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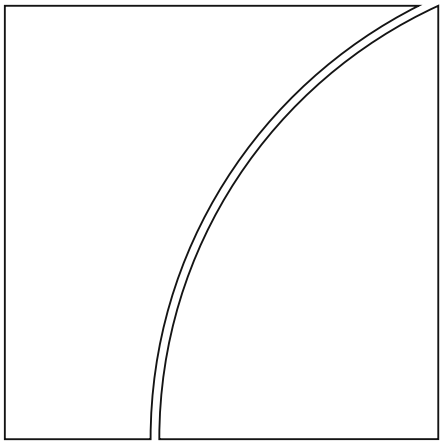

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Inflation targeting and financial stability: providing policymakers with relevant information

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Inflation targeting and financial stability: providing policymakers with relevant information

Anders Vredin[1]

Abstract

Experience from financial crises and central bank policies in the past decade has led to an intensified debate about the relationship between monetary policy and financial stability. Since there is no established theoretical framework for analysing the links between financial stability and monetary policy, it is very difficult to deliver precise recommendations for policy. The primary purpose of this paper is to present suggestions for how risks of financial instability can be taken into account in the information provided to central bank decision makers, despite the considerable uncertainty about the appropriate analytical approach. The paper starts with a discussion of the strategy of "flexible inflation targeting", which, in fact, does not provide any "simple rules" for policymakers. The next section contains a review of theoretical and empirical analyses of links between financial stability and monetary policy. Insights from inflation targeting, and more recent views on the role of financial stability, lead to suggestions regarding the type of information that should be presented to monetary policy decision makers, and how it can be organised, to help them understand the links between financial stability and monetary policy.

Keywords: monetary policy, financial stability, inflation targeting, central banks, financial crisis, financial frictions.

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[1] Sveriges Riksbank.

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Table of contents

1. Introduction

Since the signs of an impending financial crisis became apparent in 2007, central banks in many countries have felt a need to try out new ways of influencing financial markets in order to stabilise inflation and economic activity more generally. While controlling a very short-term interest rate was believed to be the best approach of the central bank before the crisis, it has become clear that even lowering that rate to virtually zero may not always be enough (or appropriate). Operations that directly affect longer-term interest rates, and various segments of the financial market, have been viewed as necessary. These operations have been reflected in, for example, expansion of central banks' balance sheets and generally very low interest rates – both short- and long-term. This course of events has led to an intensified debate about monetary policy strategies, and in particular about the relationship between monetary policy and financial stability; a discussion that had already started before 2007. Even though the measures taken are justifiable in the unusual circumstances, central banks have been – and, at least in some cases, still are – navigating uncharted waters, and new risks to financial stability may hence be building up. Furthermore, there is the question of how monetary policy should be devised once the situation has returned to normal.

Although the argument that monetary policy should pay more attention to risks of financial instability had already been put forth before the crisis – eg by Borio and Lowe (2002) and Rajan (2005) – there is still no consensus among central bankers and researchers on the desired strategy for monetary policy in principle, or on the implications for policy analyses and decisions in practice.[2] Even those who find it appropriate for monetary policy, in principle, to put more weight on financial stability than was done before the crisis – eg Stein (2014) – stress that the quantitative implication of this argument is unclear. An important reason for this is that there is no established theoretical framework for analysing the links between financial stability and monetary policy, which of course means that it is very difficult to deliver precise recommendations for policy. Hence, monetary policy experts have different views on whether only relatively minor changes of monetary policy strategies are needed, or whether a major rethink is necessary; see Woodford (2012) for an example of the former view and Eichengreen et al. (2011) as an example of the latter.

The primary purpose of this paper is to present suggestions for *how* risks of financial instability can be taken into account in the information provided to decision makers on monetary policy. When members of central bank Boards and Monetary Policy Committees make decisions on monetary policy, they presumably do not want to ignore the implications for financial stability, irrespective of whether or not there is any established framework for analysing the links between financial stability and monetary policy.[3] The situation is not entirely different from that of

[2] See Smets (2014) for a review of some different schools of thought. Borio and Lowe (2002) provide both empirical analyses and numerous references to the previous literature. Rajan (2005) primarily discusses the implications for regulation, supervision and monetary policy of innovations on financial markets.

[3] Some examples of policymakers' thinking on this issue are provided by Yellen (2014), Poloz (2015) and Ingves (2015).

some central banks in the 1990s, when they abandoned strategies of pegged exchange rates and decided to declare explicit inflation targets instead – without tailored general equilibrium models of monetary policy in the new regime. An important difference is that it was more obvious at the time that a permanent change in monetary policy strategy was truly required. Yet, there was no "conventional wisdom" about how the new regime should be implemented. Partial and possibly inconsistent models of monetary policy, inflation etc. had to be combined to provide policymakers with the best available information, and transparency (both internally at central banks and externally to a wider audience) was not very high (at least by today's standards). Given the progress that has been made since then, there are reasons to be optimistic about the possibilities of bringing more information on financial stability into monetary policy decision making, even though it will take several years before satisfactory theoretical and empirical models have been developed.[4]

This paper starts, in section 2, with a discussion of the strategy of "flexible inflation targeting" applied by many central banks, and of some issues that have remained unresolved, or at least difficult to deal with, within that framework. This provides a useful perspective on the methodological questions – about defining and measuring financial stability, for example – we face today. Some of today's challenges are not qualitatively different from the situation of twenty years ago; the implications for monetary policy of different formulations of the central bank's objectives must be modelled theoretically, and the mechanisms in the theoretical models must be estimated empirically. Not even "flexible inflation targeting" can be characterised as implementation of a "simple rule" for monetary policy; rather, it involves many difficult and strategic decisions in which policymakers have to use experience and information generated outside the available formal models. The question of if, and how, risks of financial instability should be taken into account, is in principle not very different from other problems that policymakers must consider based on information and relationships that are not captured by the standard benchmark models.

Section 3 contains a review of theoretical and empirical analyses of links between financial stability and monetary policy. Theory suggests that the degree of financial stability has implications for monetary policy both because various "financial frictions" influence the *transmission mechanisms* between monetary policy, inflation and production, and because such frictions may imply that financial stability should be one of the central bank's *objectives*. Furthermore, there are both theoretical and empirical analyses suggesting that monetary policy can affect the degree of financial stability. These results are, on the one hand, not surprising given the role central banks have played in the financial system throughout history.[5] On the other hand, a financial stability objective may sometimes be in conflict with other objectives for monetary policy in the short run, in particular stability in inflation and production.

Against this backdrop (of insights from inflation targeting, and more recent views on the role of financial stability) section 4 presents suggestions regarding the

[4] The paper by Alpanda, Cateau and Meh (2014) is an example of the progress currently being made. Leeper and Nason (2014) provide a review of the challenges facing researchers and policymakers.

[5] See eg Giannini (2011).

type of information that could be presented to monetary policy decision makers, and on how it could be organised, to help them understand the links between financial stability and monetary policy. The proposals are not drastic. Central banks already analyse indicators of financial conditions and financial stability in their usual procedures for forecasting and policy analysis. This is done with a suite of models that have been constructed for different purposes and with different strengths and weaknesses. The idea is simply to apply similar methods in pragmatic but systematic ways to shed more light on the links between monetary policy and financial stability. The suggestions are based on the analytical material in sections 2 and 3 – and the author's personal experiences as a policy advisor. Given the lack of a sufficiently rich general equilibrium model, the leap from analyses to suggestions inevitably involves a considerable degree of judgement.

The arguments presented in this paper are not new. For example, many of the difficulties of implementing inflation targeting discussed in section 2, and the links to financial stability, have been raised in a paper by Disyatat (2010) which was available as a Working Paper as early as in 2005. A theoretical general equilibrium model that covers many of the mechanisms discussed in section 3, and that can be used for policy purposes, has been presented by Alpanda et al. (2014). Theoretical foundations, and challenges, for those who want to think about interactions between financial stability and monetary policy have been reviewed by Leeper and Nason (2014). The present paper has been particularly influenced by the theoretical arguments by Woodford (2010, 2012). A framework for monitoring indicators of financial stability has been presented by Adrian and Liang (2014) and has inspired the structure of the suggestions in section 4. The contribution of this paper is, hopefully, to summarise how these and other ideas can be used to reform practical policy analyses and discussions at inflation-targeting central banks today. We are still far from having policy analysis procedures we feel as comfortable with as we did before 2008. The main messages in this paper are not normative, ie they do not stress that central banks *should* put more weight on financial stability in their monetary policy decisions. Rather, the purpose is to present suggestions on the type of information policymakers need to form their own opinion on this issue.

2. Unresolved issues in inflation targeting

This section shows that many difficult questions similar to those discussed today – about how to bring financial stability into monetary policy – have not been easy to solve under the inflation-targeting regime either. There are, for example, no simple answers as to how the central bank's targets for inflation or resource utilisation should be defined, or how these objectives should be weighed against each other. Partly for these reasons, policymakers do not follow any simple policy rules exactly. The recent debate about the role of financial stability in monetary policy is thus related to earlier and ongoing discussions about measurement problems and gaps between theory and practice.

2.1 Descriptions of flexible inflation targeting

After very negative experience from failures with macroeconomic stabilisation policy in the 1970s and 1980s, several countries – especially small and open (highly trade-

dependent) ones – introduced explicit targets for inflation intended to give price stability a larger weight in monetary policy. The change in monetary regime was often accompanied by formal changes in central bank laws, which both gave the price stability objective a formal status and the central bank a higher degree of independence from the government. The inflation target, as such, increased the autonomy of the central banks since a clear mandate limits the possibilities of exerting political pressure on the central bank to achieve objectives other than price stability. But, the degree of independence was also raised in other respects, eg how the central banks' decision making bodies for monetary policy were composed and appointed.

The introduction of explicit inflation targets did not mean that all other economic policy objectives were to have zero weight in monetary policy. Central bank laws often continued to include formulations implying that employment, economic growth and a well-functioning financial system should also be considered in monetary policymaking.[6] It also became clear from how central banks behaved under the new regime that the development of the real economy was not being neglected in decisions on interest rates. The central banks had thus not become ultra-conservative, although the target of low and stable inflation had been given a much greater weight than before.[7]

The change to a new monetary policy regime was combined with a gradual increase in central bank transparency and general openness. Often starting from a very low degree of openness, increased transparency could serve many purposes. An explicit inflation target would be easier to evaluate than more vague objectives, and could therefore lead to higher credibility for the central bank and for the inflation target. However, since the probability of attaining the target exactly is close to zero, the central bank needs to be able to explain the deviations from the target and how it intends to bring inflation closer to the target. Some minimum level of transparency is necessary to accomplish this. A high degree of transparency and accountability could also be seen as a prerequisite for legitimacy of the new regime with a politically highly independent central bank. Altogether, it was believed that an explicit target and transparency increased the efficiency of monetary policy, partly by anchoring inflation expectations.[8]

In order to discuss inflation targeting and compare it with other strategies, we need some reasonably precise definitions of the policy rules in question.[9] The most popular monetary policy rule in the academic literature, which has also been applied

[6] See Bank for International Settlements (2009, chapter 2) for a review of the roles and objectives of modern central banks.

[7] See Rogoff (1985) for theoretical arguments as to why central banks should be conservative but not ultra-conservative (ie they should put greater weight on stabilising inflation than the government, but not zero weight on eg unemployment). Fischer (1996) pointed out that it would not be credible for the central bank to argue that it only cares about stabilising inflation.

[8] Another purpose of transparency has clearly been to increase internal efficiency at central banks. This purpose is however primarily related to problems that are beyond the scope of the present paper.

