: Dijkman, 2010

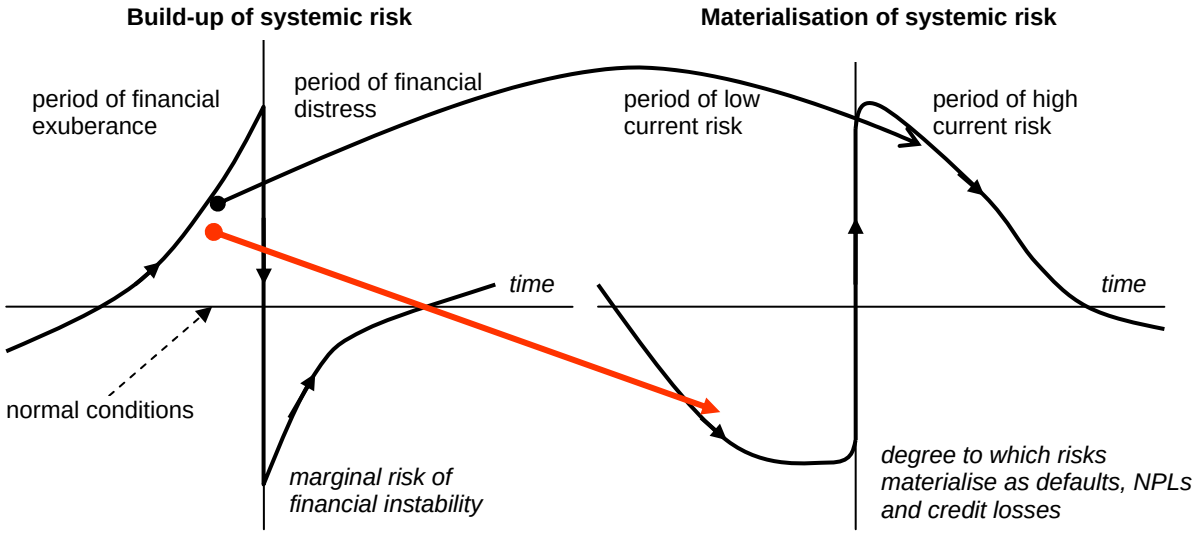
6. Indicators for Identification and Assessment of Cyclical Sources of Systemic Risk

In the previous two sections we described both cyclical (time-series perspective) and structural (cross-section perspective) sources of systemic risk. Now we can proceed to presenting the ways in which the two components of systemic risk can be traced in analytical work. A starting point is the fact that *the two main tasks of macroprudential policy* – to prevent systemic risk and, if prevention fails, to mitigate the impacts when it materialises – are given by the existence of two phases of development of systemic risk. From the prevention perspective, the main task of financial stability analysis is timely identification of the marginal contribution of the current financial environment to the *accumulation* of systemic risk (see the left-hand side of Figure 6). This contribution, which can be termed *the marginal risk of future financial instability*,[14] adds to the build-up of systemic risk in a phase of increasing leverage against a backdrop of easy access to cheap credit and over-optimistic expectations regarding future income and asset prices. If the conditions move away from long-term norms, a disorderly adjustment may follow. At a certain moment economic agents will radically revise their expectations as a result of particular information or a particular event, and a change will occur. Aspects of crisis will start to become apparent and a phase of *materialisation of the risk* accumulated in the preceding phase will occur in the form of financial instability (see the right-hand side of Figure 6). Banks will revise upwards their view of the credit, market and liquidity risk in their balance sheets, increase their credit margins or credit spreads, and tighten their lending conditions. Subsequently, a process of deleveraging will start, during which the systemic risk will gradually "de-accumulate".

[14] This particular concept has also been applied by Woodford (2011, 2012) in his writings on the link between monetary policy and financial stability.

Success in pursuing financial stability is thus to a large extent a function of the authorities' ability to identify and correctly assess the sources and evolution of systemic risk over the financial cycle separately for the two phases of its development. One approach for achieving this success is to treat the two stages of the financial cycle as separate analytical concepts. This is one of the innovations of the CNB's analytical approach (Figures 5 and 6). With regard to the two main tasks of macroprudential policy – *prevention and mitigation* – the competent authorities must in boom times (and, of course, in normal times) focus on assessing the risk of future financial instability and during crises on assessing the scale of the risk materialisation problem. The primary objective must be *to act preventively against growth in systemic risk in the risk accumulation phase*, when conditions are being created for future financial instability. During this phase, macroprudential analyses must be focused primarily on the identification of *latent risks* being generated in the balance sheets of financial intermediaries and their clients. Analytical attention, however, must also be paid to the quality of cash flows and the structure of liabilities, as financial institutions with structural problems in their balance sheets (e.g. weak balance sheet liquidity or excessively long maturity transformations) are naturally far more prone to cash-flow problems. Hahm et al. (2012) argue that the stage of financial cycle can be gauged by using information on the relative size of core vs. non-core bank liability aggregates. They highlight the link between excessive asset growth and growth of non-core liabilities in banks' balance sheets. In small open economies this growth in non-core liabilities often goes through increased foreign-exchange denominated liabilities, reflecting capital inflows. In addition, the increase in non-core liabilities is often accompanied by a shortening of maturity of liabilities. However, telling core liabilities from non-core ones is not simple. The type of funding instrument is not the only factor of separation. Who holds the claims may be even more important. Similarly, Shin (2010) states that preoccupation with loss absorbency diverts attention from the liabilities side of banks' balance sheets and vulnerabilities from the reliance on unstable funding.

Figure 6: The Financial Cycle and Systemic Risk – the Case for Forward-looking Approaches



In pursuing their objectives the authorities must therefore focus primarily on a set of *forward-looking indicators* providing information on the possibility of the future materialisation of systemic risk as a result of currently emerging financial imbalances. When identifying hidden risks, it is important to realise that *current indicators* based on the present levels of financial variables may often provide information about the degree of materialisation of systemic risk, but not so much about the probability of occurrence of financial stability in the future.[15] The key feature of a financial exuberance period, in addition to the availability of cheap credit, is the emergence of *overly optimistic expectations* about future income and asset prices. Such expectations can significantly distort the prices in financial markets, driving them away from normal or fundamentally justified levels. The opposite applies to the systemic risk materialisation phase, since in financial distress, in addition to experiencing limited availability of credit, economic agents become over-pessimistic.

The task for financial stability analysts is to convert some promising indicators into ones that have forward-looking qualities. This refers mainly to creating "gap" indicators based on the assessment of deviations of factors determining the degree of leverage from their normal or equilibrium values.[16] For example, deviations of the ratio of credit to the private sector to GDP (Geršl and Jakubík, 2010) or the ratio of property prices to income from their long-term trends would seem to be relatively reliable indicators. Such indicators send out a signal a few years ahead about financial imbalances in financial institutions' balance sheets and about the potential for the creation of dangerous bubbles (for more details, see Borio and Drehmann, 2009).[17] These are applicable for determining the position in the financial cycle or estimating the probability of a change in the financial cycle.

There is an extensive debate in the economic literature about the possibility of using a set of forward-looking indicators to construct early warning systems (EWSs; see Alessi and Detken, 2009). EWSs are used on the practical level by, for example, the International Monetary Fund (IMF-FSB Early Warning Exercises). However, if used mechanically out of sample, their information value may remain limited (Ghosh et al., 2009; Babecký et al., 2011). A discussion of this topic goes beyond the scope of this paper. One also has to be rather cautious in using actual financial market data signals in EWSs, since the limited efficiency of these markets in terms of their ability to price risks in both boom and stress times damages their forward-looking qualities.[18]

[15] In this sense, in the pre-crisis period the CNB regularly drew attention in its analyses and its Financial Stability Reports to the fact that the existing NPL ratio could not be considered evidence of low risk, since at a time of rapid credit growth, new loans, which are naturally of higher quality initially, dilute the proportion of problem loans.

[16] A complicating factor is the fact that the risk of financial instability emerges at longer and irregular intervals, reflecting the fact that the financial cycle is usually longer than the normal business cycle.

[17] It is much more difficult to obtain reliable forward-looking indicators of the cross-sectional dimension of systemic risk. Such indicators are often obtained from prices on financial markets. However, their reliability as risk indicators is reduced by the limited efficiency of financial markets.

[18] A very nice piece of evidence supporting this particular assertion is what happened during the euro area debt crisis between 2010 and 2012. Financial market participants usually turned rather optimistic immediately following EU summits and other political gatherings, and current indicators improved. A few days or weeks later, they reappraised the outcome of these gatherings and moved in the opposite direction. This pattern of behaviour caused a number of financial stability reports (including the IMF GFSR) to declare in spring 2011 that the risks to financial stability in the euro area had eased, while in reality the euro area was heading towards a systemic crisis.

One of the most challenging tasks for a financial stability analyst is to understand the delay between the formation and the manifestation of risks. Figure 6 illustrates how the process of accumulation of systemic risk (on the left-hand side) is followed by the materialisation of systemic risk (on the right-hand side). The magnitude or intensity of materialisation is easier to observe in data. Compared with the marginal risk of financial instability, it has the opposite time profile. This means that current problems in the financial sector can often be seen in current indicators, but future problems are not so visible. This creates the basis for the *financial (in)stability paradox*, which says that prior to a major financial crisis the system quite often looks strongest precisely when it is most vulnerable (Borio and Drehmann, 2009a; Borio, 2010). In other words, sources of systemic risk may be increasing when banks and their clients consider their business risks to be the lowest. Unfortunately, it is not so easy to recognise that the financial instability paradox is really at work, acknowledge it, and act accordingly. In good times, when the risk of future financial stability may be increasing, the current indicators of existing financial risks are usually improving – default rates and NPL ratios are falling and banks are provisioning to a lesser extent and reporting smaller credit losses. On the basis of current risk measures, the resilience of the financial sector can thus seem very high at such times. Nevertheless, it is difficult to come to the conclusion that the system is heading into a mess, since a tranquil situation of this sort does not always mean that the financial system is heading for a crisis. A low level of risk indication can simply mean that a truly good and long-lasting boom is under way. The financial instability paradox occurs only occasionally and irregularly. But the crises preceded by the developments it precedes tend to have high economic, social and political costs. Therefore, financial stability analysts have to keep in mind the risk of being trapped by the financial instability paradox, i.e. that unusually good values of current indicators signal a growing risk of financial instability. One of the reasons is that industry has a tendency to look at the credit risk level through the ratio of non-performing loans to total loans (the NPL ratio). The empirical analysis in Annex 2 shows that there is a pattern in the behaviour of banks over the cycle which provides room for excessive complacency in periods characterised by increased economic activity and fast credit growth. A low NPL ratio is no doubt part of the story.

For a small and very open economy such as the Czech Republic, risk sources associated with the economy's links with the external environment have specific significance. In its financial stability analyses, therefore, the CNB traditionally puts great emphasis on vulnerabilities resulting from internal and external macroeconomic imbalances and negative international positions of the financial sector. The CNB also looks a lot at the same indicators for the Czech Republic's most important trading partners, its neighbours and economies in the region. If both the Czech economy and its partners are strong in these areas, its susceptibility to contagion from abroad is greatly reduced (this was confirmed in the case of the Czech economy in the acute phase of the crisis in late 2008 and the first quarter of 2009). If, on the contrary, the economy is vulnerable in these areas, it can be hit relatively easily by financial instability as a result of a sharp change in capital flows, financial market volatility linked with public debt financing, or the drying-up of sources of balance sheet liquidity from abroad. The study of macroeconomic indicators is important, since it can reveal a lot about the timing and size of potential shocks to the economy.

Table 2: Financial Stability Indicators

Phase	Dimen-sion	Indicators
Risk accumulation	Time (cyclically induced risks)	• credit-to-GDP (deviation from long-term trend or normal) • rate of growth of loans and asset prices • gaps in asset prices and yields (deviations from long-term trend or normal) • leverage ratio (F) • default rate, NPL rate (F) • level and adequacy of provisions (loan-loss provision rate, coverage ratio, F) • credit conditions and characteristics of new loans from BLS (F) • credit spreads and risk premia (F) • haircuts on collateralized lending (F) • debt-to-assets ratio (H,C) • debt-to-income ratio (H,C) • interest-to-income ratio (H,C) • price-to-income ratio (P) • loan-to-value ratio (P) • price-to-rent ratio (P) • market liquidity in the form of market turnover (P) • macro stress tests of markets and credit risks (F) • early warning systems (F) • composite indicators of financial stability or leverage level (F) • macroeconomic imbalance indicators (government deficit and government debt, current-account deficit and external debt, national investment position, foreign exchange reserves, external financing requirements, currency under- or over-valuation)
	Cross-sectional time (structurally induced risks)	• quality of liquidity structure (loans-to-deposits ratio, ratio of funds acquired on interbank market, ratio of non-core liabilities to total funding, F) • maturity transformation ratio (maturity mismatch indicators, customer funding gap, F) • capital quality structure (F) • liquidity stress tests (F) • composite liquidity index (F) • indicators of scale of activity within financial system, including network analyses (e.g. flows between institutions, F) • degree of asset and liability concentration (F) • share of large exposures in balance sheet (F) • scale and structure of off-balance-sheet items (F) • bank foreign debt to bank foreign asset ratio (net external assets of banks, F) • currency mismatch indicators (open foreign exchange position, share of foreign currency loans, F) • composite volatility index (M) • macroeconomic imbalance indicators (capacity for external contagion shock)
Risk materialisation	Time	• dynamics of default rate and NPL ratio (F) • dynamics of provisioning (coverage ratio, LLPR, F) • decline in profitability (F) • change in CAR (F) • macro stress tests of markets and credit risks (F) • credit spreads (H,C,G,M)

	Cross-sectional	• stress tests of liquidity (F) • changes in market liquidity measures (M) • activity and spreads on interbank money market and government bond market (F) • CDS spreads (F) • interbank contagion tests (F) • CoVaR (F) • joint probability of distress (F) • contingent claim analysis (F)
Note: The table contains a list of selected indicators. Many of these tools can be directed at both the time and cross-sectional component of systemic risk. The table gives the predominant target. Sector abbreviations: H – households, C – corporations, F – financial institutions, P – property market, M – financial markets, G – government. No abbreviations are shown next to indicators that are valid for the economy as a whole. Underlined indicators are ones that we consider important for CNB analysis.		

