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Securing sustainable price stability:

Should credit come back from the wilderness?

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Introduction[1]

The quest for price stability that policymakers embarked upon at the time of the Great Inflation of the 1970s has finally borne fruit. Inflation rates are now lower and more stable across the globe than they have ever been at any time in the past 50 years, except perhaps in the early 1960s. But it is one thing to attain success, and quite another to hardwire it. For one, understanding the reasons for success and their implications for how to maintain it is far from straightforward. And success can breed overconfidence and banish doubt, sowing the seeds of its own destruction. To see this we need to look no further than to the origin of the Great Inflation. At the time, policymakers misread the lessons of the early 1960s, and hubris regarding their power to control economic outcomes helped to usher in a world that looked painfully different from the one they thought they had secured.

Guarding against the risks of falling into a similar trap in the future calls for a healthy spirit of self-doubt and vigilance, a willingness to question and expose to rigorous scrutiny well-honed convictions. It is in this spirit that in earlier work we have suggested that policymakers should explore more systematically whether changes in the economic environment and in their own policies might not have been subtly altering the dynamics of the economy and hence the challenges ahead.[2] In particular, we have conjectured that the conjunction of changes in the financial regime, in the form of financial liberalisation, and in the monetary regime, in the form of a more firm and credible anti-inflation commitment, might be raising the relative significance of financial imbalances as factors influencing business fluctuations and the inflation process itself. These imbalances, in those business fluctuations when they arise, typically build up slowly and their unwinding can also take considerable time.

Against this background, we have argued that in order to ensure price stability in a ***sustainable*** way[3] two modifications to prevailing monetary frameworks might be desirable. First, central banks should consider articulating the pursuit of their price stability objectives over ***longer horizons*** than the one- to two-year ones normally associated with inflation targeting strategies. Second, they should consider paying greater explicit attention to the ***balance of risks*** to the economic outlook, as conditioned by the presence or absence of financial imbalances. In our view, these modifications could help establish the technical framework allowing central banks to lean against the build-up of financial imbalances, if and when they arise, even if near-term inflation prospects remain subdued, thereby limiting the consequences of their unwinding on output and inflation further down the road, beyond normal policy horizons. In other words, the strategies that have best served central banks to bring inflation down may not necessarily be the best-suited to preserve those gains.

A considerable part of our previous work has been devoted to finding simple empirical proxies for such financial imbalances. Admittedly somewhat imprecisely, the term "financial imbalance", as we use it, refers to the overextension in balance sheets that may arise during some economic booms as a result of the ***interaction*** between asset prices and external financing, on those occasions when these processes go "too far". It is this overextension that can undermine the sustainability of the economic expansion and exacerbate the subsequent downturn. The empirical proxies consist of two elements. The first is a measure of ***misalignment in some key asset price***, which can be taken as an indicator of the likelihood and size of a reversal. The second is some measure of the private sector ***leverage*** (here private sector credit in relation to GDP), which can be taken as an indicator of the likely damage caused to the economy by the reversal in asset prices. Both of these elements measure deviations from the "normal" range of historical experience. These deviations are then jointly calibrated based on their ability to foreshadow financial strains with serious macroeconomic costs, in the form of banking crises. In that work, we found that the concurrence of an asset price misalignment ***and*** excessive

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[2] See Borio and Lowe (2002a, 2003), Borio et al (2003) and Borio and White (2003). A stylised historical analysis of the relationship between monetary and financial stability across regimes since the gold standard period can be found in Borio and Crockett (2000) and Borio and Lowe (2002a).

[3] See also Okina et al (2001), who aptly stress the term, and in effect put forward very similar arguments.

leverage makes them much better predictors than either taken on its own, and that they foreshadow fairly well the financial strains experienced in both industrial and emerging market countries since the early 1980s.

In this paper, we complement and extend that analysis in several directions.

First, we pay particular attention to the second of these elements, namely private sector leverage, as captured by the ratio of private sector credit to GDP. The reason is that while discussions of the analytics and operational aspects of the monetary policy dilemmas have focused on the role of misalignments or "bubbles" in asset prices,[4] by comparison the role of leverage has received less attention. This focus, in our view, is too narrow, much as it would be fruitless to try to use a pair of pliers by moving only one of the two handles. For one, rapid credit expansion without asset price misalignments need not be that damaging, while asset price booms and busts leave less of an imprint in economic activity if the bust does not interact with fixed nominal commitments. Moreover, the role of credit in monetary policy and monetary thinking has a longer and more deeply rooted tradition than that of asset prices, although its fortunes have waxed and waned through history. In particular, in the postwar period, from being a key variable in policymaking during the 1950s and 1960s, credit gave way to money as the 1970s unfolded, before both quietly exited the scene in the 1990s. Thus, in addition to recalling this tradition, we compare the information content of credit with that of (broad) monetary aggregates.

Second, we assess the information content of the financial imbalance proxies not just with reference to banking crises, but also with reference to output and inflation. After all, these are the variables that central banks ultimately care about. In this context, we investigate whether the information content of the indicators is additional to that contained in the past history of those variables.

Third, we refine the proxies of financial imbalances in such a way as to make them more useful for policy. To that end, we calculate them on the basis of quarterly as opposed to annual frequencies, and we lengthen the lead with which the indicators are expected to foreshadow developments. In particular, we "predict" between three and five years ahead. This is critical to the notion of a longer policy horizon and should also allow the authorities more time to lean against the boom well before its unwinding, given the typical lags in monetary policy. On this occasion, we limit our attention to industrial countries, a more homogeneous set, and one for which better data are available.[5]

Finally, we put our indicators to a finer test, exploring their interaction with monetary policy and the type of counterfactual policy trajectories that they might have implied during the sample period. In this case, faute de mieux, the benchmark adopted is the familiar Taylor rule. The exercise is performed on the subset of countries for which such benchmarks have been found to a reasonable descriptive ex post approximation to policy.

We reach several conclusions.

First, the performance of the indicators is very encouraging. When calibrated with reference to banking crises, relative to our previous work neither shifting from an annual to a quarterly basis nor, above all, using a more ambitious forward-looking horizon worsens the leading indicator properties of the proxies for financial imbalances. In fact, there is a considerable improvement in their information content.

Second, the preferred indicators, as calibrated with respect to banking crises, also appear to contain useful information about output and inflation. The information with respect to output is especially clear. There are also signs that the larger is the measure of the imbalance during the boom, the greater is the likelihood of subsequent output weakness and disinflation. The evidence thus seems to confirm the potential value added of the proxies for financial imbalance in the armoury of indicators used for policy purposes.

Third, credit dominates money. The results hold regardless of whether credit is considered in isolation or in conjunction with equity prices. We argue that there are good theoretical and empirical reasons why this finding should not be unexpected. It suggests that ***for the type of phenomena considered***

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[4] See below for several references to this rapidly growing literature.

[5] Our previous work also suggests that while the role of credit remains pivotal, the critical asset prices differ somewhat as between industrial and emerging market countries. In particular, in the case of emerging market countries (real) exchange appreciations appear to have information content over and above that of equity price booms. For the findings and a possible explanation, see Borio and Lowe (2002b).

in this paper, in framing monetary policy central banks should pay particular attention to credit developments. A focus on monetary aggregates alone is unlikely to be an adequate substitute.

Finally, a preliminary assessment of Taylor rules over the period since the early 1980s would seem to confirm that central banks generally either do not respond systematically to financial imbalances or, to the extent that they do, they do so asymmetrically. Specifically, they may loosen policy further than normal in the face of economic weakness associated with the unwinding of financial imbalances but do not appear to lean against them as they build up. There are also signs that, in some cases, policies may have been easier than usual during periods when, with the benefit of hindsight, warning signs were flashing, foreshadowing future strains down the road. As a result, the indicators could potentially have provided useful additional information for the setting of policy, at least assuming a "traditional" response of the economy to a tighter policy stance.

The rest of the paper is structured as follows. To set the stage, Section I traces the history of credit in monetary policy and thinking in the postwar period, from a visible presence on stage to exile in the wilderness and the latest signs of a comeback. Section II shows how, especially in combination with equity prices, credit can be useful in foreshadowing financial strains as well as future developments in output and inflation, at horizons of three years and beyond. Section III explores the role of the financial imbalance proxies in the context of Taylor rules. Finally, the Conclusions draw some inferences for policy and highlight needed future work.

I. Credit: from centre stage to the wilderness... and back?[6]

Any brief account of the history of credit in monetary policy and academic thinking in the postwar period is bound to be somewhat simplistic. Paradigms do not evolve linearly, multiple strands of thought coexist at any one time, and the cross-country variety of intellectual traditions and institutions defies simple rendering.

Even so, at the cost of some oversimplification, it is possible to discern some salient patterns and phases, even as they naturally blend into one another. Broadly speaking, one could say that, in policymaking, after enjoying considerable attention in the 1950s and 1960s, credit was overshadowed by money in the 1970s and part of the 1980s, after which both quietly exited the scene or came to play peripheral roles, with very few exceptions. Only recently have central banks shown signs of paying a certain renewed attention to credit, albeit from a rather different perspective than in the past. Over much of the period, academic thinking has generally paid far less attention to credit than money, even as different currents, such as Keynesianism and monetarism, battled for supremacy.[7] Since the late 1980s, however, credit has begun to make a comeback in mainstream academic analysis too. Nevertheless, this comeback has not as yet bestowed on credit a core analytical place in the modelling and empirical analysis aimed at underpinning policy.

Centre stage

The heyday of credit in monetary policymaking was in the 1950s and 1960s. Many factors contributed to this. In part, the nature of policy objectives was responsible. By and large, these were less strictly couched in terms of inflation control. They often put greater weight on achieving "domestic balance" subject to the external constraints imposed by the Bretton Woods system of fixed but adjustable exchange rates, typically supported by exchange rate controls. Likewise, scepticism prevailed regarding the ability of monetary policy generally, and interest rate policy in particular, to influence domestic demand. Above all, many countries had, or put in place, various restrictions on interest rates and balance sheet quantities through which they implemented a mixture of credit allocation and demand management policies. These restrictions were often instrumental in allowing the financing of

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[6] For complementary discussions of the evolution of monetary policy in the postwar period, see BIS (1997), Chapter 8, White (2002) and Cottarelli and Giannini (1997).

[7] This is most clearly reflected in central banks' view of the transmission mechanism, as they have more naturally predisposed than academics to thinking in terms of credit. See, for instance, BIS (1995), Borio (1997) and Angeloni et al (2003).

the government sector while limiting upward pressure on interest rates. In this context, credit had a salient place in policy implementation.

Admittedly there were significant differences across countries. For instance, close to one end of the spectrum was Germany. In Germany price stability was quickly enshrined in the Bundesbank Act, the authorities liberalised the financial system early on and, while paying attention to credit, monetary policy was largely implemented by adjusting the interest rate alone.[8] At the other end, repressed financial systems and, from today's perspective, less orthodox policy objectives were more common in a number of countries in continental Europe and in Japan. In between were countries that had fewer direct controls but still considered credit a key guideline for policy. An obvious such example is the United States. There, restrictions were limited to some interest rates on deposits (regulation Q) and the Fed focused on bank credit (commercial bank loans and investments) as an intermediate policy guide.[9]

The experience in the United Kingdom is illustrative of the evolution of thinking at the time. A clear milestone there was the Radcliffe report of 1959. In some respects, the report provided conceptual underpinnings to changes in the implementation of policy that had been crystallising in previous years, but it also foreshadowed new ones. The report played down the role of money on the grounds of high substitutability with other assets, favoured a broader, if not very precise, notion of "liquidity" and stressed the importance of the ability of economic agents to finance their expenditures. For practical purposes, particularly in a context of a rapid revival in the demand for private sector credit, the report was taken to justify the use of direct controls or suasion to curtail credit extension, a practice that had already been resorted to in previous years and that became more prevalent and restrictive in the 1960s.[10,11]

The wilderness

The 1970s, by contrast, saw the emergence and spreading of monetary targeting and of a focus on money at the expense of credit in policymaking. The trend gathered pace into the early 1980s before then slowly but surely losing momentum. The shift had its roots in the intellectual climate of the time and, arguably, in the political economy of inflation control.

Intellectually, the shift towards money in policymaking owed much to the growing ascendancy of monetarism. Starting back in the 1950s, this strand of thought had engaged the then prevailing Keynesian tradition in a bitter theoretical and empirical battle that ran through much of the 1960s and 1970s. In terms of objectives, the monetarist school was very influential in helping to dispel the belief in a long-run trade-off between inflation and unemployment.[12] It thus provided the basis for abandoning the overly ambitious policies pursued by governments in the late 1960s and early 1970s. In terms of means, it saw money as pivotal in the fight against inflation, based on the belief in a stable long-run demand function (M Friedman (1959)). Money was regarded as special, credit not.[13]

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[8] A key variable on which the monetary authorities appeared to have focused was "free liquid reserves", especially starting towards the end of the 1950s, as a gauge of the potential to create credit and money; see Courakis (1977). Similarly, between 1950 and 1962 the Bank of Canada followed an anti-inflation policy within the context of a liberalised financial system and free floating; thereafter, the exchange rate was pegged. It would appear that in Canada credit attracted limited attention. See Thiessen (2000) for an interesting account of the historical evolution of monetary policy in Canada.

[9] See eg Meulendyke (1998).

[10] For a review of monetary policy in the United Kingdom since the 1930s, see Courakis (1997).