[9] Some explicit rule for monetary policy is of course also logically necessary for central bank economists to make meaningful forecasts of inflation, GDP growth, interest rates etc. to guide monetary policy decisions.

by central banks for analytical and pedagogical purposes (but less commonly used in their rhetoric), is the Taylor rule (Taylor, 1993):

$$r_t = c\left[r^* + a\left(\pi_t - \pi^*\right) + b\left(y_t - y_t^*\right)\right] + (1-c)\, r_{t-1} \tag{1}$$

Here, r_t denotes the level of the central bank's policy rate in period t; π_t and y_t respectively denote inflation and GDP in period t; and π^* and y_t^* denote the targeted levels of inflation and GDP respectively. r^* denotes the level of the policy rate the central bank expects to keep, in the long run, if both inflation and GDP are at their targeted levels. The popularity of this rule in analyses and discussions of monetary policy is due to various reasons. First, it has been shown to give a good approximation of how central banks actually behave. This requires, however, the inclusion of the lagged interest rate in the rule, since policy rates are, in practice, much more persistent than a rule with $c = 1$ would imply. Second, the Taylor rule seems consistent with the idea that the central bank strives to keep inflation close to a target, but at the same time also cares about other variables, such as GDP. Third, Taylor-type rules have been shown to be relatively robust, in the sense that they deliver good outcomes (according to a certain criterion, eg the wellbeing of a hypothetical representative individual) under different but reasonable assumptions about how inflation and GDP are determined.

The Taylor rule describes the central bank as a rather myopic policymaker which focuses on the current levels of inflation and GDP (assuming that they can be observed). Intuitively, one would probably expect the central bank to have a somewhat longer planning horizon and to let the interest rate decisions also be affected by the expected development of inflation and GDP in the near future at least. In the academic literature (but also in the communication from some central banks), there is also another common description of the inflation-targeting strategy, which assumes that the central bank sets the interest rate in order to minimise a loss function of the following form:[10]

$$E\sum_t^{\infty} \beta^t \left[\left(\pi_t - \pi^*\right)^2 + \gamma\left(y_t - y_t^*\right)^2\right] \tag{2}$$

The loss the central bank is attempting to minimise with monetary policy is the expected (E) weighted average of the squared deviations of inflation and GDP from their targets, from now and until infinity. One advantage of this formulation of the central bank's objectives compared to the Taylor rule is that it allows for the realistic possibility that the central bank may tolerate different deviations from its targets for inflation and GDP depending on which factors have caused these deviations from the targets; the Taylor rule prescribes a more mechanical response to the current deviations. On the other hand, one advantage with the Taylor rule is that it is easier to understand and use as a benchmark for the audiences with which the central bank wants to communicate. The minimisation of the loss function may, in principle, be consistent with several different levels and future paths of the

[10] Rogoff (1985) used a loss function of this form to describe the central bank's decision problem, building on earlier work by Finn E. Kydland, Edward C. Prescott, Robert J. Barro and David B. Gordon. The notation here is taken from Woodford (2012). Svensson (1998, 2005) has suggested that a strategy based on a loss function like (2) should be called "inflation forecast targeting" (since it is the forecast rather than current level of inflation that matters) or "flexible inflation targeting" (since it is not only inflation but also GDP that matters).

interest rate. This rule may therefore be harder to explain and also to evaluate. Furthermore, a rule for the interest rate similar to the Taylor rule (1) may be a good approximation of the optimal monetary policy even if the central bank really wants to minimise the loss function (2). For the purposes of this paper, however, it is not necessary to delve much deeper into the theoretical arguments for and against different descriptions of monetary policy under an inflation-targeting regime. It is sufficient to note that both the Taylor rule and the loss function have been used in such descriptions, also (more or less explicitly) by the central banks themselves. Both (1) and (2) are therefore useful starting points for a discussion of the problems policymakers face when implementing inflation targeting in practice, and for structuring a discussion about an alternative policy strategy in which financial stability risks are given a more explicit role.

2.2 Strategic policy questions within the inflation-targeting regime

The definition of the inflation target. It might perhaps be considered that central banks' conviction of low and stable inflation being important to society ought also to be reflected by precise ideas about how inflation should be measured and what the optimal level of inflation is. However, since all results concerning optimal policy depend on assumptions about the workings of the economy under consideration, there are no simple answers to questions about the definition of the inflation target.

Regarding the level of inflation, there is a well-known rule, proposed by Milton Friedman, that implies that the optimal inflation rate is equal to minus the real rate of interest, ie typically a negative number (deflation). The reason for this is that inflation is a tax on money. Given that money is useful for transactions – one of the reasons why central banks fill an important role in society[11] – it may be desirable to keep the cost of holding money as low as possible. The alternative cost of holding money is the nominal return that would be obtained on less liquid financial assets, which may be well approximated by the central bank's policy rate. Setting this rate to zero gives an inflation rate equal to minus the real interest rate (since the real interest rate = nominal interest rate minus inflation). However, it is also well-known that the desirability of negative inflation only holds up in an idealised model economy without many of the frictions we can observe in the real world, eg nominal price and wage rigidities; see Carlsson and Westermark (2014) for a recent study and further references to the literature. The "base line" model reported by Carlsson and Westermark yields an optimal annual inflation rate of 1.16, but they also show that different equally plausible assumptions can give a somewhat higher or lower rate.

The next question concerns the set of goods and services that should be included in the targeted measure of inflation. Many central banks formulate their inflation target starting from each country's official consumer price index (CPI) either by appointing the CPI as the target variable exactly, or by defining the target after some small adjustment to the CPI. The reason why central banks have typically focused on the CPI does not appear to be because they are convinced that this is the theoretically most relevant measure of inflation. Rather, the argument seems to be that the CPI is the most frequently applied and well-known price index. Since one

[11] See Norman et al. (2013) for a historical perspective of central banks' role in the payment system.

important objective of inflation targeting is to anchor inflation expectations, it may seem natural to formulate the target in terms of the CPI.[12] There are however different reasons as to why monetary policy may want to focus on some measure of inflation other than the official CPI index.[13]

Inflation measured by the official CPI index can be quite volatile, influenced by temporary shocks to individual sectors of the economy that the central bank can neither counteract in the short run, nor has any reasons to counteract even if it could. This is partly handled by measuring observed and targeted inflation over a sufficiently long time period, often one year. But, to illustrate the more persistent movements in inflation, central banks also often use various measures of "underlying" or "core" inflation. Most often, such measures are not used to replace the CPI as a target variable, but for analysing and explaining the movements in the CPI (and the deviations from the target). The distinction between "actual" and "core" inflation is more important if the monetary policy strategy is described using the Taylor rule (1) than the loss function (2). Under the Taylor rule, the observed current rate of inflation is what matters for monetary policy, so the exact definitions of inflation and its target are very important. With a loss function like (2), the central bank's ambition is to stabilise inflation around its target on average, over possibly quite a long period. In this case, temporary deviations from the inflation target will presumably have smaller effects on interest rate decisions than under the Taylor rule. The strategy of inflation forecast targeting reflected in the loss function (2) thus makes the use of measures of "underlying" or "core" inflation less important for the formulation of the objectives of monetary policy, although such measures may still be useful for understanding and predicting the relevant inflation process.

Another, and methodologically more difficult, problem with the use of the CPI is that there is no straightforward way to define certain components of the CPI. In particular, different countries have chosen different ways to handle consumers' costs for owner-occupied housing (see, eg Hansson et al., 2008). In some countries, such costs are excluded altogether. In these cases, the practical implication has been that the substantial changes in house prices that many countries have been experiencing have not been reflected in the targeted measure of inflation. Other countries have chosen to measure the costs of owner-occupied housing in ways that, effectively, dampen the influence on measured inflation from rapid changes in costs and prices of houses.

The question of how to take account of changes in house prices and the costs of housing in the CPI is an example of a more general question about monetary policy, inflation and asset prices. Alchian and Klein (1973) argued that it is inappropriate for monetary policy to target the rate of price increases of a basket of current consumption only (such as the CPI). On theoretical grounds, they advocated the use of a "constant welfare price index" which also takes prices of future

[12] It should be noted, however, that there are differences between the definitions of CPI in different countries, and that some countries have formulated their inflation targets using other price indices than CPI.

[13] Arguments for and against the use of various price indices, from a policy perspective, have been surveyed by, eg Hansson et al. (2008). The choice of price index cannot, however, be separated from the more fundamental question about the design of the central bank's objective or reaction function. See Corsetti et al. (2010) for a review of the implications of different assumptions about price rigidities and other inefficiencies, in an open economy context.

consumption and, hence, asset prices into account (since assets provide possibilities for consumption in the future).

In conclusion, there does not seem to exist any straightforward best practice when it comes to defining the inflation target, despite the widespread agreement that low and stable inflation is important. Many central banks have declared targets for the CPI (or something very close to the CPI) of around 2 per cent inflation per year.[14] However, neither the CPI nor 2 per cent can be said to be theoretically justified.[15] At the same time, these choices are not innocuous. The choice to exclude asset prices from the inflation target means that monetary policy will respond less to rapid increases in eg house or stock prices, despite the empirical evidence that such developments are often signs that financial imbalances are building up (see, eg Borio and Lowe, 2002, Borio and Drehmann, 2009, and Anundsen, et al., 2014). And, the choice of 2 per cent implies that inflation rates of 0 – 1 per cent will be considered "too low", although such low levels of price increases could very well be viewed as consistent with price stability.[16]

The definition of the GDP target. In order to implement an inflation-targeting strategy, irrespective of whether it is best approximated by the Taylor rule (1) or the loss function (2), the central bank not only has to choose appropriate definitions of inflation π_t and the inflation target π^*. The levels of GDP y_t and its target y_t^* and, hence, the "output gap" $y_t - y_t^*$ must also be defined. The methodological problems in this area are at least as great as in the case of choosing an appropriate target for inflation.

Putting aside the problems of observing GDP in real time (which is more difficult than observing inflation), it is worth emphasising that the theoretically ideal target for GDP according to the so-called New Keynesian theory, which provides much of the theoretical foundations for inflation targeting, is the level of GDP that would be reached if there were no price or wage rigidities or other inefficiencies (see, eg Corsetti et al., 2010). If the GDP target y_t^* is determined as the efficient level of GDP with the use of some particular macro model, the target does not necessarily follow a smooth trend. In principle, various shocks that hit the economy may move the target level of GDP y_t^* more than actual GDP y_t.[17] Aiming for an efficient level of GDP does not necessarily imply stabilising GDP – in contrast to the

[14] Although 2 per cent is a common level among inflation targets, it is not entirely clear why many central banks have chosen this number. One argument has been that there is a an upward bias in the CPI measure of inflation when quality improvements which are hard to measure lead to higher prices. Another argument has been that policy makers want to avoid a general fall in the price level, ie deflation. Once explicit targets became more common in the early 1990s, there has also been a tendency for countries to choose a level of the inflation target that has already been declared in other countries. Lindenius (1992) presents arguments that were considered in the case of Sweden.

[15] In light of this, it is fully understandable why economists at the Reserve Bank of Australia, as early as the late 1990s, used to describe their inflation target as a "thick point".

[16] In the reassessments of the Bank of Canada's inflation-targeting regime that are done approximately every five years, the arguments for both a lower and a higher inflation target than 2% have been discussed, see Côté (2014).

[17] Blanchard et al. (2015) discuss the possibility that y_t^* may be affected by financial crises.

case of inflation, where the target is assumed to be fixed over time; see, eg Jonsson et al. (2008).