To sum up, when assessing systemic risk *during the accumulation phase*, the authorities have to build upon a *comprehensive analysis of a set of indicators* (Table 2). They must first of all reach a general consensus on the normal or sustainable values of the relevant indicators (the ones deemed highly relevant for the CNB are underlined in Table 2) and then continuously assess whether the deviations of the actual values from their normal levels are becoming critical. They also have to pay attention to *recognition of the types of likely shocks, estimating their probabilities and potential impacts*. This process will not be easy. Preventive macroprudential tools are not usually activated until a consensus has been reached that the critical values of some indicators – or rather a combination of a set of forward-looking indicators – that have a strong information content regarding the current level of risk of future financial instability have been exceeded. The difficulties in reaching a consensus create a risk of delayed activation, leading to an insufficient and inefficient policy reaction. In addition, imprecise timing of activation can result in overshooting or undershooting of macroprudential objectives (CGFS, 2012). It is therefore crucial to assess, on a continuous basis, the position of the economy in the financial cycle. This is the crucial determinant in guiding the activation and release of macroprudential tools in both stages of the cycle (preventive activation, deactivation of preventive tools if possible, release of buffers and other tools plus activation of anti-crisis measures, deactivation of anti-crisis measures). The activation of preventive tools and the deactivation of supportive measures – two critical moments that macroprudential analysis is tasked with identifying – are marked by red lines in Figure 5. The complexity of macroprudential policy over the financial cycle is described in Table 3, taken from CGFS (2012).

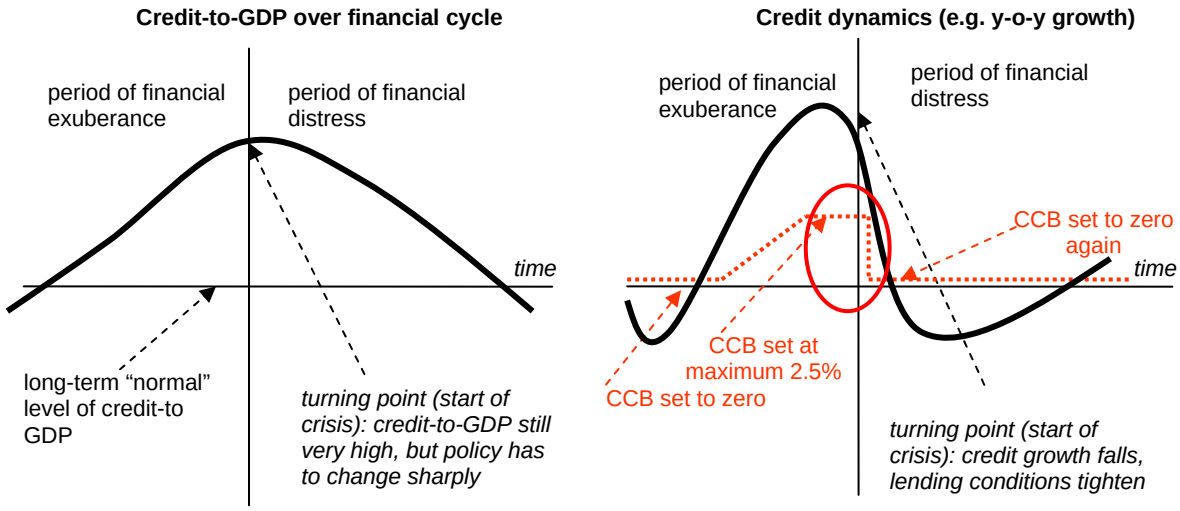
Table 3: Scenarios for the Activation and Release of Macroprudential Instruments

		Stage of financial cycle		
		Boom	*Bust*	
			With crisis	*Without crisis*
Other macroeconomic conditions	Strong	Tighten		No change or release
	Weak	No change or tighten	Release (if possible) Tighten (only if necessary)*	Release
* The case of the euro area in 2011–12 demonstrated that if banks end up without capital buffers and markets lose confidence in their stability, the authorities may be forced to resort to requiring additional capital even though this would normally constitute unwelcome tightening of policy during a crisis.				

Source: CGFS (2012, p. 5)

It is undoubtedly quite difficult to distinguish normal cyclical fluctuations and long-term trends from a dangerous financial cycle in timely fashion. At any particular point in time it is likely that some indicators are giving contradictory results. The easiest job for financial stability analysts may be to identify a critical point in a simultaneous economic and financial boom. As to the build-up of systemic risk, one can be rather sure that *if credit and some asset prices are going up quickly and moving away from historical norms, and both the quantitative and qualitative evidence indicates excessive optimism and mispricing of risk, there is a need to send out a clear warning and recommend that decision-making bodies take action*.

Figure 7: The Financial Cycle and Discontinuity in Systemic Risk and Policy Reactions



If prevention is not sufficiently effective and a systemic risk *materialisation phase* occurs, the macroprudential policy focus must be shifted to *mitigating the impact of the crisis*. The start of this phase may generally also not be so difficult to identify, since the onset of a crisis tends to be clearly visible thanks to a sharp deterioration in market variables (e.g. credit spreads or CDS spreads). Still, macroprudential analysts must take into account the high degree of discontinuity in the evolution of systemic risk and have a set of indicators at their disposal characterising the start and end of the materialisation of financial instability. Figure 7 highlights that even though the financial cycle and leverage may evolve as slow-motion processes, sharp changes in the marginal risk of financial instability may call for abrupt changes in macroprudential policies. A typical example would be a change in the setting of countercyclical capital buffers (CCB in Figure 7), which could be fully released immediately if a major financial shock occurs to avoid excessive deleveraging. This is why not only the credit stock (or credit-to-GDP ratio), but also indicators of credit dynamics have to be taken as crucially important evidence on financial cycle and systemic risk developments.

In a small open economy, financial or informational *contagion* resulting from links between the domestic economy and its institutions and the external environment can be a major source of materialisation of systemic risk and of discontinuities in the evolution of such risk. The analytical approach to identification and assessment will differ significantly from country to country depending on factors such as the net external and foreign exchange position of the banking sector and the economy as a whole, the share of foreign currency in both loans and deposits, the share of

foreign ownership of financial institutions and the dominance of subsidiaries or branches of foreign banks. The most vulnerable economies are those which run structural budget deficits financed by borrowing from abroad with a large stock of debt denominated in foreign currency.

In the systemic risk materialisation phase, it is vital to assess the financial system's ability to withstand the emerging risks. The analyses of financial stability will have to extend their focus to the short-term risks associated with adverse economic developments. *Stress tests* of the financial system's resilience are a suitable analytical instrument for performing this task. With the aid of such tests, supervisory authorities should be able to estimate whether the financial sector is capable of withstanding the adverse effects associated with risk materialisation at the given level of capital and liquidity. Stress tests are undoubtedly a very useful analytical tool in the systemic risk accumulation phase. That said, they still perform better as an indicator of resilience in the materialisation phase (for discussion see also Borio et al., 2012, or Galati and Moessner, 2011). This is due to two factors. First, they are to some extent based on current risk indicators, which in good times are usually low in value and the starting position of the segment of the financial system under test therefore tends to be relatively strong. Consequently, the results of stress tests conducted in good times may have limited information content even for high-stress scenarios. In bad times, by contrast, the starting position of the relevant segment is fragile and additional stress can have a much more visible effect. In addition, in bad times the unfavourable results of stress tests can evoke fear among decision-makers, which is often a prerequisite for making painful decisions. Second, in their current form, stress tests are focused on evaluating the impacts of mostly exogenous shocks. As the stress test methodology is gradually developed and more endogenous mechanisms are added, the information content and applicability of stress tests in the risk accumulation phase can be expected to increase. In addition to stress tests, the aforementioned current indicators in stock or flow form can be used to estimate the extent of financial stress.

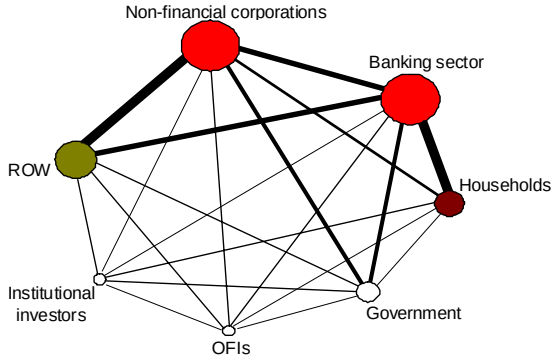
Sometimes it can be rather challenging to clearly detect the stage of the financial cycle and decide on policy actions (some of the cases in Table 3). One such case is the situation of a credit and asset market boom in a period of weak economic activity. The *activation or deactivation* of preventive tools may require extensive judgement. It may also not be easy to estimate the moment at which the effects of risk materialisation are ceasing to act in a systemic fashion and the anti-crisis measures and support policies can therefore be discontinued. A special case is the one following a major "global" financial crisis which has not been fully resolved yet, as is currently the case in the EU. In economies directly hit by the crisis it may even be necessary to tighten conditions via an increase of capital and liquidity buffers to avoid a complete loss of confidence in the ability of banks to weather the situation. The authorities in economies not directly hit by the crisis will also have to analyse how financial institutions are coping with the worse external economic environment and whether the relaxed policies are providing incentives for financial institutions and their clients to take on excessive risks. Simultaneously analysing short-term (mostly exogenous) and medium-term (mostly endogenous) risks and attempting to tackle them with a number of tools will by definition be difficult and hard to communicate. In addition, such periods will necessarily be characterised by a high level of uncertainty with adverse effects for

economic activity. The complexity of periods like this constitutes a strong argument for decisive and swift resolution of banking crises.[19]

7. Tracing Structural Sources of Systemic Risk in a Financial Network

The approaches to detecting structural sources of systemic risk are rather different from the ones used in the cyclical context. The intricate structure of the linkages within a modern financial system can be illustrated and tracked by means of network analysis (Figures 8 and 9; e.g. Upper, 2007, Allen and Gale, 2000, Freixas et al., 2000, and Nier et al., 2007).

Figure 8: Illustration of Financial Links in the Czech Economy



Note: OFIs: other financial intermediaries; ROW: rest of world. Node size is given by the sum of the assets and liabilities of the relevant sector (excluding the ROW node), while link strength is given by gross exposure between the relevant nodes. The ROW node reflects only the sum of the gross exposures that Czech sectors have w.r.t. the rest of the world (usually equity holdings). The size of the other nodes is additionally given by intra-sectoral links. Based on data as of 2010 Q2.

Source: Calculations of Frait and Komárková (2011) using data from Komárek, Kubicová and Plašil (2011)

Figure 9: Structure of the Czech Interbank Market Network

Note: The nodes are banks on the Czech interbank market or in the CERTIS payment system and the links are the significant mutual exposures and payment operations between them.

Source: Komárková et al. (2012)

Network analysis essentially involves defining a collection of nodes (financial institutions or markets) and the direct and indirect links between them (credit relationships, exposures, liquidity flows in the payment system, etc.). As a consequence of the current financial crisis, a "too interconnected to fail" paradigm has emerged alongside the traditional "too big to fail" paradigm. Parameters for identifying important nodes (a concept known in social network analysis as

[19] For example, the adverse external environment in the EU arising in autumn 2011 pushed some central banks in countries that had not been exposed to the crisis to low interest rate levels. At the same time, the demand for credit for buying "cheap" housing opened a debate on the risks of real estate busts.

centrality) have come to the fore.[20] The importance of a key financial institution (or market) is therefore measured not only by its absolute size, but also by its interconnectedness with other financial institutions (ECB, 2010).[21] Consequently, the measurement of importance combines two aspects: the functionality of the institution or market within the system, and the degree to which others in the system rely on the smooth provision of services by the given institution or market. Moreover, the systemic relevance of an institution can increase over time, especially in the growth phase of the business cycle. If the system contains an important node that is irreplaceable by others in the system (the money market, for example), the system as a whole will be as vulnerable to shocks as the important node is. Financial networks containing several important nodes can therefore be extremely volatile and vulnerable. A shock might affect just a few of them, or even just one, but if they are heavily intertwined within the system – and especially with other important nodes – a sudden breakdown in the provision of their services will lead almost certainly to propagation of the shock and probably also to amplification of its impact on the system as a whole.

Contagion in the systemic risk sense is not limited to the financial system alone (see Figure 9; the horizontal perspective). Negative shocks also propagate from the financial system to the real economy (see Figure 8; the vertical perspective). This means that a systemic event or systemic risk spreads out of the financial system via the real or information channels to the real economy and affects consumption, investment, economic growth and overall wealth. The opaque and intertwined nature of the financial system magnifies or accelerates the impact of such a shock. The objectives of macroprudential policy in this regard are to adopt measures to reduce the size or interconnectedness of systemically important nodes[22] and to make them more resilient to systemic shocks. Since there may be some conflict between these two objectives, the application of particular measures has to build upon proper analysis of existing structures. In particular, the existence of relatively large and diversified institutions may add to stability even in a small economy.

To analyse the systemic significance of banks in the Czech financial system (Komárková, et al., 2012) the CNB has meanwhile used the composite quantitative indicator-based approach (Table 4, right-hand column) based on the recommendations in the FSB/IMF/BIS (2009) report submitted to G20 finance ministers and central bank governors in October 2009 (BCBS, 2011b; Table 4, middle column). The composite quantitative indicators are supplemented with two indicators obtained from network analysis: (1) the mean centrality in the interbank market network in the interconnectedness category, and (2) the mean centrality in the CERTIS payment system network in the substitutability category. For the sake of clarity, the eleven indicators selected are grouped

[20] The properties and behaviour of a node cannot be analysed on the basis of its own properties and behaviour alone, as these may be affected by other nodes linked to it either directly or via another node. An important node can be defined according to the following criteria: (i) the function it performs is important for the business of other nodes in the system, (ii) its balance sheet and transactions are relatively large, and most importantly (iii) its function cannot be assumed by anyone else within a reasonable time and at a reasonable price. Using these criteria, which should, moreover, be relatively stable in the medium term, it is possible to identify a key financial institution, market or infrastructure – e.g. a large and active bank, the largest credit market in terms of transaction volume and frequency, a central counterparty or a large-value payment system (ECB, 2006).

[21] Traditional measures of centrality include the number of links that terminate on a node (in-degree) or that depart from a given node (out-degree), or the distance from other vertices (closeness) via the shortest paths.

[22] Such measures can include money market financing caps or additional regulatory capital requirements for highly interconnected institutions.

into five categories: size, cross-border activity, interconnectedness, substitutability and complexity (Table 4, left-hand column).