[11] In the United States, there had been close attention to the possible impact of monetary policy via credit availability, as opposed to interest rate, channels (Roosa (1951)). More generally, the 1960s saw work on credit rationing mechanisms (eg Hodgman (1960), Freimer and Gordon (1965), McMahon (1969), Jaffee and Modigliani (1969)). While some sparse literature continued into the 1970s (Harris (1974), Wood (1975)), it is fair to say that it remained rather marginal. It was not until the 1980s that this strand of work became more mainstream, based on work that highlighted informational frictions (adverse selection and moral hazard), such as the influential one by Stiglitz and Weiss (1981) (see below). For a survey, see Jaffee and Stigliz (1990).

[12] The key reference here is M Friedman (1968).

[13] Hard as the two schools of thought battled it out, they shared a fundamental point in common: they focused on what Tobin called "the capital account" of the economy (Tobin, 1969). The debate, that is, was largely carried on in terms of the degree of substitutability between different assets, of which money was one, with changes in relative yields following changes in supplies being seen as the primary channel through which expenditures were affected; see also M Friedman (1956). This dichotomy between stocks and flows is best epitomised in Hicks' (1937) IS (flow)-LM (stock) paradigm, which imbued

From a political economy perspective, monetary targets played a useful role too. First, after a long period in which monetary policy had typically accommodated other objectives, their adoption in some cases underlined the authorities' resolve to bring inflation under control. Second, expressing policy in terms of monetary aggregates rather than interest rates could help to clarify the need for the unpalatable and sometimes unprecedented increases in interest rates required to tame inflation, as in the 1979-82 phase in the United States. Finally, when backed by a simple, transparent and rigorous theoretical structure, monetary targets could facilitate communication with the public and foster convergence of inflation expectations, as most effectively done in Germany.[14]

In this context, credit fell by the wayside.[15] Admittedly, the victory of money was not uniform across countries. Variants of credit aggregates still played some role in certain cases, especially in countries where direct controls on credit would not be dismantled, sometimes until well into the 1980. In Italy, for instance, the authorities pursued targets for total domestic credit, an aggregate encompassing credit to the private and public sectors, with a particular eye towards maintaining external balance.[16] But these were the exception, not the rule. And even when credit variables played a prominent role, it was, paradoxically, a derivative one. Thus, for instance, targets for domestic credit expansion under IMF programmes were predicated on the assumption of a stable demand for money, together with substitutability between domestic and foreign sources of money creation - conditions that would help to attain the desired balance of payments objectives.[17] In countries with liberalised financial systems, few, if any, observers would dare suggest paying closer attention to credit. And when they did, they would have to argue on the basis of statistical regularities concerning the stability of relationships between credit (debt) variables and economic activity but without the comforting backbone of a widely accepted theoretical foundation.[18]

Money, however, was soon to share the same ungracious fate as credit in policymaking. There were two rather paradoxical reasons for this. First, the very conditions that had contributed to banishing credit from centre stage were at play, namely financial innovation and liberalisation. In the previous phase, financial innovation and the ability to get round direct controls had helped to convince the authorities of the futility and costliness of the restrictions on credit expansion.[19] But in the ensuing liberalised environment, the distinctiveness of credit, or specific components thereof, was hard to justify. Now, those same forces were undermining the stability of the demand for money, making it harder to use it as a cornerstone of policy.[20] Second, and later on, the very success in fighting inflation

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the postwar intellectual tradition. This paradigm is quite different from the loanable funds theory that had played a more important role in the prewar phase and to which more recent work seems to hark back (see below). Thus, the key question was whether money was sufficiently "special" as an asset (compare, say, M Friedman and Meiselman (1963) with Tobin (1961, 1969) and Tobin and Brainard (1963)). Brunner and Meltzer (1974, 1976), while leading monetarists, also included credit in their formal modelling. Their focus, however, was very much on the monetary base, and the interest in credit was primarily motivated to shed light on the money supply process. Empirically, much of the debate hinged on the relative importance of money and fiscal variables in determining expenditures, largely through reduced form regressions (eg Ando and Modigliani (1965) and Andersen and Jordan (1968)). A key issue, as highlighted by Poole (1970), was the relative stability of the "IS" and the "LM".

[14] Courakis (1981) provides an illuminating comparison between the myth and the practice of monetary targeting in the United States, the United Kingdom and Germany during the 1970s, highlighting the important but differing role of communication across the three countries. Issing (1997) stresses the pragmatic approach to monetary targeting in Germany.

[15] For a review of the experience with monetary targeting in a cross-country perspective, see the various issues of the BIS Annual Report.

[16] See eg Caranza and Padoa-Schioppa (1979) and, for a further explanation and empirical evaluation of the stability of the corresponding relationships, Borio (1986, 1988). As public sector debt accumulation could not really be restrained by monetary policy, a TDC target implied compensating adjustments in the growth of credit to the private sector. Ceilings on bank lending were imposed at times. The Bank of Italy was also rather unreceptive towards claims concerning the stability of the demand for money in the case of Italy.

[17] See Polak (1957), who is considered the father of the IMF model.

[18] See, in particular, B Friedman (1983), who in the early 1980s in the United States argued in favour of paying particular attention also to total (private and public sector) non-financial sector debt, and Shiller's (1983) characteristic response. While, based on the historical stability of that debt ratio in the postwar period, in 1983 the Fed did add it to the range of variables it monitored, it is unclear to what extent it conditioned policy in the 1980s. In a rather untypical article for the time, Modigliani and Papademos (1980) had also argued that whether money or credit would be a more relevant variable depended on the characteristics of the financial system, but without advocating strongly one or the other.

[19] Just for one example out of many, see the experience in Australia (Schedvin (1992)).

[20] See, for instance, Akthar (1983) and the chapters of the BIS Annual Report dealing with monetary policy over the years. Note, however, that Borio et al (1994) find that the instability of (broad) demand for money aggregates could be explained

played a role. Lower and more stable inflation in the 1990s not only weakened the ability to discern a stable relationship, but also strengthened the credibility of central banks, thereby eroding the political economy advantages of relying on explicit quantitative (intermediate) targets. And so did the trend towards endowing central banks with a greater degree of autonomy or "independence" to pursue mandates more clearly focused on price stability, crystallising the stronger intellectual, political and social consensus to fight inflation.

Operationally, this new consensus was reflected in the gradual adoption of more structured inflation-centred regimes, typically including specific numerical objectives for inflation. In particular, initially among countries with a history of comparatively high inflation, inflation targeting frameworks gained the ascendancy. Starting with countries such as New Zealand, Canada, the United Kingdom and Sweden, the trend subsequently extended much more widely, including several emerging market economies.[21] A distinguishing feature of these regimes has been the announcement of a numerical target for inflation over a ***particular horizon***, generally ***one to two years***. As they are conceived and portrayed today, no particular variable, be it credit or money, plays a special role, while interest rates have regained their former prominence as the main "symbols" of policy. Given the state of flux of an ever-changing financial system, discretion in interpreting developments is regarded as more important than ever. In a sense, as an anchor for policy, less discretion with respect to final objectives substitutes for increased discretion in their pursuit.

Comeback?

It is, of course, tempting to think that this is the end of the story. One can imagine a future stretching out indefinitely beyond the horizon that is very much a replication of the present. In such a world, policymakers would have found the definitive solutions to the complex challenges faced during the postwar period. Price stability would be here to stay.

And yet, the description of the evolving challenges faced during that period should give enough reason to pause and wonder. The interaction between events, their interpretation and policy responses is such that the economic environment can never stay still. It constantly throws up new challenges from unexpected quarters. Stationarity is a luxury that the world cannot afford.

In this spirit we have recently argued that, for the foreseeable future, the types of challenge faced by central banks may be subtly different from those faced during the fight against inflation. They would, however, not necessarily be easier to handle. And we trace them to those features of the economic environment that have either been treated as anomalies or have failed to induce a more significant change in the prevailing thinking about the dynamics of the economy. These are the major booms and busts in credit and asset prices, sometimes ending in serious strains on the financial system, which can amplify business cycles and derail monetary policy objectives, including price stability.

The basic argument, developed in more detail elsewhere,[22] is that financial liberalisation has made such booms and busts more likely. The experience in both industrial and emerging market countries since the mid-1980s is consistent with this view. In turn, looking forward, the regained credibility of central banks' anti-inflation commitment, together with the persistence of low and stable inflation, could play an unexpected role. In such an environment, price pressures normally associated with unsustainable expansion might take longer to emerge. Instead, the symptoms of the unsustainable boom would more likely first show up in excessive credit and asset price growth and hence in

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as the result of failing to include asset (real and equity) prices in the typical regressions. Their cross-country results indicate that, at least for the period up to the early 1990s, including an aggregate asset price index, as a proxy for wealth, re-establishes the stability of the equations and long-run unit elasticities with respect to income and the price level, conceptually sensible magnitudes (see also below).

[21] See, for instance, Bernanke et al (1999a), Schaechter et al (2000) and Mishkin and Schmidt-Hebbel (2001). Bernanke et al (1999a) also provide evidence that these explicit inflation targets have been followed by sustained disinflations in a number of cases. While inflation targets do not appear to have reduced the costs of such disinflations, they may help to bolster low inflation expectations once the disinflation has been achieved.

[22] See eg Borio et al (2001), Borio and Lowe (2002a), Borio et al (2003) and Borio and White (2003). Of course, several other economists have also noted the close empirical link between credit booms and busts and financial instability, primarily from an emerging market country perspective (see eg Gavin and Hausmann (1996), Eichengreen and Arteta (2000) and Gourinchas et al (2001) and the detailed bibliographies in the above papers). Goodhart and Delargy (1999) stress the close empirical link through history between credit and asset prices and Goodhart (2003) also notes how business cycles may now come to resemble more closely those prior to World War I, during the classical Gold Standard era.

overstretched balance sheets. This, in turn, would make the economy more vulnerable to the slowdown or contraction that, sooner or later, would follow, whether in response to a central bank tightening to quell eventually rising inflation or in the wake of the spontaneous unwinding of the imbalances. Either way, with a central bank committed to maintain inflation under control, such disguised overheating would, in the end, tend to result in economic weakness and disinflationary pressures.

This view recovers a central role for credit in policymaking, this time in conjunction with asset prices, such as those for equity and real estate. The view takes root in at least two, quite separate, lines of thought in the postwar period. The first is the now vast literature that, from the mid-1980s, established rigorous micro-foundations for a key place of credit in the transmission mechanism, based on the financial frictions arising from asymmetric information. In particular, the strands known as the "broad credit channel" and the "financial accelerator" have highlighted the interaction between credit and asset prices in propagating policy impulses.[23] The second is a somewhat older, and far less influential, line of thought, most closely associated with the works of Minsky (1982) and Kindleberger (1996). To varying degrees, this line stresses the potentially unstable nature of the interaction between credit, asset prices and real economic activity.[24,25]

Policy concerns with issues of this kind had already started to emerge in the second half of the 1980s. With varying emphasis, questions about the potential implications of the rapid build-up of debt were actively discussed in a number of countries, including in the two largest world economies, the United States and Japan.[26] That monetary policy could be conditioned by the unwinding of imbalances became painfully obvious in the subsequent recession of the early 1990s and beyond. For some countries, high debt levels or financial strains created pressure to abandon exchange rate commitments, as in the Nordic countries and the United Kingdom. For others, headwinds counselled keeping interest rates lower and for longer than would normally have been the case, as in the United States. And in Japan, the prolonged echoes of the unwinding eventually brought interest rates down to zero and ushered in the phase of quantitative easing, with the central bank targeting banks' "excess reserves".[27]

More recently, faced with such booms and busts also in an environment of benign inflation, central banks have begun to ask some hard questions.[28] How best can they identify the build-up of imbalances with sufficient timeliness and degree of comfort? Should they tighten policy even if near-term inflation pressures appear to be under control in order to forestall more serious problems down the road? If yes, how could such a course of action be reconciled with, or accommodated within, inflation targeting frameworks? And how best could it be communicated to the public?

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[23] For excellent surveys, see Gertler (1988), Bernanke and Gertler (1995) and Bernanke et al (1999b). See also the seminal contribution by Kiyotaki and Moore (1997). From the perspective of this paper, the "narrow" credit (or bank lending) channel is less significant, as it depends on imperfect substitutability between bank and other forms of credit.

[24] This line, however, was way off the mainstream. More recently, a new line of inquiry has stressed the potential for destabilising interactions but based on micro-foundations that do not envisage any form of irrationality (eg Allen and Gale (2000)). Going further back in history, the interaction between debt and the economy was central to Fisher's (1932) theory of booms and busts and the business cycle. And writers in the Austrian tradition had of course distinguished between inflation in goods and services and "profit inflation", as might be reflected in equity price booms (see eg Robertson (1922), Haberler (1932) and Hayek (1933)). The focus of these writers, however, seemed to be more on credit as the counterpart to money creation. For a discussion of these issues, see Laidler (1999, 2003). See also Eichengreen and Mitchener (2003), who revisit the role of credit and asset prices in the vicissitudes of the 1920s and 1930s.

[25] Different as they are, these two strands of thought share one characteristic that sets them apart from much of the academic work that precedes them in the postwar period, viz. the paradigms hark back to the loanable funds theory of interest rate determination rather than to the liquidity preference tradition. They do so at least in the sense that they emphasise the link between the flow of credit and expenditures, be it on financial or real assets, rather than that of stocks, as noted earlier. On aspects of the prewar debate, see Trautwein (2000) and Humphrey (2002).