In practice, central banks seldom make use of theoretically based measures of efficient GDP. Instead, the GDP target y_t^* is most often assumed to be well approximated by some measure of the trend in GDP. Alternatively, the output gap $y_t - y_t^*$ is assumed to be captured by some measure of resource utilisation, in particular measures of slack in the labour market, eg registered unemployment (and/or the deviation of unemployment from its trend or normal level) or survey-based measures of labour shortages.[18] Such measures have the advantage, compared to deviations from both efficient and trend levels of GDP, of the slack on the labour market being more easily observed and recognised by the general public. Such recognition may facilitate communication of monetary policy and thereby improve the central bank's predictability and credibility. However, these well-established practices of measuring $y_t - y_t^*$ are associated with (at least) two problems. First, when the measures of target GDP and the output gap used in practice are disconnected from the theoretical foundations of inflation targeting, it is hard to use such measures to evaluate how close to the optimum policy really is. Second, in any given situation, the quantitative differences between various measures of $y_t - y_t^*$ may have quite different implications for monetary policy.[19]

Although official data on unemployment and various measures of unemployment "gaps" are frequently used in discussions of monetary policy, it is well known that such measures are associated with considerable ambiguities.[20] One reason why it is difficult to determine a target level of unemployment or some definition of full employment is that the supply of and demand for labour associated with an efficient level of production y_t^* changes over time due, eg to demographical changes or changes in taxes and subsidies. According to the model by Carlsson and Westermark (2014), eg both the optimal rate of inflation and the average rate of unemployment depend on the level of unemployment benefits. Changes in actual employment in the form of total hours worked may also occur even if the unemployment rate is stable, if there are changes in average working time per employee. Other common measures of $y_t - y_t^*$ therefore include the deviations of total hours worked and the total number of people employed from their respective trends.[21]

[18] The outcome of inflation is also often used as an indicator of the degree of resource utilisation, based on some simple version of a Phillips curve. In the presence of supply shocks (or other changes to price-setting behaviour), however, inflation may be a misleading indicator of slack in the economy.

[19] Jonsson et al. (2008) present different measures of the output gap using Swedish data from 1996 – 2007. According to the Riksbank's model Ramses, the deviation of GDP from its efficient level was positive ($y_t - y_t^* > 0$) and about as high, almost 2 per cent, in 2007 as during the previous peak in 1999. However, a measure of the deviation of GDP from a smooth trend (a so called HP trend) suggested that the output gap in 2007 was less than half as large (around 1 per cent).

[20] See Rogerson (1997).

[21] One example of difficulties in interpreting unemployment gaps is given by the experiences in the U.S. and Sweden since 2010. In the U.S., unemployment has been falling, but this partly reflects

In conclusion, the difficulties in defining an appropriate target level for GDP, y_t^* (and, hence, the output gap $y_t - y_t^*$), seem even larger than the difficulties in finding good measures of inflation and its target. This is probably one reason why central banks typically do not express explicit targets for GDP, employment or unemployment (see, eg Giavazzi and Mishkin, 2006). Instead, several different measures are applied, both in internal analyses and external communication. Policymakers thus have to exercise a large degree of good judgement when implementing inflation-targeting policies approximated by the policy rules (1) and (2) above.

The relative weights on inflation and GDP.[22] Central banks with explicit inflation targets often declare that price stability is the primary objective of their monetary policy. For example, Sveriges Riksbank (2010) has stated that the inflation target is the "overriding" objective. Although legislation also instructs the Riksbank to "support the objectives of general economic policy with a view to achieving sustainable growth and high employment", this is expected to be done "without prejudice to the price stability target". This is consistent with the rules for the European system of central banks laid out in the Treaty on European Union. But, it is not entirely consistent with the descriptions of inflation targeting given above, in which the inflation and output gaps are treated symmetrically, although possibly with different weights. The Taylor rule (1) and the loss function (2) could just as well be described as "flexible output targeting" rather than "flexible inflation targeting".[23] If the loss function gives exactly zero weight to the output gap ($\gamma = 0$), then the inflation target can, of course, be said to be the "overriding" target, or more precisely the only target. The central bank should then be described as an "inflation nutter" according to Mervyn King (1997). But, as soon as the output gap is given some positive weight – in line with the arguments of Rogoff (1985) and Fischer (1996) – the central bank has to consider the relative sizes of the inflation and output gaps, and none of the targets can then be said to be "overriding".

It is probably fair to say that the inflation-targeting central banks, after some initial years when their communication sounded as if it came from an "inflation nutter", have converged towards a strategy of flexible inflation targeting consistent with a loss function like (2) with $\gamma > 0$.[24] For example, Sveriges Riksbank (2010) has described its strategy as follows: "A well-balanced monetary policy is normally a question of finding an appropriate balance between stabilising inflation around the inflation target and stabilising the real economy". This means that the speed at which the central bank wishes to bring inflation back to target will depend on the

lower labour force participation and not only higher employment. In Sweden, employment has increased, but so has labour force participation, and unemployment has been stable. Are the arguments for a stimulatory monetary policy stronger in Sweden than in the U.S. because *unemployment* is higher, despite the fact that the *employment* rate is also higher?

[22] There is a debate as to whether central banks should have targets for unemployment (or employment) as a complement to or instead of targets for GDP. The question of how to define the relevant target for resource utilisation has been discussed above, and in the following we will use GDP as the variable representing the central bank's target for the real economy.

[23] This comment was made by Alan Blinder at a conference organised by Sveriges Riksbank in 1998.

[24] For a critique of the early rhetoric of inflation-targeting central banks, see Faust and Henderson (2004).

current and expected amount of slack in the economy. However, it will also depend on which disturbances have hit the economy and driven inflation and output away from their targets, since this will affect the trade-off between stabilising inflation and output. In a Monetary Policy Committee, it cannot be ruled out that different members have different views on (i) the relative weights on the inflation and output targets, (ii) the measurement problems discussed above, and (iii) the identification of disturbances that have caused the deviations from the targets.

In practice, Monetary Policy Committees seldom discuss their behaviour in terms of any loss function like (2) or reaction function like (1), which are only approximations of actual policy.[25] Central banks' rhetoric most closely resembles the loss function (2), but Taylor-type rules like (1) are nevertheless more commonly used as benchmarks for descriptions and evaluations of monetary policy. One reason may be that reaction functions like (1) are easier to use in formal models of monetary policy but it can also be explained by communication objectives. It is easier to evaluate whether policy is consistent with the Taylor rule (1) than with the loss function (2). The coefficients in an "optimised" Taylor rule do not, however, give any direct information about the central bank's preferences. The coefficients will be complicated functions of such parameters and other structural features of the economy. The important point here is that monetary policy decisions, as conducted in practice, are not strictly based on explicit welfare functions that define an optimal policy. There is considerable room, and a need, for policymakers to use judgement in their policy decisions. This also means that the extent to which policymakers under an inflation-targeting regime take financial stability risks into account is an open question.

The forecast horizon. Inflation-targeting (and other) central banks typically base their decisions on monetary policy on forecasts two to three years ahead, rather than applying a policy rule with an infinitely long planning horizon, as in (2). There are various reasons for this (apart from the trivial reason that it is cumbersome to handle all the data involved in a protracted forecast horizon).

First, the models used for policy analysis and forecasting typically have the property of the effects of monetary policy on inflation and output being gradual, with the largest effects occurring after one to two years.

Second, the general uncertainty about the forecasts typically implies that forecasts beyond the one- to two-year horizon may have little information value in a statistical sense. Sometimes "naïve" forecasts, such as the simple average (for the level or the growth rate) of a variable, have as much forecasting precision as more sophisticated model-based forecasts. Forecast uncertainty, however, is not an argument against making long-run forecasts. If policy decisions have long-run consequences, these consequences must of course be estimated, even if they are very uncertain. The argument here is not that policymakers should look just two to three years ahead, just that the uncertainty involved, and the limitations of the forecasting models, may make it difficult for the policymakers to apply a longer perspective.

[25] A central bank which has come very close to revealing its loss function is Norges Bank (see, eg Norges Bank, 2012). However, even the loss function used by Norges Bank in its Monetary Policy Reports should of course only be viewed as an approximation of actual policy.

Third, a relatively short horizon, at least for hitting the target, may be necessary for the central bank's credibility. In practice, inflation-targeting central banks often declare that they normally aim to bring inflation back to target within two to three years. One example is the "simple rule" applied by Sveriges Riksbank for some years which said that

$$E\pi_{t+2} = 2.0 \tag{3}$$

According to this rule, the interest rate should be set by the central bank such that the expected rate of inflation two periods (years) ahead is equal to the target of 2 per cent. Clearly, such a rule must be justified in terms of communication and credibility objectives. From a theoretical point of view, the rule can be criticised on several grounds. One type of critique is that the rule reflects the preferences of an "inflation nutter"; even if the rule allows for a gradual return to target after a shock, the ambition is to reach the target in two years exactly, irrespective of recent shocks and the consequences for eg the output gap. Another type of critique is that the rule is not very helpful, neither for the central bank nor external observers, since the objective of reaching the target in two years can presumably be met by several different paths for the interest rate; paths that could imply quite different (and possibly unstable) developments for the inflation and output gaps before and after the two-year horizon.

The "simple rule" (3) was abandoned by the Riksbank soon after medium- and long-term inflation expectations had stabilised around the inflation target. It seems likely that the rule helped to establish credibility for the target, despite the theoretical weaknesses of the rule. Furthermore, the two-year horizon has not been entirely eliminated from the Riksbank's description of its strategy: "There is no general answer to the question of how quickly the Riksbank aims to bring the inflation rate back to 2 per cent if it deviates from the target. The Riksbank's ambition has generally been to adjust the repo rate and the repo rate path so that inflation is expected to be fairly close to the target in two years' time" (Sveriges Riksbank, 2010). Similar statements can be found in declarations from other inflation-targeting central banks (eg Bank of Canada, 2014). Obviously, the chosen horizon is a parameter determined by policymakers' preferences and judgements, not the result of any particular formal model of inflation targeting or optimal monetary policy.

Interpretations of "interest rate smoothing". As noted above, central banks' policy rates differ quite considerably from what a Taylor rule without persistence ($c = 1$) would imply. There have been two different kinds of interpretations of this observation. According to one view, put forward by Rudebusch (2002) in particular, the significance of the lagged policy rate in estimated policy rules reflects that the rules are misspecified representations of the actual policy rules that the central banks have followed. This could, eg be the case if the central banks have instead tried to minimise a loss function like (2). An alternative interpretation has been that central banks do prefer to change the interest rate gradually and that this is reflected in high estimates of *c*. The two explanations are not mutually exclusive. If the central bank puts a high weight on interest rate smoothing in its loss function, empirical estimates of a Taylor rule which includes a lagged interest rate may still be misspecifications. Söderström et al. (2005) present a quantitative analysis of US data and argue that the high degree of persistence in the short-term interest rate reflects that interest rate smoothing is part of the Fed's objective function. They also

provide references to previous work that suggests that this, in turn, reflects the Fed's preferences for financial stability.

The long-run level of the policy rate. Irrespective of whether the central bank sets its policy rate according to a Taylor rule or in order to minimise a loss function, it has to have a view of the normal level of the policy rate in the long run, when inflation and GDP are both at their target levels. This level, which we denote by r^*, is not necessarily constant but may change over time. In theory, r^* is the sum of the long-run (steady-state) level of the real policy rate and the inflation target.