Table 4: Summary of Composite Quantitative Indicators

Category	BCBS (2011b)	Komárková et al. (2012)
Size and activity Represents the factor of concentration.	• total exposures	• gross credit exposure • interest income and fee and commission income
Interconnectedness Represents the factor of direct contamination. Distress at highly interconnected institutions directly endangers the rest of the system through mutual exposures.	• claims on credit institutions • liabilities to credit institutions • wholesale funding ratio	• claims on credit institutions • liabilities to credit institutions • mean centrality in interbank market network
Cross-border activity Represents the potential channel of direct contagion from abroad.	• claims on non-residents • liabilities to non-residents	• claims on non-residents • liabilities to non-residents
Substitutability A non-substitutable institution is one whose place cannot be taken by another in the short run. Market participants and clients are therefore heavily dependent on its services and products.	• assets under custody • payments cleared and settled through payment systems • values of underwritten transactions in debt and equity markets	• assets under custody • payments cleared and settled through payment system • mean centrality in CERTIS network
Complexity Not a systemic significance criterion, but creates a risk of inadequate supervision and regulatory arbitrage. Supervisory judgement should form a substantial part of this measure.	• trading book value and available for sale value • level III assets • OTC derivatives notional value	• trading book value and available for sale value

Source: Komárková et al. (2012), BCBS (2011b)

The individual indicators are calculated for each bank separately. The score for each indicator is generally computed by dividing the amount of the relevant variable for the individual bank by the aggregate amount for the entire system. Finally, the composite indicator of systemic significance was calculated as the weighted average of these indicators.[23] In the method applied to the Czech banking system we initially – following BCBS (2011b) – assumed equal weights for each category and equal weights for the relevant indicators within each category. However, the allocation of weights in order to obtain the composite indicator of systemic significance is subject to numerous assumptions. Important roles are played by the current economic conditions, regulatory diversity, and the structure and level of development of the financial system. For these reasons, we perform further estimates of the systemic significance of Czech banks using alternative category weightings (Komárková et al., 2012). The alternative weights are designed to better reflect the conservative nature of the Czech banking sector (retail deposits as the primary banking funding source) in one option, and a change in economic conditions in another option (for

[23] For example, the score for the first indicator – gross credit exposure – was calculated by dividing the gross credit exposures of a particular bank by the total exposures across all the banks under analysis, and then giving the result a 10% weight. Simply put, this means that 10% of the share of the bank's gross credit exposures in the aggregated sum of exposures enters the bank's total systemic significance score (composite indicator).

example very low returns on domestic assets, leading to a preference for wholesale funding and market investments). The analysis presented above enables us to focus on the risks associated with the activities of non-bank institutions and their links with banks and other types of institutions via the payment system and mutual exposures.

The method used to quantitatively determine Czech SIBs helped us to rank the analysed banks by systemic significance in descending order using the defined key and identified banks with a high deviation from the average significance, but it did not adequately reveal which of these banks are systemically significant due to their high risk absorbency and which are systemically significant due to their ability to propagate risk quickly, directly or indirectly, within the system or to the real sector. The former stabilise the system, while the latter destabilise it. Moreover, it is impossible to discern from the results obtained whether an analysed bank contributes significantly to systemic risk by itself or via a group of banks; group failure can generate far higher systemic costs. For the final quantitative determination of systemically significant institutions or systemically significant groups which might potentially be subject to the new prudential regulations (see Section 7), we need to further refine the quantitative indicator-based approach (especially in the complexity[24] and substitutability categories) and also conduct further additional analyses (in particular an analysis of balance sheet correlation across banks and sectors). Such additional analyses could change the current quantitatively determined bank rankings and the deviations from the average significance.[25]

The quantitative determination of systemic significance needs to be followed by qualitative determination, or supervisory judgement. This should primarily involve setting limits on the deviation of the significance of a particular bank from the mean or median significance. Qualitative judgement should therefore just confirm the quantitative results. However, qualitative judgements can be made only after sufficient results have been obtained for the quantitative determination of systemic significance.

8. Tools for Preventing Systemic Risk and Mitigating Its Impacts

After assessing the changes in systemic risk and agreeing on the need to act accordingly, the authorities have to choose relevant prevention or mitigation tools. The two development phases and two dimensions of systemic risk can necessitate the use of different tools or combinations thereof (Table 5). The authorities can use tools that are being newly developed and implemented as macroprudential instruments or rely on the use of a number of more or less traditional instruments applied in a macroprudential manner. If necessary, macroprudential authorities can also coordinate with other policy-making ones in order to involve additional policy tools.

[24] One way of further extending the analysis of the complexity of Czech financial institutions is to take into account their ownership structure, i.e. their links to parents and subsidiaries.

[25] Owing to the complexity of the additional analyses they are not included in this article and will form part of further CNB research.

8.1 Tools for Increasing Resilience, Leaning Against the Financial Cycle and Mitigating Its Impacts

In the systemic risk accumulation phase, the authorities will primarily attempt to act against the increase in the vulnerability of the system. To the extent they have trust in the capacity of the available tools to lean against the cycle, they will also use tools that can affect the behaviour of financial institutions and their clients and thus directly reduce their contributions to the build-up of risks. We nevertheless believe that the *main intermediate target of the preventive instruments used in the accumulation phase* is to maintain the resilience of the financial system by *creating buffers* which are then used in the period of materialisation of this risk.[26] *Reducing the amplitude of the financial cycle* by suppressing lending growth and preventing excessively long maturity transformations should, in our view, be only a secondary intermediate target. Our view is based on the experience with the use of macroprudential tools in some countries suggesting that their individual effect on the financial cycle is limited (Borio, 2010). However, a *combination of macroprudential tools and microprudential instruments applied macroprudentially* (e.g. those which create additional capital requirements for risk exposures) could help to eliminate apparent excesses over the financial cycle. They might also contribute to enhancing the management of risks in individual institutions, including risks linked with cyclical increases in maturity transformation in bank financing and with the tendency of banks to rely on short-term market financing at times of easy access to liquidity. Certainly, the role of macroprudential policy cannot be to wipe out cyclical fluctuations in credit and asset prices; it can only be to *cut off extreme peaks* in the cycle that would lead to an untenable level of debt and, with a high probability, to tail events.

The key to avoiding financial system vulnerability is to ensure that the system is *robust*. For a bank-based system, robustness can be achieved via high loss absorbency, strong liquidity and barriers to excessive credit growth. *Loss absorbency* concerns the ability to withstand both expected losses (thanks to sufficient provisions; see subsection 8.3 and Frait and Komárková, 2009) and unexpected losses via capital cushions. These are comprised of a microprudential (Basel II) component, a countercyclical component (Frait, Geršl and Seidler, 2011) and a cross-sectional SIFI component (Komárková, Hausenblas and Frait, 2012). *Strong liquidity* (quick liquidity ratio, stable/core funding ratios) is an essential way of limiting fragility of liabilities (Komárková, Geršl and Komárek, 2011). Some macroprudential tools for creating barriers to *credit booms and excessive debt* such as the leverage ratio (a bank's equity in relation to its total non-risk-weighted assets, including off-balance-sheet items) may be needed, too. The obvious candidates for the toolkit are those which may help in holding back housing debt, which is particularly prone to cyclical upswings. Instruments such as sector-specific risk weights, ceilings on loan-to-value ratios (LTV ratio, mortgage cap) and ceilings on debt-to-income or payment-to-income ratios have already been used in a number of countries (CGFS, 2010; Moreno, 2011). The risks of excessive *concentration* can be reduced by imposing limits on large exposures. Obviously, the standards for keeping the system robust have to be set in such a way that it is able

[26] The main point of macroprudential buffers is to reduce the probability of sudden or panic changes in the behaviour of financial institutions during a crisis. Capital buffers, for example, allow banks to lend to the private sector even when their losses on previously granted loans are rising and negatively affecting their capital adequacy. Liquidity buffers can prevent panic sales of assets under pressure caused by a need to obtain liquidity quickly to cover deposit withdrawal requests or by investors' unwillingness to roll over short-term bonds issued by banks.

to withstand the impacts of tail events. Setting such standards to a much higher level would have negative consequences for long-term economic growth. The sufficiency of such standards has to be reassessed continuously, because in specific circumstances the risks may increase to previously unforeseen levels.

In the *systemic risk materialisation phase*, the priorities of macroprudential policy will initially be to prevent the elements of instability from escalating, to reduce the probability of panic adjustment by financial institutions and their clients in response to the revision of expectations, and to mitigate the negative impacts of the significantly worse conditions. In a prolonged crisis like the one we are currently experiencing, continuous efforts to keep the system resilient and make the public believe in it may be needed.

In bad times, the use of countercyclical buffers accumulated in good times can be regarded as the most important macroprudential tool. In a systemic crisis, however, a whole range of monetary policy instruments and regulatory and supervisory measures can become macroprudential in nature. On a concrete level, macroprudential policy in this phase will act via more or less automatic stabilisers (the release of buffers and the use of central banks' automatic facilities) or even crisis management tools (government guarantees for bank assets, bad asset transfer programmes and balance sheet clean-ups, and capital injections for ailing institutions). We agree that crisis management tools do not belong in the macroprudential toolkit. We list them in Table 5 just to remind the reader that their use may have macrofinancial effects in periods of financial distress.

Table 5: Financial Stability Tools

Phase	Dimen-sion	Tools
Risk accumulation	Time (cyclically induced risks)	• **countercyclical capital buffers** • **provisioning through cycle** • **introduction of "through-the-cycle" elements into risk management models and asset valuation models** • **countercyclical setting of margins and haircuts for contracts used to raise funding*** • *ceiling on leverage ratio** • *increased risk weights for certain types of loans (e.g. loans for residential or commercial property and foreign currency loans)* • *increased loan loss provisions depending on period in default* • *ceilings on LTV ratios for loans for house purchase (or increased capital requirements for loans with high LTV ratios)* • *ceilings on debt-to-income or payment-to-income ratios for household borrowing (or increased capital requirements for loans with high ratios)* • *increased collateral requirements for loans to corporations* • *additional reserve requirements in the event of a change in credit dynamics* • *rules for reference rates for loans for house purchase* • monetary policy tools: interest rates, minimum reserve rates and marginal reserve rates for selected liability sources, foreign exchange market interventions • fiscal and tax policy tools: tighter property taxation rules (for second and additional homes), reduction or elimination of tax deductibility of interest on loans for house purchase, introduction of transaction taxes for certain items of capital inflows from abroad, government spending cuts

	Cross-sectional time (structurally induced risks)	• **capital or liquidity surcharges for size, complexity and interconnectedness** • **systemic risk buffer (CRD IV tool targeted at structural sources of risk)** • *liquidity buffers and requirements for stable balance sheet liquidity sources** • *maturity transformation limits (maturity ladders, liquidity coverage ratio)** • *loan-to-deposit ratio ceilings* • reserve or levy on non-core bank liabilities • *margins and haircuts for fundraising contracts* • *reserve requirements (e.g. for sources in domestic or foreign currency)* • *leverage limits for financial investors* • *limits on intra-group exposures (e.g. between parent and subsidiaries) and interbank exposures* • *limits on currency mismatches (net open positions, share of net external liabilities)* • *changes to capital requirements for large exposures** • *other restrictions on large exposures** • *limits on sectoral concentration for lending or investment* • increased disclosure of risky positions • active communication by authorities regarding changes in risk
Risk materialisation	Time	• **release of capital and liquidity buffers** • **release of provisioning buffers** • funding for lending schemes • capital injections for selected banks* • active communication by authorities to explain extent of problem* • disclosure of stress test results*
	Cross-sectional	• easier access to central bank refinancing facilities* • relaxed collateral policies of central bank* • transparency regarding exposures and risks of individual market segments (e.g. CNB has disclosed extent of exposures to highly indebted governments) • activation of contingency funding plans (CM) • protection of bank creditors (e.g. government guarantees for bank liabilities, CM)* • higher or wider deposit insurance (CM) • programmes to transfer bad assets to bad banks and clean up balance sheets (CM) • communication regarding methods for dealing with illiquid and insolvent institutions (CM) • recovery and resolution plans, living wills (CM)

Note: The table contains a list of selected instruments. Many of these tools can be directed at both the time and cross-sectional component of systemic risk. The table gives the predominant target. Asterisks (*) denote tools that are also highly relevant to the second dimension. Macroprudential tools of the type of built-in stabilisers are highlighted in bold. Potential macroprudential uses of supervisory and regulatory tools are highlighted in italics. Other financial stability tools are given in normal text. Sector abbreviations: H – households, C – corporations, F – financial institutions, P – property market, M – financial markets, G – government. No abbreviations are shown next to indicators that are valid for the economy as a whole. CM – tools of crisis management going beyond financial stability mandate. The underlined tools are the ones that we consider most promising for the CNB.

At present, there is not a complete consensus on what tools can be regarded as *macroprudential policy tools*. Given that a whole spectrum of measures can have macroprudential aspects, a wide range of measures are usually included in the macroprudential toolkit. Table 5 provides a detailed list of tools structured according to the type of systemic risk and the stage of the financial cycle. When dividing the instruments into specific groups, one can look at them from various angles.[27] Given the complexity of the toolkit, we choose to divide this broad category into *"true"*

[27] Bank of England (2011) divides these tools into balance sheet tools, tools that influence the terms and conditions of new lending, and market structure tools. CGFS (2012) distinguishes the instruments as capital-based, liquidity-based and asset-side.

macroprudential tools, microprudential tools applied in a macroprudential way, and other financial stability tools. True macroprudential tools are those which were designed from the very beginning for coping with systemic risk (even though they may have microprudential origins) and have to some extent the form of pre-agreed rules and can therefore take the form of at least partially automatic stabilisers (the tools marked in bold in Annex 1). Of course, such tools are rule-based and automatic stabilisers only in a conceptual sense, while their practical use will always be based on the outcomes of judgement and a high level of discretion. They are intended not only to ensure creation of buffers, but also to limit at least partially the procyclicality of the financial system or the risky behaviour of individual institutions. They should be explicitly focused on the financial system as a whole and on endogenous processes within it. In addition, there are efforts to standardise and coordinate the application of these tools internationally. This applies especially to the EU.

In addition to true macroprudential tools, *various microprudential regulatory and supervisory tools have been extended to macroprudential purposes*.[28] If these tools are applied not to individual institutions, but across the board to all institutions in the system, they can be regarded as macroprudential instruments (the tools marked in italics in Table 5). Some of these tools can also be used in a symmetrically opposite manner in a systemic risk materialisation phase in order to preserve access to credit for the private sector as well as at times of greatly increased risk perceptions. Without doubt, the tools listed in Table 5 are not available to any economy, any time.

There is a lively debate regarding the differences between macroprudential and microprudential instruments. In our view, this debate is often confusing and a bit needless. The difference between macroprudential and microprudential tools lies in the conceptual approaches to their application. In other words, an instrument may be used in both a macroprudential and a microprudential way. The classification of instruments by an authority will thus always be rather subjective and reflect its prevailing approach to their application. Generally, a *microprudential approach* to supervision is built upon prevention through the enforcement of compliance rules and regulations of prudential behaviour and on reaction to individual institutions when a breach of the rules/regulations is identified and when prudential indicators deteriorate. Hard evidence is much more important than predictions and the reaction may appear at any point of the financial cycle. By contrast, in a *macroprudential approach,* prevention is based not so much on pre-announced rules, but on predictions of systemic risk (in a way similar to monetary policy) and subsequent policy actions are targeted at the system as whole. In addition, macroprudential prevention can work only through timely and forward-looking action. And since the financial instability paradox is at work, corrective action should therefore be taken in good times (again as with monetary policy).