[26] For instance, the Jackson Hole conference of 1986 was devoted to examining this very issue, with observers such as B Friedman (1986) and Kaufman (1986) expressing concerns, especially with the rise in the private sector component, while others were more sanguine or preferred to focus on the public sector side (eg Summers (1986)). Work at the BIS at the time was also seeking to understand the implications of developments in several countries (eg Davis (1987), BIS (1987), Borio (1990a,b)).

[27] For Japan, see Okina et al (2001) and Okina and Shiratsuka (2003). Strictly speaking, the target is for current account balances.

[28] See eg Yamaguchi (1999), Greenspan (2002), Bernanke (2002), Ferguson (2003), Issing (2002, 2003), King (2002), Bean (2003), Bäckström (2002), Gjedrem (2003) and Dodge (2003).

Regardless of the specific answer provided, a number of central banks have been monitoring credit expansion and levels of debt increasingly closely. For example, credit is one of the key indicators in the "monetary analysis" pillar of the ECB**.** More specifically, the risks raised by rapid credit expansion and booming residential property prices were one of the factors taken into account when the Bank of England and the Reserve Bank of Australia tightened policy in November 2003.

At the same time, credit does not seem to have as yet gained the right of citizenship in the mainstream analytic models of monetary policy. With very few exceptions,[29] the evaluation of policy is done on the basis of models and assumptions about stochastic processes that make the explicit consideration of credit unnecessary and its information content redundant. Indeed, credit has played second fiddle even to asset prices, as a rapidly growing literature has sought to establish under what conditions adding asset prices to benchmark reaction functions would improve policy.[30] And while money has lost much of its lustre, at least one well-accepted, if rather simplistic, micro-founded family of models, based on "limited participation", has kept it alive and has been used to motivate policy prescriptions that would give it more weight in policy formulation.[31]

This state of affairs is puzzling. In part it probably stems from the fact that capturing in a meaningful way some of the channels through which credit ***distinctly*** affects economic activity is analytically difficult. In particular, the mechanisms are likely to be fundamentally non-linear. The impact of credit should be expected to depend on initial debt levels, their interaction with asset prices and interest rates as well as on the state of the business cycle, differing between expansions and contractions. But this, after all, should also be true of asset prices. Another reason may be that macroeconomists nowadays have so far been reluctant to incorporate in their benchmark models credit and asset price booms and busts. Likewise, they tend to have a view of business fluctuations that sees them as primarily driven by short-lived exogenous shocks around equilibrium, rather than as the result of self-sustained endogenous processes.[32]

Perhaps it is time for credit to return from the wilderness, and to regain its position not just in the practice of policy but also in the macroeconomic modelling that underpins it.

II. Credit and financial imbalances: assessing their information content

Good theory relies on good observation. In this section, therefore, we investigate more closely whether credit has informational content for key economic variables of interest to central banks. By so doing, we hope to achieve two objectives. First, we take one further step in assessing whether it is possible to develop simple indicators that could help the authorities to identify financial imbalances sufficiently early so as to take action to restrain their build-up. These indicators are intended as a complement to, and by no means a substitute for, a more thorough assessment of financial vulnerabilities. Second, we hope to encourage macroeconomic theorists and modellers to develop the frameworks capable of capturing the corresponding relationships through rigorous analytics.

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[29] See, in particular, Bordo and Jeanne (2002). The interaction between credit and asset prices is also highlighted in eg Goodhart (2003).

[30] The list is growing fast; a selected set of references includes Kent and Lowe (1998), Bernanke and Gertler (1999, 2001), Cecchetti et al (2000, 2003), Filardo (2001, 2003), Dupor (2002), Gilchrist and Leahy (2002), Gruen et al (2003) and Smets and Wouters (2003).

[31] For the basic model, see Christiano et al (1997); for an application to policy, see Cristiano and Rostagno (2001); for a more general discussion of potential analytical rationalisations for the usefulness of money in monetary policy, see Masuch et al (2003); and for a thoughtful recent defence along more traditional monetarist lines, see Nelson (2003).

[32] For an elaboration, see Borio et al (2003), Borio and White (2003) and Filardo (2003).

The proxies for financial imbalances

The starting point is our previous work,[33] in which we have shown that it is possible to predict episodes of severe banking distress fairly well, based exclusively on two indicators. These indicators measure the deviations from trend ("gaps") in two key variables, namely the ratio of private sector credit to GDP and inflation-adjusted equity prices. For each country, we use the broadest definition of credit to the private sector for which historical series are available. The corresponding trends are calculated recursively (through a Hodrick-Prescott filter), using information available only up to the time when the predictions are made. That is, they are, in this sense, "ex ante" trends. As with our previous work, we rely on equity prices not necessarily because we think they are the most appropriate, but because of data limitations. In particular, property prices have historically played a key role in banking crises and, as recent experience indicates, their evolution can have a sizeable influence on economic activity more generally.[34] However, sufficiently long and comparable series across countries are not available.

Importantly, we require the critical thresholds for the two variables to be exceeded ***simultaneously***. The logic is that rapid and sustained expansion in credit relative to GDP need not necessarily be a problem if the asset prices backing that credit expansion grow at a sustainable rate. Likewise, booms and busts in asset prices need not cause great disruption if economic agents are not saddled with large debts and hence rigid liability commitments. However, the likelihood of a disruption increases greatly if the two developments occur at the same time. Thus, it is the simultaneous violation of the thresholds in the indicators denoting cumulative deviations from past experience that best proxies the notion of financial imbalance, or overextension in balance sheets. We compare the performance of these indicators with that of an ante output gap, used as a kind of control variable.

The critical thresholds are estimated on the basis of the predictive performance of the corresponding indicator as judged by the noise-to-signal ratio. However, rather than just minimising that ratio, we assess the performance partly judgmentally, making sure that a satisfactory number of crises is predicted. The reason is that, as it turns out, it is sometimes possible to reduce the noise-to-signal ratio further but at the expense of missing too many crises. This would not be useful for policy purposes. Our approach amounts to attaching more weight to Type I error, missing a crisis, than to Type II error, calling a crisis that does not materialise. As we shall see, the noise-to-signal ratio and Type II error remain below those normally found in this kind of exercises, indicating that the increase in the noise is of limited consequence.

The basic series for banking distress is the one used in the historical analysis of banking crises by Bordo et al (2001). We modify it slightly, however, by adding the episodes of serious strains experienced in the United States and United Kingdom in the early 1990s. While not erupting in full-blown crises,[35] these episodes generated severe "headwinds" for the economy. They thus represent the kind of phenomenon of macroeconomic relevance that we would like to capture.

We depart from our previous analysis in several respects.

First, we run the exercise on quarterly, as opposed to annual, data in an effort to make the analysis better suited for policy. The corresponding gap measures are calculated over the period 1974 Q1-1999 Q4. We use a period of some 10 years prior to 1974 to calculate meaningful trends, limiting distortions at the beginning of the sample. Since the precise timing of crises is hard to identify, we arbitrarily assign them to the last quarter of each year. In shifting from annual to quarterly data, when calculating the HP filter we raise the value of lambda from 1600 to 400000.[36] Note that these values are considerably higher than those normally used for annual and quarterly series, namely 100 and 1600, respectively. This means that the trends are smoothed considerably more than normal, better capturing low-frequency, cumulative deviations, and implicitly putting more weight on the mean reversion tendency of the processes.

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[33] See Borio and Lowe (2002a, b, 2003). This work takes its cue from other literature seeking to construct indicators of financial crises, notably Kaminsky and Reinhart (1999). For a recent review with specific reference to banking crises, see Bell and Pain (2000).

[34] See BIS (1993), Herring and Wachter (1999), Hilbers et al (2001) and, for a recent review, Zhu (2003). For the role of real estate prices in the East Asian crisis, see Collyns and Senhadji (2003).

[35] In fact, in the United Kingdom several small banks faced serious distress.

[36] We experimented with different values of lambda and chose the one that seemed to perform best, using also our previous results based on annual data as benchmark (Borio and Lowe (2002b)).

Second, rather than predicting crises starting in the current year, we do so with a lead of at least three years. Thus, we assess the predictive performance of the indicators over a variable horizon of three to five years ahead. A signal is said to be correct if the crisis occurs in any of the quarters covered by the corresponding horizon. The idea is to make sure that the crises are identified during the boom phase, so as to permit a timely policy response.

Third, we limit the sample to industrial countries.[37] This is partly because long time-series of good quarterly GDP data are not available for many emerging market countries. In addition, our previous work has shown that the best composite indicator for emerging market economies includes also a real exchange rate gap, capturing the appreciation that typically accompanies booms. Specifically, that indicator calls for the credit gap to be exceeded simultaneously with ***either*** the exchange rate gap ***or*** the equity price gap. For industrial countries, the exchange rate does not contain additional useful information.[38] With the sample thus restricted, there are 15 crises in 20 countries.

Fourth, in addition to the forecasting performance of credit, equity prices and the output gap, we also consider that of the money gap, calculated in the same way as that for other variables, based on the ratio of money to GDP. We use historical series for a broad monetary aggregate, roughly equivalent to M2 or M3. Presumably, a broad aggregate is the one likely to best capture the build-up of financial overextension. It is also the one more likely to be correlated with credit.

Finally, we assess the predictive performance of the indicators not just for banking distress, but also for output and inflation. To do so, we use the critical thresholds as calibrated for banking crises. The reason is that we would like to see to what extent focusing on banking distress and on the variables traditionally included in central bank objective functions are complementary. If anything, failure to re-optimise the critical thresholds with respect to output and inflation will bias the results ***against*** finding additional information content.

We next consider banking distress and output and inflation sequentially.

Financial imbalances and banking distress

Tables II.1 and II.2 summarise the predictive performance of the indicators with respect to banking distress. We simply show the "best" thresholds for each, as derived in the way explained above. The tables include the performance of each indicator taken individually (Table II.1) and a few selected joint indicators of financial imbalances, when the critical thresholds in the component variables are exceeded simultaneously (Table II.2).

A number of points deserve attention.

With the exception of the credit gap, all the indicators tend to perform better as the horizon is extended. Typically, the percentage of crises correctly predicted increases while the noise-to-signal ratio falls. In the case of credit, the failure to predict more crises as the horizon is lengthened reflects the fact that the signal goes on very early and is then more persistent than the others.

Confirming the results of our previous work, looking at individual indicators, over a three-year horizon the credit gap (with a threshold of 4%) clearly outperforms the equity price gap (60%). It predicts 80% of the crises rather than only 47%, with a noise-to-signal ratio that is slightly lower, 0.22 compared with 0.24. The fact that the noise-to-signal ratio for the equity gap falls faster than that of the credit gap as the horizon is extended partly reflects the increase in the percentage of crises predicted, up to 73% over five years. But it is also the "artificial" result of the fact that, while equity prices fall well before a crisis, the credit-to-GDP ratio shows much stronger persistence, often remaining positive even after distress materialises, as GDP slows down or contracts. "Switching off" these signals would lower the noise.

The output gap is clearly inferior to either the equity gap or the credit gap. It is a noisier indicator. The smoothed output gap (lambda equal to 400000) performs somewhat better than the traditional output gap (lambda equal to 1600), although the difference is not very large.

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[37] The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

[38] See Borio and Lowe (2002b). Admittedly, we did not experiment with other breakdowns in the sample. It may well be that the industrial/non-industrial country distinction is not the best for the purposes at hand.

Somewhat surprisingly, the money gap is the least helpful indicator. Predicting a similar percentage of episodes of banking distress to the other indicators comes at the expense of a considerably higher noise-to-signal ratio. The money gap does not outperform the output gap either, whether smoothed or not. Overall, this suggests that money is not an adequate substitute for credit in foreshadowing financial strains associated with excessive credit and asset price expansion.

The relative performance of credit and money is consistent with theory and other factual evidence. Theoretically, one might well expect the wedge between private credit and money growth to increase especially strongly during economic booms in which asset prices rise fast. On the one hand, the financial-accelerator type mechanisms would strongly drive credit along.[39] On the other, the alluring increases in expected returns on assets such as equity and real estate as well as in the appetite for risk would result in a shift away from money towards those higher-yielding assets. This would hold back somewhat the fall in velocity and hence the emergence of warning signals.[40] Empirically, previous econometric work indicates that credit is more closely correlated than money with generalised asset price movements (Borio et al (1994)). Likewise, the typical experience during the protracted booms that precede financial strains is that the ratio of private credit to money can increase considerably, as private sector credit surges forward in part reflecting reallocations away from government securities and, not infrequently, a higher proportion of interbank financing from abroad.[41]

As expected, the performance of composite proxies of financial imbalances is superior to that of individual indicators. The best proxy for a financial imbalance is the combination of the credit of 4% with an equity price gap of 60%. Over a four- or five-year horizon, this composite indicator predicts almost 75% of the crises with a noise-to-signal ratio of only 0.02, a drastic reduction compared with the ratio associated with individual indicators, by a factor of between 5 and 10. The episodes where the indicator switches on but no crisis occurs in the relevant window tend to be situations where the "on signal" comes too early and stays on until a crisis occurs. While not shown, the indicators can also be calibrated to predict episodes of distress with a shorter lead, with little change in the main results.

Table II.3 provides some additional information on the performance of the preferred indicator. It shows that the performance is not greatly sensitive to the thresholds chosen. For instance, equity gaps of 50% lead to very similar results and a 40% gap produces some increase in the noise, although two more crises are picked at the three-year horizon. Nor are the results very sensitive to varying the credit gap threshold between 3 and 5%. The same table also provides information on the statistical significance of the relationships. These are derived from probit regressions between the crisis events and the signals, treated as zero/one dummy variables. The coefficients are highly statistically significant in all cases.