In practice, there has been a downward trend in real interest rates since the early 1990s, and this is a global phenomenon. Various explanations have been offered (see eg Hamilton et al., 2015). In theory, again, the level of "the" real interest rate should depend on the rate of economic growth and on consumers' preferences for (i) current versus future consumption, and (ii) smooth consumption (ie their risk aversion). If economic growth is high, expected income higher in the future than today, and if consumers are impatient and want a smooth stream of consumption, real interest rates will be relatively high. A slowdown in global economic growth can perhaps explain the decline in real interest rates in recent years, but hardly the decline over the decade before the financial crisis. The downward trend during that period has instead been explained as a result of globally higher preferences for saving. Higher saving after the crisis may be explained by both higher precautionary savings from the private sector, and higher government savings in response to earlier budget deficits.[26]

Since there has been a downward global trend in real interest rates, the driving forces, whatever they might be, are likely to be persistent. Consequently, central banks have lowered their estimates of r^* (see, eg Miles, 2014, Armelius et al., 2014, and Bank of Canada, 2014). It is obvious that such decisions involve a high degree of judgement.

Implementing the inflation-targeting strategy – concluding comments. In discussions of whether the degree of financial stability should be taken into account in monetary policy, the starting point (benchmark) is often an idealised and oversimplified picture of how inflation targeting is implemented in practice. Policymakers face considerable uncertainty about the optimal choices of the targets for inflation and GDP, about the relative importance (weights) of these targets, about the long-run level of the nominal interest rate, and about the appropriate target horizon. Judgements are unavoidable and monetary policy, therefore, should not be described as the implementation of any "simple rule" exactly. The extent to which financial stability risks have been taken into account is an open question. Since transparency is an important part of an efficient strategy it is desirable that central banks can be as explicit as possible about their views on the links between monetary policy and financial stability. The rest of the paper is an attempt to contribute to such a discussion.

[26] For another interpretation of the downward global trend in interest rates, that puts emphasis on the role of monetary policy, see Borio and Disyatat (2014).

2.3 Why indicators of financial stability may be useful in an inflation-targeting regime[27]

So far, our presumption has been that the stability of inflation and GDP are the only objectives of monetary policy. One type of argument that has been made, in particular after the recent financial crisis, is that financial stability should be a separate *objective* of monetary policy, in addition to price and output stability. Another, much less controversial, argument is that the importance of financial stability for the objectives of price and output stability has been underestimated, possibly because of measurement problems that have been discussed in section 2.2. We will discuss the arguments for having a financial stability objective in section 3, but it is useful to introduce an objective function for the central bank proposed by Woodford (2012) already at this stage. Woodford argues that imperfections in financial markets imply that the central bank's objective function should have the following form:

$$E\sum_t^{\infty}\beta^t\left[\left(\pi_t-\pi^*\right)^2+\gamma_1\left(y_t-y_t^*\right)^2+\gamma_2\left(\omega_t-\omega^*\right)^2\right] \quad (4)$$

where $(\omega_t-\omega^*)$ is a measure of some distortion on the financial markets, ie the effects of the distortion on welfare are minimised when $\omega_t=\omega^*$.[28]

Some of the arguments for giving financial stability a larger weight in monetary policy can however be justified on the basis of our previous discussion of inflation targeting without abandoning the idea that the purpose of monetary policy is to stabilise inflation and output. For example, suppose π measures inflation in terms of the CPI but that the ideal measure of inflation that monetary policy should focus on should also include asset prices, as argued by Alchian and Klein (1973). Let this ideal measure be denoted by π_0. Then, if ω is some measure of asset price inflation, (4) may be an appropriate loss function for the stabilisation of inflation and output if

$$(\pi_{0,t}-\pi_0^*)^2=(\pi_t-\pi^*)^2+\gamma_2(\omega_t-\omega^*)^2 \quad (5)$$

Similarly, suppose $(y_t-y_t^*)^2$ measures the squared deviation of GDP from a smooth trend while the relevant measure for welfare is the squared deviation from an efficient level of GDP denoted by $(y_t-y_{0,t}^*)^2$. Furthermore, suppose measures of distortions in financial markets reflected in $(\omega_t-\omega^*)^2$ are an important source of deviations between actual and efficient levels of GDP. Then (4) may again be an appropriate loss function for the stabilisation of inflation and output if

$$\gamma_1(y_t-y_{0,t}^*)^2=\gamma_1(y_t-y_t^*)^2+\gamma_2(\omega_t-\omega^*)^2 \quad (6)$$

[27] Arguments very similar to those in this sub-section have previously been discussed, and related to the inflation-targeting framework, by Disyatat (2010).

[28] In Woodford's (2012) analysis, $\omega_t-\omega^*$ is the gap between the marginal utilities of households that are credit-constrained and those that are not.

The correction factor $\gamma_2(\omega_t - \omega^*)^2$ which yields an economically more relevant output gap may, eg make use of information on financial cycles as suggested by Borio et al. (2013).[29] They also show that such an alternative output gap is more robust to differences between real time and ex post data.

Finally, indicators of financial stability may be used to compensate for the loss of information to policymakers that is associated with the use of a relatively short forecast horizon. Suppose the loss function that maximises welfare is given by (2) while the loss function applied in practical policy work is given by

$$E\sum_{t}^{t+2}\beta^t[(\pi_t - \pi^*)^2 + \gamma_1(y_t - y_t^*)^2 + \gamma_2(\omega_t - \omega^*)^2] \quad (7)$$

Then, minimising (7) may still come close to minimising (2), if the term $\omega_t - \omega^*$ captures important information about longer term developments in $\pi_t - \pi^*$ and $y_t - y_t^*$, ie beyond the forecast horizon $t+2$.[30] The findings reported by Drehmann et al. (2012) suggest that cycles in financial variables contain such information.

These arguments suggest why it may, in principle, be appropriate to "lean against the wind" and let monetary policy respond to indicators of the degree of financial stability even if financial stability is not a separate objective of monetary policy. The arguments do not question the idea that the objective of monetary policy is to stabilise inflation and output, but suggest that indicators of financial stability can be used to compensate for measurement errors in commonly applied data on inflation and output. This should not be taken to mean that monetary policy should not have a financial stability objective. But, this is another question, which we will return to below.

3. Links between monetary policy and financial stability: theoretical arguments and practical experience

The purpose of this section is to review theoretical and empirical arguments about links between monetary policy and financial stability. The literature contains arguments as to why there may be benefits both from including financial stability as an argument in the central bank's objective function, and from augmenting a Taylor-type rule with variables that provide information about the degree of financial stability.

So far, our discussion has mostly focused on problems of implementing inflation-targeting monetary policy without questioning the desirability of that strategy as such. That is, given that the monetary policy regime can be described by a Taylor-type rule like (1) or a loss function like (2), what analytical and practical problems have to be solved within this framework when it is implemented in practice? However, even before the outbreak of the financial crisis of 2007 – 2008,

[29] Kostas Tsatsaronis suggested this interpretation in private conversations.

[30] An example of such an approach is given by Sveriges Riksbank (2013, p. 42 – 48). A model based on the same idea has been presented by Ajello et al. (2015).

central banks were criticised for focusing too much on stabilising inflation and not paying enough attention to the links between monetary policy and financial stability. The crisis has made arguments for another – or at least a revised – strategy more common. A description of this change in mindset has been given in a speech by Malcolm Edey, Assistant Governor at the Reserve Bank of Australia (Edey, 2014):

> "One of the further consequences of the crisis has been a rediscovery, or at least a substantial upgrading, of the role of central banks in financial stability policy. ... I refer to this as a rediscovery rather than an innovation, because in many ways it represents a return to the original rationale for central banking. ... It was only in recent decades that some came to see their role as being more narrowly confined to the inflation control function. What we are now seeing, I think, is a better appreciation of the broader original role."

It could be argued that a better appreciation and a substantial upgrading of the central bank's responsibility for financial stability might have been justified even without the negative experiences from the financial crisis. Financial markets were deregulated virtually all over the world during the 1980s. This, together with technological innovations, led to the rapid growth of financial markets and of the balance sheets of corporations and households, and to increased interdependencies between financial markets in different countries. Financial intermediation has become increasingly supplied by institutions other than banks, which have been the central banks' and supervisory authorities' usual "customers". Altogether, the transmission mechanisms between monetary policy, inflation and production have changed, and presumably so too have the risks of financial instability. The consequences of these developments were not fully seen, or forecast, when the inflation-targeting strategy was developed in the 1990s. At that time, the inflation bias in monetary policy and the risks of economic policy shocks were seen as the main threats to macroeconomic stability, not innovations in financial markets.[31] The financial crisis has strengthened the arguments for reconsidering both the strategy for monetary policy and its analytical underpinnings. On the other hand, the narrowing of the objectives of monetary policy in the 1990s, and the development of analytical tools supporting inflation targeting, were partly justified by negative experiences from earlier monetary policy regimes. New recommendations for policy should preferably be based on careful theoretical and empirical analyses of the links between monetary policy and financial stability.[32] Why do these links deserve more attention, how could they influence how monetary policy is devised, and what are the implications in terms of new information that has to be presented to policymakers?

In this section, we first look at why it may be argued that financial stability should be an objective for monetary policy. Next, we consider various theoretical and empirical analyses of links between monetary policy and the degree of financial instability.

[31] It has been argued that the ECB's reluctance to apply an inflation-targeting strategy and insistence on a "monetary pillar" reflected concern for the risks of financial instability. See, eg Issing (2011).

[32] See Leeper and Nason (2014) for a detailed presentation of this argument.

3.1 A case for making financial stability an objective of monetary policy

As noted above, Woodford (2012) has suggested that the loss function for monetary policy should include a measure of the degree of financial stability, ω_t, in addition to the inflation and output gap, ie a loss function of the form (4). Woodford's argument is not that financial stability matters only because it affects forecasts of inflation and the output gap – which was the assumption in section 2.3 – but that financial stability is an objective in its own right. Woodford's argument is that imperfections in credit markets may reduce welfare through mechanisms that are not fully reflected in forecasts for inflation and output.[33] In particular, such imperfections may create a wedge between the interest rates faced by borrowers and savers (and, hence, between their marginal utilities of income). If monetary policy can reduce the effects of the distortions in financial markets, it can make the economy operate more efficiently, just like efficiency is higher when inflation is closer to the target and the output gap closer to zero. However, sometimes there will be a trade-off in the short run between stabilising ω_t and stabilising π_t and y_t.

Woodford's theoretical arguments are based on joint work with Vasco Cúrdia, and the links to standard models of monetary policy and the macro economy have also been explained in an earlier paper by Woodford (2010). In that paper, Woodford modifies a standard textbook IS-LM model by allowing for a spread between the interest rate that borrowers have to pay on their loans from banks (or other financial intermediaries) and the interest rate obtained by savers. The spread is assumed to reflect various costs of financial intermediation. These costs may depend, eg on the size of the financial intermediaries' capital or on the quality of their assets (the collateral for their funding). Woodford argues that it is necessary to analyse changes in the spread and in the credit supply from financial intermediaries to understand the development before and during the financial crisis, and the implications for monetary policy.

The difference between the interest rates for borrowers and savers may be an indicator of the degree of financial stability, ω_t, and may in practice be captured by eg the spread between corporate bonds and government bonds (or the difference between banks' lending and deposit rates). In terms of a simple macroeconomic model, ω_t will affect both aggregate demand (the "IS curve"; a higher spread is associated with less efficient financial intermediation and lower aggregate expenditure) and aggregate supply ("the Phillips curve"; a higher spread means lower marginal utility of workers and higher wage demands). Although very simple, Woodford's model suggests certain implications for monetary policy. First, the financial market friction implies that the central bank's policy rate is not the only relevant interest rate; the central bank must consider the different effects of

[33] Woodford's argument for an extension of the simpler objective function (2) is an example of a more general principle that the objective function should depend on the nature of the inefficiencies in the economy. See also Corsetti et al. (2010).

monetary policy on the interest rates for borrowers and savers.[34] Second, the supply of financial intermediation may itself be a source of shocks to the economy; shocks that monetary policy presumably should try to identify and respond to. But, Woodford (2012) also stresses that it is important, in order to understand the role of financial stability, to treat financial intermediation as partly endogenously determined. Woodford (2012) assumes that the degree of financial stability ω_t is affected by the degree of leverage in the financial system. The degree of leverage, in turn, depends both on endogenous factors – the output gap – and on exogenous disturbances (eg to banks' profits or risk-taking). A more expansionary monetary policy that leads to higher economic activity thus also increases banks' leverage. Central banks should also take such effects on financial stability into account. These conclusions all seem consistent with experience from the financial crisis (and with the arguments by eg Stein, 2014).