True macroprudential tools, the introduction of which has been the subject of an international debate over the last few years, are targeted more at *the time component of systemic risk*. The first set of such tools is aimed at the through-the-cycle (or countercyclical) capitalisation of banks, which by 2018 at the latest should face an obligation to create countercyclical capital surcharges above and beyond the microprudentially derived minimum capital adequacy ratio to reflect the

[28] Over the past decade, the application of macroprudential tools has been observable mainly in emerging economies (see, for example, CGFS, 2010, or Moreno, 2011). One possible reason is that the existing international regulatory framework applied in advanced economies, including the EU, can put tight constraints on national macroprudential discretion.

extent of changing systemic risk over the cycle (Geršl and Seidler, 2011). According to the Basel III accord, which will be implemented in the EU via the CRD IV/CRR package, in good times, when a particular aggregate level of credit in the economy is exceeded, banks will have to start creating a capital buffer that can be used to absorb the negative impacts of future financial instability (Drehmann, et al., 2010, or BCBS, 2010). Another set of proposals is directed at ensuring provisioning across the cycle so as to better capture expected credit portfolio losses and force banks to create buffers to cover credit risk. Even though this is primarily an accounting issue not a regulatory one, we cover it in subsection 8.3 and the empirical analysis in Annex 1 due to its high importance.

When using tools oriented towards the *cross-sectional dimension*, the intermediate target in the preventive phase should be to contain the risks that individual financial institutions, markets and instruments can create for the system as a whole. To limit this dimension of risk, associated with interconnectedness, size or significance within the system, it is necessary first to assess the contribution of individual institutions, markets and instruments to systemic risk (Section 5) and then to reduce this contribution or set a limit on it. This should give rise to lower probability of collapse of large, complex or excessively interconnected institutions as a result of credit, market or liquidity risks, greater resilience of institutions, markets and instruments to contagion within the system, and a related overall reduction of loss of confidence in the financial system.

Macroprudential tools currently in the initial stage of implementation include, for example, capital surcharges for individual institutions deemed systemically important set in the form of additional capital requirements taking into account their contribution to systemic risk by dint of their size, complexity and interconnectedness. The practical method chosen should reflect the specifics of the financial sector of the country concerned.[29] The point of applying systemic surcharges as a macroprudential policy tool is to inform a specific financial institution about the authorities' assessment of its systemic significance or excessive interconnectedness and thereby give it an incentive to change its structure. Basel III also includes new liquidity requirements, which are also targeted mainly, although not exclusively, at the cross-sectional dimension (a requirement for a specific ratio of stable sources of balance sheet liquidity or coverage of potential outflows by highly liquid assets). Margining, i.e. the requirement for a buffer between the value of collateral and the amount which an institution borrows against it, can also be regarded as an instrument fostering the creation of buffers for liquidity risk. This buffer should allow for the absorption of even a large fall in collateral value resulting from a crisis in asset markets. The possibility of configuring liquidity risk management tools so that they also have some countercyclical effect is also being discussed. Within them, maturity transformation limits, limits on intra-group exposures and extra capital requirements for large exposures are worth considering.

The use of macroprudential policy tools is not free from controversies. CGFS (2012) distinguishes two approaches to policy reaction following systemic risk identification. One is a top-down approach based on the evaluation of overall economic developments. The problem with this approach is that a generally accepted theoretical and empirical framework for macroprudential

[29] Given the characteristics of the Czech financial sector, it would make sense to track the size factor rather than the interconnectedness factor when calculating the systemic surcharge, as it is highly likely that any negative externalities for the Czech economy would be linked more with the failure of large financial institutions or with concentration risk (financial institutions hold identical or correlated assets in their balance sheets or finance themselves on identical or correlated markets).

policy is not yet available and there are doubts whether one ever will be. The bottom-up approach starts with a set of instruments and assesses the vulnerabilities they can address and the types of indicators that should be used to trigger their implementation and release. The downside of this approach is the existence of potential negative externalities or unintended consequences of instruments applied in this way.

In addition, the simultaneous use of various tools opens the issue of their mutual interaction. This crucial issue is deliberately put beyond the ambitions of this paper, since it requires detailed and very deep investigation. Obviously, the simultaneous use of several tools may boost or weaken their individual effects. Some tools will not work without the support of another. And some combinations of tools may create negative externalities. Therefore, each tool requires a proper assessment prior to its use. The authorities have to give answers to *a number of crucial questions*: Which dimension of systemic risk does it primarily affect? Which externality does it cure? What is it supposed to prevent? What potentially adverse effects does it have? What transmission channels does it work through (for an extensive discussion of this issue see CGFS, 2012)? What instruments are complements or substitutes relative to it? Which instruments are in conflict with it? How effective can it be? Can it be implemented in the existing legal framework? How easily could it be bypassed (arbitraged away) through switching the activity abroad or to a different kind of entity? Does it require international coordination? Is there any experience with its use abroad? Which EU or international body is responsible for setting its standards? How soon it can be used in practice? What way of communicating its use is optimal?

8.2 Macroprudential Tools Most Relevant From the Perspective of the Czech Economy

In conducting macroprudential policy, each country has to choose a limited spectrum of tools reflecting the structure and nature of the local financial system as well as the legal and regulatory environment within which it operates. The issue of the effectiveness of particular tools has to be taken into account (for country experiences with various tools see Lim et al., 2011, Crowe et al., 2011, or Dell'Ariccia et al., 2012). Unfortunately, our knowledge regarding the effectiveness of individual tools or combinations thereof is currently rather limited. A set of the most relevant indicators for individual tools should therefore be established (CGFS, 2012, Table 2.3).

The underlined tools in Table 5 constitute a set of instruments that could be useful, in our view, for macroprudential policy in an economy like that of the Czech Republic. The calibration of some of them can be varied over the cycle and address the risks associated with the dynamics of credit. In practice, the Czech Republic, like other individual countries, is to some extent constrained by external regulatory and accounting rules. Macroprudential authorities in the EU are facing a complex situation, since they have to comply with both international and EU-wide rules. In the EU framework, the tools can be divided into national, national with reciprocity, national with EU coordination, EU-wide actions and ones induced by international agreement. In particular, the EU legislation – adopted via regulations and directives – creates a clear constraint. In other words, national authorities in the EU countries do not have the same discretion in applying the tools as the emerging countries' authorities do (Moreno, 2011). Besides this, the national authorities have to assess how the use of the tools under their discretion affects economic agents in other EU member states and coordinate with their authorities accordingly. Since the most important banks in the Czech Republic are stand-alone subsidiaries of EU cross-border

groups, some home-host issues may arise that require discussion within supervisory colleges. The use of the macroprudential tools that are now being prepared on the EU level will require the national authorities to follow the recommendations of the ESRB, notify it of their actions and discuss their approaches in the structures of the European System of Financial Supervisors where necessary.

A special issue is how to cope with the financial cycle while being a *member of the euro area and also of the "banking union"* that is now being pushed for in the EU. The diversity in the EU's economic and financial landscape is naturally reflected in misalignment of financial cycles. Membership in both the monetary and banking union means that national authorities cannot react with autonomous monetary policy and may not have some micro- and macroprudential instruments fully at their disposal. In such case, the members would to some extent be deprived of the tools they need to address risks related to their own cycles and structural specificities. In addition, in a centralised decision-making set-up in the monetary and banking union, the concerns of smaller countries may not be sufficiently taken into account. The Czech Republic is not a member of this union and will not be for the next couple of years. But the conduct of economic policy in such a setting is one of the crucial issues that lie ahead.

Table 6: Key Sources of Systemic Risks and Appropriate Tools

Source of systemic risk (of vulnerability)	*Appropriate tool*
• Undue leverage • Excessive credit growth accompanied by lenient lending practices	• Countercyclical capital buffer • Through-the-cycle provisioning • LTV and LTI (PTI) limits • Leverage ratio • Increased risk weights for specific sectors
• Shortage of quick liquidity • Maturity mismatches regarding asset and liabilities • Unstable structure of bank funding	• LCR • NSFR • LTD ratio or core funding ratio
• Excessive interconnectedness of financial institutions • Complexity and opacity of financial sector • Reliance on bail-out of large and important institutions	• SIFI capital surcharges • Systemic risk capital surcharges
• Excessive concentration in assets or liabilities of financial institutions	• Large exposure limits

Table 6 provides a summary of the key tools associated with particular sources of vulnerability. The *most promising tools for the CNB*, similarly to central banks in most small advanced economies, appear to be those included in the Basel III accord and some that have been used with success in the past in both advanced and emerging economies. Countercyclical capital buffers, leverage ratios and large exposure limits, plus LTV caps, LTI caps and sectoral weights for real estate loans, are natural candidates for addressing risks associated with fast credit growth and leverage. In addition to these regulatory tools, through-the-cycle provisioning can contribute to some extent. Excessive maturity mismatches can be tackled by liquidity ratios such as LCR and LCR or indicative targets for the loan-to-deposit ratio or the core funding ratio. Concentration risks can be reduced by limits on large exposures, while SIFI surcharges may influence interconnectedness and expectations of bail-outs. Not all these instruments, no matter how desirable and appealing they are, can be made operational at the moment. They can be included in

a standard set of macroprudential instruments only after we have a better knowledge of their consistency with the new regulatory framework in the EU and of their potential effectiveness.

8.3 The Financial Cycle and Accounting for Potential Credit Losses

The ongoing financial crisis has greatly increased the interest of regulators – and economists generally – in procyclical behaviour of banks. One of the issues regarding procyclicality is the creation of provisions against impaired assets over the cycle. Even though this issue is sometimes downplayed by "it's only accounting" statements, it has crucial importance for the resilience of the banking sector in particular. The bursting of housing market bubbles and the crisis in the residential mortgage market in several advanced economies and the sovereign debt crisis in the euro area opened the question of how much not only the regulatory framework, but also the accounting framework itself contributes to procyclicality and credit risk myopia. The loss of confidence in the reported state of bank balance sheets in the euro area that escalated in the first half of 2012 brought to attention not only the quality of loans, but also the adequacy of provisions against loans classified as non-performing (at default). Provisioning is important not only because the provisions serve as a buffer against expected loan losses, but also because they provide significant information on how banks price credit risk. Procyclicality in provisioning may therefore mean that during good times credit risk is underpriced, creating conditions for a credit boom followed by a costly bust during which credit risk is overpriced, thus contributing to negative developments in the real economy. Indeed, the possibility of implementing through-the-cycle provisioning in practice has launched a debate between accounting standard setters and financial market regulators, the results of which will be seen only in the years ahead.

Certain features of through-the-cycle provisioning have been used by banks in some countries in the past on a voluntary basis (Frait and Komárková, 2009). Likewise, some regulators have used methods based on assessing expected or potential losses and provisioning for those losses. However, it was not until 2000 in Spain that a comprehensive and mandatory system for the application of dynamic provisioning was introduced in order to reduce procyclicality in bank behaviour (for details see Saurina, 2009, Balla and McKenna, 2009, or Wezel et al., 2012).[30] A similar approach has been used in some Latin American countries (Ren, 2011). In the period 2000–2004, in addition to specific and general[31] provisions against the profit-and-loss account, Spanish banks set aside "statistical provisions" (a statistical estimate of long-term expected losses) to cover the latent risks on different homogeneous asset portfolios. The statistical provisions had the nature of dynamic provisions, as they rose when the actual losses in a given year were lower than statistically predicted and fell when the actual losses were higher. The statistical provisions had a fixed upper limit and were not tax deductible. The system was introduced at a good time, i.e. well before the onset of the recession and financial crisis. This allowed a buffer to accumulate

[30] One of the primary reasons was the Spanish central bank's concerns that amid rapid credit growth supported by declining interest rates connected with the introduction of the euro, the existing provisions greatly underestimated the extent of the potential credit risk. The fact is, however, that although in the early years the system absorbed a significant proportion of banks' pre-tax profits (around 20%), bank loans still grew at very high rates in this period (Caruana, 2005). This supports the hypothesis that credit booms are highly complex events that are difficult to influence with standard instruments.

[31] General provisions were set as a fixed percentage of the specific asset class and were tax deductible.

to cover future losses. The expected and desired result of this system was a reduction in the year-on-year volatility of bank profits.

The introduction of dynamic provisioning in Spain in 2000 was not easy. Banks had major reservations at first. Nor was it welcomed by the setters of international accounting standards, who argued that it allowed manipulative adjustment of profits and thereby limited investors' ability to assess the true financial condition of the bank. The counter-argument was that investors had information on both specific and statistical provisions and were also aware of the relatively simple rules according to which the statistical provisions were created. As a result, they could easily discount the impact of the statistical provisions on the bank's financial results in any given year and thus had enough information on the bank's true financial condition. In response to the introduction of International Financial Reporting Standards (IFRS), the provisioning system in Spain was modified in 2005, although even the new system retained certain features of dynamic provisioning. Statistical provisions were "concealed" in the general provisions through comparison of the specific provisions actually set aside in a given period with the historical average of the specific provisions in each group of homogeneous loans. However, even this modification failed to lead to agreement between the creators of international accounting standards and the Spanish authorities.[32]

The application of elements of dynamic provisioning enabled Spanish banks to build up quite a large buffer in the form of accumulated provisions in just a few years. Even after the 2005 reform, banks maintained a high level of provisions in accordance with the regulations previously in force and entered the financial crisis at the end of 2007 with a fairly sizeable buffer in the form of a general provision fund. At the start of 2008, non-performing loans were 200% covered in Spain, while the EU average was around 60%. Unfortunately, the accumulated provisions were not sufficient to maintain the stability of the banking system, as the developments in 2011 and 2012 revealed. This is sometimes interpreted as a failure of dynamic provisioning in Spain and as evidence that through-the-cycle accounting is not a viable concept. In our view this is not a correct argument. Spanish dynamic provisioning has to be assessed in light of the fact that Spain went through an exceptionally large boom and bust cycle which was macroeconomically determined (the effects of euro adoption in a booming economy and a favourable external environment) and politically driven (fiscal policy not sufficiently tight and local support of large construction projects). The correct interpretation is that without the buffer of accumulated provisions Spanish banks would have been in a much worse position during the crisis, especially given the slump in property prices and the potential depth and length of the recession (Jiménez et al., 2012). The pressure exerted on banks by the regulator to provision more was justified and should have been applied with greater boldness on a larger scale. But one cannot expect an economy to cope with dynamic cyclical upsurges like the one in Spain with just a single instrument. Such upsurges require a concerted set of instruments coordinated with macroprudential policies with some political support.

