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Looking into the Rear-View Mirror: Lessons from Japan for the Eurozone and the U.S?

Pierre L. Siklos*

Abstract

Until recently, Japan has been treated as an outlier of sorts, apparently mired in slow growth and low to mildly negative inflation for over a decade. Monetary policy especially, but not alone, has received a healthy share of the blame for Japan's predicament. However, other major economies, notably the U.S. and the Eurozone, have since shown signs of what observers now call 'Japanification'.

This paper revisits and reconsiders the narratives surrounding Japan's economic performance since the 1980s in relation to the experiences of the U.S. and the Eurozone. Although there are clearly important differences between these three economies, including important institutional and structural differences, there are also some striking parallels. Equally important, at least according to the metrics used in this study, is that the poor reputation of the Bank of Japan's monetary policy is underserved. To be sure, there were periods of excessive tightness in policy, but the same is true for the other two economies considered. Indeed, the BoJ has been more credible than the other two central banks considered most of the time over the past decade.

Of course, important economic challenges remain but Japan is not an outlier. However, in the area of monetary policy, the current policy strategy may have put the 'cart before the horse'. Arguably, the largest risk is the loss of credibility unless all elements of the three 'arrows' of Abenomics have been aimed properly.

Keywords: Bank of Japan; monetary policy regimes; deflation; central bank credibility

JEL classification: E31, E32, E42, E44, E52, E58, C32, C34, C38

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This paper was prepared in part while the author was a visiting scholar at the Institute for Monetary and Economic Studies (IMES), Bank of Japan in November and December 2019. This paper has its genesis in several conversations about Japan and the Bank of Japan's monetary policy over ten years ago when I first visited the IMES. I thank the Staff at IMES over the years who were generous with their time, advice and comments. I am also grateful for discussions with current and former members of the Bank of Japan's Policy Board. Comments on earlier drafts by Michael Bordo, Richard Burdekin, Andrew Filardo, Jouchi Nakajima, and Shunichi Yoneyama are gratefully acknowledged. A previous version was presented at an IMES seminar. To conserve space, additional data and results are in separate appendices on the author's website. The views expressed in this paper are those of the author and do not necessarily reflect the official views of the Bank of Japan.

“How did you get bankrupt? Two ways. Gradually, and then suddenly.” (E. Hemingway (1926), The Sun Also Rises (New York: Scribner), book 2, chapter 13).

“The crisis takes a much longer time coming than you think, and then it happens much faster than you would have thought.” (R. Dornbusch (United States. Congress. Senate. Committee on the Budget (2012). Concurrent Resolution on the Budget Fiscal Year 2013. p. 95)).

1. Introduction

For decades central banks claimed to be forward-looking, that is, act today on their expectations of future economic conditions. More recently, ‘data dependence’ is the watchword even though there are subtle differences in policy makers’ understanding of the term. Bullard (2016), suggests that the expression means that “..., decisions should be based not only on the current dynamics in the data but also on the longer-run trends and expectations for data going forward.” The current FOMC Chair, Jerome Powell (2019) states that data dependence translates into “...seeking new and better sources of information...” Regardless of the precise meaning, all definitions share the view that policy making involves a considerable amount of looking into the rear-view mirror. Unfortunately, this also leaves open the possibility that blind spots will develop or that assumptions are made that may not hold up to additional scrutiny.

For at least two decades Japan, at least in economic policy terms, was seen by several outside observers as a country mired in a form of paralysis gave rise to the expression “the lost decades”.¹ Indeed, former Fed Chair Bernanke once commented that Japanese policy members suffered from “self-induced paralysis” and lacked “Rooseveltian resolve” (Bernanke 2000). Krugman (2014), an early contributor to analyses of Japan’s economy, refers to that country’s “[T]imidity trap”. Both these views suggest that Japan missed opportunities to deal with low inflation and stagnation, now associated with the label ‘Japanification’, by avoiding a necessary regime shift to extricate the country from an undesirable state.

Yet, there is also a suspicion that the foregoing narrative does not accurately describe Japan. “Time and again, Americans are told to look to Japan as a warning of what the country might become if the right path is not followed. But that presentation of Japan is a myth.” (Fingleton

¹ This expression is also used to describe the current economic predicament faced by Latin and South America. See, for example, Stott (2019).

2012). Plots of per capita real GDP reveals two potential stories. As shown in Figure 1, one's interpretation of the development of real economic activity is partly a function of whether the data are expressed in US dollar or in local currency terms. The former metric sees the Eurozone as under-performing throughout, with Japan overtaking the US until the 'lost decades' emerge. Even so the data appear to show a stagnant level of real GDP for Japan that begins to reverse in the early 2000s. A lost decade perhaps but not more. Other than the fact that the units are the same it is, of course, unclear why USD comparisons are sufficiently informative of an economy's performance. Indeed, Japan's performance looks much improved when real GDP levels are expressed in local currency units. With a few exceptions it is the Eurozone that lags the US especially.

An early warning that Japan's economic policies were facing difficult challenges came from Krugman (1998) who impressed many with his assertion that Japan was in a liquidity trap despite skepticism and doubts about some of the policy implications stemming from his analysis (e.g., see Dominguez 1998, Rogoff 1998). At the time, the liquidity trap narrative seemed persuasive primarily because the Bank of Japan's (hereafter BoJ) policy rate was nearing zero percent. Indeed, the year following publication of Krugman's piece, the BoJ would announce its zero-interest rate policy (ZIRP). Other policies, now labelled 'unconventional', would soon follow. No doubt Krugman's thesis was also motivated in part by the sharp drop in broad money growth in Japan in the early 1990s. However, the US experiences a less dramatic but equally significant drop beginning in the early 1980s followed by a slow but more permanent recovery starting in the mid-1990s. Japan also experiences a recovery in money growth, but levels never approach ones reached in the US. Interestingly, the Eurozone suffers a money growth drop around the GFC that mirrors the one experienced almost three decades earlier in Japan.²

Subsequent events have not been kind to many of Krugman's views including the view that Japan was stuck in a liquidity trap (e.g., see Weberpals 1997). For example, there is ample evidence of a continued desire to hold Japanese government bonds (JGB) while observers also underestimated Japanese households' willingness to search for higher yields abroad in spite of

² The foregoing interpretation is based on the M3 money growth levels over a two-year horizon which is often used as the short-hand definition of the horizon for the economic impact of monetary policy.

the underlying currency risks.³ Nevertheless, what has remained constant is a sense that the Japanese should have done things differently, or that others (e.g., U.S. policy makers) have done better while still others (e.g., the Eurozone) have unwittingly followed the path laid out by the Japanese. Suffice it to say, however, that the history of Japanese economic policy, as some observers outside of Japan have described it, may not faithfully describe its performance. Part of the reason, as we shall see, is that, with some notable exceptions, academic research has focused on certain episodes and events, or specific forms of intervention by policy makers, as opposed to a broader retrospective view of the sequence of events and policies over a longer span of time. Others have looked for large shifts in policy oblivious to the possibility that a series of small shifts may well produce the same result. And, finally, any assessment of Japan's experience should be contrasted with the performance of similarly large, and systematically important economies, such as the US and the Eurozone. However, in the interests of brevity, much of the focus will be on Japan's record with passing references to measures and policies adopted by the other two economies.

There are four issues broadly describing the various policy predicaments and challenges faced by Japan. In no order of importance, they are: the liquidity trap, monetary policy failures, the stop-go nature of fiscal policy, and the combined impact of changes in productivity and demographic pressures on Japanese society. Although the paper briefly mentions these narratives, it cannot do justice to all of them. The present study instead focuses its attention on BoJ monetary policy since the 1980s.

Generally, the extant literature amounts to three narratives about financial crises and central bank responses. For Japan, it is largely “muddling through” a series of crises that began in the equity market in the late 1980s, eventually engulfing the banking sector and, finally, the entire economy. For the US, it is a “stitch-in-time-saves-nine” strategy. In other words, US authorities did respond in 2008, with a lag, enough to avoid a second Great Depression and facilitate a recovery. For the Eurozone, ideology substitutes, and arguably continues to do so, for good economic policy. This emerges from the overarching need for budget discipline and low inflation, as far as the German authorities and their “northern” European supporters are

³ Stories of Japanese ‘housewives’ searching for higher yields became famous for a time (e.g., see Pilling 2009). Indeed, Australia and New Zealand bonds, for example appealed to many Japanese investors. See, for example, Drage, Munro, and Sleeman (2005).

concerned, while the rest of the Eurozone argues for more fiscal and monetary stimulus. As a result, the aftershocks of the sovereign debt crisis that peaked between 2010 and 2012 continue to plague the single currency area to this day.

As we shall see, a unifying theme in all of the narratives describing the evolution of monetary policy making especially has been the importance attached to regime breaks, shifts or changes as a necessary condition to overcome crisis conditions and restore economic performance and policies to some semblance of normality. Bernanke, Geithner, and Paulson (2019), Romer (2014), and Geithner (2014) are recent illustrations of the argument that what is needed in a crisis is a regime “shift”. As we shall see, the arguments sound persuasive *ex post* while data are not always as supportive of the hypothesis.

Difficulties emerge because regime shifts, as observed by historians or other observers at the time, may not show up as such when empirical evidence is brought to bear on the issue.⁴ Matters are still more complicated when one considers that the large number of series policy makers examine to assess the current state of the economy need not provide the same signals let alone indicate a regime shift at the same time. Even if a regime shift is deemed necessary to emerge from the aftermath of a financial crisis, it may be inadequate when dealing with fundamental problems of the structural variety.

In the area of monetary policy expectations are also crucial. Yet, the extant literature has tended to assume the problem away by asserting that, so long as a policy shift is credible, the new regime will be successful. However, as will be shown below, this condition is not often met. Not all observers believe that a sharp break from the past is necessary. For example, difficult to observe norms must also change (Akerlof 2007, 2019). Alternatively, it is equally plausible that a series of small shocks can lead to a tipping point giving rise to the impression that a regime shift has taken place (Akerlof and Yellen 1985a, 1985b, Schelling 1988) since crises can emerge from the slow build-up of economic imbalances.

The rest of the paper is organized as follows. The next section is a review of what we know about the record of policy making in Japan including, but not limited to, the role of monetary

⁴ There is potentially more than one kind of regime shift. Observers are not always clear whether this is a reference to a temporary shift, a permanent one, a shift in the intercept in, say, the trajectory of a variable of interest, a change in the trend of the same variable, or both.

policy, as well as how this has echoed abroad in the U.S. and the Eurozone. Given the vastness of the relevant literature, and the usual space limitations, I cannot do justice to all that has been written. However, readers will be able to delve more deeply into the issues from the many references contained in the works cited. Section 3 provides empirical evidence about regime shifts and what these imply about financial crises and an economy's ability to emerge from such conditions. Some stylized facts are discussed, followed by econometric evidence about the relative effectiveness of monetary policies in Japan, the U.S., and the Eurozone in response to the changing credibility of their respective central banks. Section 4 concludes and broadly assesses existing narratives about Japan's record in monetary policy.

While the other two economies under study may have fared better in some respect, there is little indication that 'Japanification' is a unique phenomenon. Indeed, an old lesson in macroeconomic policy, namely that monetary and fiscal policies (both the discretionary and structural kinds) need to coordinate, not just in times of crisis, is a lesson that keeps getting lost even if some authors have largely made the same point.⁵ Second, the usual interpretation that Japan was mired in deflation exaggerates the role of falling prices on expectations. Indeed, central bank credibility is found to have a powerful effect on inflation. Hence, paraphrasing Romer and Romer (2014), it is a "dangerous idea" to assume that monetary policy has lost its ability to influence economic activity.

Finally, it is difficult to identify clear regime shifts in the data that foretell success in monetary policy shifts. In particular, the GFC looms large in both narrative and statistical accounts of the impact of monetary policy. Other shocks, such as the change in monetary policy strategy at the BoJ in 2013 seem to pale in comparison even if the announcement had an impact. Instead, consistent application of policy rules may well ensure that large shocks are absorbed when there is also coordination with other major policy making institutions responsible for carrying out economic stabilization policies. The adage, namely that 'slow and steady wins the race' holds. Regime shifts, in the sense of a large shock, have their place but they are rare enough events from which to draw sweeping conclusions.

⁵ For example, IEO (2019) argues that the IMF could have devoted more attention to policy trade-offs between unconventional monetary policy and other macroeconomic policies.

2. Lessons from Japan and Echoes from Abroad

2.1 *Some History*

Understanding developments in monetary policy especially must begin with a brief look back at the global consequences of events that took place beginning in the 1970s.⁶ In the aftermath of two oil price shocks the resulting high inflation and stagnation in advanced economies is one reason why central banks obtained increased autonomy, together with a mandate to achieve price stability. Of course, economic theory and evidence contributed to this debate, but the result is perhaps most easily seen in the success of four countries, namely Germany, Japan, Switzerland, and the U.S. to dominate an emerging series of attempts to measure the independence of central banks, primarily by association with inflation performance (not shown but see the appendix). Indeed, with one notable exception, Japan fared poorly in such rankings. It is Japan's success, especially after the second oil shock of the 1970s, alongside Germany and Switzerland, in controlling inflation that arguably gave policy makers in Japan reason to believe that they were able to deliver price stability in an era of rapid economic growth. Whether this led the Bank of Japan to fall into a complacency trap is debatable. The 1980s were less kind to Japan in rankings of central bank independence also because a lingering banking crisis would divert attention away from the still undefined goal of price stability.⁷ To be sure, there were banking crises in the U.S. and in Europe around the same time (not shown but see the appendix) but their size and scope did not appear to match that which affected the Japanese economy. It is plausible to think that this experience fostered a form of tunnel vision at the BoJ. Nevertheless, whereas prior to the banking crisis, the Finance Ministry was largely responsible for financial stability cooperation between the BoJ and the Treasury became essential. Moreover, institutional changes followed with the creation of Japan's Financial Services Agency. Of course, prior to the new BoJ Law of

⁶ This section is intended as a brief introduction to some of the forces influencing policy making during the 1980s and beyond in Japan. Readers are asked to consult, for example, Shizume (2018a, 2018b), and Wakatabe (2015), for broader overviews of the history of the Bank of Japan and Volcker and Gyoten (1992) for an account of policy making in Japan and the U.S. during the 1970s.