Importantly, the indicators capture all the episodes with clear macroeconomic significance. Notably, these include the banking crises in the Nordic countries and Japan as well as the serious financial strains experienced in the early 1990s in the United States, United Kingdom and Australia. As expected, because of its different nature, the crisis of the savings and loan industry is missed.[42]

Financial imbalances, output and inflation

What about the performance of the indicators with respect to output and inflation? There are good reasons to expect them to contain useful information about these variables too. After all, serious

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[39] See, in particular, Borio et al (1994), with reference to the link between credit and an aggregate asset price index, and, more recently, Gerlach and Peng (2002), Hofmann (2001) and Davis and Zhu (2003) for the link between credit and property prices.

[40] Of course, this suggests that the behaviour of the ratio may itself have useful, possibly additional, information content. We have, however, not evaluated this possibility so far. In addition, all this is not to say that, on balance, the demand for money will not rise during booms (and velocity fall), since the ratio of wealth to income will also increase. For clear empirical evidence on this, based on the aggregate asset price index (including both equity and property prices) as a proxy for wealth, see Borio et al (1994).

[41] For some historical evidence on this, see Gerdrup (2003).

[42] One crisis which is missed, but falls into the category of one preceded by rapid credit and asset price growth, is the secondary banking crisis in the United Kingdom in the early 1970s. The main reason is that, as is well known, equity prices did not do well during the inflationary period: the misalignment was exclusively in property prices, the main factor behind the financial strains. In less inflationary periods, equity prices play a more useful proxy role for property prices, too. See Borio et al (1994).

episodes of financial distress tend to go hand in hand with economic weakness and to reinforce it. And economic weakness tends to put downward pressure on prices. At the same time, the relationship with prices over the relevant horizon is likely to be noisier, since factors other than economic slack influence it. For example, the currency depreciations that not infrequently accompany banking crises, especially in the case of twin crises, may result in temporary increases in inflation. In what follows, we do not control for such extraneous influences.

We assess the information content by comparing the conditional and unconditional probabilities of observing specific ranges of values for output and inflation ("events") over specific horizons, aided by probit analysis. We define output events to be predicted as (ex ante) output gaps below minus 1%. We experimented with different thresholds, but this did not change the results much. The inflation event is defined as an average year-on-year decline. We consider the forecasts two, three and four years ahead. And we assess the sensitivity of the results to the threshold chosen for the best composite indicator of future banking distress, the credit-cum-equity gap.

The additional information content of the composite indicator is quite strong with respect to the output gap (Table II.4). On its own, a positive output gap in excess of 2%, the best output gap threshold to predict banking distress, does not help predict future negative output gaps of less than 1%: the increase in the probability of the event is rather small, regardless of the horizon, and mostly not statistically significant. Mean reversion does not appear to be that strong. By contrast, the composite credit-cum-equity gap indicator does much better. The probability of observing such economic slack rises from almost 40% to 66% and 75% respectively in the third and fourth year following the quarter in which the signal goes on. The coefficients on the composite indicator are highly statistically significant. And if one requires the three thresholds, for the credit, equity ***and*** output gaps, to be exceeded at the same time, making the composite indicator even more selective, then the probability of economic weakness increases further to 99% and 100%, respectively.[43]

As before, the combination of the credit and equity price gap is far superior to either of the two taken in isolation (same table). This is true both in terms of the increase in the conditional probability and of statistical significance. While the credit gap outperforms the equity gap over a horizon of two years, they are roughly equivalent at three years, while equity does better at longer horizons. As before, this probably reflects the greater persistence in the credit gap, which leads to more frequent signs of economic weakness at shorter horizons.

Experimenting with somewhat different thresholds did not alter the results much (Table II.5). For instance, setting the threshold for the equity gap within the 40-60% range and/or lowering that for the credit gap to 3% indicates that the performance of the indicator still improves as the horizon lengthens. Similarly, the increases in the probability of the event remain very high, especially for equity gaps of 50% or above. Overall, the results tend to indicate that the more serious the imbalance during the boom, the stronger the mean reversion forces.

The performance of money is, on balance, inferior to that of credit (Table II.4). In contrast to credit, when money is considered in isolation or in combination with the output gap, its information content is hardly discernible, either economically or statistically. It seems to perform adequately only when combined with the equity gap. However, in this case, as the other results suggest, it is the asset price which is doing the bulk of the work, and the information content does not quite match that of the credit-cum-equity gap.

What about inflation? As expected, the indicator also contains information about this variable which is additional to that of the output gap, with a clear time pattern as the horizon is lengthened. The predictive performance, however, is not quite as good as that with respect to output (Table II.6).[44] An ex ante output gap in excess of 2% tends to be followed by a decline in inflation in the third and fourth year ahead, with the probability of the event rising from around 50% to close to 60%. The credit or the equity gap, on their own or combined, tend to ***reduce*** the probability of observing a decline in

[43] This composite indicator is selective indeed, as there are only nine occurrences in the overall sample where these thresholds are exceeded. Making the indicator less restrictive does not alter the basic results. Note also that the probability of the output gap falling short of minus 2% is still almost 80% in the fourth year.

[44] The fact that the relationship is not as strong should not come as a surprise. Empirically, for instance, a considerable literature suggests that at least asset prices are better predictors of output than inflation; see Stock and Watson (2003) for a recent survey. See also English et al (2003) for an empirical analysis of the predictive content of financial variables generally based on principal components.

inflation over two years, but to ***increase*** it thereafter, suggesting some upward pressure on inflation which is then reversed, as imbalances unwind. The composite credit-cum-equity gap indicator is slightly better than the output gap for a horizon of four years, for which the conditional probability of a decline in inflation rises to over 60%, and is statistically significant. It is inferior to the output gap over a three-year horizon. Finally, and importantly, as with the predictions of economic slack, combining the financial indicators with the output gap indicator improves performance considerably. It raises the probability of a decline in inflation from 60% to over 90% in the fourth year ahead compared with predictions based on the output gap alone.

As in the case of output predictions, the sensitivity of the results for the best composite indicator with respect to the precise thresholds chosen is very small (Table II.7). Varying the equity gap threshold between 40 and 60% and/or lowering the credit threshold to 3% produces a similar pattern of findings, the main difference being some decline in the size of the increment in the conditional probability. This confirms the fact that the downward pressure on economic activity and inflation increases with the size of the imbalance during the boom.

In this context, there is less to choose between money and credit (Table II.6). Neither of them, in fact, appears to have information content on their own, except that a positive money gap in excess of 2% does lead to some upward pressure on inflation over a two-year horizon. It is only when combined with the output gap or the equity gap that the gaps help to predict declines in inflation at three-year horizons or beyond. The outperformance of credit emerges only when combined with the equity and output gaps simultaneously, as noted above.

Overall, we interpret these results as suggesting that the proxy for financial imbalances contains valuable information about future economic developments and the balance of risks facing the economy, especially ***beyond*** the traditional horizons used for policy. Financial imbalances, so measured, tend to raise the frequency of output weakness and declines in inflation at three-year horizons or beyond. And the pattern appears to be stronger, the larger is the imbalance during the boom. The fact that the ***in-sample*** relationship with future inflation is not as strong as that with future output confirms the existence of forces other than economic weakness that may influence the inflation process. It is arguably less of an issue in true forecasting/forward-looking mode, however. This would be so as long as the degree of economic slack was seen as the main factor affecting inflation, with the influence of other factors perhaps regarded as less persistent and more transitory and/or harder to predict.

III. Financial imbalances and central bank reaction functions

Having evaluated the information content of the indicators, it is now time to look at their interaction with monetary policy more closely. Two questions deserve attention. First, to what extent does the behaviour of the various "gap" measures help to "explain" actual policy during the period? Second, and in a more counterfactual sense, what would the proxies for financial imbalances have implied for the policy rate path had the authorities reacted to them?

To answer these questions, one needs a "benchmark" to describe "standard" policy. Any simple benchmark is bound to be arbitrary. Unashamedly, however, here we follow the common practice of capturing policy through the popular "Taylor rule" (Taylor (1993)). This portrays monetary policy as if the policy rate (the instrument) responded exclusively to a measure of economic slack (the output gap) and inflation itself. This is done not so much because we feel that this is an accurate description of how policy is actually decided; that would obviously be wrong. Rather, because it is the most accepted practice, faute de mieux.

To limit the risk of finding misleading results, we carry out the analysis only for those countries in the sample for which this type of rule has been found, in the past, to be a reasonable approximation to policy rate trajectories. These comprise the United States, Japan, Germany and Australia.[45] In other countries, changes in policy regimes and greater attention to exchange rates, given the openness of

[45] On the United States, Japan and Germany, see eg Clarida et al (2000); on Australia, see de Brouwer and Gilbert (2003) and Gruen et al (2002).

the economy, would have called for richer specifications, which are left for future work.[46] Since in Germany the composite proxy for financial imbalances never "goes on" in the pre-EMU period,[47] one can think of this country as a "control" case.

We perform two types of analysis, corresponding to the two questions asked.

In the first, we ***estimate*** the Taylor rules and check whether the financial gap variables contain additional information, ie whether they help to explain the interest rate path. We look at the information contained in the "normal" evolution of the gap variables as well as that captured by their "abnormal" behaviour, when they occasionally move outside their range and exceed the critical thresholds during booms, signalling the presence of financial imbalances. If the answer to either of these questions is yes, at least two interpretations are possible, assuming that the Taylor rule is a useful benchmark. Either the authorities were *consciously* reacting to the additional variables as providing further information about the economic outlook (eg, using them as information variables) or they were responding to a richer information set, not well captured by the standard variables included in the rule. Measurement error in the relevant variables, notably the output gap, can be thought of as falling under this same category. Probably the best way of adjudicating between these two interpretations is to see what the authorities actually say they were trying to do.[48]

In the second, we ***impose*** a range of "reasonable" coefficients on the Taylor rules and check at what point the best proxy for financial imbalances would have counselled a tighter monetary policy. The idea here is to compare policy with those sets of parameter values that have been found to perform reasonably well in models where financial imbalances do not play a fundamental role and which have become standard benchmarks for analysis. This procedure is not subject to the vagaries of estimation. It also allows us to get a better feel for the usefulness of the signals and for the counterfactual interest rate trajectory. Of course, importantly, without a "model" of the economy we cannot say anything about the desirable size of the interest rate adjustments.

Before we proceed, a "health warning" is in order. The analysis of this section should be taken as preliminary and exploratory. It is intended to begin to assess the difficult questions raised and to provide further food for thought, not to answer them in any definite way.

The message from estimated reaction functions

As a first step, the benchmark Taylor rules used here are backward-looking variants. They use contemporaneous output gaps and inflation, so that no account is taken of the problems that would arise in using real-time information only.[49] The output gaps are the ex ante gaps calculated in the first part of the paper, with the lambda set at the traditional value of 1600. No allowance is made for possible variations in the "neutral" or "natural" interest rate over time.

We try two variants, one without and the other with partial adjustment. There is, of course, a growing literature on how exactly to interpret the lagged dependent variable, in particular whether it might reflect omitted variables or truly sluggish adjustment towards equilibrium values.[50] We do not, however, examine this issue in detail here. If a variable is found to be relevant in both versions, we simply interpret this as corroborating evidence that it might "belong" there, and try to evaluate this based on other, non-statistical information, such as what is known about policy in the corresponding country. Thus, the two benchmark regressions run are:

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[46] See Ball (1999). Preliminary results in fact showed that standard specifications performed poorly in the other cases for which they were tried, including the United Kingdom, Canada, Sweden, Finland and Norway.

[47] The composite indicator does flash in one quarter following the creation of the euro area, namely in 2000 Q1. Interestingly, this episode, too, was subsequently followed by a period of weak growth with some strains, although not acute, in parts of the banking system. See BIS (2003).

[48] An alternative possibility to do this would be to estimate forward-looking Taylor rules subject to the rational expectations restriction that the forecasts are the best (linear) projections on a given information set, as originally suggested by Clarida et al (2000). However, we do not find this restriction particularly appealing, especially at times of potential financial imbalances; see also Okina and Shiratsuka (2003).

[49] These were first highlighted by Orphanides (2001), and since then have attracted considerable attention; see, for instance, de Brouwer and Gilbert (2003) for Australia.

[50] For attempts to adjudicate between the two hypotheses in the United States, see in particular Rudebusch (2002), Gerlach-Kristen (2002) and English et al (2002).

$$(1) \qquad r_t = r^n + \alpha\ (\pi_t - \pi^*) + \beta\,(y_t - y_t^*) + \gamma\, x_t + \mu_t$$

$$(2) \qquad r_t = (1-\rho)\ r_t^* + \rho\, r_{t-1} + \varepsilon_t$$

where $r_t = i_t - \pi_t$

Here, r_t, $(y_t - y_t^*)$, and π and π^* are, respectively, the inflation-adjusted ("real") policy rate, the contemporaneous output gap, the contemporaneous inflation rate and the implicit "target" rate of inflation, both measured in terms of a core consumer price index.[51] X represents the set (vector) of additional variables. r^n is the long-term neutral ("natural") real rate of interest.[52] r_t^* denotes the target policy rates as determined by the Taylor rule without partial adjustment. The parameter ρ captures the speed of adjustment to the desired level of the interest rate. We expect $\alpha > 0$, which implies that inflation-adjusted policy rates are increased as inflation rises (the so-called "Taylor principle"). The term in square brackets is assumed to be constant. μ_t and ε_t are i.i.d. error terms. The estimation period is 1983 Q1-2002 Q4, ending in 1998 Q4 for Germany only.