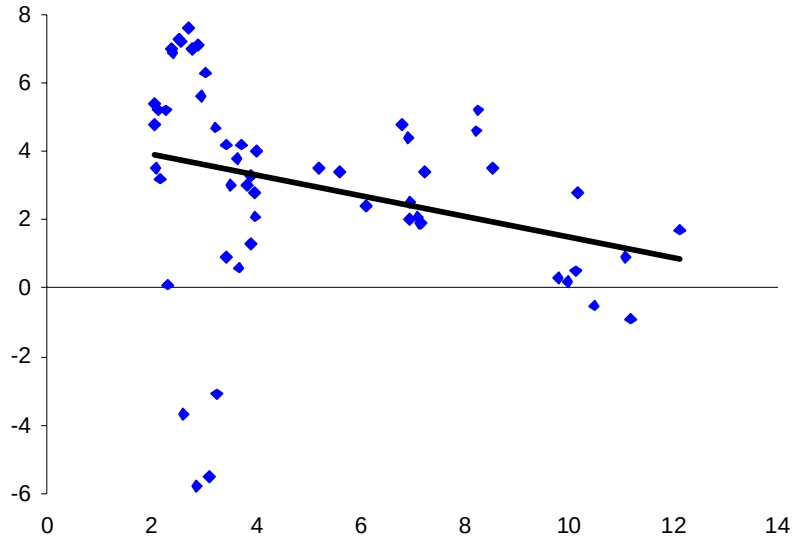
Could a through-the-cycle provisioning regime be useful in economies like the Czech one? The answer depends on the level of procyclicality in provisioning. Figure 10 shows that there really is

[32] The Spanish authorities regard the new system as being IFRS compatible. Referring to IAS 39 (point 64), they argue that the general provisions are the result of collective assessment for impairment, capturing incurred losses that have not yet been assigned to individual loans. They thus cover loans whose losses have not yet been individually assessed and loans that have been assessed but not identified as impaired.

a negative relationship between GDP growth and the ratio of loan loss provisions to total loans in the Czech Republic for the period 1998–2011. This, after all, should be a logical consequence of the prevailing IFRS-based provisioning system. Nevertheless, a more convincing answer can be obtained only via an empirical analysis. The results of such analysis may also reveal the extent to which other factors affecting banks' behaviour constrain the aforementioned negative relationship.

Figure 10: Loan Loss Provisions/Total Loans and GDP Growth

(Czech Republic, 1998 Q1–2011 Q4)



Note: y-axis: GDP growth in %; x-axis: ratio of provisions to loans in %; only loans provided to real economy are included.

Source: CNB, CZSO

A number of empirical studies focus on provisioning in Asian and emerging economies (Kraft, 2004; Craig et al., 2006; Angklomkliew et al., 2009, Fernández de Lis and Garcia-Herrero, 2010; Floro, 2010). In the most recent study, Packer and Zhu (2012) found mixed evidence for counter-cyclicality in provisioning of Asian banks. They show that countercyclical loan loss provisioning has dominated throughout emerging Asia. Loan loss provisioning did not simply become more conservative at all points in time subsequent to the Asian financial crisis, but actively leaned in a fashion that moderated swings in earnings and the macroeconomy. On the other hand, Japanese banks showed procyclical provisioning. Evidence is also available on advanced economies prior to the adoption of the IFRS and the crisis (Borio et al., 2001; Cavallo and Majnoni, 2002; Laeven and Majnoni, 2003; Bikker and Metzemakers, 2005; Bouvatier and Lepetit, 2008). However, there is limited information on banks' provisioning in European countries after IRFS adoption, including the period of the crisis. Annex 1 attempts to fill the gap to some extent by looking empirically at the level of procyclicality in banks' provisioning in the Czech Republic using supervisory data on the Czech banking sector. The findings for the Czech Republic are cross-checked by estimation of the same equation for selected European economies using publicly available data. The results of the analysis confirm that the provisioning performed by banks from the Czech Republic and some other EU economies contains a cyclical component which might be smoothed to some extent by the introduction of through-the-cycle provisioning. We also found some features in banks' behaviour that partially reduce the level of procyclicality.

The results of the analysis represent a meaningful argument for putting through-the-cycle provisioning into accounting and regulatory practice. The lessons from the crisis were taken seriously by accounting standard setters, who acknowledged the shortcomings of the impaired loss approach. Facing criticism of the existing framework and the conclusions of a report produced by the Financial Stability Forum's Working Group on Provisioning, the International Accounting Standards Board (IASB) suggested a move to the expected loss (EL) approach in June 2009 as part of the IASB's project on replacing IAS 39 Financial Instruments Measurement and Recognition. The EL approach represents a major deviation from the incurred loss approach, since no trigger for an impairment test is required. The IASB's objective is to maintain a link between the pricing of loans and expected credit losses. In this respect, the EL approach should better reflect the economic reality of banks' lending activities than the incurred loss approach, in that it requires earlier recognition of expected credit losses, and should help to avoid "incurred but not reported losses". The EL approach appears to be rather simple. The present value of the expected future cash flows is measured using an initial internal rate of return calculated on the basis of cash flows actually expected at inception (taking into account expected credit losses), and not on the basis of contractually agreed cash flows. The initial internal rate of return is thus lower than the contractual rate, with the difference representing the risk premium charged to the borrower in order to cover the statistically foreseeable risk of non-recovery. Any difference between cash flows received that represent contractual interest and interest calculated as revenues on the basis of the (lower) internal rate of return would be recognised in the balance sheet as a credit expected loss provision. Subsequent or additional impairment loss is recognised through continuous re-estimation of credit loss expectations. Reversal of impairment loss is entered as profit when there is a favourable change in credit risk expectations. In reality, the EL approach may be quite complex and could generate excessive subjectivity and credibility issues. Any expected loss model has to rely on judgement supported by a set of indicators. But the quest for a precise model of this sort can give rise to undue complexity.

In June 2010, the Basel Committee on Banking Supervision (BCBS, 2010b), having this in mind, came up with its own proposal, in which provisions are based on best estimates of expected credit losses built over the life of the loan at the balance sheet date considering the loss experience over the complete economic cycle. Provisions are generally built up progressively by allocating a share of the interest income over the life of the loan or loan portfolio to an allowance account at the time interest income is recognised. The BCBS also argued for the use of a simplified average loss rate, which would represent expected credit losses by loan type derived from historical experience based on some measure of actual losses and adjusted for current conditions. In an updated reaction to a new proposal from the IASB, the Basel Committee on Banking Supervision (BCBS, 2011a) expressed its support for an approach that requires the recognition of adequate levels of provisions on the balance sheet to absorb all expected credit losses. Not reflecting an adequate level of an allowance for expected credit losses on the balance sheet could result in overstating the related asset balances as well as the yield on those assets in any given period in the income statement. This could be potentially misleading to investors, other users and other market participants, while also raising the safety and soundness concerns of prudential authorities. The BCBS underlines that incorporating a broader range of available credit information than presently included in the incurred loss model should result in an earlier identification of credit losses. Initially, there were expectations that the existing approach would be replaced quite soon by the forward-looking countercyclical provisioning methodology being developed by the BCBS and the IASB. However,

the pace of preparation of the new approach has become rather slow. There is thus no current "best practice" for a through-the-cycle provisioning system, nor will there be for some time. Any country seeking to introduce one unilaterally would have to address a whole range of difficult questions. Current international accounting standards still constitute a major barrier to through-the-cycle provisioning, as the latter is not compatible with the former. Efforts towards isolated application at the national level may have negative consequences. What is more important, the introduction of through-the-cycle provisioning would not provide a remedy for many advanced countries in the next few years owing to the current phase of the credit cycle. It is impossible to create a fund of through-the-cycle provisions in a situation where the quality of bank portfolios has deteriorated significantly as a result of declining economic activity and deflated asset prices.

A key item for discussion is the true influence of through-the-cycle provisioning on credit growth and bank stability. It is likely that during a strong boom the system would not provide a sufficiently strong negative incentive for banks as regards lending. Although it would help to create a buffer for worse times, this buffer might prove to be inadequate in a deep recession anyway. In other words, through-the-cycle provisioning can hardly alone prevent the negative impacts of strong booms followed by strong recessions. Other instruments besides through-the-cycle provisioning can be used to curb the procyclicality of lending activities (see Table 4).

8.4 Macroprudential Policy and Macroeconomic Policies

A capacity to influence the business cycle makes macroeconomic policies natural candidates for assisting macroprudential tools in coping with extreme occurrences of systemic risk in both its accumulation and materialisation phases. Both *monetary policy tools* and *fiscal policy tools* can be effective in booms and busts in taming cyclical upswings and downswings in economic activity and financial market participants' sentiment. Since central banks in most countries serve also as macroprudential authorities, we focus below on monetary policy and its role in supporting macroprudential policy.

Should macroprudential and monetary policies have more in common than similarities in operational frameworks? Before the crisis, a dichotomy between monetary policy and financial stability was assumed (Hahm et al., 2012). However, the lessons from the financial crisis have affected the consensus on the proper way of conducting monetary policy and a new consensus on its relationship with financial stability has begun to emerge (Zamrazilová, 2011). It is no accident that this new consensus also builds to a large extent on the contributions of BIS economists, i.e. on their debate regarding the relationship between monetary policy, asset prices and financial stability. Borio et al. (1994), Borio et al. (2003) and Borio and White (2004) ascertained that financial imbalances could build up in a low-inflation environment and that in some circumstances it is appropriate for policy to respond to contain these imbalances.[33] They point out that a highly credible monetary policy focused on price stability can paradoxically even contribute to the build-up of financial imbalances. If inflation expectations are strongly anchored, demand-pull inflationary pressures may accumulate for quite some time without being fully reflected in actual inflation. Excess demand pressures may show up first in credit aggregates and asset prices,

[33] Some academic researchers also paid attention to the implications of asset market fluctuations for monetary policy. The classical contribution is Cecchetti et al. (2002). Bernanke and Gertler (1999) and other speakers at the 1999 Jackson Hole symposium emphasized the importance of credit-based channels and asset markets for central banks' policies.

rather than in the prices of goods and services, which can make it harder for monetary policy to be sufficiently pre-emptive. If explicit or implicit inflation targets are defined for too short a horizon in this environment, which, given central banks' efforts to achieve accountability, is natural, the response to potential inflation pressures may be postponed for quite some time. Monetary policy will then accommodate the build-up of financial imbalances and associated distortions in the real economy – notably excessive capital accumulation, until it is too late and the risk of financial instability arises. In the light of these particular framework features, longer policy horizons and a greater emphasis on the balance of risks in economic projections, as opposed to central scenarios or most likely outcomes, were recommended.

Borio and White (2004) acknowledge that protecting against the aforementioned processes and the risks they generate is not easy. They suggest that the role of monetary policy would be to anchor the monetary liquidity creation process and, hence, the availability of external finance, since lending plays a key role in determining macroeconomic dynamics. Such anchoring would help to reduce the "elasticity" of the economy, i.e. its ability to generate financial imbalances, thereby providing critical support to macroprudential policy. The authorities could implement it by being prepared to lean against the build-up of financial imbalances by tightening policy, when necessary, even if near-term inflation pressures were not apparent. The rationale for such a strategy is not just to cool down the economy in a particular phase of economic upswing. More importantly, it would seek to limit the downside risks for the macroeconomy in the medium to long term. It would also take out some insurance against the risk of monetary policy losing effectiveness due to the zero lower bound.

As a result of the lessons from the crisis, academic economists have started to come up with proposals to increase the room for manoeuvre in their models of flexible inflation targeting. A new consensus has emerged, consisting of an amended model of flexible inflation or price-level targeting in which the central bank "should sometimes lean but can still clean" (Woodford, 2012[34]). In this framework (for details see Frait, Komárek and Komárková, 2011), financial stability becomes a separate objective of the central bank, affecting its short-term behaviour without changing its long-term commitment to price stability. The primary instruments for safeguarding financial stability are still financial market regulation, capitalisation of financial institutions and macroprudential policy measures (these should also involve modifications in the regulatory framework aimed at reducing its procyclical features). Since these instruments may not be sufficient to curb the enthusiasm in the financial system and reduce the risks to financial stability, monetary policy cannot ignore the risk of financial instability and acts pre-emptively when financial imbalances occur. Central banks start to lean against the wind and become ready to justify, via convincing public communication, the desirability of setting of interest rates at a level different from that consistent with achieving the inflation target even at the expense of inflation slipping below the target for some time. Three critical assumptions have to be stressed. First, the pre-emptive reaction described above is relevant in cases of joint credit and real estate booms. Bubbles of the irrational exuberance kind do not call for such a reaction. Second, the bulk of the

[34] Lars Svensson, one of the fathers of inflation targeting, argues in a commentary on Woodford's paper that the suggested approach creates a risk of conceptual and practical confusion between monetary policy and financial-stability policy. He criticises the ideas that monetary policy and financial-stability policy should be integrated and conducted together, since monetary policy and financial-stability policy are distinct and separate policies. He believes that monetary policy should be conducted autonomously, just taking the conduct of financial-stability policy into account, and vice versa.

action has to be taken on the prudential policy level, while monetary policy can only provide co-insurance. Third, the authorities should be aware not only of the complementarities between monetary and macroprudential policies, but also of potential conflicts (Angelini et al., 2012).

The cornerstone of this framework is the canon that the object of the reaction of the monetary authority should be the growing financial imbalances generated by a credit boom, which may potentially result in strong macroeconomic fluctuations, and not the asset market bubbles themselves. The *marginal risk of financial instability* (Figure 6), assessed and quantified in a certain way, should determine the reaction. Since the monetary cycle is on average considerably shorter than the financial cycle, the reaction to the risk of financial instability will be occasional, irregular and strongly non-linear. At normal times, the monetary policy framework should therefore still behave almost identically to orthodox flexible inflation targeting. Financial stability considerations will become a factor of monetary policy reaction only if times are departing from the normal, i.e. when the authorities conclude that a certain threshold of financial vulnerability has been exceeded, leading to a high risk of financial instability. In such a situation, policy makers will consider the need to restrain lending growth and excessive risk taking (*excessive leverage* in short). It will not be appropriate to follow the simple Taylor rule in the crisis materialisation phase, either. If this phase occurs, it will be necessary to supplement the rule with a reaction to an increase in risk margins in response to the reassessment of credit risk or other risks, i.e. to offset the sharply increased risk margins with a more pronounced fall in monetary policy rates (meaning that monetary policy should clean to a certain extent) in periods of immense risks to financial stability.

A critical issue for small open economies may be how to address the contribution to systemic risk arising from *destabilising behaviour of public finance* (see, for example, Janáček et al., 2012). A credit boom accompanied or even promoted by structural budget deficits financed by borrowing from abroad is potentially the riskiest setting. A credit boom can also be promoted by some features of taxation providing incentives to take on more debt (see Table 5). Increasing internal and external imbalances may end up in a combination of banking crisis, sovereign debt crisis and currency crisis. Efforts by the macroprudential authority to address such a mess usually lead to political conflict. And even without a credit boom, a large and growing stock of government debt denominated in foreign currency is significant source of systemic risk on its own. One possible policy tool for addressing this source of risk is broad agreement among the authorities that issuing debt in foreign currencies should be the exception rather than the rule, applying, for example, in the case of roll-overs of previous issues.[35] In its financial stability analyses and the communication of such analyses to the public, the CNB has therefore always paid attention to developments in the external balance and the issuance of public debt in foreign currencies.

9. Some Important Issues in the Operationalisation of Macroprudential Policy

An important condition for efficient and effective implementation of macroprudential policy is its operationalisation (Houben et al., 2012). To succeed, the competent authorities should gradually

[35] This may not fully apply to economies with a currency board with agents having their incomes and savings in foreign currency.

head towards a similarly sophisticated operational framework as that currently applied in flexible inflation targeting. The properties of such a framework have been defined step by step through this paper. We link ultimate objectives to intermediate ones and define sets of indicators for identifying systemic risk and instruments for addressing it (Table 7).