⁷ It has been suggested to me that the ambiguity regarding what policy makers thought was meant by price stability partly reflects the traditional ambiguity of the Japanese language but also the political turmoil in that country in the mid to late 1990s.

1998, the central bank was not as independent in the statutory sense as noted above and this too may have contributed to the central bank's myopia.⁸

International observers were also interested in the conduct of policy in Japan. A succinct way of establishing how outsiders saw the evolution of policies in Japan is to consider surveys and assessments published by the OECD and the IMF. I relegate to an appendix highlights extracted from bi-annual surveys conducted by the OECD since 1980 as article IV reports published by the IMF.⁹ The OECD notes in its 1992 Survey that price stability “has virtually been achieved” though there is no precise definition of the term. Prior to that, the remarkable growth of the economy is highlighted, together with approval of “structural” reforms enacted, while monetary policy was more often than not interpreted as being “expansionary”. These themes are consistently present in surveys published since 1980. Shortly after success in achieving price stability in the early 1990s the call for “structural reforms” comes to dominate the content of several surveys and this theme continues to be repeated to this day. Along the way, there are calls to introduce a more “aggressive” monetary policy to end deflation (e.g., the 2004 and 2005 Economic Surveys) and this theme is highlighted on several occasions in later years.¹⁰ It is during the middle part of the decade of the 2000s that worries over the consequences of population ageing and the need to consider fiscal consolidation become more frequent.¹¹

Many of the IMF article IV reports contain recommendations comparable to ones found in the OECD surveys. A couple of themes in the IMF's consultation, however, stand out. First, “deep-seated” structural problems of varying degrees of importance are underscored in almost every report published during the 2001-2018 period. Second, calls for monetary policy to be more

⁸ Cargill and O'Driscoll (2018) specifically refer to Japan and the US to argue that the independence concept, which they never actually define, reflects a “crony” relationship between the government and the central bank. Therefore, central bank independence (CBI) does not result in ‘optimal’ policy outcomes. Setting aside the precise nature of central bank – government links, CBI was never intended to sever the links between the two but simply clarify the scope of independent decision-making of the two institutions. Indeed, it is arguably the failure to appreciate the critical need for fiscal and monetary policy to operate in harmony that is the source of the current predicament several advanced economies find themselves in.

⁹ At the time of writing article IV reports were only available online back to 2001. Article IV reports are prepared by staff at the IMF and are referred to as consultation reports, that is, an assessment of overall economic conditions normally conducted on an annual basis. See <https://www.imf.org/en/Publications/SPROLLs/Article-iv-staff-reports#sort=%40imfdate%20descending>.

¹⁰ As early as in the Economic Survey of 2004 there are calls for the BoJ, as part of its QE campaign, to purchase a wider range of financial assets.

¹¹ Interestingly, however, the potential economic difficulties surrounding population ageing is also mentioned as early as in the 1990 Economic Survey.

aggressive, and the necessity of conquering deflation, are listed as priorities. These two factors contribute importantly to the state of the Japanese economy though a formal causal link, for example, between the conduct of monetary policy and overall economic performance is never clearly established.¹²

A useful way of summarizing the record of policy making in Japan and elsewhere over the past several decades is to consider inflation and real GDP growth performance over time. Figure 2 provides a scatter plot of the volatility of the two series for Japan, the U.S., and Germany since the early 1970s.¹³ Three results stand out. First, in Japan and the U.S., the overall direction is a fall in both series towards the origin indicative of a trend toward adopting best practice in monetary policy. Second, when inflation volatility is high this is often when real GDP growth volatility is also relatively high and both patterns follow the oil price shocks of the 1970s. In the case of Germany, the 1970s through the early 1990s see several years when inflation volatility is considerably higher than output growth volatility and vice-versa during the years of the GFC.¹⁴ Third, Japan does not stand out from the other two economies examined.

2.2 Japan's Economy and Echoes From Abroad: Non-Monetary Policy Aspects

Any attempt to survey the relevant research dealing with assessments of various forces that explain economic performance in the three economies being investigated since the 1980s must be highly selective. As pointed out in the introduction there exist a few broad narratives to describe the conduct of policy in general, including monetary policy. Clearly, these narratives are also inspired, at least in the case of the U.S. and the Eurozone, by the events culminating in the GFC and the subsequent Eurozone sovereign debt crisis. A partial list of relevant readings that deal primarily with the U.S. and European experiences would include, in no order of importance,

¹² I mention this because by the early 2000s empirical research was being published that cast doubt on the view that all deflations were of the 'bad' variety. Rather, it appears that bad deflations were more likely the result of collapsing asset prices, as in the late 1980s bursting of the stock market bubble in Japan (see the next section), and not a bout of mild deflation. See, for example, Burdekin and Siklos (2004), Borio and Filardo (2004), and Borio, Erdem, Filardo and Hofmann (2015). The theme of "structural reforms" is also a perennial one in G7 and G20 Summit Declarations. Hence, it is far from clear that this issue is one where Japan is an outlier. See the appendix.

¹³ The practice of plotting these two series stems from the efficient (or Taylor) policy frontier concept derived from optimal policy rules. See Clarida, Galí, and Gertler (1999). Although the focus shifts to the Eurozone there are effectively no usable observations before the late 1990s. Instead, I chose Germany since it is, by a wide margin, the largest Eurozone economy.

¹⁴ One should not forget the impact of German reunification in 1989 and the march to the introduction of the single currency at the end of the 1990s.

Bernanke (2015), Brunnermeier, James, and Landau (2016), El-Arian (2016), King (2016), Blinder (2013), Eichengreen (2015), Geithner (2014), and Mody (2018).

Also relevant for the Japanese case is that many retrospectives of monetary policy over the past decade have focused on the consequences of unconventional interventions by central banks, especially in the systemically important advanced economies. These interventions were mainly intended to ease financial conditions, although it may still be too soon to reach a consensus on the macroeconomic effects of unconventional monetary policies (UMP). Contributions in this area include Dell’Ariccia, Rabanal, and Sandri (2018), Kuttner (2018), and Lombardi, Siklos, and St. Amand (2018). Nevertheless, with the exception of Kuttner (2009), and Lombardi, Siklos, and St. Amand (2018), comparisons have tended to shy away from contrasting the Japanese experience with more recent policy undertakings in, for example, the U.S. and the Eurozone. This despite the recognition that policy makers in Japan have usually been ahead of their colleagues elsewhere in experimenting with instruments and policies to maintain the effectiveness of monetary policy (e.g., see Shirakawa 2010, Bernanke 2017).

Turning to Japan there are several surveys and overviews of Japan’s experience over the decades. These include Cargill, Hutchison and Ito (1997), Kuttner and Posen (2001), Fujiki, Okina, and Shiratsuka (2001), Okina, Shirakawa, and Shiratsuka (2001), Okina and Shiratsuka (2002), Ugai (2007), Koo (2003, 2008, 2015, 2018), Ikeda and Kurozumi (2019), Nakaso (2001), Shirakawa (2010), Syed, Kang, and Tokuoka (2009), Hamada and Noguchi (2005), and Wakatabe (2015). More recently, Bernanke (2017) revisits some of his earlier work dealing with Japan (e.g., see Bernanke 1992) while acknowledging, as indicated earlier in the debate over Krugman’s (1998) liquidity trap thesis, that economists in general underestimated the importance of fiscal and monetary policy coordination in the story of the ‘lost decades’ of Japan. Indeed, preoccupation with whether Japan’s predicament is replicated elsewhere has often been a concern of policy makers, especially in the U.S. (e.g., see Bullard 2010, El-Arian 2019).

Although interest in Japan’s experience arguably began with the possibility that it was experiencing a liquidity trap (Krugman 1998) interest waned but has not vanished entirely thanks to some theoretical advances in our understanding of money demand when interest rates are at or even below the ZLB. For example, although Watanabe and Yabu (2019) never refer to the liquidity trap concept their results suggest that it cannot be ruled out for Japan.

Another narrative that describes the Japanese experience focuses on longer run factors such as demographics (i.e., Japan's aging population) and the decline in productivity (i.e., labor or total factor productivity; hereafter TFP) due to the consequences of prolonged financial crisis conditions. Indeed, as a result, there has been a revival of the secular stagnation hypothesis (e.g., see Summers 2014) and its effects are now being explicitly incorporated into standard economic models (e.g., see Eggertsson, Mehrotra, and Robbins 2019). Based on the usual metrics of labor productivity and total factor productivity (not shown but see the appendix) Japan does not stand out, for example, from the Eurozone's experience.¹⁵ However, in view of the mixed messages from the data, due possibly to measurement issues, it is difficult to reach a definitive conclusion. Nevertheless, Hayashi and Prescott (2003) argue that the 'lost decade' of the 1990s is explained by lower productivity while Ikeda and Kurozumi (2014) also highlight the role of a slowdown in TFP in Japan. However, Posen (1998, 2001, 2002) disputes Japan's decline in potential growth and finds fault elsewhere, namely 'misguided' macroeconomic and financial policies. Subsequently, both the IMF (2003) and the OECD (2004) would argue that Japan's potential output suffered in the first 'lost decade' (i.e., the 1990s).

Interestingly, much of the cited literature emerged prior to the GFC. As a result, the role of the financial sector, which experienced significant regulation and change beginning in the 1980s, is downplayed in accounts of whether Japan's low inflation and stagnation can be primarily explained by supply or demand factors.

As noted earlier, there was reluctance among observers early on to suggest that fiscal policy can come to the aid of monetary policy when conditions require it. This is surprising since it is a tenet of macroeconomic theory that aggregate policies work best when the monetary and fiscal authorities cooperate. Failure to do so in Japan's case is apparently one of the culprits for the inability to exorcise deflation expectations (e.g., see Eggertsson and Woodford 2003). However, in an era of central bank autonomy, a confusion arose between the advantages of pursuing a common objective, say raising growth or eliminating deflation, and appearing subservient to the fiscal authorities. Indeed, among advanced economies, monetary dominance came to define policy making while fiscal policy mostly took a back seat. Moreover, just as monetary policy

¹⁵ TFP for Japan, obtained from two sources, clearly reveals important differences with one suggesting that Japan does not do badly on this score while the other paints a much less flattering picture of the Japanese experience.

was criticized for its stop-go strategy (e.g., see Goodfriend (1991), Chappell, Harris, McGregor, and Spencer (2019) for the U.S. case) Japanese fiscal policy generated the same criticism in part because of the government's habit of regularly announcing supplementary budgets or fiscal stimulus packages only to backtrack when debts and deficits raised broader economic concerns. Koo (2003, 2008, 2015, 2018) has pointed out repeatedly that fiscal policy had beneficial effects in Japan but inconsistency and a failure to sustain fiscal interventions over time was lacking. While estimates of cyclically adjusted budget balances for Japan are comparable to ones for the U.S., and the Japanese government has been a net borrower since the early 1990s, it is the rise of government debt to GDP that has raised concerns both domestically and in international financial markets.¹⁶

2.3 Monetary Policy and Regime Shifts

Empirical assessments of the conduct and effectiveness of monetary policy in Japan (and elsewhere) have ordinarily taken two forms. Monetary policy rules, generally variants of a Taylor type rule, are estimated to determine how much weight the BoJ, on average, has placed on inflation versus output gap control. On this basis, and as a device to evaluate the BoJ's track record, interpretations are made about whether policy was too loose or too tight. Conclusions from these studies run the gamut. Some indicate that Taylor type rules suggest similar monetary policy responses in the three economies investigated here (e.g., Gerdesmeier, Mongelli, and Roffia 2007). Others ask whether certain policy changes (e.g., the ZIRP period) led to changes in the BoJ's reaction function (e.g., Jinishi, Kuroki, and Miyao 2000), while still others raise serious questions about the viability of estimating a policy rule when output gap are estimates are highly sensitive to how they are constructed (Kuttner and Posen 2004).

Although many estimated policy rules are of the simple linear variety, frequent policy changes (see the next section), together with some potential technical challenges around interest rates at the ZLB for a considerable period of time, have also generated more sophisticated policy rule models. These include non-linear and quantile regression-based variants (e.g., see Chen and Kashiwagi (2016), Chevapatrakul, Kim, and Mizen (2009), Kim and Mizen (2010), and Wolters

¹⁶ The appendix provides some estimates of data related to fiscal policy. Of course, comparisons with the Eurozone are problematic since there is no central fiscal policy body. Nevertheless, cyclically-adjusted budget balance estimates suggest considerably tighter fiscal policy in the Eurozone than in either the U.S. or Japan.

(2012)) though it is not entirely clear whether these provide new insights into our understanding of the conduct of monetary policy.