One question about the links between monetary policy and financial stability that has been discussed both among researchers and policymakers, is whether the degree of financial stability has implications for monetary policy only in crisis situations, or if also more normal fluctuations in financial intermediation have to be considered. Woodford (2012) chooses to model the degree of financial stability as jumping between two states. Either ω_t is low, a normal state, or high, a crisis state. It is the probability of the economy making a transition from one state to the other that is assumed to depend on the degree of leverage in the financial sector. But, Woodford emphasises that, in practice, the central bank has reasons to consider a whole vector of variables capturing the supply of credit and other measures of risk in the financial system. *This is completely analogous to the discussion about how to measure the inflation gap and the output gap; certain definitions of financial stability may be suggested by certain models, but in practice policymakers have to consider a wide range of different measures*.

Woodford (2012) stresses that the quantitative implications for monetary policy of having a financial stability objective in addition to inflation and the output gap will vary over time and may be small or large. [35] They will be small when the degree of financial instability is low in relation to the deviations of inflation or output from their targets, but they may be large if eg leverage is high while inflation and output are relatively close to their targets. The implications of the financial stability objective may also depend on whether the central bank or some other authority has access to other policy instruments that can be used to affect the degree of financial stability.

Even Woodford's simple model suggests a list of variables that the central bank needs to model and forecast, in addition to inflation, the output gap and its own policy rate: credit volumes, the levels of, and spreads between, various bank interest rates or market rates, and banks' (and other financial intermediaries') profits, capital and risk-taking. A central bank typically has very good access to such data due to its

[34] In 2012, Norges Bank introduced a new objective function with a third argument that was supposed to capture the degree of financial stability (Norges Bank, 2012). However, the new gap that was included in the objective function was not the bond spread but the difference between the policy rate and its long-run level, $r_t - r^*$. This gap may of course be correlated with the bond spread.

[35] Stein (2014) presents similar arguments on this issue.

responsibilities for the payment system and (possibly) supervision of financial institutions and markets.[36] Exactly what data will be used and how depends on which models of financial stability and monetary policy the central bank prefers. In practice, of course, richer models and larger data sets than those suggested by Woodford's analysis are needed, but Woodford's model still gives clear guidance as to the questions policymakers and their advisors need to address, namely:

- What are the frictions on financial markets that policymakers need to analyse?
- What factors are most important for estimating the probability of a financial crisis?
- How can monetary policy affect financial frictions and the probability of a crisis?
- Should monetary policy only take risks of financial stability into account when a financial crisis appears to be imminent, or should monetary policy also stabilise more normal fluctuations in the degree of financial stability?[37]
- What are the implications for monetary policy if there are other policy instruments that can also affect the degree of financial stability, in addition to the central bank's interest rate?

Before turning to other contributions to the literature on these issues, it deserves to be mentioned, firstly, that an objective function like (4) with a financial stability objective, as suggested by Woodford (2012), can been criticised on the grounds that the objectives of monetary policy in many central banks' legislation are often limited to stabilisation of π_t and y_t. According to this view, the central bank's objective is not, as assumed by Woodford (2012), to maximise the welfare of the representative individual, but to implement flexible inflation-targeting. However, central banks' mandates often include a responsibility to "promote a safe and efficient payment system" (or similar formulation), and this furthermore seems to be fully in line with the central bank's "original role" (Edey, 2014; see also Giannini, 2011, and Norman et al., 2013).[38] But, secondly, the financial friction in Woodford's model (and other models we will consider below) implies that the economy is characterised by imperfect risk-sharing (in Woodford's model between borrowers and savers). This, in turn, may imply that if monetary policy is used to dampen the effects of the friction(s), then monetary policy will affect not only aggregate welfare but also its distribution. This makes the discussion of the optimal design of monetary policy more complicated because it adds a political dimension.[39] Whether

[36] See eg Peek at al. (2009), who argue that the FOMC in the U.S. has changed the Fed funds rate not only in response to changes in the outlook for inflation and output, but also based on information about the health of the banking system.

[37] This distinction is perhaps less interesting than it first may seem. Even if the "crisis"/"no crisis" indicator is a binary variable, the probability of a crisis is a continuous variable. If the central bank wants to stabilise the probability of a crisis, it will presumably also have to intervene in "normal" times. This also appears to be the policy conclusion drawn by Woodford (2012) and Stein (2014).

[38] See Billi and Vredin (2014) for a review of related arguments.

[39] It deserves to be emphasised that monetary policy may have distributional consequences even in the absence of financial frictions. See Leeper and Nason (2014) for a more detailed discussion. Acharya (2015) presents political-economy arguments for and against giving the central bank an explicit financial stability mandate. Acharya focuses on the connections between monetary policy and the central bank's role as a lender of last resort.

or not an objective function like (4) may be viewed as a fully legitimate interpretation of the central bank's mandate can therefore be a controversial issue.

3.2 Models of financial frictions, financial stability and monetary policy

Woodford's (2012) argument for including a financial stability objective in the loss function for monetary policy is not, in principle, based on the occurrence of financial crises. That more normal variations in the degree of financial stability also may be welfare-reducing has been shown in extensive and growing literature on the implications of financial frictions. Some of the analyses in this literature focus on frictions due to constraints on the financial intermediaries' balance sheets, like Woodford (2010, 2012). Other models focus on constraints associated with the borrowers' – non-financial firms and/or households – balance sheets instead.[40] In some of the contributions to the literature, explicit assumptions about the central bank's behaviour are made, either in the form of a reaction function like (1) or an objective function like (2). But, in some analyses monetary policy is not explicitly modelled.

Gertler and Kiyotaki (2011) present a theoretical model of financial intermediation which includes a market for loans between banks, ie an interbank market. Banks' lending is subject to an endogenous capital constraint due to the fact that depositors and other banks expect there to be a probability that the bank may default. The capital constraint on lending implies that the interest rate on banks' loans will be higher than the interest rate on deposits. Negative shocks to the economy will be amplified through the negative effects on bank capital and lending, and the strength of this accelerator (which is also reflected in the interest rate spread) is proportional to bank leverage. In the case of a negative shock, the effects can be counteracted by "credit policies" from the central bank. The central bank can either lend directly to non-financial firms or to banks on the interbank market ("discount window lending"), or inject capital into the banks. All such activities are costly and hence the costs of such funds will exceed the interest rates on deposits and government bonds (which are the same).

Gertler and Kiyotaki stress that their model is a real model without nominal rigidities. The model thus explains how real changes in the central bank's balance sheet – credit policies that are essentially fiscal policy – can influence the supply of credit in the economy. It also explains why it may be reasonable for the central bank to intervene when the economy is subject to various shocks, reflected in eg changes in spreads and banks' capital. A central bank that reacts to increases in spreads can dampen the effects on output. Although the model does not analyse monetary policy in the form of changes in a nominal interest rate, it does support Woodford's (2010, 2012) general idea that it may be desirable for the central bank to use its instruments to counteract disruptions in financial intermediation.

Gertler and Karadi (2013) present a model which enables comparing credit policies of the type implemented by several central banks during the crisis with more "conventional" monetary policy described by a Taylor rule for the short-term nominal interest rate. The model of financial intermediation and frictions is similar

[40] The latter models are sometimes referred to as models of the "broad balance sheet channel" or "broad credit channel", while the former analyses are called models of the "bank capital channel".

to the model proposed by Gertler and Kiyotaki (2011).[41] If the central bank – which, in contrast to private banks, is assumed not to be finance-constrained (because it is expected to always honour its obligations) – makes open market operations in the form of purchases of long-term government bonds or private securities, this will affect the excess returns on these assets compared to short-term government bonds or deposits (which are assumed to be perfect substitutes). If the economy is hit by a negative shock which lowers the banks' net worth and their lending capacity, spreads will go up and GDP and inflation down. The central bank can dampen these effects by purchasing government bonds or private securities.[42] A given size of asset purchases has a larger effect if the central bank buys private securities rather than government bonds, because the former relaxes the banks' balance sheet constraints more. Gertler and Karadi stress that the effects of these types of credit policies are qualitatively the same as the effects of conventional monetary policy, which in their model implies that the central bank changes the nominal interest rate on short bonds (and deposits).[43] That is, it is in principle possible to calibrate changes in the short-term nominal interest rate and purchases of long government bonds or private securities so that the effects on the economy are the same. One difference is that the zero lower bound on nominal interest rates becomes more easily binding for the short-term nominal interest rate than for the other asset returns (which give excess returns because of the financial frictions).

Lambertini, Mendicino and Punzi (2013) show, also within a calibrated theoretical model, that it may be desirable for monetary policy to respond to changes in household debt. Their model does not include any financial frictions that give rise to any spread between the interest rate set by the central bank and households' borrowing rate. However, some households face borrowing constraints. Another imperfection is that households' expectations are based on signals about future shocks to technology (including housing production) and monetary policy that may not materialise. There are two different kinds of households: borrowers and lenders. Their expectations can generate undesirable financial cycles in the form of booms and busts in housing prices, household debt, GDP, inflation, etc. Lambertini et al. show that a Taylor-type interest rate rule that optimises social welfare includes a response to changes in household debt, even in the case when there is a countercyclical loan-to-value restriction that also responds to debt.[44] However, the modified Taylor rule and the countercyclical LTV restriction have different welfare implications for borrowers and savers.

[41] As in the Gertler-Kiyotaki model, banks are assumed to be constrained by the size of their capital, and households are assumed not to be able to lend (without costs) directly to corporations but only via banks. In addition, households can only (without costs) invest in long bonds via banks.

[42] Gertler and Karadi do not present any reaction function for the central bank which includes asset purchases. Rather, the experiments analysed involve exogenous interventions.

[43] When Gertler and Karadi analyse the effects of asset purchases from the central bank, the experiment also involves a monetary policy shock, because the central bank is assumed to deviate from the Taylor rule and keep the nominal short term interest rate constant for a certain period.

[44] Interestingly, optimal monetary policy involves no interest rate smoothing in the analyses by Lambertini et al. One (positive) interpretation of the empirical findings of interest rate smoothing may thus be that they reflect the influence on monetary policy from variables that have been omitted from the Taylor rule (as suggested by Rudebusch, 2002); it may reflect a financial stability motive, eg to stabilise household debt.

Gambacorta and Signoretti (2013) present a model with both a loan-to-value restriction on households/entrepreneurs (similar to that in the model by Lambertini et al.) and a financial friction that makes the banks' supply of loans dependent on the size of their capital (as in the Gertler-Kiyotaki and Gertler-Karadi models discussed above). The central bank determines the *real* interest rate on households' deposits with the banks (ie the central bank in effect determines the supply of funds to the banks), and the banks set the loan rate as a mark-up on the deposit (policy) rate. The mark-up depends on the banks' capital-to-asset ratio. Using a somewhat different criterion for optimal policy, and focusing on the effects of supply-side shocks, Gambacorta and Signoretti reach a different conclusion than Lambertini et al.: it may be more important for the central bank to "lean against" fluctuations in asset prices than in credit.