Table 7: Properties of Macroprudential Policy Framework

Horizon	• relatively long and variable
Ultimate target	• preventing the accumulation of systemic risk (reducing the probability of occurrence of financial crises with large output losses and/or costs for public budgets) • mitigating the impacts of the materialisation of systemic risk if prevention fails
Indicators for identifying risks and their intensity (for details see Table 2)	• macroeconomic indicators • banking sector indicators • data from non-bank financial sectors • data from financial markets • qualitative information
Intermediate targets	• securing resilience and shock-absorbing capacity of the financial system • preventing excessive credit growth and leverage and thereby lowering the potential amplitude of the financial cycle • averting large asset price misalignments (especially overheating of the real estate market) • setting limits on maturity transformation, concentration, interconnectedness and complexity of financial institutions • limiting the level of uncertainty regarding the soundness of the system at times of financial instability
Instruments (for details see Table 5)	• built-in stabilisers oriented towards creating and releasing buffers • macroprudentially calibrated supervisory and regulatory instruments • communication
Transmission mechanisms (instruments functioning via)	• bank capital and liquidity requirements affecting the price of loans and the supply of and demand for credit • banks' income and costs related to the risk of new and existing exposures • penalisation of increasing scale of risk assumed by financial institutions • financial institutions' risk management stances • perception of risk of investors and creditors of financial institutions • expectations of financial institutions and their clients

As in the case of monetary policy, macroprudential policy-making should be accompanied by well thought out and sometimes also forceful communication towards the financial markets and the public, including predictions of financial market variables, risk indicators and disclosures of stress test results, in order to reduce the level of uncertainty about the stability of the financial sector. For example, the CNB moved into more active communication mode during the financial crisis and since February 2010 has been providing the public with quarterly information about the results of its macro stress tests of the banking sector. Communication is a very important tool in the systemic risk accumulation phase as well. Although systemic risk was growing to only a relatively limited extent in the Czech Republic in the pre-crisis years, the CNB in its Financial Stability Report 2006 (published in spring 2007) warned against over-optimistic expectations typical of the peak of the business cycle and against risks emerging on the property market.

The important lesson of the current crisis is that the organisation of financial stability conduct in a country might be crucially important (for an extensive discussion of these issues see IMF, 2011). What matters are the relations between all decision-makers involved in taking care of the stability of financial markets. The desired structure is one that aligns the macroprudential authority's

incentives and instruments with the macroprudential policy objectives (Houben et al., 2012). The recent changes in the structure of the financial system have made a strong case for the integration of sectoral supervisors into a single national supervisor. The experience gained in handling the crisis has also made the integration of supervisory structures into a central bank attractive. All stakeholders expect the central bank to act as a lender of last resort – or even a market maker of last resort – but this is a difficult task without sufficient information and knowledge about the state of affairs. The merits of integrating the supervision of financial sectors into independent national central banks are numerous. Such integration allows a focus on systemic risk (integration of prudential supervision of individual entities and risk assessment across the financial sector as a whole), information-sharing synergies, strong technical and professional support, and independent and apolitical decision-making, among other benefits.

Consolidation of financial market regulation and supervision at the national level in a central bank will create conditions for the effective exchange of truly relevant data, data integration and potential consolidation of analytical work. Only in an integrated institution is it possible to completely avoid the constraint that holds back financial stability analysts in many countries – limited or non-existent access to supervisory data on individual institutions. However, without such data it may not be possible to identify latent sources of vulnerabilities in the financial sector. In an institution acting as central bank and integrated supervisor the decision-making body enjoys full information coverage from the real economy, from financial markets and from supervisory activities. This has important pre-emptive potential, since the body has a strong incentive to react if signs of overheating are accompanied by signs of relaxed lending standards and deteriorating credit quality. The division of tasks between a central bank and a stand-alone supervisor(s) creates the risk of delayed actions due to disrupted information flows and reliance on actions of other stakeholders.[36] In a real crisis, a single institution is ideally placed to work with the government and act expeditiously.

Besides enhancing the organisation of supervision, it is also very important to establish operational internal relations between expert teams contributing to understanding developments in the economy and influencing the conduct of policies. If financial stability experts conclude that there are growing risks to financial stability, the governing body has to consider measures to limit the risks. Again, in an integrated institution things can proceed more smoothly. In a single institution, the governing body can directly and immediately address departments responsible for both monetary policy and regulation and supervision. If the country's overall financial structure involves more than one central institution, effective action is rather difficult. Prior to the most recent financial crisis, the financial stability reports of some central banks highlighted the growing risk to financial stability without invoking any response from the supervisory agencies. In a single institution, there is a much higher probability of breaking the bias towards inaction. As Houben et al. (2012, p. 21) explain, this bias stems from a number of factors that make it naturally strong.[37]

[36] Kashyap (2012) stresses the importance of setting a policy framework that makes the coordination of the objectives of price stability, output stability and financial stability likely to happen. One of the key conditions for securing the proper level of coordination is strong accountability. Kashyap is rather sceptical about the properties of the new frameworks in the US and the euro area in this respect and suggests scrapping the committee arrangements and charging a single entity with systemic risk management.

[37] " … the benefits of macroprudential policy are hard to observe and can only be determined in the long run, if at all, whereas the costs of macroprudential policy measures are generally highly visible and directly felt. In the case of cyclical risks, macroprudential policy tightening during an upswing is intrinsically unpopular and is

It is also crucially important to establish informal and regular cooperation between microprudential and macroprudential staff in the integrated authority. Supervisors should listen more carefully to financial stability experts and take macroeconomic developments into account in their thinking. Clearly, they have to act somehow if a general consensus emerges that macroeconomic imbalances and asset market booms are likely to end in a hard landing. The autonomy of the financial stability team of the supervisory body is very important. First, supervisors tend to be naturally technocratic and by definition look at the behaviour and status of individual institutions. Such behaviour may lead to underestimation of business- and credit-cycle-induced risks. Second, it might be difficult for supervisors to emphasise the growth of risks, since these could be viewed as a failure of their work. Third, supervisors are not used to communicating risks publicly, because it may cause a panic reaction. The opinions of financial stability analysts may be viewed as research results, which are much easier to communicate publicly. On the other hand, financial stability analysts need to learn much more about financial sector regulation, supervisory processes and the constraints they impose on macroprudential authority actions.

10. Conclusion

This paper delineates a presentable framework for macroprudential policy in a small EU economy as a key component of the financial stability policy toolkit. The macroprudential policy objective is to prevent systemic risk from forming and spreading in the financial system and thereby reduce the probability of occurrence of financial crises with large real output losses for the entire economy. Macroprudential policy should act primarily preventively against signs of financial instability in the future and secondarily to mitigate their impacts if prevention fails. These two main tasks reflect the two phases of evolution of systemic risk – its accumulation and subsequent potential materialisation. When conducting macroprudential policy it is also vital to respect the fact that systemic risk has two different dimensions. The time dimension is linked with procyclicality in the behaviour of financial institutions and their clients, manifesting itself as financial cycles. The cross-sectional dimension arises as a result of mutual exposures and network linkages between financial institutions. In a bank-based economy with a relatively small and simple financial sector like the one in the Czech Republic, the time dimension of systemic risk is identified as being more important and the Czech Republic is advised to prefer a relatively narrow macroprudential policy concept focused primarily on risks associated with the financial cycle. Given also that financial or informational contagion resulting from links between the economy and its institutions and the external environment can be a major source of systemic risk, the macroprudential policy framework must also include the cross-sectional dimension and external macroeconomic and financial developments.

Constructing a sophisticated operational framework linking the individual dimensions and development phases of systemic risk with relevant indicators and instruments will be an important condition for efficient and effective implementation of macroprudential policy. When performing

likely to be resisted. Similarly, measures to address structural risks are likely to face opposition on grounds of excessive cost, lack of urgency or market interference. Pressure from the financial industry, political bodies and contrarian economists create incentives for the policymaker to delay or refrain from taking action. The bias towards inaction also stems from the high uncertainty governing tail risks, which creates a preference for false negatives (an incorrect judgement that there is no need for action) over false positives (incorrectly judging that action must be taken)."

the two main tasks mentioned above, macroprudential authorities must focus their attention on forward-looking indicators and simultaneously take into account the potentially high degree of discontinuity in the evolution of systemic risk. To this end, they need to use specific sets of indicators and tools reflecting the different dimensions and phases of systemic risk.

Over the financial cycle it will be necessary, using forward-looking indicators, to catch the moment at which systemic risk starts to accumulate, identify the point at which the tolerable limit for systemic risk has been exceeded, and send out a signal that macroprudential tools need to be activated. If prevention fails, it will be necessary, using a different set of indicators, to determine the point at which a financial instability event has to be declared, assess the potential scale and seriousness of the manifestations of the crisis, and recommend appropriate anti-crisis tools. Forward-looking analytical tools should then ultimately help us to detect when systemic risk has fallen below the critical level and tell us when we can discontinue the anti-crisis measures and support policies.

Within the macroprudential policy operational framework there must still be a trigger mechanism for the use of tools in the risk inception and manifestation phase. This mechanism should be relatively complex yet flexible. When implementing such policy, it will be vital to combine a rigorous analytical approach with a large dose of judgement. Although the priority should be to use rules and more or less automatically applied tools, it will be necessary to leave the macroprudential authority considerable room to exercise discretion.

The paper also discusses the toolkit for conducting macroprudential policy and reveals the preferences for a small EU bank-based economy as far as the most promising tools are concerned. Besides the tools embodied in bank regulations, one accounting instrument is addressed as well, namely through-the-cycle provisioning against impaired assets. The discussion regarding this instrument is supported by an empirical analysis of the extent of procyclicality in provisioning in selected European countries and the Czech Republic separately.

No macroprudential policy tool can work as a magic wand for "making sure it won't happen again". Some tools can help in building up buffers in good times for weathering bad times. Yet it would not be realistic to expect them to be very effective in curbing credit booms. These are complex phenomena that need to be addressed by a concerted set of policies and tools. In other words, if, in the future, the international economy starts undergoing a dynamic drive again, accompanied by credit and asset price booms, the authorities will have to apply a set of microprudential and macroprudential measures to tame the immoderate optimism. Factors mitigating procyclicality embodied in regulations will hopefully ensure accumulation of buffers, and better supervision may prevent bank managers from taking excessive risks. Monetary policy-makers might need to step in directly using the interest-rate channel or indirectly using prudential tools to change its transmission. Still, plenty of courage, luck and communication skills will be needed to succeed.

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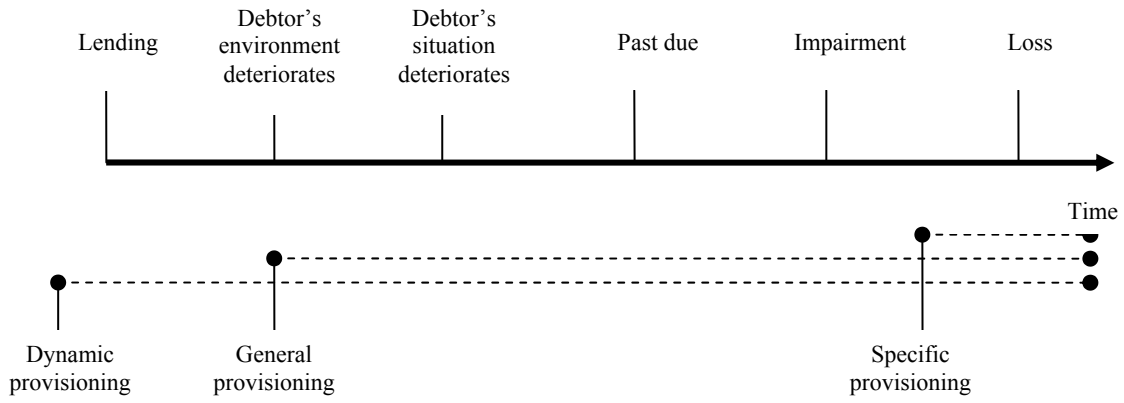
Annex 1: Procyclicality and Provisioning for Impaired Assets

Analysis of provisioning over the cycle is one of the best ways of studying the extent of procyclicality in bank lending and the motives banks may have to behave procyclically in pricing credit risk, since, unlike the data on the quality of bank loans, the data on created provisions are available in a standardised and comparable form. This section thus analyses the cyclical behaviour of bank loans and loan loss provisioning in the Czech Republic and selected European economies in order to discuss the true scope of procyclicality and the room for applying through-the-cycle provisioning as a potential remedy for procyclicality, or at least for applying tools for coping with its after-effects. This is because if the analysis confirms that banks have a tendency to provision in a highly procyclical way, there is a case for a policy reaction, i.e. for setting a through-the-cycle provisioning regime (for a proposal, see, for example, Wezel et al., 2012). We believe that understanding the true extent of procyclicality in provisioning is a crucial factor in designing any regime of this sort. We therefore examine bank loans and provisioning in relation to the business cycle in an attempt to identify whether these variables behave procyclically. Data for banks in the Czech Republic and for large commercial banks in selected European countries are used for separate analyses.

Banks set aside provisions to cover their expected losses. Their capital should primarily be used to cover unexpected losses. There generally exist several provisioning systems differing in either when the provisions are created and entered in the accounts or what event triggers provisioning (Figure A1.1). The prevailing practice is "specific" provisioning. Specific provisions are fixed against losses on predominantly individually assessed loans and start at the moment an evident event occurs, i.e. in a situation where there is already verifiable evidence that losses will probably arise on the relevant loans. For this reason, specific provisioning is backward looking (i.e. it identifies risk ex post) and should not be considered a buffer against future losses. General and through-the-cycle (dynamic) provisions, where permitted by the authorities, can be forward looking (i.e. they identify credit risk ex ante). However, the international accounting standards currently in force (IAS 39) allow banks to provision only for loans for which there is clear evidence of impairment (i.e. backward-looking provisioning).

Figure A1.1: Potential Events Resulting in Provisioning



Source: Banque de France (2001); authors' modifications

One can say – again simplifying somewhat – that specific provisions are created and entered in the accounts only after credit risk comes to light (which usually occurs in times of recession), whereas in the through-the-cycle provisioning system provisions are created when credit risk comes into being (i.e. to a large degree in times of boom). So in the through-the-cycle provisioning system, banks provision against existing loans in each accounting period in accordance with the assumption for expected losses. At times when actual losses are smaller than assumed a buffer is created which can then be used at times when losses exceed the estimated level.

The creation of provisions – especially those directly linked to impaired loans ("specific provisions") – can be affected by changes in the macroeconomic environment, the solvency of counterparties to lending transactions, the regulatory and taxation rules in force and, last but not least, by the actual behaviour of a particular bank in a given environment.[38] Consequently, to examine bank provisioning over the economic cycle, one needs to use a model with variables that sufficiently reflect the changing quality of the loan portfolio. Studies that document a strong negative correlation of bank provisioning with the business cycle include Borio et al. (2001), Cavallo and Majnoni (2002), Laeven and Majnoni (2003), Bikker and Metzemakers (2003) and Craig et al. (2006).