Another strand of the literature estimates macro models. Typically, these are grounded in prevailing views about the central importance of price stability in delivering the best macroeconomic outcomes as most clearly spelled out by Woodford (2003). Here the emphasis is on the role and influence of inflation expectations. For example, Hattori, Kang, Packer and Sekine (2019), Hattori and Yetman (2017), and Fukuda, and Soma (2019) focus on the determinants of inflation expectations and the sources of inflation forecast disagreement. Although these studies tend to conclude that various policy changes were ‘successful’ and impacted expectations (e.g., the introduction of a numeric inflation target in 2013 followed by the adoption of quantitative and qualitative easing) all are forced to acknowledge that past attempts at raising inflation expectations have yet to reach their objective.

Alternatively, the aim of several of these studies is to ascertain the nature of the monetary policy transmission process. Cross-country comparisons have also been published. For example, Muellbauer and Murata (2009) argue, due to housing markets differences, that the transmission mechanisms of monetary policy in Japan and the U.S. differ sharply from each other. McAdam (2003) contrasts business cycle activity in Japan, the U.S., and the Eurozone. This study concludes that Japan’s performance includes some unique features such as a near absence of cyclical content while, more broadly, business cycles in the three economies are “distinct”.

Often, a VAR of some kind is estimated and the responses to shocks are reported (i.e., impulse responses) though other metrics (e.g., variance and historical decompositions) are also evaluated. Other estimation techniques, such as Markov switching models, have also proved popular. The bottom line, based on a wide variety of models, restrictions and increasingly sophisticated attempts to pinpoint the impact of various monetary policy easing interventions by the BoJ (i.e., QE type policies), is that they do influence inflation, inflation expectations, and real economic activity. However, their impact is modest and temporary. Ichiue and Ueno (2018), Koeda (2018), Michaelis and Watzka (2019), and Okimoto (2019) are recent examples of studies of this kind. Girardin and Moussa (2011), however, conclude that QE’s impact is ‘considerable’. Others, such as Shibata and Kasada (2018), and De Michelis and Iacoviello (2017), are less complimentary about UMP citing a lack of credibility in the 2013 policy regime shift (i.e., QQE), and an

excessive reliance on such monetary policy interventions to stimulate economic activity. Finally, any examination of the connection between policy announcements and regime shifts tend to be episodic, that is, they focus on particularly significant policy change announcements (e.g., QE in 2001, and QQE in 2013) as opposed to trying to determine whether some events more than others qualify as regime shifts.

The notion of a regime shift is a subtle one since the concept is based either on a historical analysis or on a series of statistical tests. Complicating matters are significant developments over the past two decades in how regime shifts are estimated or detected (see below). Romer (2014), cited earlier, is an example. Historical illustrations, namely a comparison of the Great Depression and the more recent U.S. experience, where a regime shift is assumed to have taken place based on the behavior of key macroeconomic aggregates and the events surrounding their development, are used to argue that it takes a ‘regime shift’ to deal with the aftermath of large economic or financial shocks. Similarly, Bordo and Siklos (2018) define policy regime shifts in historical terms since the late 19th century in ten economies, Japan included. However, that study’s historical analysis includes statistical testing to determine the compatibility of the two methodologies to date regime shifts. An additional difficulty is that many ‘regime’ changes are conceivable. There are fiscal regimes, exchange rate regimes, regulatory regimes. While there is a risk in focusing too narrowly on monetary policy regimes, both theory and a considerable amount of empirical evidence suggests that it is the credibility of the monetary policy regime that is a necessary, if not sufficient, condition. Arguably, the Volcker disinflation of the 1980s, or former President Mario Draghi’s promise in 2012 to do “...whatever it takes...And believe me it will be enough...”, serve as examples of the critical importance of monetary policy credibility.

While major events (e.g., the Great Depression of the 1930s) bring about regime change there are plenty of other candidates that serve as examples of a regime shift but which may not appear to be as dramatic when visual comparisons of time series are made. Indeed, Akerlof and Yellen (1985a, 1985b) remind us, it that it is conceivable that a series of small shocks can also produce large real economic effects. Similarly, Schelling (1988) describes what has since been called the ‘tipping point’ theory wherein a series of past events, each of which may be small, eventually produce large consequence. Hence, a regime shift may be necessary, but not sufficient, to generate a new equilibrium. Instead, for example, the timing and credibility of policies, not to

mention how they are communicated, may be at least as important, if not more so, than an abrupt policy change.

3. Empirical Evidence

Empirical testing proceeds in two stages. First, I introduce and describe some of the key macroeconomic and financial variables that will form the basis of subsequent empirical testing relying on data from Japan, the Eurozone and the US. Key concepts such as credibility and regimes shifts are then defined. Finally, the econometric methodology is described and tests are carried out with the aim of drawing insights from a comparison of the macroeconomic experiences of the three economies.

3.1 Data

The estimated models (see section 3.3) consist of five core variables sampled at the quarterly frequency. Samples can vary but they begin in 1980Q1 and end in 2018Q4. Some individual time series are available until early 2019 (Q1 or Q2) but not all series were available when the data were collected through the Spring and Summer of 2019. The sample for Eurozone data is shorter with data beginning in 1999Q1 before any transformations are applied.¹⁷ All data were obtained from the following sources: Federal Reserve Bank of St. Louis Economic Data (FRED; <https://fred.stlouisfed.org/>) for U.S. data, the Bank of Japan (<https://www.boj.or.jp/en/statistics/index.htm/>), the Euro Area Wide Business Cycle Network Model data base (<https://eabcn.org/page/area-wide-model>) and the ECB Statistical Data Warehouse (<https://sdw.ecb.europa.eu/>). Financial data (e.g., credit, housing prices, central bank policy rates, real effective exchange rates) are obtained from the BIS (<https://www.bis.org/statistics/index.htm>).

A few other series that do not appear in the modelling exercise but are used to discuss certain stylized facts (i.e., section 2) were obtained from the World Bank Development Indicators database (<http://datatopics.worldbank.org/world-development-indicators/>), the CEPR (Eurozone reference cycle dates), the NBER (U.S. reference cycle chronology), and the ECRI (<https://www.businesscycle.com/>). Some of the data are modified versions of proxies for

¹⁷ A few series are available earlier by combining individual Eurozone series. However, I have tried, with some exceptions (see below) to consider only samples that begin in 1999.

monetary policy effectiveness proposed in Bordo and Siklos (2017, 2019; see below). Separate appendices provide additional information about data sources the series themselves and additional results that are not shown due to space limitations.

The core series are inflation, defined as the annualized quarterly inflation rate in the CPI¹⁸; the output gap defined as the median estimate from up to six different estimates of the output gap (see below); an estimate of central bank credibility; a proxy for financial conditions estimated from a time-varying factor model (see below); and an estimate of the real exchange rate gap.¹⁹ The proxy for financial conditions is used for two reasons. First, the debate about which kind of financial shock is most important in influencing macroeconomic conditions is unresolved.²⁰ Depending on the economy, and the episode in question, variables including credit, term spreads, housing prices, and lending standards all appear to significantly impact economic conditions, including inflation. The factor model approach combines these indicators into one series. This approach is now also widely used by several central banks and international organizations. Another advantage is that, by combining several relevant indicators, fewer degrees of freedom are lost.

Since there is also nothing approaching a consensus on how to estimate the output gap, I estimate or collect several variants. For the US and Japan ‘official’ estimates are available, respectively from the Congressional Budget Office and the BoJ.²¹ Next, the mean-adjusted growth rate in real GDP is used, as is an estimate of the gap generated by applying Hamilton’s (2018) filter, a one-sided H-P filter (see n.15) and, finally, a fixed length band pass filter (Christiano and Fitzgerald

¹⁸ For the Eurozone I use the Harmonized Price Index (HICP). For Japan it is common to use inflation that excludes fresh food because the Policy Board’s inflation outlook is set in these terms, although the impact on the results is minimal when all items CPI is used. For the US many studies prefer to use the Personal Consumption Expenditures index. Conclusions are unchanged when the CPI is used. Hence, to ensure cross-economy comparability Headline CPI is used.

¹⁹ The real exchange rate gap is the difference between the log of the real effective exchange rate and a one-sided H-P filter with a smoothing parameter of 1600 estimated using the Ravn-Uhlig (2002) rule (power is set to 2).

²⁰ Thus, for example Borio, Drehmann and Xia (2019) suggest that their indicator of the financial cycle, comparable but not identical to the ones used in this paper, outperforms the term spread considered to be the most widely used recession indicator. Of course, the present study is not focused on recessions alone but economic activity throughout the business cycle.

²¹ https://www.boj.or.jp/en/research/research_data/gap/index.htm/.

2003). For the Eurozone there were no ‘official’ output gap estimates.²² Hence, the median of five separate estimates are used.

The estimated financial factor is obtained as follows: Each economy is identified by j . If \mathbf{X} denotes a vector of variables we can write

$$\mathbf{X}_{jt} = \boldsymbol{\alpha}_j \mathbf{F}_t + \boldsymbol{\varepsilon}_{jt} \quad (1)$$

where \mathbf{X} are vectors of observable time series from which factors \mathbf{F} are estimated, $\boldsymbol{\alpha}$ are the factor loadings. The first principal component (PCA) is extracted which then serves as the proxy for the financial factor.²³ I estimate in a rolling manner the same factor models for samples of a decade in length starting with the 1980Q1-1989Q4 sample. The sample is rolled ahead two years at a time. This produces a series of overlapping samples. The estimated factor scores are averaged when samples overlap to produce a unique factor estimate that is time-varying (also, see Siklos 2018).

Finally, only a brief explanation of the proxy for central bank credibility (CRED) is provided. Readers are asked to consult Bordo and Siklos (2017, 2019) and Siklos (2013) for more details. Essentially, the proxy for credibility is an aggregation of two components, namely one portion that captures a penalty for deviating from some inflation objective, which need not be observed, and an estimate of monetary policy uncertainty (MPU) that aggregates differences in inflation and real GDP growth forecasts across forecasters. Deviations from the inflation target make allowances for the fact that the loss of credibility is likely to be small around some tolerance range (i.e., 1% around the target) but grows larger once inflation exceeds the target range.²⁴ Aggregation of squared differences in forecasts vis-à-vis the median forecasts of inflation (π^M) and real GDP growth rates (y^M) represents MPU.²⁵ More formally, the definition of credibility

²² The European Commission does publish an output gap measure although it is not, strictly speaking, comparable to ones produced in the other two countries. Also, the series does not appear to go back far enough for the purposes of this study.

²³ Owing to the sample lengths I elected not to include more than one principal component. However, the first component explains much of the variation in the series included (results not shown).

²⁴ It is constructed as in Bordo and Siklos (2019) except that the ‘global’ component is omitted since the three economies studied here are systemically important and generate the lion’s share of the global component. Second, unlike Bordo and Siklos (2019) where forecasts from only two sources were available, a much larger number of forecasts are available for use here. An appendix provides the source of inflation and real GDP growth forecasts.

²⁵ For Japan 11 different inflation forecasts are used, and 7 real GDP growth forecasts; for the U.S., 14 inflation and 9 real GDP growth forecasts; for the Eurozone 9 inflation and 5 real GDP growth forecasts are used.

improves on earlier estimates of monetary policy credibility (Bordo and Siklos 2015, 2017) by combining two elements as noted above. Therefore, write:

$$\begin{aligned}
& (\bar{\pi}_{t+1}^f - \pi_t^*), \text{ if } \pi_t^* - \theta \leq \bar{\pi}_{t+1}^e \leq \pi_t^* + \theta \\
& (\bar{\pi}_{t+1}^f - \pi_t^*)^2, \text{ if } \pi_t^* - \theta > \bar{\pi}_{t+1}^e > \pi_t^* + \theta \\
& \theta = 1 \\
& \text{MPU} = \sum_{k=1}^N [(\pi_{t+1}^k - \pi_{t+1}^M)^2 + (\dot{y}_{t+1}^k - \dot{y}_{t+1}^M)^2]
\end{aligned}$$

The first two lines define the credibility ‘penalty’ central banks suffer when they miss their targets (π^*), and where $\bar{\pi}_{t+1}^e$ is the mean expected inflation for the year ahead (t+1) which is proxied by $\bar{\pi}_{t+1}^f$, the one year ahead fixed horizon mean inflation forecast. Specifically, the tolerance level around the target is set at 1% as indicated by the value of θ as shown in the third line above. Once inflation expectations exceed the tolerance band, given by the inequality in the first two lines, the penalty becomes a quadratic consistent with most definitions of central bank loss functions. Positive and negative misses are penalized symmetrically but now in terms of the absolute value of the level of misses when these are inside the tolerance range so that misses inside and outside the target range are treated differently. I consider three different proxies for the gap between expected inflation and the target (i.e., $\pi_{t+1}^f - \pi_t^*$). They are: the average one year ahead inflation expectations; last year’s observed inflation; and, finally, a two-year moving average of inflation.

Next, the inflation target (π_t^*) is not observed.²⁶ I proxy the *de facto* inflation target as the mean from 3 different filters applied to observed inflation. They are: a 5-year moving average of inflation, the inflation obtained by a band pass filter for frequencies ranging from 2 to 8 quarters, and a one-sided Hodrick-Prescott filter previously described. These are applied to the full available span of the data. The other element of credibility is monetary policy uncertainty defined above.

²⁶ Other than Japan where the 2% target is notional with a target date that has moved over time, the Fed’s target is a medium-term one that it has set without a formal agreement with the Treasury. The same is true for the ECB’s below, but close to, 2% target which it has set for itself.