We include the additional variables in the following sequence. First, we include the credit and equity gaps per se, regardless of whether they exceed the thresholds or not. These would capture the "normal" explanatory power of the corresponding financial variables. Second, we add alongside them the composite proxy for financial imbalances, ie a dummy that takes the value of 1 if the critical thresholds used to predict banking distress are simultaneously exceeded. This would capture any "non-linear" explanatory power, as would be the case if the authorities deviated from their normal policy at times when economic booms moved out of line with average historical experience. For simplicity, only the most selective threshold is used (credit gap and equity gaps equal to 4% and 60% respectively). The previous analysis has suggested, however, that even less demanding thresholds contain similar information. Finally, we test for asymmetric responses as between positive and negative values of the gaps. It is not uncommon for central banks to argue that they find it desirable and much easier to respond by loosening policy as imbalances unwind, such as to counteract "headwinds", than to tighten as they build up. This procedure might help to find evidence of that type of behaviour.

Tables III.1 to III.4 show the main results. The results of the benchmark regressions look broadly in line with previous work. The coefficients on the key variables generally have the "right" orders of magnitude and are statistically significant. Beyond this, the picture that emerges differs considerably across countries.

In the case of Germany, the additional financial variables lack meaningful explanatory power for the behaviour of the policy rate (Table III.1). The coefficients are generally not statistically significant and where some significance can be discerned the signs are not those that might have been expected, in that they imply a tightening of policy in the face of weak financial conditions. This is hard to interpret in a meaningful way. Overall, we infer from these results that in Germany the financial variables considered have not systematically played a significant and explicit role in policy during the estimation period.

The evidence for Australia is more mixed (Table III.2). The credit and equity gaps both have the expected signs in the regressions without partial adjustment. While the coefficients are not individually significant, they are jointly significant, providing some tentative evidence that financial variables may help to explain policy. There is, however, no evidence of non-linear responses. And the relationship does not survive the partial adjustment specification.

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[51] See the Graphs for a detailed definition of the variables. In estimating the equation for Australia we assume that between 1983 and 1989, π^* was equal to the average rate of inflation over that period. From 1989 onwards, π^* is set equal to 2½%. For the other non-inflation targeting countries, we take the average inflation rate during the period (ranging from between close to 1% to just above 2%).

[52] Note, however, that since the ex ante gap variables in the regression do not necessarily have mean zero (in fact, they are statistically different from zero in sample), the constant in the regression cannot really be interpreted as the natural rate of interest.

For Japan there are stronger signs that financial variables contain some additional information (Table III.3). The policy rate tends to be lower when financial conditions are weak, but not to deviate systematically from benchmark Taylor rules during the "normal" upswings in these variables. This is reflected in significant coefficients for the negative gap variables only, although the message becomes noisier in the partial adjustment specification. The message is consistent with descriptions of policy in the face of financial system weakness. There is also some, but not robust, evidence of non-linear relationships. In particular, a higher rate than normal prevailed when the financial imbalance proxy was flashing in the run-up to the stock market crash of 1987 (see below). Particular difficulties in measuring the output gap in Japan and signs of residual serial correlation even in the partial adjustment equation (not shown) counsel caution in the interpretation of the results. Even so, at least the stronger response to proxies of financial weakness is consistent with the central bank's own portrayal of policy.

The least ambiguous indications that financial variables may have played some role come from the United States (Table III.4). As judged by statistical significance and coefficient size, overall there is less ambiguous evidence of asymmetric responses.[53] Policy rates do not rise above "benchmark" levels when the financial gaps are positive, but appear to be lower when they are negative.[54,55] The response to the "headwinds" of the early 1990s and that following the autumn 1998 market turbulence are consistent with a purposeful reaction to the potential impact of financial "headwinds" on the economy.[56] The coefficient on the negative credit gap implies that US interest rates were more than 2 percentage points lower in the early 1990s than would have been the case had the credit gap been positive. Similarly, the coefficient on the negative equity gap suggests that recently interest rates have been more than 2 percentage points lower than would have been the case in the absence of equity market weakness. Once we allow for these asymmetric effects, there is no further evidence of a non-linear relationship, with the coefficient on the financial imbalances indicator variable not significantly different from zero. Overall, the message from the regressions is broadly in line with the authorities' description of their policies over this period.[57]

On balance, the picture that emerges from this type of analysis is that central banks either do not respond much to financial imbalances or, to the extent that they do, they respond asymmetrically. Policy appears to be loosened in the face of the unwinding of imbalances beyond what would be suggested by the behaviour of inflation and the output gap alone, but does not seem to be tightened as imbalances build up. This is clearly consistent with the serious technical difficulties in measuring those imbalances and in calibrating a response to them. It is also consistent with the daunting political economy and communication problems that would be faced if policy was tightened in the absence of obvious signs of near-term inflation pressures.

The message from imposed reaction functions

The broad conclusions that emerge from a look at imposed reaction functions are similar, although certain nuances emerge. In addition, the analysis clarifies the nature of the policy dilemmas faced by policymakers.

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[53] Similar results (not reported) are found when we regress the residuals from the standard Taylor equation (without partial adjustment) on the various financial gap measures. This statistical procedure "raises the bar" for them, in so far as the initial regression should already capture any correlation of the standard variables with the omitted ones. The results are clearly statistically significant for the United States, with the corresponding adjusted R squared being of the order of 50%. The asymmetric pattern emerges again.

[54] This result is consistent with the recent findings by Cecchetti (2003). Based on the estimation of forward-looking Taylor rules, he finds that a measure of the equity premium is statistically significant for the United States. He does not, however, test for the possibility of an asymmetric information content.

[55] No such evidence of an asymmetric response to positive and negative output gaps is found in regressions that allow for asymmetric responses to the output gap in addition to those to the financial variables, while the asymmetric response to the financial variables survives. This asymmetry is also present if one includes, in addition, a credit quality spread (the difference between the spread on a AAA and BBB index), as done is Gerlach-Kristen (2002).

[56] Visual inspection of the residuals confirms that at least part of the explanatory power of the variable comes from these episodes. The fact that, in the asymmetric response, the equity gap comes out more clearly than the credit gap is consistent with the stronger persistence in the credit gap variables, which continues to rise for a while as economic weakness materialises, partly because GDP falls. For the early 1990s, see Greenspan (1997).

[57] See, for instance, Ferguson (2003).

The procedure followed here is similar to that in BIS (2003).[58] We again use backward-looking Taylor rules, with and without partial adjustment. The "central coefficients" of the rules set in terms of inflation-adjusted policy rates are 0.5 (inflation deviations from the desired level and output gap) and 0.4 for the partial adjustment coefficient. The desired inflation rate is assumed to be 2% and the equilibrium, long-run ("natural") real rate of interest 3%. The point estimate of the response to inflation deviations is varied from 0.5 to 2.0 and that to the output gap from 0.5 to 1.0; the natural real interest rate is allowed to vary between 2.5 and 3.5; the partial adjustment coefficient is kept fixed. In contrast to the analysis above, we use OECD (ex post) output gaps. This is because variables based on ex post (more) information are closer approximation to the "right" output gaps used in the models from which the range of coefficients are drawn. It also allows us to check the robustness of previous results. The price indices are variants of core consumer prices, but we purge them of the influence of one-off increases in indirect taxation, which would lead to artificial shifts in the corresponding policy rate paths.[59]

The basic results are shown in Graphs III.1 to III.3. Shaded areas around the "central" rules capture the variation due to the sensitivity analysis. The vertical shades refer to the quarters in which the composite proxy for financial imbalances goes on, again using only the most restrictive thresholds. At least four points stand out.

First, the evidence tends to confirm the typical asymmetric central bank response found in the estimated reaction functions (see Graph III.1 and also Graph III.2). By and large the trajectories of the policy rates remain within the (considerable) range of variation allowed for.[60] The main exceptions relate to periods that saw the unwinding of financial imbalances, such as the early 1990s in both the United States and Japan, and the most recent period, in the wake of the reversal of the equity market boom. During these phases, policy rates were sometimes below the bottom of the confidence region. A possible qualification to this is that in Japan between 1985 and early 1987 policy rates, while coming down rather quickly and to very low levels in nominal terms, actually remain unusually high in inflation-adjusted terms.[61] However, while at the time the authorities were watchful about rapid monetary and asset price increases, the "high" level appears to have reflected unusually low inflation rates and the echoes of the previous period of high rates, rather than a deliberate attempt to discourage the potential build-up of imbalances.[62]

Second, as calibrated, the composite indicator points to the build-up of risks in the United States, Japan and Australia at various points in the second half of the 1980s. This was roughly between mid-1986 and late 1987 in the United States, between 1987 and early 1989 in Japan and 1987 in Australia. During that period, policy rates both in the United States and Australia tended to move along the lower part of confidence region around the imposed Taylor rules, and they actually fell through the bottom in late 1987.[63] By contrast, in Germany policy rates remained above the corresponding region for much of the period, suggesting a tighter policy even in the absence of equivalent signs of imbalances.

Finally, as calibrated, the lag between the signal of the indicators and the subsequent problems is quite long, since difficulties materialised considerably later. Importantly, this is partly because real estate prices continued to rise, peaking a couple of years after equity prices[64] (Graph III.3). In fact,

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[58] For an analysis of the performance of the various rules in macro-models, see the volume edited by Taylor (1999).

[59] These correspond to 1989-90 and 1997-98 in Japan and 2000-01 in Australia.

[60] In Japan, policy would look unusually easy in 1989 (1988 if one used forward-looking rules) because of the increase in indirect taxes, if the indices were not corrected for this. See in particular Okina and Shiratsuka (2003), who note how the results obtained by McCallum (2001) and Bernanke and Gertler (1999) are partly distorted by this factor. Those papers include a much more thorough discussion of policy in Japan during the period, from different perspectives.

[61] A thorough analysis of the policy stance would also need to take into account the level of nominal rates, as these can have important effects on cash flows and, more controversially, psychology too.

[62] See Okina et al (2001) for an excellent description of policy from 1986 to the early 1990s.

[63] The fact that the policy rates actually lie below the bottom of the range must be interpreted with caution. In particular, given the comparatively high inflation rate at the time, the central bank's de facto "target" level of inflation may have been higher than the 2% assumed here. This would shift the range downwards. This problem does not arise in either Germany or Japan as much, since inflation was lower there, hence also the smaller "sensitivity range" of the imposed rules. The main message to infer is that policy rates were comparatively low by the standard benchmarks used in this exercise.

[64] For an analysis of the relationship between equity and property price peaks, see BIS (2003), Borio and White (2003) and, for a more detailed discussion, Borio and McGuire (forthcoming).

policy was eased somewhat after the stock market crash of October 1987, when policy rates reached their trough, and rates started to rise only in the first quarter of 1988. These differences in asset price dynamics greatly complicate the calibration of the appropriate policy response.[65] They also strongly suggest that a proper analysis of the imbalances would need to take into account the behaviour of property prices too.

This point is quite clear in the case of Australia. The Reserve Bank of Australia increased policy rates considerably above those suggested by the policy rule in 1989, two years after the signal calibrated using equity prices goes on. One interpretation of this is that the central bank was responding to a combination of persistently high inflation and the strong increases in credit and property prices that were occurring at the time.[66] Indeed, a combined credit and property price indicator (constructed in the same way as the combined credit and equity price indicator) suggests that the likelihood of financial strains was increasing through the late 1980s (not shown). The situation in Japan was very similar. And in the United States, while less evident in the nationwide data, property prices kept increasing rapidly in some regions, such as the North-East.

Conclusions

The findings in this paper suggest that identifying ***in a timely way*** the development of financial imbalances with potential unwelcome implications for output and inflation, while very hard, is not impossible. This represents a further step towards laying the technical basis for a policy response aimed at restraining the build-up of imbalances, rather than limiting policy action to seeking simply to offset the economic consequences of their unwinding. A pre-emptive response calls for horizons that are longer than the one- to two-year intervals that have been adopted in a number of inflation targeting regimes.[67] Importantly, however, it is not inconsistent with inflation targeting as long as the horizons are lengthened and the authorities entertain a view of the economy that recognises the key role that financial imbalances can play.

Recognising this role implies paying greater attention to credit in policymaking than has generally been the case since at least the 1960s. In particular, it is the interaction of credit and asset prices that is at the core of the drawn-out but ultimately disruptive processes that can catch policymakers off-guard, as they can arise even in the context of benign near-term inflation pressures.

In calling for a more important role for credit, it is important to stress that we are not arguing for a form of credit targeting or for central banks to set guidelines for "acceptable" credit growth. Rather, we are arguing that simply setting monetary policy so that the two-year inflation forecast is at the central bank's target may, on occasions, be less than optimal. In particular, there may be occasions when the central bank may want to deviate from such a rule, most notably when developments in the financial system are exposing the macroeconomy to materially increased risk.[68] As our analysis suggests, one important indicator that such risk is building up is sustained and rapid credit growth, alongside unusually large and sustained increases in asset prices. Ignoring such growth may ultimately lead to greater unwelcome fluctuations in both output and inflation.

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[65] The risks of monetary accommodation in these circumstances are highlighted by White (2003).

[66] For a discussion of monetary policy in Australia during this period, see Grenville (1997) and Stevens (1992).