The links between monetary policy and financial stability highlighted in the literature on financial frictions have so far only partially been included in central banks' core macroeconomic models. For instance, Sveriges Riksbank's DSGE model, Ramses II[45], includes an endogenous spread which is due to financial frictions. The existence of financial frictions amplifies the effects of monetary policy on investment, but not on consumption, hours worked or GDP. Increases in the deposit rate (= the central bank's policy rate) increase the spread (and vice versa for decreases in the deposit rate). The reason for this is that a higher nominal interest rate reduces the net worth of corporations.[46] Given that the spread reflects financial frictions – and given the insights from similar models reported in this section[47] – it seems reasonable to assume that an augmented Taylor rule would indeed raise welfare in a model like Ramses II.

This brief (and selective) literature review indicates that the policy conclusions that can be drawn from Woodford's (2010, 2012) simple models can be supported by more elaborate models of the interactions between financial intermediation, the real economy and monetary policy. It may be desirable to allow monetary policy to stabilise not only inflation and production, as in the standard inflation-targeting framework, but also some measures of financial stability (such as spreads, credit or asset prices). Woodford (2012) argues that financial stability should be one of the central bank's objectives, along with price and output stability. Macroeconomic models with financial frictions often do not address this question directly, but a common result is that welfare can be improved if a central bank that follows a simple Taylor rule like (1) augments the rule with some measure of the effects of financial frictions.

3.3 The risk-taking channel

Gertler and Karadi (2013) show that monetary policy in the form of large-scale asset purchases may be used as a supplement, or substitute, for a Taylor-rule policy. They view large-scale asset purchases as becoming relevant only when financial intermediation is severely distorted, partly because such asset purchases are

[45] Adolfson, Laseen, Christiano, Trabandt and Walentin (2013).

[46] The model by Gertler and Karadi (2013) shows the same relationship between monetary policy and the spread.

[47] See also Gilchrist and Zakrajsek (2011).

associated with costs for the central bank, but also because they become necessary only when the nominal interest rate has reached its zero lower bound. However, Gertler and Karadi also show that "conventional" monetary policy in the form of changes in a nominal interest rate rule and "unconventional" policy in the form of asset purchases (or sales) have qualitatively the same effects. This is an example of how analyses of the links between monetary policy and financial stability have involved a return to an older "portfolio balance" view of monetary policy in the tradition of James Tobin.[48]

One channel for the effects of monetary policy on the private sector's decisions on savings, investments and portfolio composition may go through effects on risk premia and, hence, risk-taking. Several researchers have emphasised that experiences from the recent financial crisis (both the initial expansion on financial markets and the subsequent downturn) have shown not only that an active monetary policy may dampen the negative effects of financial frictions, but also that it may affect the private sector's risk-taking behaviour. Theoretical arguments on the risk-taking channel have been presented by, eg Borio and Zhu (2008), Adrian and Shin (2010) and Drechsler et al. (2014).

Borio and Zhu (2008) define the risk-taking channel as "the impact of changes in policy rates on either risk perceptions or risk tolerance". In the case of banks, their risk tolerance may eg increase if lower policy rates lead to an overall more positive economic development that leads banks to lower their estimates of their "value-at-risk" (Adrian and Shin, 2010). Lower short-term interest rates also increase banks' profitability and hence their "risk-taking capacity". These mechanisms may encourage the banks to expand their balance sheets and increase their leverage, something that could eventually lead to higher risks (Drechsler et al., 2014). Empirical evidence on the links between monetary policy and banks' risk-taking have been presented by, eg Jimenez et al. (2014) and Bomfim and Soares (2014). As banks increase their supply of bank loans, they also seem to give loans to riskier borrowers.

The risk-taking channel does not only apply to banks, however. Both empirical and theoretical arguments suggest that financial intermediaries outside the banking system seem to have at least as strong risk-taking incentives as banks; see Rajan (2005) and Adrian and Shin (2010). Rajan (2005) suggested that a low nominal interest rate level may lead to more risk-taking by financial intermediaries which have fixed targets for returns in nominal terms (eg pension funds), the so-called "search for yield" behaviour. Adrian and Shin (2010) have stressed the increased importance of non-bank financial intermediaries and that their financial constraints seem to have been more important before and during the crisis than the constraints facing commercial banks.

Rajan (2005) argued that developments on financial markets – deregulation, technological and financial innovations, and globalisation – have lowered financial frictions and in this sense have made the world economy more efficient. However, these developments have also led to new and higher risks. Increased competition between banks and new forms of financial intermediation have, for example, led banks to take higher liquidity risks and investment managers to take higher risks in

[48] For another example, see the analysis of the Swiss central bank's actions by Christensen and Krogstrup (2014).

general. The growth of credit supply is increasingly funded via financial markets rather than bank deposits. This makes credit supply more sensitive to market disturbances (also on global markets), and also changes investors' incentives and possibilities to monitor credit and liquidity risk. Rajan recommended that the central bank should take the effects of monetary policy on asset prices into account (in line with the recommendations by Alchian and Klein, 1973); that the effects of monetary policy not only via the banking system but through the whole financial system must be considered; and that central banks should "be vigilant for any possible shortfalls in aggregate liquidity" (p. 352).[49]

There is also a more macroeconomic version of the argument about risk-taking which takes a broader perspective on the question of how monetary policy influences the private sector's behaviour and expectations. Reforms that gave central banks more independence and explicit inflation targets were introduced to counteract a time-consistency problem in monetary policy that gives rise to an inflation bias (see, eg Rogoff, 1985). Over time, a consensus emerged among researchers and central bankers that flexible inflation targeting was an appropriate strategy (see section 2), implying that the central bank should stabilise not only inflation but also real economic activity. For a decade or even longer, experiences were very positive and monetary policy seemed to contribute to better outcomes for inflation, production and employment – the so called Great Moderation. But, evidently, risks that were underestimated were building up. Borio and Lowe (2002), Rajan (2005) and Greenspan (2004) all noted that the active stabilisation policy from central banks may have lowered private agents' uncertainty and increased their optimism more than could really be justified.[50]

3.4 Early warnings of financial crises

The theoretical analyses presented so far suggest that frictions on financial markets may amplify the effects of various disturbances to the economy, including changes in monetary policy, that changes in the frictions themselves may give rise to fluctuations in inflation and production etc., and that monetary policy may be used to dampen the effects of the frictions. Woodford (2012) has suggested that some measure of the degree of distortions on financial markets may be used as an

[49] The idea that the central bank's policies affect risk-taking in the financial system is not new. But, traditionally this link has been discussed in connection with the central bank's role as lender of last resort. The connection between monetary policy and the role as lender of last resort has not been widely discussed. For an exception, see Sargent (2011), who points out that questions about the central bank's role in the financial system generally concern a trade-off between stability and efficiency.

[50] Greenspan (2004, p. 35): "Perhaps the greatest irony of the past decade is that gradually unfolding success against inflation may well have contributed to the stock price bubble of the latter part of the 1990's". Borio and Lowe (2002, p. 21): "a successful record by the central bank may well reduce the probability that the public assign to the occurrence of a sustained economic downturn. Lower uncertainty can then translate into higher asset prices and an increased willingness of investors to borrow, and financial institutions to lend. These responses can ultimately make the financial system more vulnerable to an economic downturn". Rajan (2005, p. 333) notes that there had been "growing perceptions of reliability, accentuated by good times". The arguments made by Borio and Lowe (2002), Rajan (2005) and Greenspan (2004) are based on the assumption that expectations may be at least partly irrational. The literature reviewed by Sargent (2011) includes models with both rational and exogenous expectations.

operational definition of financial stability that may be included in the central bank's objective or reaction function, along with measures of price and output stability. However, the models reviewed so far do not typically generate as large swings in the macro economy as can be observed in connection with financial crises. However, there is extensive literature about "early warnings" of financial crises which suggests that crises are preceded by substantial movements in the same variables that are believed to provide good measures of financial frictions. Therefore, if monetary policy can be used to dampen normal business cycle fluctuations that are exacerbated by financial frictions (and risk-taking), an argument can be made that this will also lower the risk of financial instability in the form of broader crises.

Based on data for 34 countries from 1960 – 1999, Borio and Lowe (2002) showed that the deviation of the credit-to-GDP ratio from trend, ie a credit gap, is a good indicator of an impending financial crisis. If the credit gap is combined with an asset (equity) price gap, the signal becomes even clearer. They also showed that there is no systematic pattern of inflation picking up in the years before a financial crisis or before years characterised as lending booms (with unusually high credit gaps). These findings led Borio and Lowe to conclude that financial imbalances can also build up in low-inflation environments and that it is appropriate for policy to respond to such imbalances "in some cases".

Later studies using longer and/or more recent datasets largely corroborate Borio and Lowe's (2002) findings. For example, Schularick and Taylor (2012) use annual data for 14 countries from 1870 – 2008, Drehmann and Juselius (2013) analyse quarterly data for 26 countries from 1980 – 2012, and Anundsen et al. (2014) use quarterly data for 16 countries from 1970 - 2013.[51]

Drehmann and Juselius confirm that the credit gap is a useful indicator. They also argue that the debt service ratio can be used as an early warning of financial crises. Schularick and Taylor emphasise the role of credit growth, rather than the credit gap, but they also show that the level of credit in relation to GDP has the power to predict financial crises.

Anundsen et al. confirm that credit is an informative early warning indicator of crises, irrespective of whether it is measured in terms of a credit gap or a growth rate. In addition, they find that house prices (in relation to income, or growth rates) and the structure of the liability side of banks' balance sheets (bank capital and dependence on non-core funding) indicate the vulnerability of the financial system. Anundsen et al. also show that the output gap has a significant effect on the probability of a financial crisis when the other indicators are included in the model, although it is difficult to detect any unusual movements in output gaps as such before crises. The latter finding supports the idea, discussed in section 2.3 and also put forward by Borio and Lowe (2002), that indicators of financial vulnerability may provide useful information about the future development of the output gap that is not reflected in observations of the output gap itself (or of inflation). Anundsen et al. also investigate the role of global factors. Measures of a global credit-to-GDP gap provide no extra information when domestic factors have been accounted for,

[51] These papers also contain more information about the extensive previous literature on early warning indicators.

but a global house price-to-income gap is found to have a significant effect on the probability of a financial crisis.[52]

Empirical regularities thus suggest that if the central bank wants to promote financial stability, it should closely monitor, and try to influence, variables such as credit, debt service, house prices and banks' balance sheets. A relevant counter-argument is that the empirical regularities do not, in and of themselves, permit causal interpretations, and if the central bank were to change its policy then the observed correlations would also change (an example of the so-called Lucas critique). However, it is, in principle, possible to interpret the empirical regularities using eg Woodford's (2012) simple model, which does provide a theoretical framework for analyses of the links between the early warning indicators of financial instability and monetary policy. Other theoretical explanations of the mechanisms involved have been offered by Rajan's (2005) "early warning" of the recent financial crisis.

Despite the early warnings from Borio and Lowe (2002) and Rajan (2005), and the subsequent crisis, there is still no consensus about whether or how financial market vulnerabilities should be counteracted through the use of monetary policy. Woodford (2012) and Stein (2014) argue that the interesting question is no longer about *if* monetary policy should respond to changes in the degree of financial stability – they both view this argument as reasonable, in principle – but about *how* this should be done, and about the *quantitative* implications for monetary policy in practice. For practical policy, it is not sufficient to know that it may be desirable to let monetary policy respond to eg credit (in addition to the usual goal variables, inflation and the output gap). It is also necessary to know what measure of credit should be targeted in that case.[53] This question is obviously closely related to the discussion about the measurement of target variables for macroprudential policy; see eg Drehmann and Tsatsaronis (2013) for a discussion of the "credit gap". But, in principle, this question of finding empirical representations of theoretical concepts is no different from questions that have been under discussion in the inflation-targeting regime (see section 2.2). In section 4 we will discuss the kind of information on which policymakers need to form views in terms of risks of financial instability and consequences for monetary policy.