Once the individual components of credibility are estimated they are aggregated. Normalized estimates are used in subsequent testing. Therefore, credibility is:

$$\text{CRED}_{jt} = \begin{cases} (\bar{\pi}_{j,t+1}^f - \pi_{jt}^*), & \text{if } \pi_{jt}^* - \theta \leq \bar{\pi}_{i,t+1}^e \leq \pi_{jt}^* + \theta \\ (\bar{\pi}_{j,t+1}^f - \pi_{jt}^*)^2, & \text{if } \pi_{jt}^* - \theta > \bar{\pi}_{i,t+1}^e > \pi_{jt}^* + \theta \end{cases} + \text{MPU}_{jt} \quad (2)$$

where CRED is the estimate of monetary policy credibility for economy j (=JPN, USA, EUR) at time t and all other terms were previously defined. Positive values for each component imply a reduction in credibility since the gap between observed and expected inflation widens, while greater monetary policy uncertainty, which also rises when there is more disagreement among inflation and real GDP growth forecasts, also raised CRED. Normalized estimate of CRED then range from 0 (perfect credibility) to 1 (no credibility).²⁷

3.2 Stylized Facts

One aim of the paper asks whether regime change can explain the relative success, or lack thereof, of monetary policy in delivering the notional amount of inflation. Hence, it is useful to consider as markers not only important milestones in monetary policy but events with likely significant economic implications more generally. Table 1 lists a few, in the main monetary policy, events for the three economies under study that are worth keeping in mind when interpreting subsequent econometric results. Dating some of these can be done precisely (e.g., Louvre Accord) while others have longer duration because they represent periods when a series of smaller interventions took place (e.g., UMP during 2008Q4-2010Q1 in Japan).

Nevertheless, since *a priori*, it is unclear which events are likely to emerge as significant regime shifts in a statistical sense, a separate appendix provides a more complete list of other events of a regulatory, fiscal, and economic nature (e.g., recession chronologies) that may assist with a narrative approach to identifying regime shifts. These include major pieces of legislation, selected fiscal events that may have had reverberations for monetary policy as well as other events, non-monetary or financial in nature but which may have had consequences for the stance

²⁷ Readers will see that the two components of (2) are equally weighted. Although one could, obviously, experiment with different weights no theoretical guidance is available yet.

of monetary policy (e.g., 2001 terrorist attacks on the U.S., earthquakes in Japan, international summits (G7, G20)).

Figure 3 plots the four elements that make-up the vector representing financial conditions from which the PC are extracted (see section 3.1) for the three economies considered. The vertical lines and shaded areas highlight selected events, monetary and otherwise, that may provide some insights about the evolution of these variables for Japan (also see Table 1 and the appendix).

In the case of credit Japan's experience (top left plot) stands out until the GFC in at least two ways. First, levels of credit, as a percent of GDP, rise quickly until the bursting of the stock market bubble and the peak in land prices and remain high until the banking crisis of the early to mid-1990s. Thereafter, levels fall slowly but steadily until they become largely indistinguishable from each other in all three economies shortly before the GFC. The timing of some of the broader movements in the credit to GDP ratio are clearly linked to major economic events.

Lending conditions are shown next in the top right-hand corner of Figure 3. A rise signifies a tightening of lending conditions according to surveys of senior loan officers at commercial banks. In Japan, lending conditions tighten as the banking crisis of the 1990s progresses but there is a dramatic loosening by the time this episode is thought to have ended in 1997. Notice also how lending conditions tighten gradually during the 1980s but loosen dramatically approximately three years prior to the banking crisis. There appears to be no obvious link between the tightness of lending conditions and the various interventions with monetary policy implications for Japan since the early 1990s. Lending standards in the U.S. are more volatile than in either of the other two economies considered but we see the substantial weakening of standards in the run-up to the GFC followed by a sharp tightening which is rapidly reversed once the Fed begins to intervene in financial markets. Similarly, there is a tightening prior to the GFC in the Eurozone followed by a loosening which is temporary only to be reversed since the sovereign debt crisis peaked in 2012.²⁸

Turning to the growth in housing prices, shown in the bottom left hand corner of Figure 3, Japan only stands out once the post-bubble in land prices bursts until around 2010 when price growth

²⁸ The importance of lending standards in measuring financial conditions is recognized by an increasing number of central banks that survey loan officers. See, for example, Siklos (2015), Siklos and Lavender (2015), and Filardo and Siklos (2018).

once again becomes positive. Notice that, other than this period, the growth in housing prices in all three economies parallel each other and the drop seen in the early 1990s is common everywhere but more dramatic in Japan's case. In contrast, it is the precipitous drop in U.S. housing prices on the eve of the GFC that stands out from the rest. The final plot is the term spread shown in the bottom right hand corner of Figure 3. What is salient in the figure, other than the sharp drop in the spread in Japan during the mid-1980s, is the steady drop in the spread in Japan since the GFC. The spread remains substantially lower in Japan but, towards the end of the sample, that is, by the end of 2018, spreads in all three economies show signs of converging. Hence, all indicators of financial conditions reveal for the three economies what appear to be some common features although clearly there are also idiosyncratic movements that may be explained by specific episodes or events unique to each economy in question.

The top two plots in Figure 4 show median inflation and real GDP growth forecasts for Japan, the U.S., and the Eurozone. The bottom two plots show the estimates for MPU and CRED. Other than a brief spurt of inflation in the late 1980s and early 1990s in Japan expectations hover close to zero for most of the sample. Nevertheless, based on the median of several forecasts, from professional and households, there is no evidence of a permanent slide beyond a mild deflation. One might well ask why several BoJ Governors felt it necessary to speak out against the notion that a deflation spiral was in the offing. There appears to be little evidence of this to speak of.²⁹ There are two episodes, in 2001-2 and again in 2009-11, when there are signs of deflation. The latter is clearly associated with the GFC as seen from the equally sharp decline, but from higher levels, in U.S. and Eurozone inflation. The earlier episode takes place at the conclusion of the ZIRP (see Table 1). Overall, we see the steady decline in inflation expectations in the U.S. and the Eurozone until the early 2000s and again after 2011. Policy makers in Japan (e.g., see BoJ 2016) contend that expectations are strongly backward-looking, and this hampers the BoJ's ability to meet its inflation objective. However, using the same specification as the report of QQE's impact on expectations (BoJ 2016), Table 2 reports that, if median expectations are used,

²⁹ This is even more dramatically illustrated when individual inflation expectations data are examined (see the appendix). For example, former Governor Shirakawa spoke at a news conference in 2009 where he advised listeners: "At the moment, Japan faces no risk of falling into a deflationary spiral (Shirakawa 2009). A previous Governor, Fukui, explained in 2003 that the "drastic monetary easing measures" were essential to prevent deflation from going out of control. And, more recently, current Governor Kuroda also interpreted the most recent monetary policy regime changes as necessary to escape from the "deflationary trap" Japan found itself in (Kuroda 2016).

there is nothing, at least statistically, that distinguishes Japan's record from that of the U.S. or the Eurozone even when breaks in the relationship are considered.

Real GDP growth forecasts are consistently higher in the U.S. beginning in the 2000s except during the GFC. Otherwise there is little that separates forecasts for Japan and the Eurozone though a divergence begins to emerge in the last three years of the sample with Japan showing a steady decline in forecasted real GDP growth beginning around 2011.

Turning to MPU and CRED, the bottom portion of Figure 4 highlights that higher inflation combined with higher MPU reduce central bank credibility. Note, however, that whereas the Fed and the ECB suffer large credibility losses as a result of the GFC there are only small changes in BoJ credibility during this period. The BoJ is seen as losing a lot of credibility before the stock market bubble bursts in the late 1980s while there seem to be no dramatic rises or decrease in BoJ credibility since the early 2000s. A modest gain in BoJ credibility is evident around 2014 but this change does not stand out from other episodes of changes in the stance of monetary policy. This is in spite of the apparent importance of the policy shift at the BoJ as part of the 'three arrows' of Abenomics. Notice also, however, that MPU in Japan rises sharply after QQE is introduced and generally remains higher than in the other two economies considered.

I conclude the description of stylized facts with Figure 5. This plots the distribution of inflation and inflation expectations for all the available data.³⁰ Mean inflation is significantly lower in Japan than in either the Eurozone or the U.S. The same result holds when comparing mean inflation expectations. Inflation expectations show no signs of being negative in the Eurozone and the U.S. whereas this is not the case for Japan. Nevertheless, the simple hypothesis that the mean of inflation expectations is negative in Japan is soundly rejected.³¹ In any case the mass of data for expectations below zero percent is clearly larger in Japan than in either of the other two economies, but the data are overwhelmingly to the right of zero. Finally, notice that the overall distribution of inflation expectations for the U.S. and the Eurozone is shifted to the left based on the areas to the left of the mean. The bottom line is that observed and expected inflation display

³⁰ Because of data limitations for some of the other variables the sample are shorter when econometric estimates are discussed.

³¹ The foregoing discussion is based on simple hypothesis testing (t -test) of the mean against the sample estimated one (results not shown).

significantly different behavior. Moreover, it will also be helpful to keep in mind there is some evidence that expectations behavior may be partly driven by outliers.³²

3.3 Regime Shifts and Central Bank Credibility: Methodologies and Results

As noted previously, a common barometer of the effectiveness and stance of monetary policy is the estimation or reporting of calibrated Taylor type rules. In the three equations below i_t^T is the policy rate that emerges from different calibrations of the policy rule; π_t, π_t^* are inflation and the inflation goal or target of the central bank, y_t is an estimate of the output gap, and r_t^* is the policy neutral real interest rate. Notice that r_t^* is time-varying in the equations below.³³ This is a recent modification of the Taylor rule specification stemming from empirical evidence suggesting that longer run factors, including demographic and secular slump factors raised earlier, have contributed to reducing the neutral real rate relative to the 2% often assumed when this variable is treated as a constant (e.g., Taylor 1993, Holston, Laubach, and Williams 2016). Similarly, as central banks became more forward looking by targeting inflation, inflation in Taylor rules were often replaced by some indicator of expected inflation (see Clarida, Galí, and Gertler 1999). The numerical coefficient (1, 0.5, and 2) attached to each one of these variables represents the weights placed on these twin objectives.

Three versions of the Taylor rule are especially noteworthy as they have often been used by academics and policy makers to represent ‘best practice’ in delivering monetary policy. They are: Taylor (1993), the originally published rule shown as equation (2) below; the so-called balanced rule, shown as equation (3), that places greater weight on real economic performance possibly because inflation rates have trended down since Taylor’s originally proposed rule; finally, Taylor (1999), shown below as equation (4), that places relatively greater emphasis on

³² There is some evidence of excess skewness in observed inflation in US and Eurozone data (Japan: 1.04; USA: 1.54; Eurozone: -0.27). Skewness in inflation expectations also differs as suggested above and appears excessive in the US case (Japan: 0.80; USA: 1.81; Eurozone: 1.01). Quantile-Quantile plots (not shown) suggest that US data (both observed and expected inflation) may be driven in part by outliers (both ends of the distribution) but there is no such evidence for the Eurozone.

³³ Although detailed discussion of demographic factors is beyond the scope of the paper it is sometimes part of the narrative surrounding the “Japanification” concept. Unsurprisingly, the topic is one that has elicited considerable attention especially since an aging population is a phenomenon that extends well beyond Japan. See, for example, Shirakawa (2011, 2012, 2016), and Sudo and Tazizuka (2018) for the Japanese case.

inflation control by ensuring that a surge of inflation is short-circuited via higher real interest rates.³⁴

$$i_t^T = r_t^* + \pi_t + 0.5(\pi_t - \pi^*) + 1y_t \quad (2)$$

$$i_t^T = r_t^* + \pi_t + 0.5(\pi_t - \pi^*) + 2y_t \quad (3)$$

$$i_t^T = r_t^* + \pi_t + 1.5(\pi_t - \pi^*) + 0.5y_t \quad (4)$$

Since we have at least two measures of inflation, observed and (median) expected, and two indicators of real economic activity, namely the (median) output gap and expected real GDP growth, then, together with the three versions of the policy rule, we can evaluate twelve different versions of equations (2) to (4).³⁵ Next, we ask what is the size of the deviation from any of the rules listed above and observed policy rates, that is, I calculate

$$DEV_t = i_t - i_t^T \quad (5)$$

Figure 6 reports two set of estimates for equation (5), namely the smallest deviation (DEV) between the observed and calibrated policy rates as well as the median (MED) estimates for the same deviation. A useful benchmark is zero percent since this indicates that a central bank sets a policy rate such that it follows the median of 12 potential estimates of the three rules considered. The median and smallest values are calculated for every observation t . In essence, the smallest value (MIN) is the rule that provides the most favorable view of the policy rate adopted by each central bank.³⁶ As a result, we obtain a snapshot of two points in the distribution of potential responses, as seen through the setting of a policy rate, to inflation and output gap shocks.

Both the MIN and MED estimates suggest sharp monetary policy tightening pre-GFC with a short delay in Japan and the Eurozone. In all three economies the tightening is quickly reversed

³⁴ Estimation or reporting of such rules is not uncommon at many central banks. The Fed's *Tealbook* frames some policy stance discussion around the performance of the rules shown as equations (2) to (4). Indeed, a fourth rule is also often discussed, namely the first difference rule which, as the name suggests, is expressed in terms of changes in the relevant variables. See, for example,

<https://www.federalreserve.gov/monetarypolicy/files/FOMC20130130tealbookb20130124.pdf>

³⁵ As before plots showing the estimates, and details of regressions mentioned below, are relegated to an appendix.