To examine the potential procyclical behaviour of Czech banks and banks from some selected European countries, we applied the following model for loan loss provisions:

$$(LLP/TA)_{i,j,t} = \alpha_{1,i} + \alpha_2 (LLP/TA)_{i,j,t-1} + \alpha_3 \Delta \ln GDP_{j,t} + \alpha_4 UNEMPL\_gap_{j,t}$$
$$+ \alpha_5 (EARN/TA)_{i,j,t} + \alpha_6 \Delta \ln LOANS_{i,j,t} + \alpha_7 (LOANS/TA)_{i,j,t} + \alpha_8 (CAP/TA)_{i,j,t} + \varepsilon_{i,t}$$

Using this equation we try in a simplified way to determine banks' dependence on the business cycle when provisioning. In other words, we determine whether there is a significant relationship between bank provisioning (the left-hand side of the equation) and proxies for the business cycle (the right-hand side of the equation). An important aspect when looking at this dependence is the timing of provisioning with respect to the business cycle and the related issue of procyclicality, which is generally associated with risk-based capital regulation.

The variables in the equation can be divided into (i) macroeconomic variables – the growth rate of real GDP per capita (Δ ln GDP) and the unemployment gap (UNEMPL_gap[39]), and (ii) bank-specific variables – the ratio of loan loss provisions to average total assets[40] (LLP/TA), real loan growth (Δ ln LOANS), the ratio of total loans to average total assets (LOANS/TA), pre-tax earnings (EARN), defined as the sum of pre-tax profit and loan loss provisions, and the ratio of equity capital to average total assets (CAP/TA). TA stands for average total assets for the current and previous year ($0.5(TA_t + TA_{t-1})$). Some bank-specific variables are divided by total assets (TA) to allow for comparison across banks of different sizes. Subscript "t" denotes time, subscript

[38] A low-market-share bank will clearly behave differently from a systematically important bank, even if they operate in the same environment.

[39] The gap was used for the purposes of the model because the trend was too encumbered by the sizeable growth in long-term unemployment. Using the Eurostat database, the long-term unemployment rate was deducted from the overall unemployment rate.

[40] We chose the ratio to total assets (the sum of the assets of all the banks under review) to allow for comparison across banks of different sizes.

"i" denotes an individual bank, and subscript "j" denotes an individual country. Lags of the dependent variable are included in the set of regressors to capture the effect of omitted explanatory variables and the persistence of LLP.

The growth rate of real GDP and the level of unemployment are used in the equation to proxy the business cycle. If banks behave procyclically, the rate of economic growth will be negatively correlated with provisioning, because an economic downturn is usually followed by growth in the volume of provisions. In our model, economic growth is regarded as the main indicator of demand for banking services (including loans) and is thus a direct determinant of banks' earnings. The unemployment rate should logically be positively correlated with provisioning. At a time of economic growth, unemployment falls and the number of creditworthy borrowers increases. Conversely, at a time of economic recession, unemployment rises and the probability of default increases. The unemployment rate follows GDP growth with a lag and affects banks' earnings indirectly. It was included in the model because unlike GDP, which "only" indicates the degree of change in the business cycle, the level of unemployment shows the actual phase of the cycle.

The other factors in the equation are real loan growth and the ratio of total loans to total assets, which we included in order to capture credit risk. Credit variables should be expected to be important determinants of loan loss provisions.[41] Both these variables should tend to be positively associated with loan loss provisions (lower credit quality, i.e. higher credit risk, higher risk absorber). However, in some studies (e.g. Laeven and Majnoni, 2003) provisioning expenses vary negatively with loan growth, which is consistent with provisions declining even as surges in new loans might indicate increased riskiness. An increase in the loan growth rate (indirectly growth in credit risk) usually reflects over-optimistic expectations about future economic developments and future earnings.[42] Over-optimistic expectations and misestimation of credit risk, in turn, usually result in a low growth rate of provisions relative to loan growth. In other words, as credit risk increases the level of hedging against it de facto decreases. However, the relationship between these factors might also be positive. If banks behaved prudently, as the dynamic provisioning model assumes, as credit exposures rose the provisions would also increase at least proportionally due to the elevated credit risk associated with tapping potentially risky borrowers. This model of behaviour is considered less likely, though.

Another variable in the model is pre-tax profit. Regulatory constraints on capital can motivate a bank manager to smooth earnings over time. In addition to meeting capital requirements, bank managers may smooth their income with a view to (i) positively affecting risk perceptions of the bank by reducing earnings variability (Greenwald and Sinkey, 1988), (ii) optimising tax expenditure (Rozycky, 1997), (iii) minimising the chance of being fired (Fudenberg and Tirole, 1995), (iv) pursuing managerial self-interest, especially if their compensation packages are tied to income stability (Lambert, 1984) and other things (Laeven and Majnoni, 2003). In general, banks with less volatile income tend to be regarded as good performers, which then influences their share prices, external ratings and external funding costs and ultimately also management incomes.

[41] The non-performing loan (NPL) ratio is a more suitable variable as a proxy for credit quality. However, NPL data were not available from the Bankscope database for all selected European banks.

[42] Assessing developments can be more difficult in transforming economies, as the credit growth rate can be particularly high at the start of the transformation process owing to a low base, financial system development and real convergence. In specific cases, therefore, it may be better to consider deviations of the credit growth rate from the trend.

The declared profit subsequently determines the amount of tax levied. Banks can influence their profit to some extent by adjusting the amount of provisions they set aside.[43] If a bank smooths its income (or optimises its taxes), it will reduce its "excessive" profits, which rise at times of economic growth, by means of increased provisioning, and vice versa. Given income smoothing, provisioning should be positively correlated with profits. With perfect income smoothing, earnings are either not affected or less affected by fluctuations in credit losses over the cycle. Loan loss provisions would increase in good times and decrease in bad times (Kim and Santomero, 1993) – they would be countercyclical. There is some evidence of the existence of earnings smoothing through provisions, at least for advanced countries (Pérez et al., 2008; Bikker and Metzemakers, 2003), whereas studies on emerging markets, especially in emerging Asia, have not found evidence of earnings smoothing (Leaven and Majnoni, 2003).

The final variable included is the ratio of equity capital to total assets. Loan losses are generally divided into expected losses and unexpected losses. Expected losses are assumed to be covered by provisions, whereas unexpected losses are assumed to be covered by capital. The equity capital to total assets ratio is therefore an important indicator of the capacity of a bank to absorb unexpected shocks. The relationship between provisioning and capital can be either negative or positive. If a bank takes into account its equity ratio when provisioning, the relationship between the variables is negative. The amount of provisions thus depends to some extent on the size of its capital buffer. If the bank decides that its capital buffer is large enough to cover any loan losses arising, as is usual at times of credit (economic) expansion, its provisioning may be excessively low. When the business cycle changes, or if an unexpected shock occurs, the excessively low level of provisions may not be enough to cover the bank's expected losses and it will be forced to cover them from its capital buffer. Its capital will thus be covering not only unexpected losses, but also expected losses, which may ultimately have an adverse effect on its capital adequacy compliance. By contrast, a positive relationship would suggest that provisions and capital are more or less independent of each other. The bank thus sets aside loan loss provisions no matter how large its capital buffer is. If we observe procyclicality in provisioning, a negative correlation can be presumed for the capital-provisioning relationship. As the economy grows, the capital buffer of the bank expands and provisioning decreases. Regardless of their correlation, if both categories of shock absorbers (loan loss provisions and capital) are procyclical (more capital or provisions are required during recessions exactly because credit risks in banks' portfolios increase in cyclical downturns) there might be an increased likelihood of capital shortages during a recession potentially reducing the supply of credit to the economy (a so-called "capital crunch").

We employed panel data models with fixed effects. Fixed effects regression is the model to use when we need to control for omitted variables that differ between banks but are constant over time. It lets us use the changes in the variables over time to estimate the effects of the independent variable on our dependent variable, and is the main technique used for analysis of panel data. This is equivalent to generating dummy variables for each of our cases and including them in a standard linear regression to control for these fixed "bank-specific effects". We would prefer to have fewer banks and more time periods, as each dummy variable removes one degree of freedom from our model. Fixed effects are reasonable to use in our case, as we focus on a specific set of

[43] It is worth noting that income smoothing is considered a violation of internationally accepted accounting standards (IFRS or IAS 39). There is a widely shared view within the accounting profession that income smoothing has negative connotations because it introduces judgemental modifications to a firm's earnings and tends to reduce the comparability of results across firms and may impair shareholder' equity.

banks that are not randomly selected. However, we run a Hausman test[44] to check that we chose a more efficient model against a less efficient but consistent model.

It is worth noting that correlations involving three key explanatory variables – between GDP growth and bank earnings and between GDP growth and growth of loans – might cause a multicollinearity problem in the econometric analysis, as in general a positive correlation is expected in both cases. However, our investigation into the data suggests that the correlation between real GDP growth per capita and bank earnings and even between GDP and lending is not very high. There are substantial differences across banks even within the same country, but multicollinearity is not a big issue in our analysis.

To estimate the procyclicality in provisioning in the case of the Czech Republic, we used quarterly data for the period 2001 Q1–2011 Q4 from the balance sheets and income statements of 15 banks operating in the Czech Republic at the end of 2011. We realise that the results may have been partially influenced by the fact that the time period is not sufficiently long[45] to represent the recommended two complete business cycles. The initial phase of the chosen period was additionally accompanied by structural problems in the banking system. However, the time period should be sufficient to test the behaviour of the banking system over at least one cycle. The macroeconomic variables entering the model were taken from official Eurostat figures, and data specific to individual commercial banks were obtained from internal CNB sources.

We hypothesise that a bank shows imprudent provisioning behaviour if loan loss provisions are negatively associated with (i) GDP growth, or (ii) loan growth, or (iii) banks' earnings. The key results of interest in our analysis are the coefficients on GDP growth, pre-tax profit, loan growth and loans/TA. Table A1.1 presents the estimated results of the equation for the chosen sample.

[44] The Hausman test tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If they are (insignificant P-value larger than 0.05) then one can use random effects. If the result is a significant P-value, then it is better to use fixed effects (see Table A1.1).

[45] Fernándes De Lis et al. (2001), for example, used Spanish data covering a 16-year period, representing two full business cycles.

Table A1.1: Loan Loss Provisions: Fixed Effect Regressions

Variables/Methods	CZ	OTHER COUNTRIES
LLP/TA (-1)	0,5301	0,2574
	(0.1451)***	(0.0806)***
? ln GDP	-0,0011	-0,0004
	(0.0005)**	(0.0001)***
UNEMPL_gap	0,0009	0,0004
	(0.0005)**	(0.0002)*
EARN/TA	0,4175	0,1752
	(0.1725)**	(0.1292)*
? ln LOANS	0,0001	-0,0001
	(-0.0001)	(0.0001)*
LOANS/TA	0,0048	0,0069
	(0.0015)***	(0.0049)*
CAP/TA	-0,0275	-0,1065
	(0.0145)*	(0.0603)*
Time period	1Q2001 – 4Q2011	1999 – 2010
Number of obs.	645	396
Number of groups	15	36
R-squared overall	0,9861	0,1561
R-squared within (between banks)	0,9596	0,4169
R-squared between (over time)	0,9978	0,0548
F (7,14)/(7,35)	453,24	7,6
rho	0,3371	0,4975
Prob>F	0,0000	0,0000
Hausman test (p-value)	0.0000***	0.0000***

Note: ***, **, and * denote significance at 1, 5, or 10%; Robust std. err. in brackets.

As expected, the coefficient on GDP growth was negative, indicating that provisioning is higher during economic downswings and lower during upswings. The positive coefficient on the unemployment gap also indicates that provisioning is procyclical and lacks forward-looking assessment of cycle-related risk.

The procyclicality in banks' provisioning behaviour may be partly offset by the evolution of gross profit. Given its positive coefficient it is apparent that banks provisioned more as profits rose and less as they fell. The results thus suggest that banks tried to smooth their income (or optimise their taxes) in the period under review by provisioning. This behaviour thus partially reduces the procyclicality expressed by the coefficient on GDP growth.

The positive coefficient for the relationship between provisioning and the ratio of total loans to total assets confirms a generally positive effect of credit risk. The coefficient indicates that Czech banks tend to behave prudently to some extent. If a bank has a relatively large open credit position, for which there is a higher probability of rising credit risk, it sets aside more provisions.

The final relationship under review is that between the equity capital to total assets ratio and provisioning. These variables are negatively correlated, supporting the assumption discussed above that banks are influenced in their provisioning by their capital ratio. In other words, banks set aside fewer provisions to cover their expected losses when their capital buffer is larger.

To sum up, the results confirmed the assumptions regarding the procyclical provisioning behaviour of banks. This may indicate that the provisioning performed by Czech banks contains a

cyclical component which might be smoothed to some extent by the introduction of through-the-cycle provisioning, for example.

For comparison the paper analyses the cyclical patterns of bank loan loss provisions followed by large commercial banks from selected countries of Europe. The empirical panel analysis covers nine economies, namely Austria, Belgium, Germany, Denmark, France, Hungary, Sweden, Slovakia and the Czech Republic. The data for the eight foreign countries and 40 banks come from two sources: bank-level data are taken from the Bankscope database (loans/total assets, loan growth, capital/total assets, loan loss provisions/total assets and equity before taxes) and macroeconomic data (real GDP growth per capita, unemployment rate and inflation) from the Eurostat database. The data are available on an annual basis for a period of 12 years (from 1999 to 2010). Our sample is dominated by German, Denmark, French and Swedish banks.

We expected some of the results (Table A1.1) to be analogous with previous ones for the Czech banks. The results suggest that bankers from the other selected countries create on average lower provisions in good times and are then forced to increase them during cyclical downturns (see the negative significant coefficient on the real GDP growth rate). We also find a positive relationship between the ratio of loan loss provisions and bank earnings. This suggests that the European banks in our sample have followed an income-smoothing pattern on average. The real loan growth rate and the loans-to-assets ratio also indicate rather imprudent provisioning behaviour. The selected European banks appear to have increased the amount of provisions during periods of positive profits, but they have been less prudent during periods of credit growth.

We employed three tests for unit roots or stationarity in our panel balanced datasets. The first two are the Levin, Lin and Chu (2002) and Im, Pesaran and Shin (2003)[46] tests. These have as the null hypothesis that all the panels contain a unit root. The third test, proposed by Hadri (2000), is the Lagrange multiplier (LM) test, which has as the null hypothesis that all the panels are (trend) stationary. The results are presented in Tables A1.2 and A1.3 and show that it was appropriate to apply this econometric approach.

[46] The Im-Pesaran-Shin test also allows for unbalanced panels.