[67] In recent years, there has been a tendency for some central banks to adopt more medium-term inflation targets. The most obvious example is the Reserve Bank of New Zealand. In the latest Policy Targets Agreement, the objective of the central bank was changed to keeping inflation within the target band "on average over the medium term". In Australia, the inflation target has always been expressed in terms of medium-term outcomes. See Stevens (2003) for a recent discussion of the horizon issue. Note also that the notion of a longer horizon should ***not*** simply be taken to mean that one or two years are mechanically added to model-based forecasts from which point predictions may be derived. For one, current models are not easily capable of handling the processes discussed in the paper. In addition, the timing of the unwinding of the financial imbalances is exceedingly hard to predict. Rather, the longer horizon should be used as a device to assess the balance of risks faced by the economy and the costs of policy action and inaction in a more meaningful way. Therefore, the two concepts – horizon and balance of risks – are intimately related and mutually supportive. They also play a key role as communication devices.

[68] Another example is where a significant move in the exchange rate causes forecast inflation to move away from the central bank's target. In such cases, attempting to offset the effect of the change in the exchange rate on overall inflation may make both output and inflation more volatile.

It is sometimes argued that addressing the build-up of imbalances is ultimately the task of prudential authorities, for it is they that are primarily responsible for ensuring the stability of the financial system. As explained elsewhere, however, while these authorities have an important role to play, it may not be appropriate to leave the task ***exclusively*** to them.[69] First, because of the specifics of their mandate and culture, prudential authorities may not be naturally favourably disposed towards tackling a problem that could be seen as having a macroeconomic origin. Second, devising effective prudential tools is hard, just as it is hard to calibrate a monetary policy response. Third, and importantly, serious macroeconomic consequences can arise even if financial imbalances do not lead to a full-blown banking crisis. Arguably, capital market financing is subject to similar boom-and-bust cycles. Moreover, banks may remain relatively healthy and willing to supply credit to creditworthy clients but borrowers may be under great pressure to retrench and cut expenditures in order to restructure badly damaged balance sheets. In other words, the source of disruption may be weak demand for external funding rather than unusually restrained supply. Finally, the influence over the supply of aggregate credit ultimately lies with the central bank, however imperfect that influence might be.

Nevertheless, even if the analysis of this paper is accepted, a number of serious obstacles remain before a policy of the kind proposed could be effectively implemented.

Some of these are of a technical nature. The indicators developed can only be one element in a more thorough assessment of macroeconomic and financial system vulnerabilities. The evolution of property prices and sectoral balance sheets should play an important complementary role too. And the authorities should strike a delicate balance between remaining alert to possible changes in financial structure that might alter historical relationships, on the one hand, and avoiding falling victim to the temptation to think that past experience should be discounted, on the other. A heavy dose of judgment is obviously necessary.

A second set of obstacles has to do with communication and political economy constraints. Given the rhetoric employed until recently in inflation targeting regimes, communicating the desirability of a policy response to the build-up of financial imbalances and explaining its consistency with the pursuit of inflation objectives can be exceedingly hard. And even in less explicit regimes, there is a risk that the authorities may incorrectly be seen as pursuing policies that go beyond their mandate. Educational efforts are essential.[70]

To this end, it is also important that academic work devotes greater attention to the analytics of financial imbalances and their interaction with business fluctuations and inflation. Modelling such processes is quite hard, not least as they necessarily involve fundamentally non-linear relationships. It also requires blending two lines of enquiry that have been largely evolving independently, dealing respectively with traditional macroeconomic issues and financial crises. But, as they say, the higher the mountain, the greater the excitement of the climb!

[69] See, for instance, Borio and Lowe (2002a) and Borio and White (2003).

[70] In particular, speeches and studies by Bank of England officials have been moving in this direction; see, for instance, King (2002) and Bean (2003).

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List of Tables and Graphs

Table II.1
Single indicators of banking distress[1]

Horizon (years)[2]	Credit gaps[3] (4)		Equity price gaps[4] (60)		Output gap[5] (1)		Smoothed output gap[6] (2)		Money gap[7] (3)	
	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted
3	.22	80	.24	47	.46	53	.37	60	.51	53
3,4	.21	80	.15	67	.39	60	.32	67	.43	60
3,4,5	.19	80	.12	73	.30	73	.28	73	.42	60

[1] A gap is measured as percentage points from an ex ante, recursively calculated Hodrick-Prescott trend; the size of the threshold is shown in brackets. [2] A signal is correct if a crisis takes place in any one of the years included in the horizon ahead. Year 3 means the year starting 12 quarters ahead; "year 3,4" means either year 3 or year 4; etc. Noise is identified as mistaken predictions within the same horizon. Given the data frequency and difficulties in assigning crises to a specific date, banking stress is arbitrarily assigned to the last quarter in any given year. [3] Credit is measured as the ratio of private sector credit to GDP (and lambda = 400000). [4] Real equity price index (and lambda = 400000). [5] GDP (and lambda = 1600). [6] GDP (and lambda = 400000). [7] Money is measured as the ratio of money to GDP (lambda = 400000). The monetary aggregate used is roughly equivalent to M2 or M3 depending on the country.

Source: Authors' calculations based on national data.

Table II.2
Composite indicators of banking distress[1]

Horizon (years)	Combined gaps											
	Money (2) and credit (4)		Money (2) and ouput (2)		Money (2) and asset price (60)		Credit (4) and output (2)		Credit (4) and asset price (60)		Credit (4), asset price (40) and output (1.5)	
	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted	Noise/ signal	% crises predicted
3	.21	60	.21	47	.09	47	.13	53	.06	47	.05	27
3,4	.20	60	.17	53	.07	53	.07	73	.02	73	.02	47
3,4,5	.19	60	.16	53	.06	53	.06	73	.02	73	.01	60

[1] See Table II.1 for definitions.

Source: Authors' calculations based on national data.

Table II.3
Composite credit and equity gap indicator: sensitivity analysis[1]

Thresholds (credit/equity)	% crises predicted			Noise-to-signal ratio			z-statistics[2]		
	Year 3	Year 3,4	Year 3,4,5	Year 3	Year 3,4	Year 3,4,5	Year 3	Year 3,4	Year 3,4,5
3/30	67	73	73	.10	.08	.06	8.76	10.11	13.14
3/40	60	73	73	.09	.04	.03	8.73	10.47	13.87
3/50	60	73	73	.07	.03	.02	8.27	11.34	14.94
3/60	47	73	73	.07	.02	.02	9.06	11.77	15.77
4/30	67	73	73	.09	.07	.05	9.30	10.89	14.10
4/40	60	73	73	.08	.04	.03	9.24	11.15	14.70
4/50	60	73	73	.06	.03	.02	8.91	12.23	16.04
4/60	47	73	73	.06	.02	.02	9.55	12.78	17.03
5/30	60	67	67	.09	.07	.05	8.79	11.54	14.39
5/40	53	67	67	.09	.04	.03	8.40	11.61	14.73
5/50	67	67	67	.07	.03	.03	7.93	12.52	15.86
5/60	67	67	67	.08	.03	.02	8.49	12.86	16.56

[1] See Table II.1 for definitions. [2] z-statistic of probit regression of banking distress variable on corresponding composite indicator, both measured as zero/one dummy variables. The sample is 1976 Q1-1999 Q4.

Table II.4

Financial imbalances as indicators of the output gap[1]

Conditional probabilities of an output gap of less than minus 1%[2] (unconditional = 39)							
Single indicators				**Composite indicators**			
Gaps	**Year 2**	**Year 3**	**Year 4**	**Gaps**	**Year 2**	**Year 3**	**Year 4**
Output (2)	37 (-.53)	42 (.94)	49** (2.92)	Credit (4) and equity (60)	41 (.50)	66** (5.54)	75** (7.00)
Credit (4)	54** (6.43)	47** (3.36)	37 (-.63)	Credit (4) and output (2)	56* (2.34)	60** (2.74)	53 (1.78)
Equity (60)	35 (-1.25)	53** (4.61)	59** (6.68)	Equity (60) and output (2)	34 (-.69)	63** (3.19)	77** (4.71)
Money (2)	42 (1.42)	42 (1.52)	40 (.53)	Credit (4), equity (60) and output (2)	55 (1.06)	99** (2.91)	1.00[3] -
				Money (2) and credit (4)	50** (4.11)	44 (1.78)	37 (-.64)
				Money (2) and output (2)	31 (-1.44)	39 (.11)	40 (.19)
				Money (2) and equity (60)	37 (-.41)	61** (4.39)	65** (5.46)

[1] Results of probit regressions in which the variable predicted and the predictors are treated as zero/one dummies depending on whether the corresponding conditions defining the event are met; z-statistics in brackets. The sample is 1974 Q1-1999 Q4. Two and one asteriks correspond to statistical significance at the 1% and 5% levels respectively. [2] Ex ante output (lambda = 1600, throughout the table). The prediction relates to the ex ante output gap satisfying the condition (here, less than minus 1) in any one of four successive quarters (year). Thus, if the prediction is made in Q1 of, say, 1980, in the case of year 2 ahead the negative output gap of minus 1 relates to any one of 1982 Q1, Q2, Q3 and Q4, ie any one of 8, 9, 10 or 11 quarters ahead. Thus, the two-year horizon is only approximate. The same applies to the other horizons. [3] Conditional probability calculated by counting the frequency of events; the econometric routine does not converge.

Table II.5
Financial imbalances as indicators of the output gap: sensitivity analysis

Conditiional probabilities of an output gap of less than minus 1% (unconditional = 39)							
Credit gap = 4% with				**Credit gap = 3% with**			
Gaps	**Year 2**	**Year 3**	**Year 4**	**Gaps**	**Year 2**	**Year 3**	**Year 4**
Equity (60)	41 (.49)	66** (5.54)	75** (7.00)	Equity (60)	44 (1.16)	68** (6.25)	75** (7.30)
Equity (50)	44 (1.37)	64** (6.00)	71** (7.31)	Equity (50)	45 (1.60)	65** (6.27)	72** (7.67)
Equity (40)	46* (1.96)	62** (6.00)	67** (7.05)	Equity (40)	46* (2.10)	62** (6.21)	67** (7.36)
Equity (60) and output (2)	55 (1.06)	99** (2.91)	1.00[1] -	Equity (60) and output (2)	57 (1.39)	1.00** (3.22)	86** (2.72)
Equity (50) and output (2)	44 (1.20)	64** (4.88)	70** (5.84)	Equity (50) and output (2)	57 (1.71)	87** (3.42)	85** (3.25)
Equity (40) and output (2)	46 (1.59)	61** (4.93)	65** 5.46)	Equity (40) and output (2)	50 (1.22)	69** (2.75)	62* (2.13)

[1] Conditional probability calculated by counting the frequency of events; the econometric routine does not converge.

Table II.6
Financial imbalances as indicators of inflation[1]

Conditional probabilities of a decline[2] (unconditional = 50)

Single indicators				**Composite indicators**			
Gaps	**Year 2**	**Year 3**	**Year 4**	**Gaps**	**Year 2**	**Year 3**	**Year 4**
Output (2)	47 (-.71)	60** (2.64)	58* (2.11)	Credit (4) and equity (60)	41* (-2.08)	53 (.58)	63** (2.69)
Credit (4)	50 (.17)	51 (.27)	54 (1.70)	Credit (4) and output (2)	29** (-2.84)	68* (2.46)	62 (1.53)
Equity (60)	41** (-2.99)	52 (.68)	56* (2.11)	Equity (60) and output (2)	41 (-1.35)	56 (.87)	71** (2.79)
Money (2)	45* (-2.16)	52 (1.02)	54 (1.92)	Credit (4), equity (60) and output (2)	36 (-1.07)	55 (.31)	92* (2.38)
				Money (2) and credit (4)	49 (-.20)	52 (.63)	52 (.92)
				Money (2) and output (2)	46 (-.75)	62* (2.28)	59 (1.56)
				Money (2) and equity (60)	42 (-1.73)	54 (.99)	63** (2.85)
				Money (2), equity (60) and output (2)	47 (-.23)	56 (.50)	74 (1.80)

[1] Results of probit regressions in which the variable predicted and the predictors are treated as zero/one dummies depending on whether the corresponding conditions defining the event are met; z-statistics for the underlying regression coefficients in brackets. The sample is 1974 Q1-1999 Q4. Two and one asteriks correspond to statistical significance at the 1% and 5% levels respectively. [2] Inflation is defined as an average year-on-year change over four quarters. Thus, if the prediction is made in Q1 of, say, 1980, in the case of year 2 ahead the decline in inflation relates to the average year-on-year change between 1982 and 1981.