³⁶ In generating the calibrated estimates, I rely on the neutral real rate estimates for the US, and the Eurozone published by Holston, Laubach, and Williams (2016) while the ones for Japan are obtained from Howorth, Lombardi and Siklos (2019).

once the severity of the crisis becomes clear. The MED estimates suggest that all three central banks have, by far, tended to stick closest to the balanced policy rule followed by the Taylor (1999) rule. At least for the samples considered, Taylor (1993) does not emerge as a rule that is followed. Interestingly, Taylor (1999) is followed prior to the adoption of ZIRP, QE, and the GFC in Japan, during the Volcker disinflation of the early 1980s and again pre-GFC in the U.S., and in 2012 in the Eurozone, that is, around the peak period of the sovereign debt crisis.³⁷

Next, since equation (5) is evaluated in terms of the observed policy rate, I ask whether observed deviations can be explained by any variables that are believed to impact monetary policy but are normally excluded from Taylor rule type estimation.³⁸ This is done by estimating, via least squares, regressions where DEV_t is the dependent variables and a proxy for financial conditions, the real effective exchange rate gap, and central bank credibility, are the independent variables.³⁹ Since Figure 6 also suggests that there is some persistence in DEV_t a one period lag in this variable is also added. Selected results are shown in Table 4, which accompany the ones shown in Figure 6 (additional results are in the appendix), suggest that Taylor rule type deviations are influenced by these variables, but the size and statistical significance of the various determinants is sensitive according to whether MED or MIN deviations are considered. Hence, one's interpretation of central bank responses to shocks is conditional on whether one examines the median or some other portions of the distribution of DEV. Below, I return to considering additional implications of this finding.

The most economically important factor is central bank credibility.⁴⁰ Moreover, in all three economies, lower credibility leads to a narrowing of DEV. This suggests that central banks do

³⁷ The Appendix provides some information about which policy rule comes closest each quarter to one of the specified rules. Also, see the notes to Figure 5.

³⁸ There is a large literature that adds variables such as exchange rates and financial stability proxies to Taylor rules of the kind shown in equations (2) to (4).

³⁹ The proxy described earlier, estimated from PCA, is used because it provides the longest sample. Nevertheless, conclusions are unchanged when the IMF's proxy for financial conditions is used (see IMF *Global Financial Stability Report*, April 2017; <https://www.imf.org/en/Publications/GFSR/Issues/2017/03/30/global-financial-stability-report-april-2017>). Separate testing (not shown) shows that there is a slight phase delay between the IMF's estimate of financial conditions and ones derived here from the financial variables described earlier. In particular, the PCA generated proxy is more synchronous with actual financial developments than is the IMF's proxy which appears to contain a forward-looking component.

⁴⁰ Although credibility is related to inflation performance it is, at best, a highly variable and non-linear relationship since it is constructed from inflation and real GDP growth forecasts and not directly from observed inflation (see Bordo and Siklos 2019). It should be stressed that the interpretations below are not intended to be causal.

respond to the factors that contribute to changing credibility and are especially sensitive to a loss of credibility. Other than the financial conditions proxy, all other determinants are economically small when they are statistically significant. Regardless of the chosen proxy a tightening of financial conditions is associated with a decline in DEV. This suggests that all three central banks engaged in some ‘leaning against the wind’. However, the size of the estimated coefficients indicates that the U.S. Fed engaged in the least amount of LAW. It is worth noting that while credibility is usually highly significant, whether the MIN or MED versions of DEV are examined, the size of the coefficient on this variable is considerably larger for the MIN case. Therefore, deviations from some version of the Taylor rule (almost always of the balanced variety) responds most sharply when the most favorable view of how all three central banks set monetary policy is assumed. As with many of the other characteristics of policy setting the bottom line is that it is likely that how central banks respond, and what they respond to, may well be sensitive to how far inflation is from some objective.

We explore the foregoing possibility in more detail in Figure 7 which shows, for all three economies considered, how inflation responds to central bank credibility among other potential determinants. Estimates are based on a factor-augmented quantile regression (RS-FAQR), conditional on previously estimated regime shifts, which can be written as

$$Q(\tau | \mathbf{X}_{jt}, \boldsymbol{\beta}_s(\tau)) = \mathbf{X}_{j(t-i)}' \boldsymbol{\beta}_s(\tau) + \boldsymbol{\delta}_{jt} \mathbf{D}_t + \varepsilon_t(\tau) \quad (6)$$

where Q indicates that the regression of inflation is estimated over quantiles τ , that the estimated coefficients are regime-specific, and where \mathbf{X} is the matrix of independent variables j . \mathbf{D} are regime shift variables that are obtained either from common break tests, where the regime shifts are endogenously estimated (see below), or via the imposition of regime shift dummies based on the historical narratives for each economy considered (see Table 1).

The variables that make up \mathbf{X} are the same as the ones used to explain variations in DEV (see equation (5)). To repeat, they consist of: a measure of financial conditions, here the index constructed from the PCA approach outlined earlier, the real exchange rate gap, the median

output gap, and central bank credibility.⁴¹ One lag for each right-hand side variable is deemed adequate (i.e., $i=1$). The dating of regime changes is based on the results in Tables 1 and 3 where either break dates are estimated or are chosen based on historical evidence. The endogenously estimated regime switch dates are based on Bai and Perron (1998, 2003a, 2003b) as extended to the search for a common break by Bai (2010). Coefficient estimates for quantiles ranging from 0.1 to 0.9 are shown in Figure 7 with statistically significant quantiles (at the 10% level) highlighted by the shaded areas.

In general, all three economies reveal that greater central bank credibility reduces inflation in the first estimated regime. That said, in the first regime, while all quantiles are statistically significant for Japan (i.e., coefficient $c(4)$), only the lower quantiles are significant for the U.S. while changes in credibility impact only the upper quantiles for the Eurozone. Therefore, there is a tendency for tail end changes in credibility to matter for inflation in the U.S. and the Eurozone while inflation throughout the distribution of credibility influences inflation in Japan. The situation changes in the second regime (i.e., coefficients $c(13)$ and $c(14)$). Now lower tail end (i.e., $\tau < 0.3$ for Japan and $\tau < 0.5$) changes in credibility no longer impact inflation in Japan and the Eurozone while the entire distribution of central bank credibility impacts U.S. inflation (i.e., $c(14)$). Estimates for a third regime are available only for Japan (i.e., coefficients $c(22)$ and $c(23)$) when the historical narrative approach is applied. Once again only some of the lower and upper tail quantiles for credibility (i.e., $\tau = [0.2, 0.3]$ and $[0.8, 0.9]$) lagged one period impact inflation.

Overall, estimates based on dating chosen via historical narratives are compatible with the estimated ones for all three economies based on the sign of the relationship between credibility and inflation, even if the estimated coefficients are not the same size. The bottom line is that central bank credibility is crucial to inflation regardless whether regime shifts are endogenously estimated or chosen based on historical evidence. The main difference between the two styles of regime shift selection is the size of the inflation response to a credibility shock. Therefore, it does take a regime shift to change inflation, but this must come from increased central bank

⁴¹ Other variables such as a lag in inflation (domestic and/or U.S. inflation) did not alter the conclusions discussed below (not shown).

credibility.⁴² An announcement may not be enough. Moreover, it is not the case that all regime shifts are associated with dramatic policy shifts.

The final test consists of examining the average response to a credibility shock by obtaining impulse responses from factor-augmented local projections (FALP) of the form

$$\pi_{t+h} = \mu_h + \beta_h \mathbf{X}_{t-i} + \alpha_h \mathbf{D}_t + \varepsilon_t \quad (7)$$

where $h=0, \dots, 10$ is the horizons for the linear projection and \mathbf{X} was previously defined. The local projection impulse responses of inflation (π) with respect to \mathbf{X} is $\{\beta_h\}_{h \geq 0}$. \mathbf{D}_t capture regime shifts, assumed exogenous, defined according to whether they are, respectively, estimated or historically chosen relying on the same dates as ones used to estimate equation (6). Since, as above, the signs (but not necessarily the sizes) of the responses are the same regardless of how regime shifts are estimated Figure 8 displays the results for the endogenously selected regime changes only. Also, given foregoing discussion, I will focus on the nexus linking credibility, inflation, the (median) output gap, and financial conditions.

Recall that regime shifts, as defined above, are accounted for. The impulse responses shown in Figure 8 suggest⁴³ that lower central bank credibility raises the output gap, that is, creates conditions wherein there is an excess in observed versus trend output. Otherwise, a few differences emerge. Higher credibility reduces inflation in Japan and the Eurozone. Credibility seems to have, on average no significant impact on inflation in the U.S. Of course, it is well known that the Fed has a dual mandate that considers more than inflation. Note that, the credibility proxy used here does contain some information from real GDP forecasts (see equation (2)). Alternatively, it may be that the credibility effect is dominated by the result reported above, namely that credibility and inflation are unrelated in the U.S. since the GFC.

Tighter financial conditions impact credibility at all three central banks and this is indicative that, whether statutorily responsible or not, central banks are responsive to financial stability concerns. Nevertheless, whereas tighter financial conditions reduce credibility in Japan and the

⁴² Adding a lagged U.S. inflation term, to account for potential spillover effects, does not change the conclusions.

⁴³ I tried estimating quantile FALP but, as seen from Figure 7, the results are unlikely to be very informative since there is considerable heterogeneity in the relationship between credibility and inflation across the three economies and regimes.

U.S., the same stance produces an improvement in credibility in the Eurozone. In the case of the Eurozone the previous result may be explained by the association of lower credibility with looser financial conditions. Similarly, the link between changes in financial conditions and credibility is seen as due to the reduction of credibility that follows a loosening of financial conditions in both Japan and the U.S. Hence, there is an element of LAW after all in the U.S. and the Eurozone but not so in Japan which appears not to LAW. All the results, except for the LAW result for Japan, are broadly consistent with the quantile and Taylor rule methodologies reported above.⁴⁴

4. Conclusions: Whither ‘Japanification’?

For over a decade, the view that policy making in Japan differs markedly from that implemented in other large, systemically important, economies such as the U.S. and the Eurozone brought comfort and succor to observers who felt that they could escape the threat of a ‘lost decade’. Fast forward to today and worries that ‘Japanification’ can spread have become real.

This paper has attempted to marshal both narrative and econometric evidence to suggest that, at least in the case of monetary policy, the Bank of Japan’s performance does not stand out from the Fed and the ECB as much as many previously cited observers believe. That is not to say, of course, that differences between the three economies studied here do not exist. Clearly, inflation and inflationary expectations have been relatively lower in Japan than in either the U.S. and the Eurozone for well over a decade. Nevertheless, and despite the fact that the ‘mass’ of inflation performance includes a substantial amount of deflation, there is far less evidence of this phenomenon spreading to inflationary expectations. Even when inflation performance is negative it is mainly in the zero to -1 percent interval.

Central bank credibility is a critical ingredient in influencing inflation performance and changes substantially over time unlike most models where it is assumed to be perfect. Indeed, changes in

⁴⁴ I note that the estimated or historical dummies are not statistically significant (at least at the 10% level of significance) in all equations in the VARs. For the endogenously estimated breaks, the dummies for Japan are significant for the real exchange rate equation and financial conditions for the historically determined break. For the U.S. estimated breaks impact inflation, financial conditions, the real exchange rate and output gaps equations; historical break dates impact the output and real exchange rate gaps equations. In the Eurozone case, estimated breaks are significant in the inflation, output gap, and financial conditions equations; only the inflation equation is significantly impacted by the addition of breaks. I also tried alternatives to the Choleski ordering discussed above by placing the real exchange rate and financial conditions ahead of central bank credibility. None of the conclusions in Figure 7 are impacted.

credibility are often associated with key events such as financial crises or changes in policy strategy. Nevertheless, while the Fed and the ECB lost considerable credibility in the run-up to the GFC and the Eurozone's sovereign debt crisis the BoJ did not suffer a comparable loss. Perhaps this is one reason why the introduction of QQE in 2013 does not show up as a dramatic event. Moreover, a reduction in credibility is seen as reducing inflation and this result holds whether estimates are conditioned on breaks selected by the data or imposed based on historical depictions of policy changes. If this is the case then it is unclear why a regime shift, that is, a change in policy strategy, that aims to raise inflation will suffice when there is an unchanged risk that inflation target misses will be just as likely at higher inflation rates. Stated differently, higher monetary policy uncertainty may well be the price paid for a regime shift.

Another complication is that all three central banks evince a concern for financial conditions. Tighter financial conditions reduce central bank credibility in Japan and the U.S. but not the Eurozone. However, a reduction of credibility is also associated with tighter financial conditions in Japan and the Eurozone but loosens financial conditions in the U.S. There is a potential unpleasant loop wherein, for Japan and the Eurozone, a fall in credibility leads to tighter financial conditions which, in turn, leads to additional credibility losses. Only for the U.S. is the reduction in credibility stemming from tighter financial conditions reversed by raising central bank credibility.

Several extensions to the foregoing analysis follow. First, asymmetries between rising and falling inflation were not considered. After all, between the end of 1998 until the end of 2017, inflation has been below zero considerably more often than it has been positive though, as noted above, rarely below -1%. However, it may well be that the link between credibility and inflation differs between periods of rising versus falling inflation. Next, there is no consensus yet on how to definitively measure financial conditions. Once we have a clear idea of how these evolve over time the relationship between credibility, financial conditions and inflation needs to be reconsidered. Perhaps more importantly, data limitations prevent conditioning the results presented here on the stop-go nature of fiscal policy and how this may have spilled over into inflation and growth expectations. Finally, it would be helpful if additional evidence were brought to bear on the question whether the myth of Japan's 'failure' is the new narrative that ought to replace the current one.

Perhaps another lesson is that we need to be careful not to conflate great events, such as the GFC (or the Great Depression in the U.S.), with many other events that can also give rise to structural breaks as defined by econometricians. A narrative approach suggests potentially many more candidates for regime shifts than does econometric testing. However, the narrative approach also potentially leaves too few observations between regimes to provide useful assessments of reactions to policy changes. Indeed, another possibility is that regime shifts that need to concern policy makers most result from the slow build-up of shocks over time until a tipping point is reached.