3.5 Lessons

The review in this and the previous section suggests some lessons about the links between financial stability and monetary policy that can be drawn from history and theory. These lessons also provide guidance on how information about financial stability can be included in monetary policymaking, which is the subject of the next section.

[52] Borio and Drehmann (2009) also examine the roles of property prices and global linkages.

[53] Ideally, the central bank should be able to identify the various shocks that drive inflation, output and credit etc., since the optimal response, in general, will depend on which type of shock has generated the fluctuations. However, macro models that describe monetary policy in terms of a Taylor-type rule like (1), rather than a loss function like (2), are based on the implicit assumption that the central bank cannot observe individual shocks but only the outcomes of the macro variables.

Lesson 1. Inflation targeting is not governed by any "simple rules". There are, eg no straightforward definitions of the targets for inflation or output, or of the steady-state level of the nominal interest rate. Furthermore, the optimal speed of adjustment back to the targets depends, in principle, on the type of shocks that have created the deviations, but these shocks are not directly observable. Policymakers recognise this uncertainty and do not follow any simple policy rules exactly. They have to apply judgement and put some weight on information and risks that are not included in the standard analyses presented to them. Attention to risks of financial instability need not break the logic of inflation targeting, as implemented in practice.[54]

Lesson 2. Frictions on financial markets affect the transmission mechanisms of monetary policy, but may also affect the central bank's objectives. Changes to the degrees of stability and efficiency of financial markets affect the links between the central bank's policy instruments and the credit supply to households and corporations. However, the existence of such disturbances also provides justification for why financial stability can be one of the central bank's objectives – in addition to the stabilisation of inflation and GDP.[55]

Lesson 3. Monetary policy affects the degree of financial stability. Irrespective of whether we choose to define financial stability in a narrow sense (eg as the probability of a financial crisis) or in a broad sense (eg as the stability and efficiency of the payment and credit system), theoretical and empirical analyses suggest that the design of monetary policy affects financial stability. A more expansionary monetary policy alleviates the effects of financial constraints on financial intermediaries, non-financial corporations and households.[56] But, it may also lead to higher risk-taking, and therefore higher risks of financial instability.[57] The quantitative importance of this argument remains an open issue, however.

Lesson 4. The central bank has reasons to adjust its policy instrument(s) in response not only to expected fluctuations in inflation and GDP, but also to measures of financial stability. This result emerges in models in which the central bank follows a simple (suboptimal) Taylor-type rule. But, as noted above, there are also reasons for why the central bank should have a financial stability objective, in which case it becomes even more important to monitor and respond to indicators of financial stability. This can contribute to higher welfare eg by stabilising consumption when the economy is hit by normal shocks to business conditions. It can, however, also reduce the risk of a financial crisis (eg by counteracting great fluctuations in credit and asset prices – factors that are known to precede financial crises).[58] More quantitative analyses of these links are needed, however.

Lesson 5. There is no straightforward optimal single indicator of financial stability, so the central bank will have to monitor, and possibly respond to, a vector of indicators.

[54] This argument was explained in more detail in section 2.3. See also Disyatat (2010).

[55] See Woodford (2012).

[56] See section 3.2.

[57] See section 3.3.

[58] Empirical analyses of the correlations between financial crises, credit and asset prices were presented in section 3.4. Arguments for why Taylor-type rules should be augmented with indicators of financial stability were presented in section 3.2.

One reason for this is that no single indicator can identify the shocks to which the central bank should respond. Monetary policy should presumably respond differently to a change in eg credit depending on whether the change is driven by a demand or supply shock. Another reason is that any definition of an optimal target or indicator is model-specific, ie it depends on specific assumptions about the links between monetary policy and financial stability. These observations apply to the inflation-targeting strategy as well (see section 2). They explain why there is a significant element of discretion in monetary policy – which presumably involves both advantages and disadvantages and has to be balanced by a high degree of transparency.

Lesson 6. The appropriate interest rate policy will depend on other policies for financial stability, and vice versa. First, "conventional" and "unconventional" monetary policies have similar effects on credit supply, inflation and GDP.[59] Second, the effects of monetary policy and macroprudential policy work through similar channels.[60] Therefore, the central bank's interest-rate policy will depend on how the other instruments are used.

4. Different ways of including measures of financial stability in monetary policymaking

The purpose of this section is to provide specific and constructive suggestions on information and analyses that can help policymakers to understand the links between monetary policy and financial stability – even if no fully fledged analytical framework is available. The objective is to achieve "a more systematic and structured assessment of the risks" (BIS 84th Annual Report, 2014, p. 19). This can be done by firstly extending the standard information set considered in monetary policy with more information about financial conditions and indicators of financial stability. This information can then be used in a suite of models in ways similar to the analyses conducted by central banks today; partial and general equilibrium models, and structural and non-structural models, can be used to produce forecasts and alternative scenarios.

In the previous section, we reviewed arguments for why decisions on monetary policy should be based not only on forecasts of inflation and the output gap, in line with the inflation-targeting strategy discussed in section 2, but also on information about financial stability and its connections to monetary policy. Against that backdrop, this section presents suggestions on *how* financial stability can be brought into monetary policymaking.

Central banks already analyse indicators of financial conditions and financial stability in their usual procedures for forecasting and policy analysis. This is done with a suite of models that have been constructed for different purposes and with different strengths and weaknesses. For instance, univariate or bivariate indicator models are used to make short-term forecasts (eg in so called "now-casting" models), larger non-structural models are used for longer-term forecasts, and structural models (based on more economic theory) are used to analyse alternative

[59] See Gertler and Karadi (2013).

[60] See Cecchetti and Kohler (2012) and Alpanda et al. (2014).

scenarios, including different alternatives for monetary policy. The suggestion here is simply to apply similar methods in systematic ways to shed more light on the links between monetary policy and financial stability. Given that there is no generally accepted single theoretical model that can capture all important connections between monetary policy and financial stability, it is completely natural to consider a suite of indicators and models, without any obvious ranking or order. In this section, we have organised the presentation into three sub-sections: financial conditions and the transmission mechanisms of monetary policy, indicators of financial stability, and implications for monetary policy.[61]

4.1 Financial conditions and the transmission mechanisms of monetary policy

A natural first step in the provision of information to a Monetary Policy Committee before an interest rate decision would seem to be reports on the conditions on financial markets and whether the conditions seem to be consistent with a stable and efficient transmission mechanism between monetary policy and the central bank's objectives. Have conditions on financial markets developed as expected, or can any new shocks be identified? To the extent that there have been big surprises, have these shocks originated on financial markets, or have the markets just reacted to new information about the rest of the economy? Are there any signs of irrational expectations or is the development largely consistent with "fundamentals"? Are there any changes in financial frictions that would justify a monetary policy reaction even in the absence of other shocks to inflation and GDP?

Against the background of analyses reviewed in section 3, a decision-making board has reason to ask for the following information:[62]

The development of broad credit aggregates: The volume of banks' lending to households and corporations is an indication both of the effects of monetary policy and of potential risks to financial stability. But, households and corporations' borrowing from financial intermediaries other than banks should also be considered. In addition, corporations' financing via financial markets (corporate bonds, the stock market) should be monitored. Such information is often presented

[61] This sequence of arguments resembles the organisational charts (and internal meeting structures) at many central banks, where there often are separate departments for financial markets, financial stability and monetary policy (or "economics"). The three sub-sections also resemble the analytical structure proposed by Adrian and Liang (2014). The lists of data in sections 4.1 and 4.2 that the central bank is advised to consider are considerably smaller than the information set suggested by Adrian and Liang. This is not because this paper views the extra information as unnecessary. Rather, it can be explained by the ambition to provide a simple structure for the information presented to a Monetary Policy Committee; and as a first step towards including more information about financial stability in monetary policy discussions than is typically done today. The ideal information set will also depend on each country's financial structure. For example, shadow banks are more important in the U.S. than in the world economy on average. The model by Alpanda et al. (2014) is also a useful starting point for a discussion of how to organise information on financial stability and monetary policy for policymakers.

[62] The discussion in this sub-section is focused on information on financial conditions that are particularly interesting for the purpose of taking *financial stability* into account. Monetary policymakers also have other reasons to monitor financial developments, since such developments also have importance for inflation and GDP via channels that are of little importance from a financial stability perspective.

to monetary policy committees; the argument here is that the analyses should attempt to shed light on whether volumes reflect a normal and expected development, given the current state of the business cycle (as indicated by eg some measures of "credit gaps"), or whether there are any signs of growing imbalances (eg rationing or excessive borrowing).

Interest rates and spreads: Monetary policy is designed to achieve (among other things) certain effects on credit conditions for households and corporations. If the transmission mechanisms via financial intermediaries and financial markets are efficient and stable, the central bank does not have to change the way it implements monetary policy. Indications of whether any changes are needed are provided by various interest rates and spreads.

- Spreads of private debt instruments over government debt (both at longer maturities and short-term instruments, as reflected in eg the so-called TED spread) reflect both credit risk premia, liquidity premia and the severity of various financial constraints. See Woodford (2012) and Stein (2014).
- Spreads between short and long-term interest rates may provide similar information. Spreads between long and short securities, and between banks' lending and borrowing rates, reflect expectations about monetary policy but also term risk premia. Lower-term spreads (reflecting expectations about lower future policy rates and/or lower-term premia) also affect the profitability and risk-taking capacity of banks and other financial intermediaries. See Adrian and Shin (2010).

Other asset and commodity prices and indices of volatility: Do the levels and volatilities of stock prices, real estate prices, exchange rates, and selected commodity prices reflect a normal and expected development, given the current state of the business cycle? Or, are there any signs of behaviour that are hard to explain in terms of "fundamentals"?

Overall assessment: Data on financial conditions are regularly presented to decision makers at central banks. To shed more light on the links between monetary policy and the degree of financial stability, there should be more emphasis on whether the financial conditions provide any information about unexpected developments on financial markets per se or on changes in the transmission mechanisms of monetary policy. Has monetary policy had the expected effects on financial conditions, including both broad developments of credit aggregates and financing costs? To the extent that some important unexpected developments have been identified, do the patterns of changes in spreads and volumes seem to reflect shocks to supply of credit (financial intermediation) or demand? Have prices of risk gone up or down? What is the importance of domestic and global factors, respectively? Do the data on financial aggregates and prices suggest that frictions on financial markets have become larger or smaller? Have there been any important changes in the transmission mechanisms of monetary policy that go via financial markets? Would such changes have any implications for monetary policy even if there was no other new information on inflation or GDP? Experience from the financial crisis suggests that the importance of changes in financial conditions has been underestimated, so monetary policy committees should devote more attention to such developments in the future.

4.2 Indicators of financial stability[63]

A central bank has access to much more information on the degree of financial stability than is reflected in the time series and macro data discussed in the previous subsection, irrespective of whether or not the central bank is responsible for micro- and macroprudential policies. For instance, central banks have (or are entitled to obtain) detailed information on banks' assets and liabilities and the conditions they apply to loans to households and corporations (in addition to the interest rate levels). One reason for why this information is required is the central bank's role as lender of last resort. Central banks may experience greater difficulty in obtaining detailed information on financial intermediaries other than banks and on non-financial corporations and households.