Table II.7
Financial imbalance as indicators of inflation: sensitivity analysis

Conditional probabilities of a decline in inflation (unconditional = 50)							
Credit gap = 4% with				**Credit gap = 3% with**			
Gaps	**Year 2**	**Year 3**	**Year 4**	**Gaps**	**Year 2**	**Year 3**	**Year 4**
Equity (60)	41* (-2.08)	53 (.58)	63** (2.68)	Equity (60)	43 (-1.56)	51 (.28)	64** (2.95)
Equity (50)	44 (-1.52)	54 (.93)	58 (1.80)	Equity (50)	45 (-1.30)	52 (.41)	58* (1.96)
Equity (40)	45 (-1.23)	55 (1.38)	55 (1.25)	Equity (40)	46 (-1.04)	53 (.82)	56 (1.51)
Equity (60) and output (2)	36 (-1.07)	55 (.31)	92* (2.38)	Equity (60) and output (2)	35 (-1.21)	43 (-.53)	94** (2.67)
Equity (50) and output (2)	48 (-.22)	44 (-.47)	81* (-2.29)	Equity (50) and output (2)	46 (-.41)	38 (-1.09)	84** (2.62)
Equity (40) and output (2)	39 (-1.14)	56 (.61)	70 (1.79)	Equity (40) and output (2)	39 (-1.26)	50 (.01)	73* (2.13)

Table III.1

Estimated Taylor rules: do financial variables matter?[1]

Germany											
Partial adjustment	**Constant**	**Inflation**	**Output gap**	**Credit gap**	**Equity gap**	**Financial imbalance**	**Credit gap**		**Equity gap**		$\overline{R}^2$
							Positive	**Negative**	**Positive**	**Negative**	
	2.91** (22.00)	.53** (4.56)	.54** (5.11)			–					.34
	3.49** (19.44)	.21 (1.72)	.25* (2.08)	-.17** (-4.70)	-.007 (-1.65)	–					.52
	2.34** (7.01)	.23* (2.22)	.26 (1.91)			–	-.05 (-1.12)	-.52** (-3.85)	.005 (.99)	-.15** (-4.24)	.64
.87 (15.72)	2.81** (6.25)	.20 (.48)	1.30** (2.53)			–					.87
.83 (12.51)	3.45** (6.36)	-.002 (-.005)	.93 (1.93)	-.13 (-1.15)	-.01 (-.93)	–					.87
.76** (10.36)	2.34** (2.90)	.08 (.29)	.86 (2.13)			–	-.04 (-.32)	-.38 (-1.14)	.001 (.84)	-.22* (-2.49)	.88

[1] Sample 1983 Q1–1998 Q4. Backward-looking Taylor rules. The interest rate is the tender rate. Inflation is measured by a core consumer price index. The output gap is the ex ante (one-sided) gap based on an HP filter (lambda = 1600). The regression with partial adjustment is estimated by NLLS, the one without it by OLS. The gap variables and the inflation rate are contemporaneous to the inflation-adjusted interest rate. Two and one asteriks correspond to statistical significance at the 1% and 5% levels respectively.

Table III.2
Estimated Taylor rules: do financial variables matter?[1]

Australia											
Partial adjustment	**Constant**	**Inflation**	**Output gap**	**Credit gap**	**Equity gap**	**Financial imbalance**	**Credit gap**		**Equity gap**		$\bar{R}^2$
							Positive	**Negative**	**Positive**	**Negative**	
	4.43** (19.82)	1.43** (8.92)	.69** (4.27)								.50
	3.96** (14.09)	1.22** (6,69)	.60** (3.46)	.10 (1.75)	.01 (1.04)						.53
	4.41** (19.40)	1.42** (8.73)	.68** (4.18)			.52 (.54)					.49
	3.81** (12.56)	1.23** (6.79)	.51** (2.71)	.09 (1.49)	.03 (1.66)	-1.91 (-1.28)					.53
	3.98** (9.09)	1.21** (6.21)	.58** (3.18)				.11 (1.26)	.08 (.51)	.01 (.79)	.06 (.67)	.52
	3.79** (8.15)	1.22** (6.27)	.50* (2.59)			-1.84 (-1.16)	.10 (1.07)	.07 (.42)	.03 (1.41)	.04 (.51)	.52
.85 (13.01)	3.88** (4.34)	1.39* (2.28)	1.96* (2.18)								.84
.86** (12.61)	3.67** (3.12)	.78 (.98)	2.65 (1.91)	.48 (1.47)	-.09 (-1.15)						.85
.87** (13.19)	4.02** (4.01)	1.52* (2.17)	2.28 (1.95)			-6.44 (-1.11)					.85
.86** (12.42)	3.27** (2.63)	.84 (1.12)	2.28 (1.83)	.42 (1.40)	-.03 (-.37)	-5.30 (-.85)					.85
.86** (12.42)	3.31 (1.78)	.69 (.80)	2.57 (1.85)				.58 (1.25)	.26 (.37)	-0.1 (-1.15)	-.02 (-.06)	.84
.86** (12.26)	2.78 (1.43)	.75 (.90)	2.25 (1.78)			-5.52 (-.83)	.51 (1.18)	.21 (.32)	-.03 (-.33)	-.06 (-.17)	.84

[1] Sample 1983 Q1–2002 Q4. Backward-looking Taylor rules. The interest rate is the cash rate. Inflation is measured by the weighted-median consumer price index. The output gap is the ex ante (one-sided) gap based on an HP filter (lambda = 1600). The regression with partial adjustment is estimated by NLLS, the one without it by OLS. The gap variables and the inflation rate are contemporaneous to the inflation-adjusted interest rate. Two and one asteriks correspond to statistical significance at the 1% and 5% levels respectively.

Table III.3
Estimated Taylor rules: do financial variables matter?[1]

Japan											
Partial adjustment	**Constant**	**Inflation**	**Output gap**	**Credit gap**	**Equity gap**	**Financial imbalance**	**Credit gap**		**Equity gap**		$\bar{R}^2$
							Positive	**Negative**	**Positive**	**Negative**	
	1.55** (15.07)	.51** (5.97)	.19* (2.58)								.33
	1.54** (16.00)	.18 (1.28)	.03 (.39)	.07 (1.94)	.003 (.46)						.45
	1.42** (13.28)	.55** (6.65)	.11 (1.45)			.96** (2.99)					.40
	1.59** (13.41)	.10 (.51)	.03 (.31)	.08* (2.01)	.003 (.58)	-.36 (-.67)					.45
	2.95** (9.46)	-.13 (-.93)	.09 (.93)				.003 (.06)	.20** (4.08)	-.01 (-1.78)	.03** (2.99)	.57
	2.95** (9.43)	-.07 (-.43)	.92 (.93)			.31 (.62)	-.007 (-.12)	.19** (3.69)	-.01 (-1.88)	.03** (3.04)	.57
.90 (18.12)	1.36** (3.08)	.37 (1.02)	.47 (1.35)								.87
.88** (15.60)	1.41 (3.57)	.11 (.19)	.34 (.88)	.07 (.48)	-.002 (-.07)						.87
.90** (16.79)	1.36 (2.87)	.38 (1.00)	.47 (1.18)			.06 (.04)					.87
.88** (15.51)	1.62** (3.45)	-.28 (-.36)	.31 (.81)	.13 (.80)	.002 (0.09)	-1.66 (-.75)					.87
.81** (14.44)	4.17** (4.30)	-.61 (-1.42)	.11 (.41)				.08 (.57)	.25 (1.83)	-0.5* (-2.01)	.09* (2.45)	.89
.81** (14.31)	4.17** (4.31)	-.50 (-1.02)	.11 (.42)			.54 (.40)	.07 (.43)	.23 (1.63)	-.05* (-2.01)	.09* (2.46)	.89

[1] Sample 1983 Q1–2002 Q4. Backward-looking Taylor rules. The interest rate is the overnight call money rate. Inflation is measured by a core consumer price index. The output gap is the ex ante (one-sided) gap based on an HP filter (lambda = 1600). The regression with partial adjustment is estimated by NLLS, the one without it by OLS. The gap variables and the inflation rate are contemporaneous to the inflation-adjusted interest rate. Two and one asteriks correspond to statistical significance at the 1% and 5% levels respectively.

Table III.4

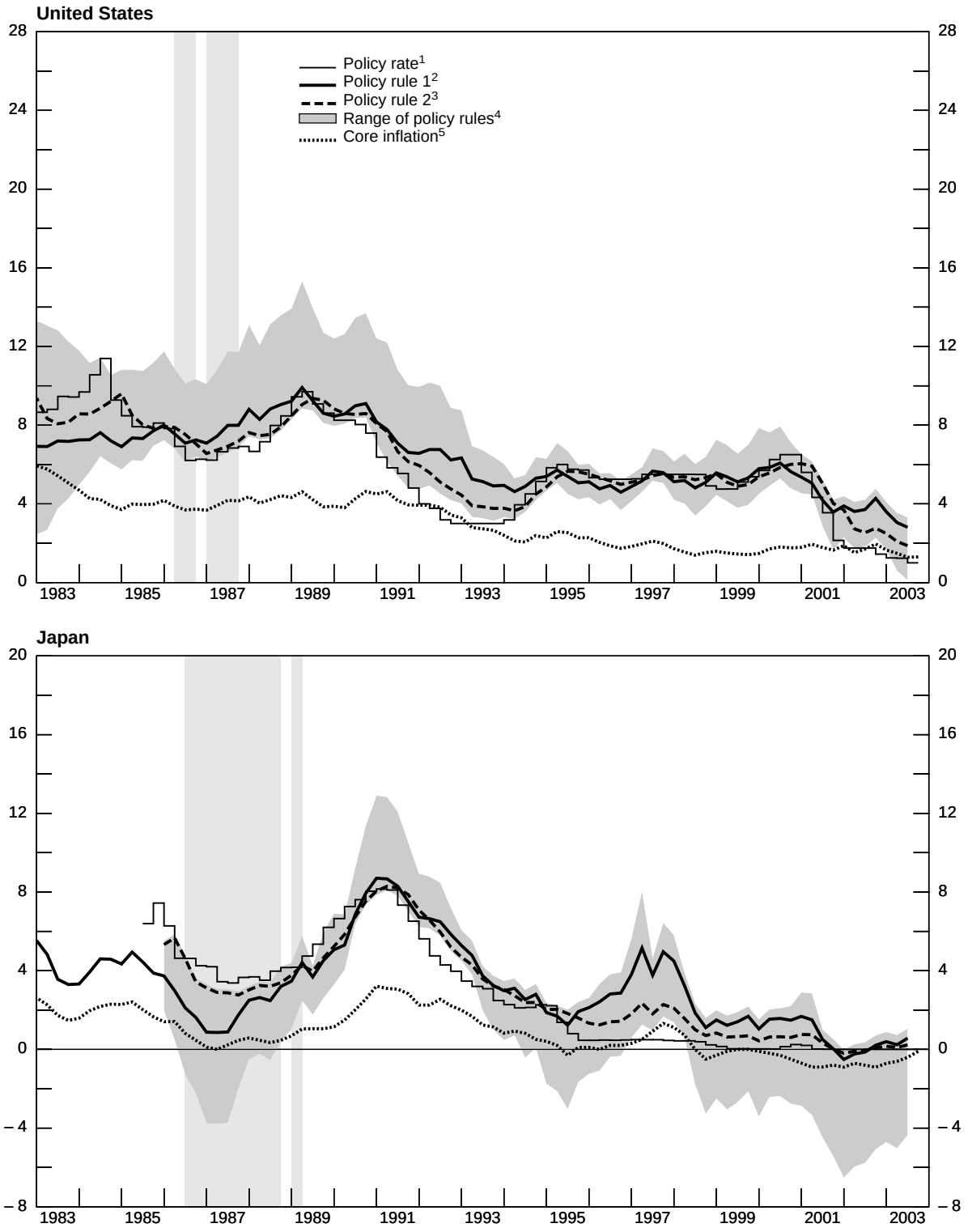
Estimated Taylor rules: do financial variables matter?[1]

United States											
Partial adjustment	**Constant**	**Inflation**	**Output gap**	**Credit gap**	**Equity gap**	**Financial imbalance**	**Credit gap**		**Equity gap**		$\bar{R}^2$
							Positive	**Negative**	**Positive**	**Negative**	
	2.90** (21.23)	.55** (4.46)	.78** (8.11)								.50
	2.15** (9.56)	.38** (3.37)	.77** (7.86)	.07* (3.27)	.02* (3.03)						.62
	2.88** (20.36)	.55** (4.40)	.79** (8.08)			.27 (0.49)					.52
	1.81** (7.73)	.32** (2.99)	.71** (7.61)	.09** (4.26)	.04** (4.60)	-1.96** (-3.41)					.67
	3.81** (12.74)	.17 (1.83)	.80** (10.07)				-.05 (-1.54)	.34** (7.50)	.001 (.09)	.13** (4.18)	.76
	3.70 (9.38)	.17 (1.82)	0.79 (9.64)			-.25 (-.43)	-.04 (-1.15)	.33** (6.63)	.00 (.35)	.13** (4.08)	.76
0.85 (20.35)	2.25** (5.29)	0.55 (1.64)	1.64** (4.24)								.92
.86** (16.90)	1.77* (2.49)	.52 (1.47)	1.46** (3.57)	-.05 (-.61)	.02 (.97)						.92
.86** (20.31)	2.32 (5.33)	.57 (1.64)	1.66** (4.11)			-1.39 (-.86)					.92
.82** (15.68)	1.35* (2.04)	.41 (1.38)	1.24** (3.89)	-0.00 (-.00)	0.04* (1.97)	-2.82 (-1.77)					.92
.78** (12.34)	3.43** (4.39)	.27 (1.08)	1.24** (4.77)				-.08 (-.92)	.22 (1.79)	-.002 (-.12)	.16* (1.98)	.92
.78** (12.35)	2.80 (2.62)	.27 (1.08)	1.19** (4.64)			-1.42 (-.92)	-.04 (-.36)	.17 (1.21)	.01 (.54)	.15 (1.86)	.92

[1] Sample 1983 Q1–2002 Q4. Backward-looking Taylor rules. The interest rate is the Fed funds rate. Inflation is measured by thechain-type private consumption expenditure deflator. The output gap is the ex ante (one-sided) gap based on an HP filter (lambda = 1600). The regression with partial adjustment is estimated by NLLS, the one without it by OLS. The gap variables and the inflation rate are contemporaneous to the inflation-adjusted interest rate. Two and one asteriks correspond to statistical significance at the 1% and 5% levels respectively.