Unfortunately, the results presented here do not point to obvious ways Japan, or any other economy, can escape its current predicament. While it is reasonable to suggest that passive monetary policy may well have prevented much worse outcomes the experience of the past three decades also suggest that a return to an era of higher growth and higher inflation will not be found in the conduct of monetary policy alone. Whether the appropriate response is even more aggressive policies is another matter since the wisdom of this kind of reaction is based on very few observations. Clearly, there are dangers in looking at policy solely from the rear-view mirror.

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Table 1
Selected Monetary Events in Japan, the U.S., and the Eurozone Since 1980

<i>Japan</i>	<i>United States</i>	<i>Eurozone</i>
Plaza Accord 1985Q3	1979Q4-1982Q4: Monetary Targeting	1999Q1: Euro introduced
Louvre Accord 1987Q1	1987Q4: Black Monday	2008Q4: LTRO#
1989Q4/1990: Nikkei peaks followed by bubble bursting	2000Q1: dot.com bubble bursts	2010Q2: SMP
Banking crisis: 1992-1997*	QE 1: 2008Q4-2010Q3	2012Q3: OMT
1999Q1-2000Q3: Zero Interest Rate Policy	QE2: 2010Q4-2011Q2	2015Q1: QE
2001Q1-2006Q1: Quantitative Easing (QE)	QE 3: 2012Q3-2014Q4	
2008Q4-2010Q1: Variety of BoJ interventions**		
2013Q2-: Quantitative and Qualitative Easing (QQE) and Yield Curve Control (2016Q3)		

Note: See text and the appendix for sources. The above list is not intended to be comprehensive. Additional events (e.g., major earthquakes in Japan) are relegated to the appendix. LTRO: long-term refinancing operation; SMP: securities market program; OMT: Outright monetary transactions (follows former ECB President Mario Draghi's July 2012 speech defending the euro). *There are differing views about the dating of Japan's banking crisis. The dates shown here are the most 'generous' in terms of the span of time.** There were interventions after 2010Q1 . Arguably, these were of a different variety. Again, there is room for disagreement on this point (e.g., see Wakatabe 2015). # consists of more than one program (for example, a new program announced 2011Q4). Also, see Fawley and Neely (2013).

Table 2
How Entrenched are Inflation Expectations?
Some Evidence for Japan, the U.S., and the Eurozone

Economy	SAMPLE (YR:Q)	(1): λ	(2): λ	BREAKS: (N1)	BREAKS: (N2)
JP	91:4-17:3	.26	.20	NIL	95:2
USA	91:4-17:3	.31	.33	NIL	02:4/12:3
EUR	00:1-17:3	.35	.26	NIL	13:1 (3 if sample starts in 1980; 96:3/00:2/13:2)

Note: the estimates of λ are based on the following two regressions (also see BoJ 2016).

$$\pi_{t+1}^e = \lambda \pi_{t-1} + (1 - \lambda) \pi_{t+5}^e \quad (N1)$$

$$\pi_{t+5t}^e = \lambda \pi_{t-1} + (1 - \lambda) \pi^T \quad (N2)$$

In N1 and N2 π^e and π^T are CPI expected and target inflation rates as defined in the text also see the appendix), and t is the time subscript. Breaks are estimated via the Bai-Perron (1998) method as follows: a trend and an intercept are included in the specification, but only additive outliers are permitted. The test is then one for a break in the intercept. Testing is limited to a maximum of 3 breaks using sequential testing (i.e., the Null of B_l+1 versus B_l breaks, where B_l and $l=0$ to 3).

Table 3
Searching For Common Breaks

(i) Inflation: observed vs. median forecast

JAPAN		UNITED STATES		EUROZONE	
80Q1-19Q2 [observed]	85Q3-19Q4 [forecast]	81Q1-19Q2 [observed]	80Q1-19Q4 [forecast]	97Q1-18Q4 [observed]	89Q4-19Q4 [forecast]
2016Q2	2014Q4	2014Q3	2014Q3	2013Q2	<i>2013Q3</i>
2008Q4	2008Q4	2008Q3	2008Q3		2008Q4
1998Q4	1998Q3	<i>1991Q3</i>	<i>1997Q4</i>		1997Q2
1993Q3	1994Q2	1982Q2	<i>1991Q2</i>		1996Q1
1981Q4	1992Q3		<i>1997Q4</i>		
	1986Q4		1981Q3		

(ii) Real GDP (log)

JAPAN: 80Q1-19Q1	UNITED STATES: 80Q4-19Q2	EUROZONE: 95Q1-19Q2
2014Q1	2012Q2	2012Q2
2008Q3	2012Q4	2012Q4
1998Q4	2008Q4	2008Q4
1993Q2	2007Q4	2002Q4
1992Q1	1990Q3	
1982Q2	1981Q3	

(iii) Real GDP Growth Forecasts and the Output Gap

JAPAN: 90Q13-19Q2		UNITED STATES: 80Q1-19Q2		EUROZONE: 95Q1-19Q2	
FORECAST	OUTPUT GAP	FORECAST	OUTPOUT GAP	FORECAST	OUTPUT GAP
2014Q2	2001Q1	2008Q3	2016Q2	2001Q1	2018Q3
2005Q1	2009Q3	2006Q1	2009Q3	2004Q1	2009Q3
2008Q1	2008Q1	2001Q4	2006Q3	2002Q1	2008Q2
1994Q4	2000Q1	1996Q4	1999Q2		2002Q1
	1995Q2	1984Q3	1998Q4		
			1984Q3		

Note: in bold the first estimated break. Subsequently breaks are estimated from the beginning of the sample to the first break; then from the quarter following the first estimated break to the end of the sample. Highlighted are breaks that are common across two or more economies. All tests conclude that (log) real GDP are I(1) with the estimated breaks shown. Breaks are listed from most recent to earliest. Also see notes to Table 2. Bai's (2010) test is used to search for common breaks between inflation or real GDP growth and expected inflation or the (median) output gap.

Table 4
Explaining Deviations from the Taylor Rule

(a) Smallest Deviations

Dependent Variable: TR_DEV_MIN_JPN - JAPAN

Sample (adjusted): 1990Q3 2017Q4

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.03	0.74	-5.48	0.00
RNJP_GAP	0.07	0.02	3.68	0.00
<i>CREDN4B_JPN</i>	-7.16	1.72	-4.17	0.00
JP_EPU	0.03	0.00	5.45	0.00
TR_DEV_MIN_USA(-1)	0.34	0.08	4.42	0.00
MEAN_JPN_F1	-1.00	0.26	-3.89	0.00
R-squared	0.49	Mean dependent var		-3.44
Adjusted R-squared	0.46	S.D. dependent var		1.98

Dependent Variable: TR_DEV_MIN_USA - USA

Sample (adjusted): 1985Q1 2017Q4

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.41	0.92	-3.73	0.00
RNUS_GAP	-0.01	0.04	-0.25	0.80
<i>CREDN4B_USA</i>	6.16	1.57	3.92	0.00
US_EPU	-0.02	0.01	-1.86	0.07
MEAN_USA_F1	-0.93	0.39	-2.40	0.02
R-squared	0.14	Mean dependent var		-3.68
Adjusted R-squared	0.11	S.D. dependent var		2.61

Dependent Variable: TR_DEV_MIN_EUR - Eurozone

Sample (adjusted): 2003Q1 2017Q4

Included observations: 60 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.90	0.63	-1.42	0.16
RNXM_GAP	-0.02	0.02	-0.79	0.43
<i>CREDN4B_EUR</i>	-1.60	0.59	-2.71	0.01
EZ_EPU	0.00	0.00	0.80	0.43
TR_DEV_MIN_USA(-1)	0.28	0.05	5.32	0.00
JPN_SPREAD2	0.17	0.32	0.55	0.58
MEAN_EUR_F1	-1.53	0.14	-11.13	0.00
R-squared	0.79	Mean dependent var		-2.47
Adjusted R-squared	0.77	S.D. dependent var		1.44

(b) Median Deviations

Dependent Variable: TR_DEV_MED_JPN - JAPAN

Included observations: 110 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.34	0.66	2.01	0.05
RNJP_GAP	0.13	0.02	7.74	0.00
CREDN4B_JPN	-1.94	1.55	-1.25	0.21
JP_EPU	0.00	0.00	0.53	0.60
TR_DEV_MIN_USA(-1)	0.41	0.07	5.88	0.00
MEAN_JPN_F1	-1.37	0.23	-5.90	0.00
R-squared	0.53	Mean dependent var		-0.32
Adjusted R-squared	0.51	S.D. dependent var		1.87

Dependent Variable: TR_DEV_MED_USA - USA

Method: Least Squares

Sample (adjusted): 1985Q1 2017Q4

Included observations: 132 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.10	0.69	1.60	0.11
RNUS_GAP	-0.01	0.03	-0.16	0.87
CREDN4B_USA	5.01	1.18	4.24	0.00
US_EPU	-0.02	0.01	-2.49	0.01
MEAN_USA_F1	-0.54	0.29	-1.87	0.06
R-squared	0.15	Mean dependent var		0.56
Adjusted R-squared	0.13	S.D. dependent var		1.98

Dependent Variable: TR_DEV_MED_EUR - Eurozone

Method: Least Squares

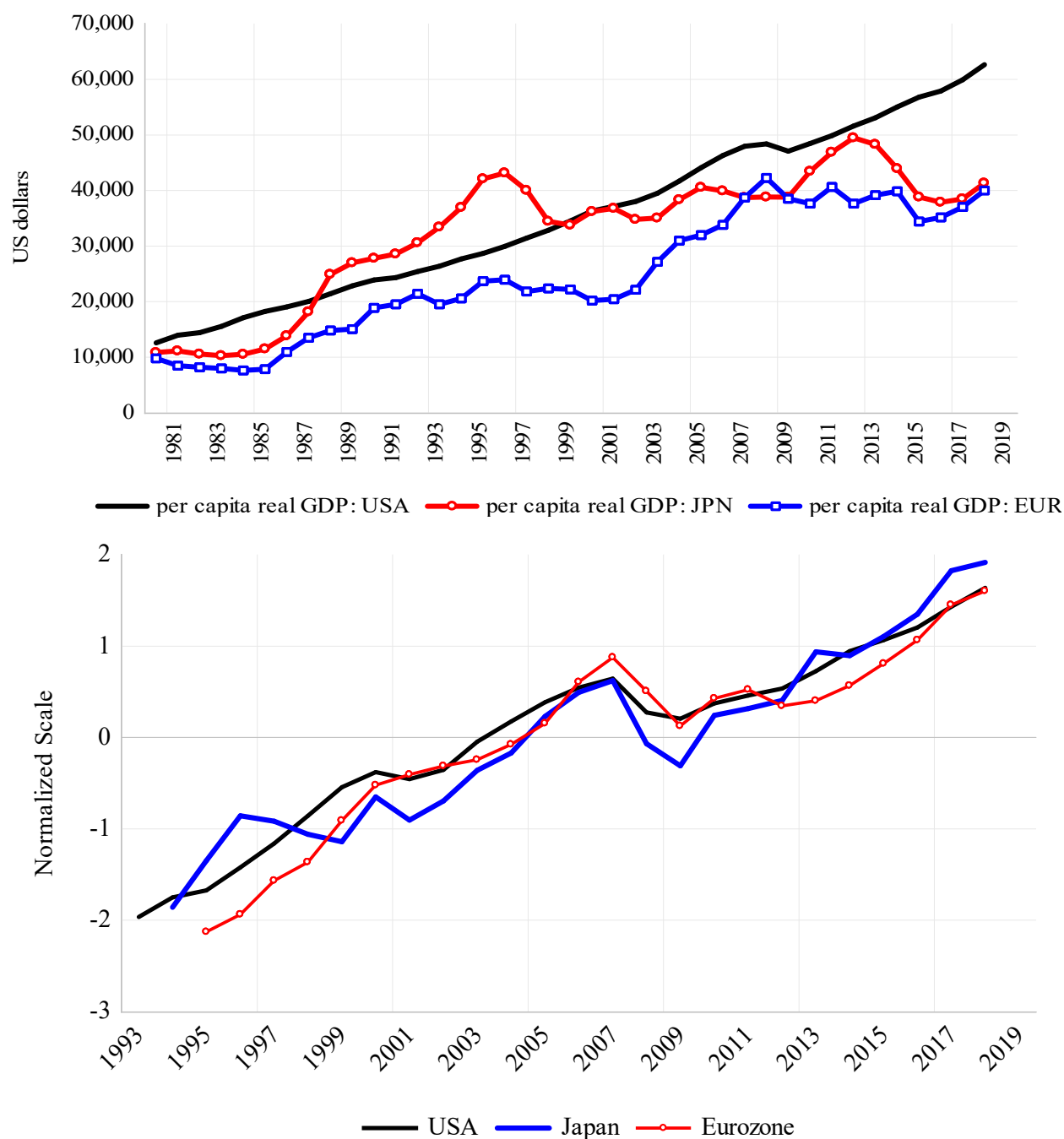
Sample (adjusted): 2003Q1 2017Q4

Included observations: 60 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.59	0.79	3.29	0.00
RNXM_GAP	0.04	0.03	1.41	0.17
CREDN4B_EUR	-0.36	0.73	-0.49	0.63
EZ_EPU	-0.01	0.00	-2.54	0.01
TR_DEV_MIN_USA(-1)	0.15	0.06	2.31	0.02
JPN_SPREAD2	-0.33	0.39	-0.84	0.40
MEAN_EUR_F1	-1.25	0.17	-7.31	0.00
R-squared	0.64	Mean dependent var		0.06
Adjusted R-squared	0.60	S.D. dependent var		1.35