Data on financial intermediaries. The sizes of balance sheets, capital and leverage indicate both risks of default of individual institutions and systemic risk (Adrian and Shin, 2010). The turnover and interest rates on the interbank market provide information about the banks' confidence in other banks and about the stability of monetary policy transmission mechanisms. The banks' reliance on deposits and non-core (especially short-term and foreign) funding also provides information about the stability of the financial system. Volumes and haircuts on repo markets also provide information about risks in financial intermediation. What are the results from various stress tests on financial intermediaries (including sensitivity to changes in monetary policy)?[64]

Household finances. The debt service ratio of households can also provide a signal about the degree of financial stability, in addition to the aggregate volume of credit (growth rate or some gap), see Drehmann and Juselius (2013), and Juselius and Drehmann (2015). The extent to which households' borrowing consists of fixed versus floating interest rates may have implications for households' vulnerability to changing macro conditions, including monetary policy. Measures of households' solvency and liquidity are, of course, also important. It is important to look not only at aggregate data but also to study the distribution of eg debt and debt service across households, since the private sector's sensitivity to various shocks may be more related to the status of the marginal than the average borrower. It is also important for the central bank to form a view on whether households' expectations about future interest rates are realistic.

Risk-taking. Can the changes in spreads, risk premia and other aggregate financial conditions (reported earlier) be understood in view of the more detailed data on financial intermediaries' activities and household finances? Are there any signs of higher or lower risk-taking? What does eg the high-yield share in corporate bonds issuance say about risk-taking (Stein, 2013, Becker and Ivashina, 2013)?

Micro- and macroprudential policies. The discussion in this paper focuses on the questions of whether the degree of financial stability should be taken into account

[63] As in the previous subsection, the discussion in this subsection is focused on information that is particularly interesting for the purpose of taking financial stability into account in *monetary policy*. But, central banks also have other responsibilities for financial stability, as reflected in eg the content of Financial Stability Reports that some central banks publish.

[64] An example of this type of analysis can be found in Bank of Japan's Financial System Report (Bank of Japan, 2013, chapter IV). I am grateful to Franklin Allen for this information.

in monetary policy and, if so, how. Insofar that there are other instruments – available to the central bank, or to other authorities – that can address the financial stability risks, the arguments for using monetary policy to promote financial stability may become weaker. The potential inability of micro- and macroprudential policy to sufficiently reduce the risks of financial instability in practice has been an important assumption behind the arguments for using monetary policy for financial stability purposes presented by, eg Woodford (2012) and Stein (2013). Nevertheless, policy makers need information about other measures to promote financial stability that have been taken, or are planned. How will they affect the financial conditions and indicators of financial stability?[65] Are there reasons to expect that micro- and macroprudential policies will lead to "regulatory arbitrage", and, if so, what are the implications for monetary policy?

Domestic and global developments. Even if the risks of financial instability have not changed on domestic markets, are there any signs of increased risks globally that may spill over to domestic institutions and markets?[66]

Overall assessment. The purpose of this monitoring of indicators of financial stability, for monetary policy purposes, is to gather some measures of overall "financial market vulnerability", in Woodford's (2012) and Stein's (2014) sense, and possibly be able to identify "financial cycles" (Drehmann et al., 2012) that are not easily captured in the usual data on GDP growth, inflation, etc. Have risks of default or liquidity problems for financial intermediaries increased or decreased? Has the probability of a sharp downturn or crisis in the economy due to financial imbalances, in the short, medium and long run increased or decreased? What type of shocks could generate a sharp downturn? "Early warning" models of the type discussed in section 3.4 could be used to shed light on such questions.

4.3 Implications for monetary policy

The type of information on financial conditions, indicators of financial stability and possible changes in the transmission mechanisms of monetary policy discussed in sections 4.1 and 4.2 above is important information for monetary policymakers in its own right. Policymakers need this information to make their judgements on the likely development of the macroeconomy and the financial system. But, the information can also be included in formal models used for forecasting and policy analysis. This subsection presents suggestions for how this can be done. The method is completely analogous to the way that different models are currently combined in forecasting and policy analysis, when the degree of financial stability is given less explicit weight in the analyses.

Should assumptions about steady-state relations be revised? The information about spreads, balance sheets, etc. may suggest that there have been persistent changes

[65] A general equilibrium model like the one presented by Alpanda et al. (2014) can shed light on such questions. Even if no equilibrium model is available, however, current plans for micro- and macroprudential policies are presumably based on some assumptions about the likely effects of the policy changes in question.

[66] As noted above, Anundsen et al. (2014) find that a global house price-to-income gap can be used as an "early warning". The literature on international financial spillovers is now rapidly growing, see, eg the Working Paper series from the Bank for International Settlements.

in important relationships such as: the difference between the central bank's policy rate and the interest rates on loans to households and corporations; the ratio of household debt and debt service-to-GDP (or disposable income); the leverage ratio of banks and other financial intermediaries; and the ratio of house prices or other asset prices to consumer prices or disposable income. The central bank may have to revise the assumptions about steady-state relationships which are imposed on the models for forecasting and policy analysis. Not only that, however; the central bank's views on the long-run level of the nominal interest rate (r^*), the target level of output (y_t^*) and perhaps even the inflation target (π^*) may have to be revised (although preferably only infrequently).[67]

Forecasts of financial conditions and indicators of financial stability. Ideally, of course, the central bank should produce forecasts of the standard macro variables (inflation, GDP, the policy rate, etc.) and forecasts of financial conditions and indicators of financial stability within one consistent model. In practice, this is not feasible for all macro variables and financial indicators that the central bank has reasons to consider. One step towards giving risks of financial stability greater weight would be to use the information discussed in sections 4.1 and 4.2 to produce forecasts of a relatively large set of financial indicators that would normally not be included in the standard macro models. This could resemble the methods applied for "now-casting" by some central banks, where a large set of indicators of price developments and general business conditions are used in non-structural models to make short-term forecasts of inflation and GDP. Given that the central bank has some responsibility for financial stability, forecasts of a relatively large set of financial indicators are of interest in their own right, over and above any implications they may have for forecasts of inflation, GDP and monetary policy.

The sensitivity of macro models to various indicators of financial conditions and financial stability. Based on the information and analyses described above, it should be possible to make some theoretically and empirically relevant definitions of the financial stability objective ($\omega_t - \omega^*$).[68] All such definitions are open to criticism, but this is also true of the other objectives ($\pi_t - \pi^*$ and $y_t - y_t^*$). Central banks already have experience from including at least some variables reflecting the degree of financial stability (eg credit and house prices) in their structural (eg DSGE) and non-structural (eg BVAR) models (see eg Alpanda et al., 2014). However, this can presumably be done more routinely and systematically. The sensitivity of the properties of these models (eg for forecasts) to the inclusion of various sub-sets of the information on financial conditions and financial stability discussed above should be examined systematically. This can be done fairly easily with the non-structural models but is, of course, much more difficult to do in a satisfactory way

[67] Miles (2014) and Hamilton et al. (2015) discuss how structural changes on financial markets may give rise to persistent changes in r^*. Hamilton et al. also discuss the hypothesis of "secular stagnation", ie a persistent change in y_t^*, and its connections to developments on financial markets (see also Blanchard et al., 2015). In Canada, the level of the inflation target π^* is reconsidered in renewals of the inflation-targeting agreement with the government approximately every five years; see Côté (2014).

[68] Woodford (2012) stresses that the financial stability objective cannot be captured by any single variable but must be represented by a vector.

with the structural models (where theoretical restrictions are important). The purpose of these exercises could be twofold. One purpose could be to narrow down the set of financial indicators to a small number of indicators of financial stability which seem to have the largest information value for the other objectives (inflation and GDP) – ie to identify the most relevant measures of "financial market vulnerability" in Woodford's (2012) and Stein's (2014) sense. Another purpose could be to compare differences between forecasts of macro variables from models with and without (the most relevant) measures of financial stability. How are forecasts for inflation, GDP, the policy rate, etc. affected? Is it possible to interpret the deviations between forecasts from models including and excluding ($\omega_t - \omega^*$) using economic theory? Even if such interpretations are difficult to offer, do the deviations provide signals of risks that could not be noticed in the models excluding ($\omega_t - \omega^*$)?

Alternative scenarios based on a given policy rule. Assuming that the central bank has an objective or reaction function that is affected by inflation, output and financial stability, how are the forecasts of these variables and the policy rate affected by various shocks to the economy, including shocks to the financial stability variable(s)?

Alternative scenarios based on different policy rules. How do different assumptions about the path for the policy rate or about the policy rule affect the forecasts of inflation, output and financial stability? It is important to highlight the most relevant *trade-offs* that policymakers should consider. If the central bank wants to put a large weight on stabilising inflation, what are the implications for the output gap and financial stability? If financial stability is given a large weight, what are the implications for inflation and the output gap? How are the answers to questions like these affected by different assumptions about micro- and macroprudential policies?[69]

Policy implications. Different policy recommendations could be derived from eg the following different sets of models:

(i) Models which neglect financial stability variables in both transmission mechanisms and the objective/reaction function;

(ii) Models which include financial stability variables in the transmission mechanisms but not in the objective/reaction function;

(iii) Models which include financial stability variables in both the transmission mechanisms and the objective/reaction function.

The differences between (ii) and (iii) are informative because they will illustrate the quantitative implications of different views on what monetary policy should be

[69] It is widely recognised that monetary and macroprudential policies, in principle, may affect the macroeconomy and various measures of financial stability through very similar channels, possibly even to the effect that monetary policy and eg capital requirements may be perfect substitutes (see, eg Cecchetti and Kohler, 2012). Alpanda et al. (2014) have presented a general equilibrium model that sheds light on the links between monetary policy and macroprudential instruments. How monetary and macroprudential policies should be implemented, and whether they should be co-ordinated or separated, cannot be answered on the basis of economic theory alone. It is partly an empirical issue (about the strengths of various mechanisms) and partly a political question (regarding how much power that should be delegated to different authorities, see also Acharya, 2015).

doing. The differences between (i) and (ii) may be interesting only temporarily, as the central banks are moving from well-established models which neglect the links between financial stability and monetary policy to newer but also more preliminary models that allow for such links.

5. Concluding comments

In discussions about if and how risks of financial stability should be taken into account in monetary policy, it is sometimes argued that such risks should matter only insofar that they are reflected in the current or expected development of inflation or GDP. This argument is consistent with the view that the monetary policy strategy can be described by a Taylor-type rule like (1) or by the loss function (2). While these rules have been used as a starting point for the review in this paper too, several arguments can be made to suggest that the rules are too restrictive to be used for recommendations about how policy should be conducted at central banks in practice.

First, theoretical analyses have shown that if there are certain frictions on financial markets, welfare can be improved if the rule for monetary policy also includes explicit and separate indicators of the degree of financial stability.[70]

A second argument is that monetary policy, as conducted in practice, does not follow any simple rules. Even the strategy of flexible inflation targeting involves a high degree of judgement from policymakers and their advisors. This concerns, eg the nature of shocks that have hit the economy, the preferred definitions of the inflation and GDP targets and of the long-run (steady-state) level of the policy interest rate. Policymakers partly base their decisions on a suite of models, but relevant information that cannot be captured by those models must always be taken into account. It is thus quite possible that risks to financial instability are already taken into account, to some extent. However, more explicit analyses of the links between monetary policy and financial stability would facilitate policy discussions, communication and policy evaluation.

A third argument is that central banks typically have some legislated responsibility for financial stability. Although this responsibility is often shared with other authorities, and although separate instruments for promotion of financial stability may be available or theoretically possible, the central bank has to form a view on the present financial stability risks, in order to decide whether or not they should have any consequences for monetary policy. Section 4 in this paper contains some examples of how this can be done. Some analyses of this sort are arguably already taking place at some central banks, but recent research – and experience from the financial crisis – suggests that there is room for improvement.

[70] More generally, other types of friction too may imply that monetary policy should follow other rules than (1) or (2), see eg Corsetti et al. (2010).

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