Table A1.2: Panel Unit Root Tests: FE Regressions for Czech Banking LLP

Variable	LLC test		IPS test		H test	
	levels	differences	levels	differences	levels	differences
LLP/TA (-1)	[0.7749]	[0.0000]	[1.0000]	[0.0000]	[0.0000]	[0.0000]
LOANS/TA	[0.2538]	[0.0000]	[0.9966]	[0.0000]	[0.0000]	[0.0000]
CAP/TA	[0.9323]	[0.0000]	[1.0000]	[0.0000]	[0.0000]	[0.9937]
EARN/TA	[0.7749]	[0.0000]	[0.8281]	[0.0000]	[0.0000]	[0.2349]
?lnLOANS	[0.0000]	[0.0000]	[1.0000]	[0.0000]	[0.0000]	[0.5789]
UNEM_gap	[0.0001]	[0.0000]	[0.4544]	[0.0000]	[0.0000]	[0.9183]
?lnGDP	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.9998]

Note: LLC stands for the Levin, Lin, and Chu (2002) test, where the null hypothesis that each individual time series is a unit root is tested against the alternative that all of them are stationary. IPS stands for the IM, Pesaran, and Shin (1997) test, where the assumption of homogeneity is relaxed under the alternative hypothesis that some of the individual time series are stationary. H stands for the Hadri (2000) LM test, which has the null hypothesis that all the panels are stationary, perhaps around a linear trend if the trend option is specified, and the alternative hypothesis that at least some of the panels contain a unit root. The p-values of the corresponding t-statistics are shown in brackets.

Table A1.3: Panel Unit Root Tests: FE Regressions for Other Banking LLP

Variable	LLC test		IPS test		H test	
	levels	differences	levels	differences	levels	differences
LLP/TA (-1)	[0.0000]	[0.0000]	[0.0063]	[0.0000]	[0.0000]	[0.0009]
LOANS/TA	[0.0000]	[0.0000]	[0.5932]	[0.0000]	[0.0000]	[0.0351]
CAP/TA	[0.0000]	[0.0000]	[0.9592]	[0.0000]	[0.0000]	[0.7850]
EARN/TA	[0.0011]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.3505]
?lnLOANS	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0167]	[0.9999]
UNEM_gap	[0.0001]	[0.0000]	[0.9855]	[0.0000]	[0.0000]	[0.0587]
?lnGDP	[0.0000]	[0.5065]	[0.0000]	[0.0000]	[0.0076]	[0.9999]

Note: LLC stands for the Levin, Lin, and Chu (2002) test, where the null hypothesis that each individual time series is a unit root is tested against the alternative that all of them are stationary. IPS stands for the IM, Pesaran, and Shin (1997) test, where the assumption of homogeneity is relaxed under the alternative hypothesis that some of the individual time series are stationary. H stands for the Hadri (2000) LM test, which has the null hypothesis that all the panels are stationary, perhaps around a linear trend if the trend option is specified, and the alternative hypothesis that at least some of the panels contain a unit root. The p-values of the corresponding t-statistics are shown in brackets.

Annex 2: Credit Risk Measured by the NPL Ratio Over the Business Cycle

There is a general tendency to look at the credit risk level through the ratio of non-performing loans to total loans (NPL ratio). This applies despite the fact that default rates or other indicators provide more important insight into the dynamics of credit risk. Due to its rather backward-looking qualities as a stock variable, the NPL ratio is a natural candidate for a variable subject to the financial instability paradox. How much does the assumption that elevated credit losses follow a period of high economic activity and credit boom hold empirically? To assess it, in this annex we apply panel data methods to examine the determinants of non-performing loans (NPLs) in the Czech banking sector in order to investigate the effects of both macroeconomic and bank-specific variables on loan quality. The exercise is intended not to identify the determinants of credit risk, but to demonstrate the how the NPL ratio evolves over the business cycle. Quite a lot of studies try to investigate the determinants that induced the financial crisis. Using a multivariate logistic model for both developing and developed countries during the period 1980–1994, Demirgüc-Kunt and Detragiache (1998) find that inflation and the real interest rate are positively associated with a banking crisis, whereas GDP growth has an inverse relationship. The high likelihood of banking system distress associated with declining economic growth following a credit boom is confirmed by Hardy and Pazarbasioglu (1998). Salas and Saurina (2002) estimate the relationship between rapid credit growth and loan losses by covering two credit cycles of the Spanish banking sector. They find robust evidence that during upturns, riskier borrowers get bank loans while collateralised loans decrease, as they confirm a significant negative contemporaneous effect of GDP growth on the NPL ratio and transmission of macroeconomic developments to the ability of households and firms to service their loans.

Louzis et al. (2010) examine the determinants of NPLs in the Greek banking sector. Using dynamic panel data methods they find that macroeconomic variables, specifically the real GDP growth rate, the unemployment rate and lending rates, have a strong effect on the level of Greek banks' NPLs. A similar result can be found in Vogiazas and Nikolaidou (2011), who investigate the determinants of NPLs in the Romanian banking system by means of time series modelling techniques. They use macro-cyclical indicators, monetary aggregates, interest rates, financial markets and bank-specific variables. The novelty of that study lies in the introduction of proxies for the Greek debt crisis. They find that the leading indicators of credit risk deterioration are macroeconomic variables and the potential contagion risk arising from foreign (Greek) ownership in the Romanian banking sector. ECB (2011) reviews trends in the credit quality of banks' loan books over the past decade, as measured by NPLs, based on an econometric analysis for a panel of 80 countries. Their econometric analysis of the empirical determinants of NPLs suggests that real GDP growth has been the main driver of NPLs during the past decade. It appears from this that a drop in economic activity remains the most important risk for bank asset quality in the current circumstances.

The above-mentioned empirical studies, along with many more (Kalirai and Scheicher, 2002, and Delgado and Saurina, 2004, for example), tend to confirm the link between the phase of the business cycle and credit defaults. In line with this link, during an expansionary phase of the economy the number of NPLs is relatively low, as households and firms have sufficient income and revenues. Nonetheless, as the boom period continues, credit standards decline. When the

recession phase arrives, banks face insolvency due to falling asset values, with debtors unable to repay their debts as a result of adverse shocks to economic activity. Using a similar approach as in related studies, we estimate on historical data the sensitivity of banks' balance sheets to adverse changes in macro fundamentals. We focus on the Czech banking sector and use quarterly data for the period 2001 Q1–2011 Q4 for the estimation. The macroeconomic variables entering the model were taken from official Eurostat figures, financial variables were sourced from Thomson Reuters, and data specific to individual commercial banks were obtained from internal CNB sources.

The selection of variables for the empirical part of the study is as follows. The dependent variable, NPLs, is defined as the ratio of impaired loans to total loans. The macroeconomic variables used as indicators of general macroeconomic performance or states of the macroeconomic environment are:

(a) *GDP* growth (real growth per capita) – expected to be negatively related to NPLs, as a growing economy is likely to be associated with rising incomes and revenues and reduced financial distress.

(b) The unemployment gap (*UNEM*, the gap between the unemployment rate and the long-term unemployment rate) – expected to be positive, as the unemployment rate negatively influences cash flow streams of households and increases their debt burden and/or leads to a decrease in revenues and a fragile debt condition in the case of firms.

(c) The spread between the lending interest rate and the three-month interbank interest rate (*SIR*, the spread between the IMF IFS Lending Rate and the 3-month PRIBOR) – expected to be positively related to NPLs, as any interest rate hikes increase the probability of loan defaults as borrowers are less able to service their debts. However, it should be noted that most business and consumer loans are floating-rate loans, whereas mortgages are mainly fixed-rate loans. For this reason it should be more suitable to analyse the determinants separately for each type of loan, but for data reasons this was not possible.

(d) The nominal exchange rate gap (*NER*, the gap between the nominal exchange rate and its Hodrick-Prescott trend) – indeterminate in relation to NPLs, as a weakening of the national currency would have significant adverse consequences for asset quality (the balance sheet channel), but on the other hand can strengthen the competitiveness of export-oriented firms (the competitiveness channel).

(e) The determinants of NPLs should not be sought exclusively in macroeconomic factors, so a bank-specific variable was employed – real loan growth (*LOANS*). A negative relationship between credit growth and NPLs highlights banks' risk appetite given a lending boom and potential credit risk problems at the core of the banking system.

The equation for the panel regression takes the following form:

$$NPL_{i,t} = \alpha_{1,i} + \alpha_2 NPL_{i,t-1} + \alpha_3 GDP_t + \alpha_4 UNEM_t + \alpha_5 SIR_t + \alpha_6 NER_t + \alpha_7 LOANS_{i,t} + \varepsilon_{it},$$

where the subscripts i (i = 1–15, the number of banks) and t denote the cross-sectional and time dimension of the panel sample respectively, α are coefficients to be estimated, and ε_{it} are the error

terms. Lags of the dependent variable are included in the set of regressors to capture the effect of omitted explanatory variables and the persistence of NPLs.

We use panel data methods to examine the determinants of NPLs in the Czech banking sector. First, we fit a panel regression with fixed effects including lagged dependent variables (model 1). We chose fixed effects according to the Hausman test, which confirms a model with fixed effects as being more efficient (a zero and significant P-value – see Table A2.1). However, in the panels the lagged dependent variable on the right-hand side could be correlated with the error term (dynamic panel bias – Nickell, 1981) and not all of the macroeconomic data used as explanatory variables can be expected to be strictly exogenous (considering the possible endogeneity of the regressors), so we additionally employ the system generalised method-of-moments estimator (GMM, model 2) developed by Arellano and Bover (1995) and Blundell and Bond (1998). As we assume that all the independent variables are weakly exogenous, we instrument them all. However, we are aware that from an econometric point of view, the limited number of cross-sectional units in the sample (there are 15 banks) poses additional limitations on the number of instruments that can be used in the estimation and subsequently on the number of exogenous variables that can be added to the equation. We have tried to keep to the suggested rule of thumb that the number of instruments should be less than the number of groups. The reason is that otherwise both the standard errors and the Sargan test are downward-biased and as a consequence the asymptotic inference maybe misleading. We cope with this problem by adding just one bank-specific variable at a time, reducing the need for extra instruments. The Sargan test of validity of instruments reached a satisfactory level, not robust but not weakened by too many instruments. The models are run with the variables in first differences.

It is worth noting that the correlations between key explanatory variables, especially GDP growth and growth of loans, might cause a multicollinearity problem in the econometric analysis, as those two are in general expected to be positively correlated. However, our investigation into the data suggests that the correlation between real GDP growth per capita and bank loan growth is not very high. We are aware that this could be due to the fact that the analysis is based on total loans instead of a particular type of loans. There might be different developments between household and corporate loans. There are substantial differences across banks, but multicollinearity is not a big issue in our analysis.

In both models, the signs of the explanatory variables are intuitive (Table A2.1):

Table A2.1: Determinants of Non-performing Loans

Variable/Method	FE[1]	GMM[2]
NPL (-1)	0,8935	0,9301
	(0.0154)***	(0.0251)***
GDP	-0,0167	-0,0183
	(0.0076)**	(0.0069)***
UNEM	0,0397	0,0561
	(0.0286)*	(0.0326)**
LOANS	-0,0017	-0,0016
	(0.0005)***	(0.0005)***
SIR	0,0746	0,033
	(0.0433)*	(0.0419)
NER	0,0052	0,0053
	(0.0016)***	(0.0015)***
No. of observation	645	
No. of groups	15	
No. of instruments		13
Hausman test	0.0000***	
R-squared overall	0,9596	
R-squared within	0,9039	
R-squared between	0,9987	

Note: ***, **, and * denote significance at 1, 5, and 10%, respectively. Standard errors are below the coefficient estimates in brackets. [1] Robust std. err. in brackets, F(6,14)=1388, Prob>F=0.0000, rho=0.1188. [2] Sargan test of overid. restrictions: chi2(6)=24.62, Prob>chi2=0.0000, AR(1): z=-11.14, Pr>z=0.0000, AR(2): z=1.84, Pr>z=0.066.

In the case of both models, the estimated regression coefficients have the same sign, and all but one of them are significant. The coefficient of the lagged dependent variable is positive, suggesting that the NPL ratio is likely to increase when it has increased in the previous quarter. The macroeconomic variables both have the expected signs (GDP negative and UNEM positive). As expected, an increase in real GDP growth leads to a decline in NPLs. With respect to unemployment, the impact is also as expected, with an increase in unemployment affecting households' ability to service their debts. Lending interest rates should have a greater impact on NPLs, with a decline in the former bringing about a decline in problem loans. However, the coefficient on the lending rate is insignificant in the case of the GMM model. Also, the negative coefficient in the case of loan growth may indicate that the Czech banking sector adopts a loose credit policy during the boom phase of the cycle and a tight policy in the downturn phase. Nevertheless, we again note that the analysis is based on total loans and the relationship may differ across different types of loans. With respect to the exchange rate, the results suggest that a depreciation of the domestic currency leads to a deterioration in asset quality (the balance sheet channel). A depreciation of the domestic currency may improve the competitiveness of exporters, so they can increase the amount of goods and services they export and increase their profitability. Nevertheless, the positive effect on exporters' creditworthiness typically materialises with some lag (ECB, 2011).

We employ three tests for unit roots or stationarity in our panel balanced datasets. The first two are the Levin-Lin-Chu (2002) and Im-Pesaran-Shin (2003)[47] tests, which have as the null hypothesis that all the panels contain a unit root. The third test, proposed by Hadri (2000), is the

[47] The Im-Pesaran-Shin test also allows for unbalanced panels.

Lagrange multiplier (LM) test, which has as the null hypothesis that all the panels are (trend) stationary. The results are presented in Table A2.2 and show that it was appropriate to apply this econometric approach.

Table A2.2: Panel Unit Root Tests

Variable	LLC test		IPS test		H test	
	levels	differences	levels	differences	levels	differences
NPL	[0.0041]	[0.0000]	[0.0711]	[0.0000]	[0.0000]	[0.0000]
LOANS	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.5788]
UNEM	[0.0001]	[0.0000]	[0.4544]	[0.0000]	[0.0000]	[0.9183]
GDP	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.9998]
NER	[0.0001]	[0.0000]	[0.7595]	[0.2197]	[0.0167]	[0.1422]
SIR	[0.1459]	[0.0000]	[0.0663]	[0.0000]	[0.0000]	[0.0049]

Note: LLC stands for the Levin, Lin, and Chu (2002) test, where the null hypothesis that each individual time series is a unit root is tested against the alternative that all of them are stationary. IPS stands for the IM, Pesaran, and Shin (1997) test, where the assumption of homogeneity is relaxed under the alternative hypothesis that some of the individual time series are stationary. H stands for the Hadri (2000) LM test, which has the null hypothesis that all the panels are stationary, perhaps around a linear trend if the trend option is specified, and the alternative hypothesis that at least some of the panels contain a unit root. The p-values of the corresponding t-statistics are shown in brackets. * Variables are in first differences.

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