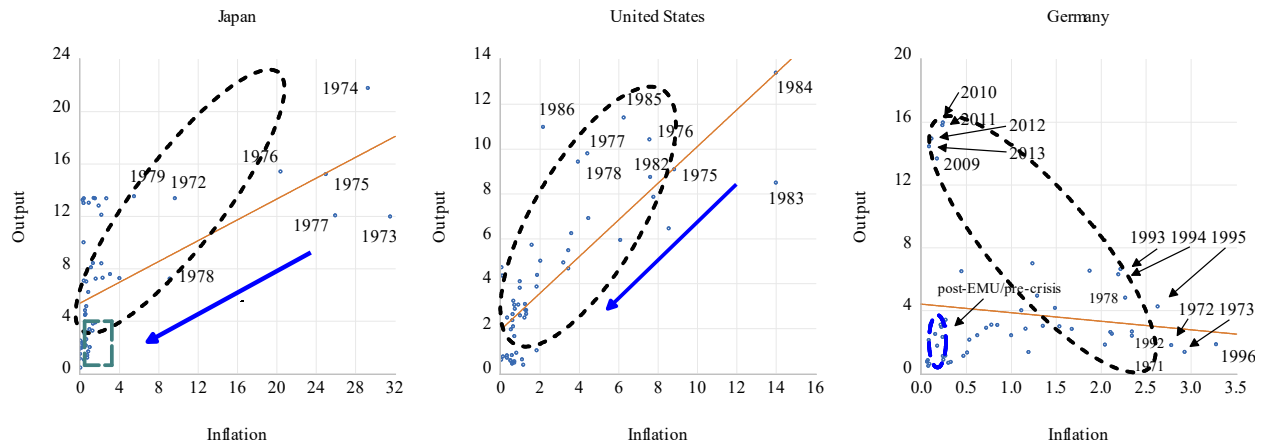
Note: TR_DEV represents deviations from the Taylor rule as defined in equation (5). MED refers to median deviations; MIN to smallest deviations. C is the constant, CRED* is the credibility proxy, EPU is economic policy uncertainty, SPREAD is the long-short interest rate spread, MEAN_..._F1 is the mean forecast proxied as the first principal component, RN_..._GAP is the real exchange rate gap. US and USA refer to US data, EZ or XM refer to Eurozone data, JP or JPN refer to Japanese data.

Figure 1 Two Views of real GDP Developments in Japan, the US, and the Eurozone



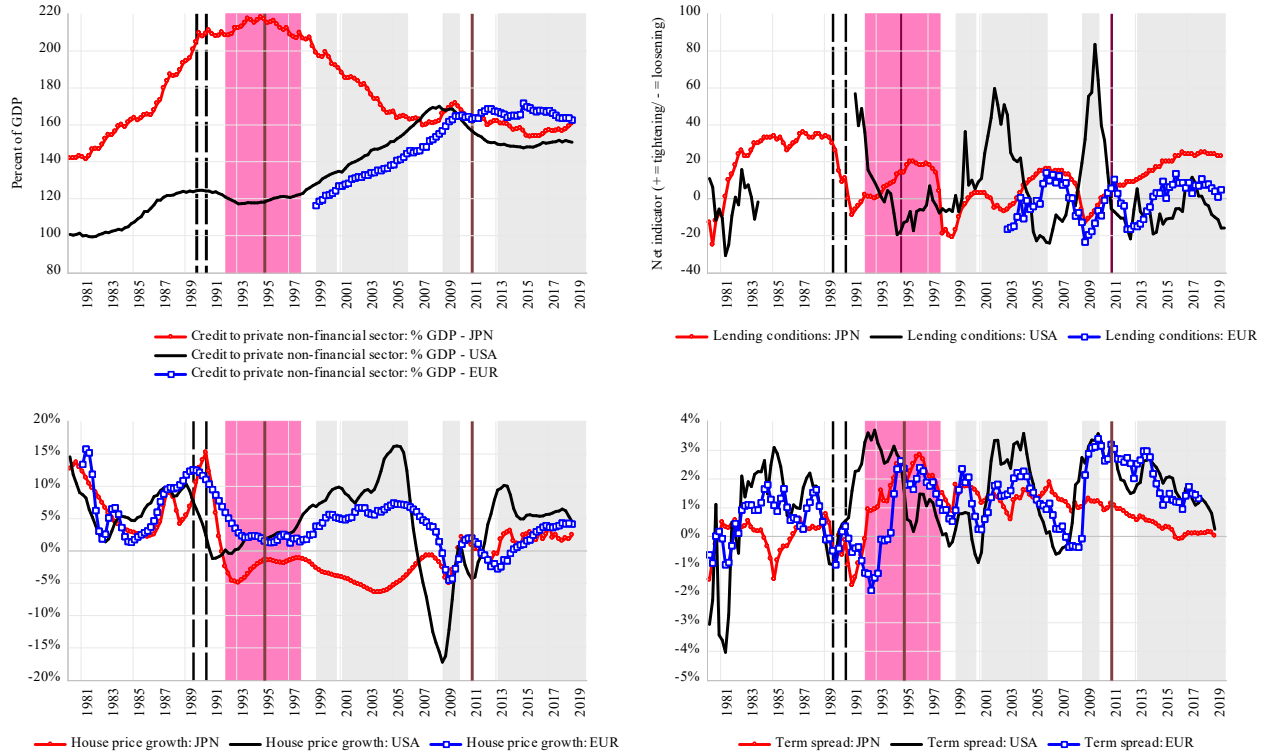
Note: the USD dollar estimates are from World Bank World Development Indicators. The bottom: for US series GDPC1 (real GDP) divided by POPTHM (population); for Japan JPNTGDPEXP divided by POPTOTJPA647NWDB; for the Eurozone CLVMEURSCAB1GQEA19 divided but SPPOPTOTLEMU. The series mnemonics are from FRED. Since the original units differ across the three economies the series plotted are shown on a normalized scale.

Figure 2
The Trade-Off Between Inflation and Output Growth Volatility Since the 1970s:
Japan, the U.S., and Germany



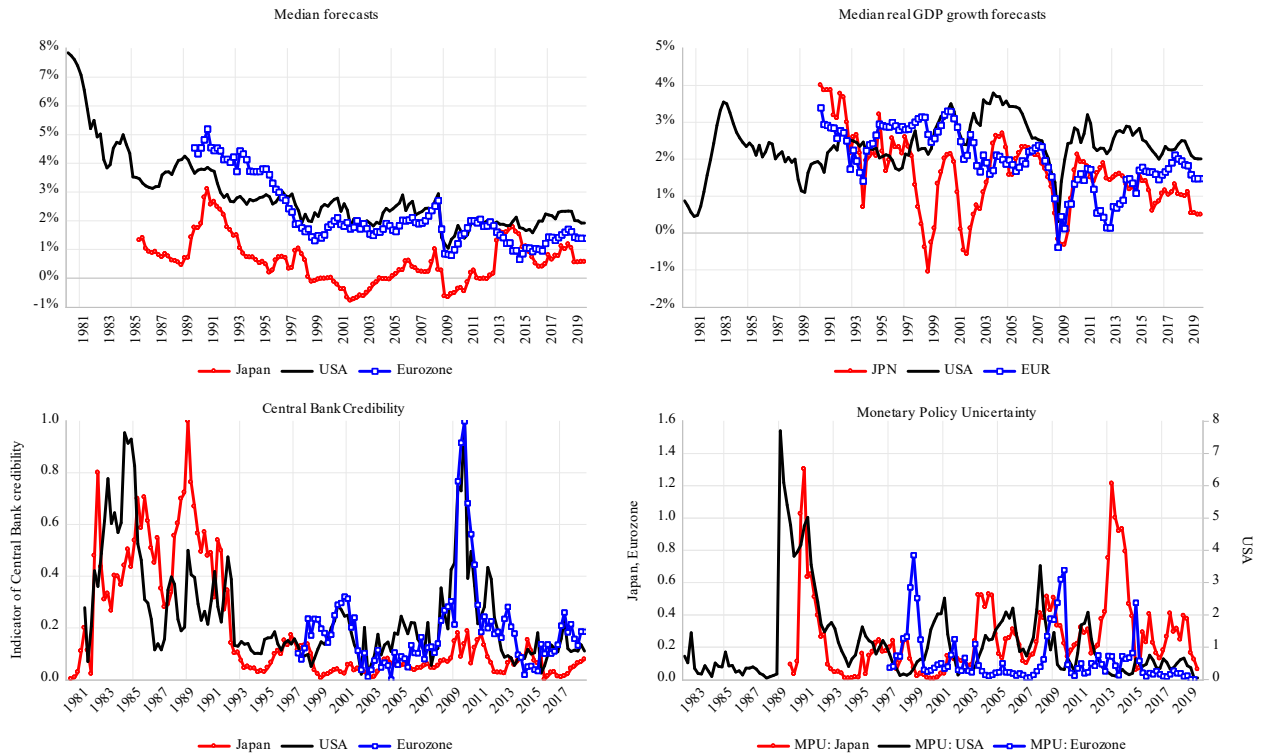
Note: Based on annual inflation and real GDP growth rates as defined in the text. Annualized twenty quarter moving variances of inflation and real GDP growth are plotted. The straight lines are least squares estimates of the relationship between the variances. The ellipses are drawn in a manner to capture the overall direction of the trade-offs. The dashed rectangle for Japan is, broadly, the era of near zero to zero, or less, policy rates. Data before 1980 were obtained from the International Monetary Fund's International Financial Statistics (<https://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B>). See the main text for sources of data since 1980. Years shown in the Figures identify calendar years.

Figure 3
Indicators of Financial Conditions in Japan, the U.S., and the Eurozone



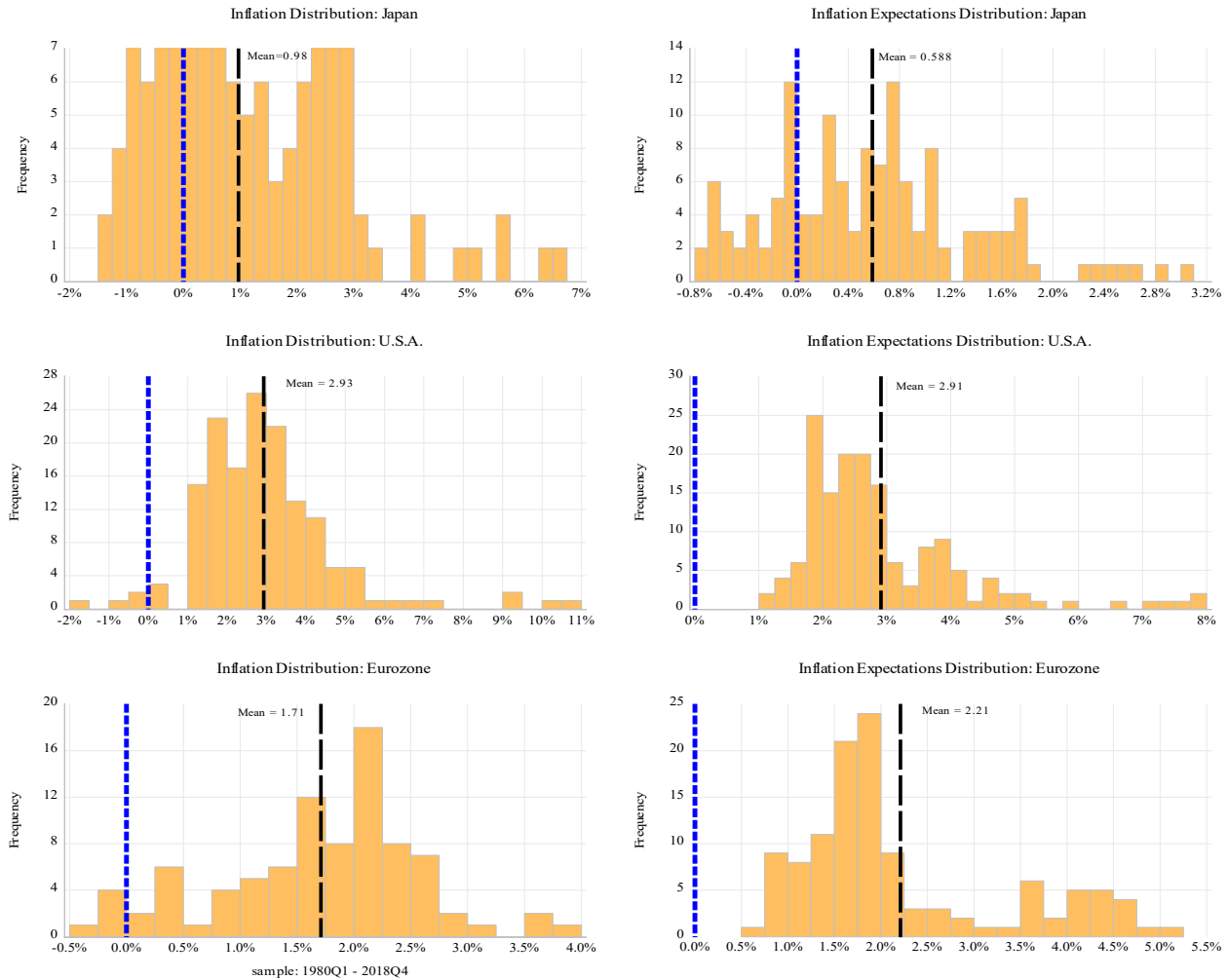
Note: Definition and sources are provided in the text. For Japan the lending survey data represent the diffusion-index (i.e., an indicator of the tendency of loan officers to tighten or loosen lending standards) for the lending attitude vis-à-vis medium-sized enterprises, all industries. The gap in lending standards for the U.S. is due to the non-collection of data during this period. Filardo and Siklos (2018) also contains much more details about international lending standards data. Interpolation using the Chow-Lin method is used to fill the gap. Shaded areas and vertical lines are events highlighted in Table 1.