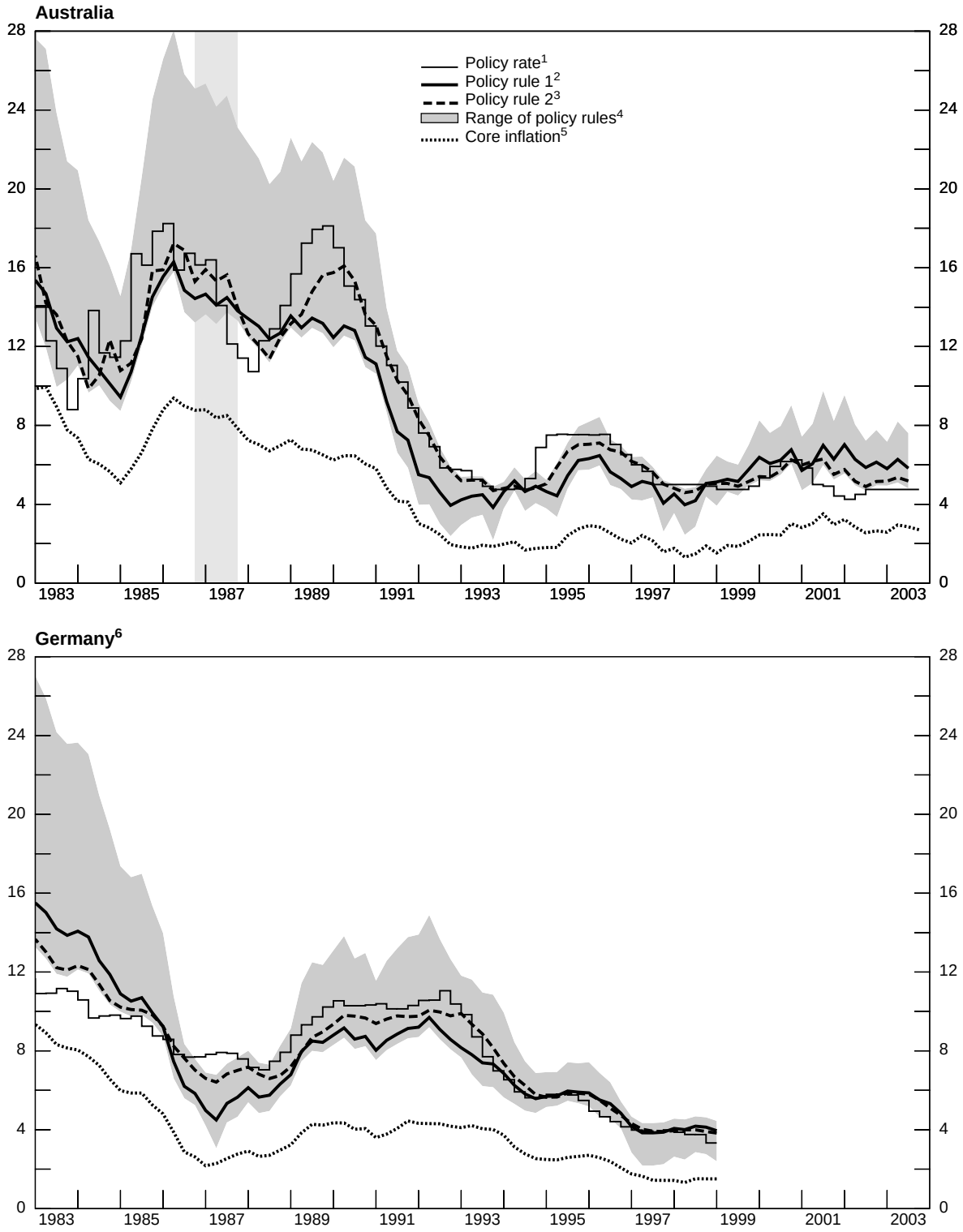
Graph III.1

Imposed Taylor rules: sensitivity analysis



Note: See opposite for an explanation of the footnotes.

Graph III.1 (cont)

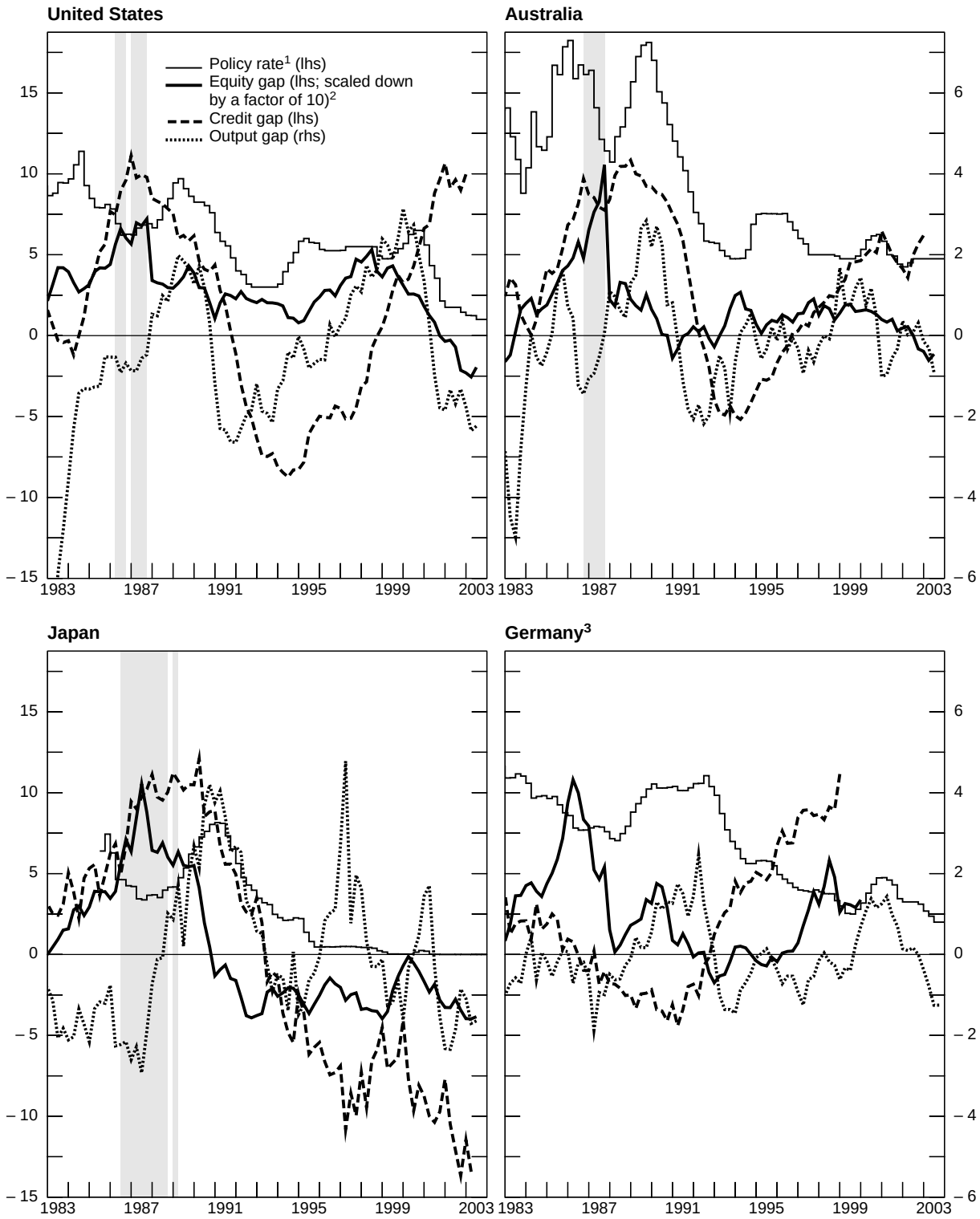


Note: The vertical shading represent periods where the composite credit (4%) and equity (60%) gap indicator signals a financial imbalance.

[1] For the United States, federal funds rate target; for Japan, uncollateralised overnight money market rate; for Australia, cash rate; for Germany, tender rate. [2] Rule 1 = $r + \pi_t + \alpha (\pi_t - \pi^*) + \beta (y_t - y^*_t)$, where r is the natural rate of interest (assumed to equal 3%), π_t is core inflation, $(y_t - y^*_t)$ is the output gap, π^* is the baseline inflation (assumed to equal = 2%), $\alpha = 0.5$ and $\beta = 0.5$. [3] Rule 2 = 0.4 (rule 1) + $0.6 i_{t-1}$, where i_{t-1} is the policy rate lagged one quarter. [4] Range of policy rules with r set to 2.5 or 3.5%, α set to 0.5 or 2 and β set to 0.5 or 1. [5] Percentage change over four quarters in core consumer prices. For Japan and Australia, excluding the effect of the introduction (1989) and increase (1997) of the consumption tax and the introduction (2000) of the sales tax, respectively. [6] Not applicable from the beginning of 1999 following monetary union in the euro area.

Graph III.2

Imposed Taylor rules: the role of the credit, equity and output gaps

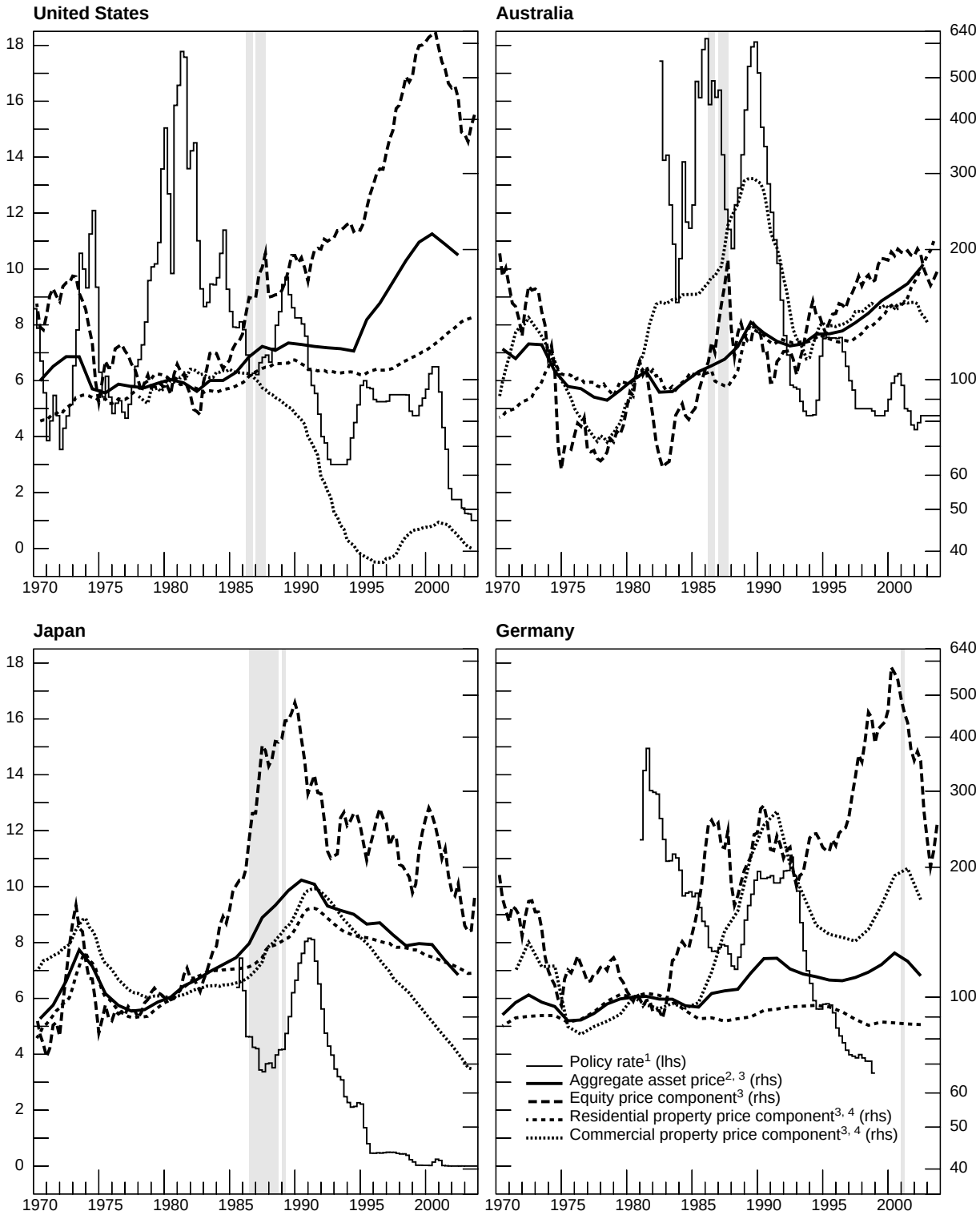


Note: The vertical shading represent periods where the composite credit (4%) and equity (60%) gap indicator signals a financial imbalance.

[1] See footnote 1 of Graph III.1. [2] Ie from –150 to 187.5. [3] See footnote 6 of Graph III.1.

Graph III.3

Imposed Taylor rules: the behaviour of asset prices



Note: The vertical shading represent periods where the composite credit (4%) and equity (60%) gap indicator signals a financial imbalance.

[1] See footnote 1 of Graph III.1 and, for Germany, footnote 6. [2] Calculated as a weighted geometric mean of the three components. The weights are based on net wealth data; the calculation uses 5-year windows (8-year for 1995 weights) starting in 1970. [3] Inflation-adjusted (using the personal consumption deflator); 1980 = 100 (semi-logarithmic scale). [4] For Japan, land prices.

Sources: Private real estate associations; national data; BIS calculations.