Figure 4
Expected Inflation, real GDP Forecasts, Monetary Policy Uncertainty and Credibility
in Japan, the U.S., and the Eurozone



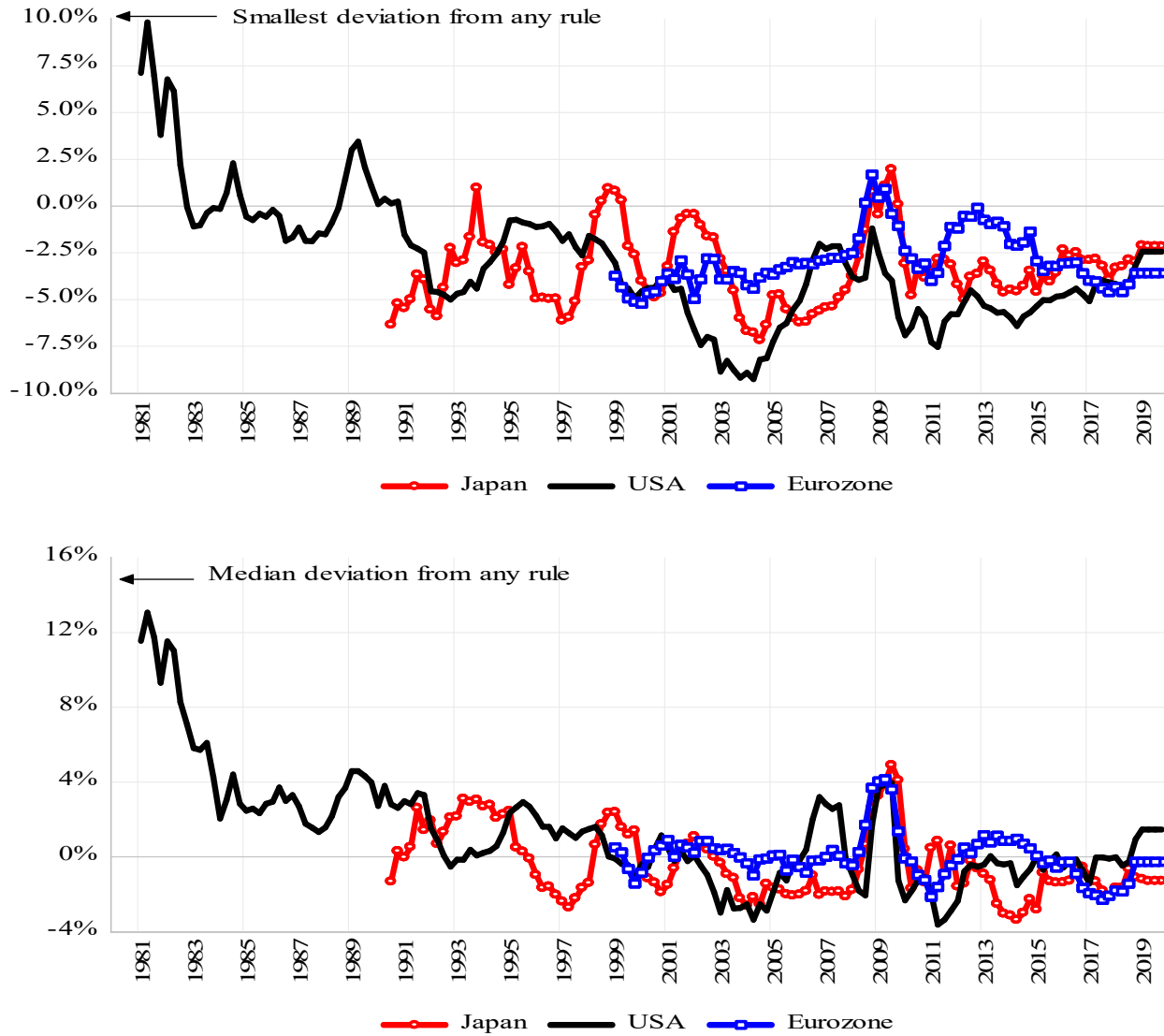
Note: Median estimates of inflation and real GDP growth forecasts are based on multiple forecasts (see n. 20). Credibility and monetary policy uncertainty (MPU) are also defined in the main body of the text. In the case of MPU the plots are based on available forecasts. Longer series are available for Japan prior to 1990 when only TANKAN and WEO forecasts are available in contrast to many more forecasts available beginning and after 1990.

Figure 5
The Distribution of Inflation Rates in Japan, the U.S. and the Eurozone



Note: Sources and definitions of the variables are in the text. The number of forecasts over which the median estimates are taken changes over time. See the appendix for data availability for individual series. Prior to 1999 data for the Eurozone is a synthetic version from the sources listed in the paper. Samples are: 1980-2018 (Japan, USA), and 1997-2018 (Eurozone).

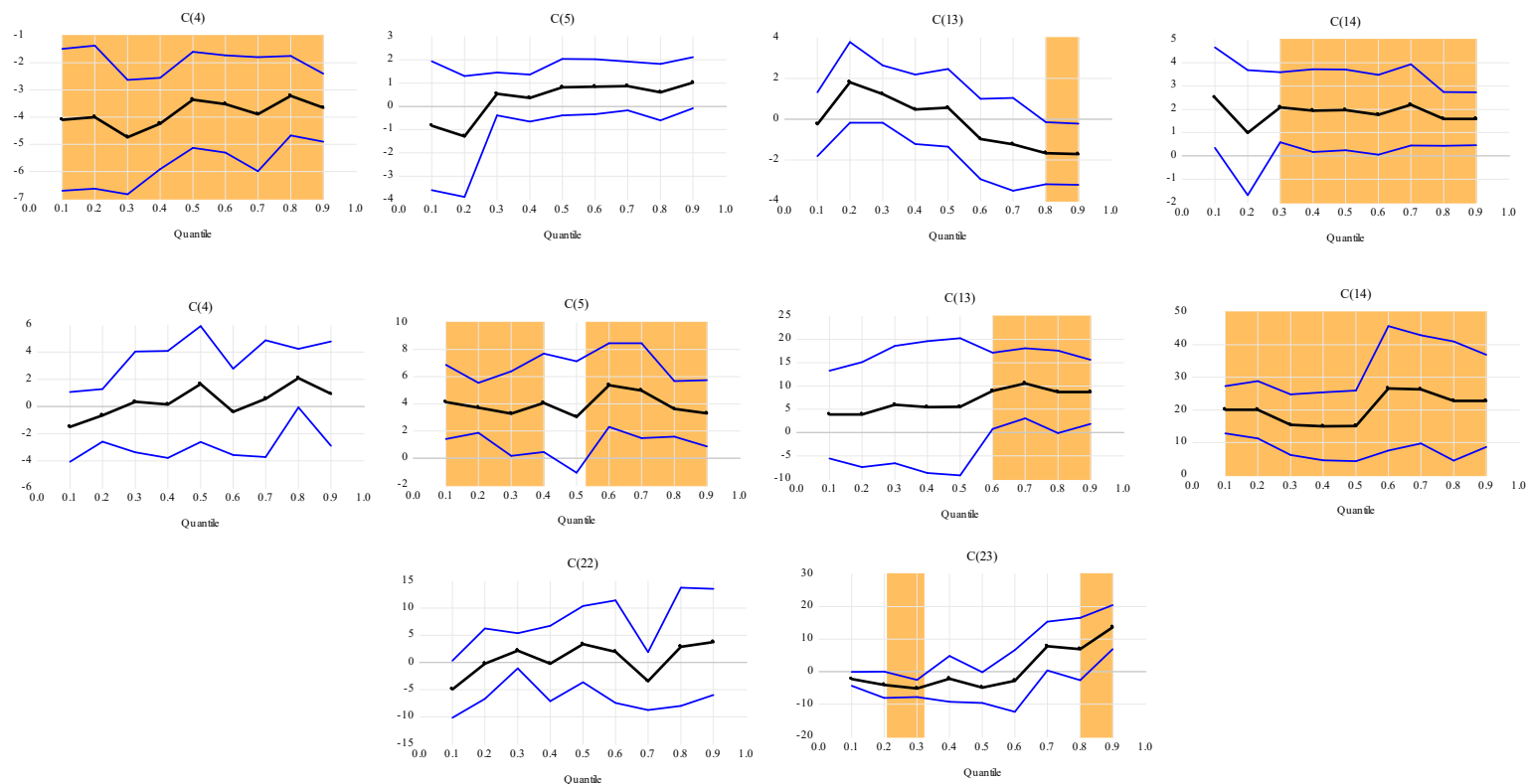
Figure 6
Departures from Selected Policy Rules



Note: DEV is defined in equation (5). The figures above display median estimates obtained from 12 estimated of calibrated Taylor rules. The smallest deviations represent the most favorable rule (i.e., the one providing the greatest easing). The box below provided the details.

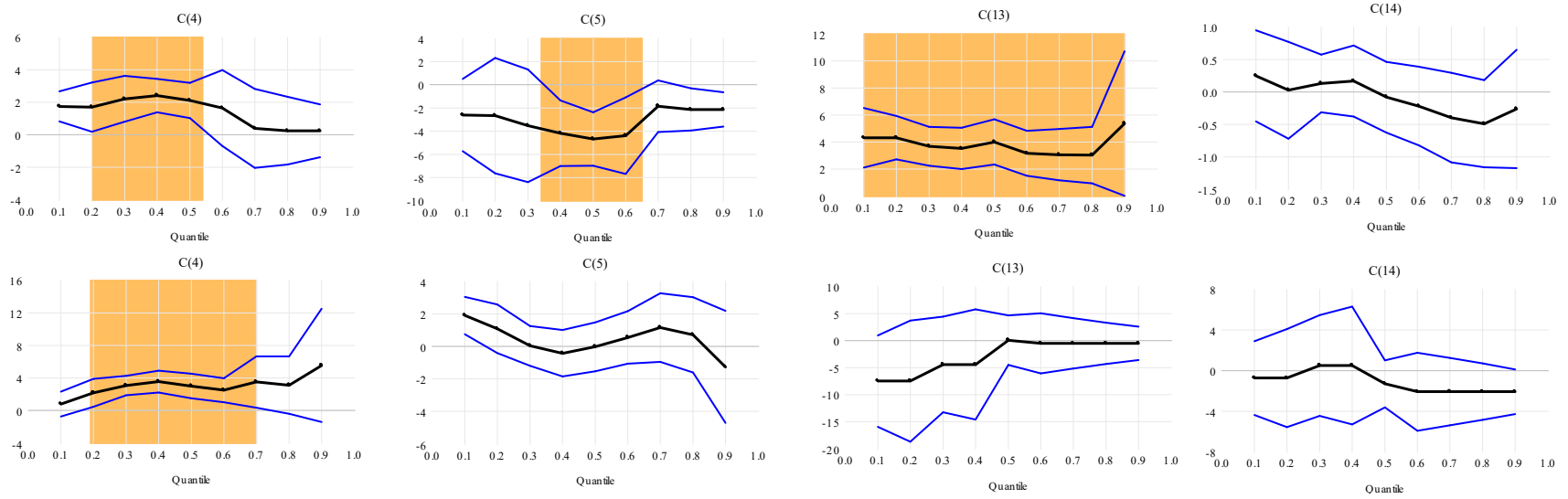
Calibration #	Taylor Rule Type	Coefficient on Inflation Gap, Output Gap
1, 4, 7, 10	Taylor 1993	.5, 1
2, 5, 8, 11	Balanced	.5, 2
3, 6, 9, 12	Taylor 1999	1.5, .5
MEASUREMENT OF VARIABLES		
Inflation: one-sided H-P filter; Output gap: Median estimate: 1, 2, 3		
Inflation: one-sided H-P filter; Output gap: Median forecast: 4, 5, 6		
Inflation: median inflation forecast; Output gap: Median estimate: 7, 8, 9		
Inflation: median inflation forecast; Output gap: Median forecast: 10, 11, 12		

Figure 7
JAPAN



Note: C(4), C(5), C(13), C(14), C(22), C(23) are coefficient estimates of the impact of credibility (CREDN4B) on inflation based on the factor-augmented quantile regression given by equation (6). The first two (C(4), C(5)) estimates are for the first regime, the second two (C(13), C(14)) estimates for the second regime, the last two (C(22), C(23)) estimates for the third regime. C(4), C(13), C(22) are the contemporaneous coefficients; C(5), C(14), and C(23) are coefficients lagged on period. Estimates in the first row are based on narrative breaks; estimates in the second (and third) row are based on endogenously estimated. Endogenously estimated breaks are: 1990Q2, 1998Q2 (Japan); 1987Q2, 2008Q4 (USA); 2008Q4 (Eurozone). Narrative breaks are: 2013Q1 (Japan), 2008Q3, 2012Q1 (USA), 2008Q3 (Eurozone). See Table 1 for descriptions. Shaded areas indicate statistically significant coefficients at the 10% level of significance.

Figure 7 (cont'd)
U.S.A.



Note: C(22) and C(23) all highly insignificant at all quantiles for both the endogenously estimated and narrative breaks and are not shown to conserve space.

Figure 7 (cont'd)
Eurozone

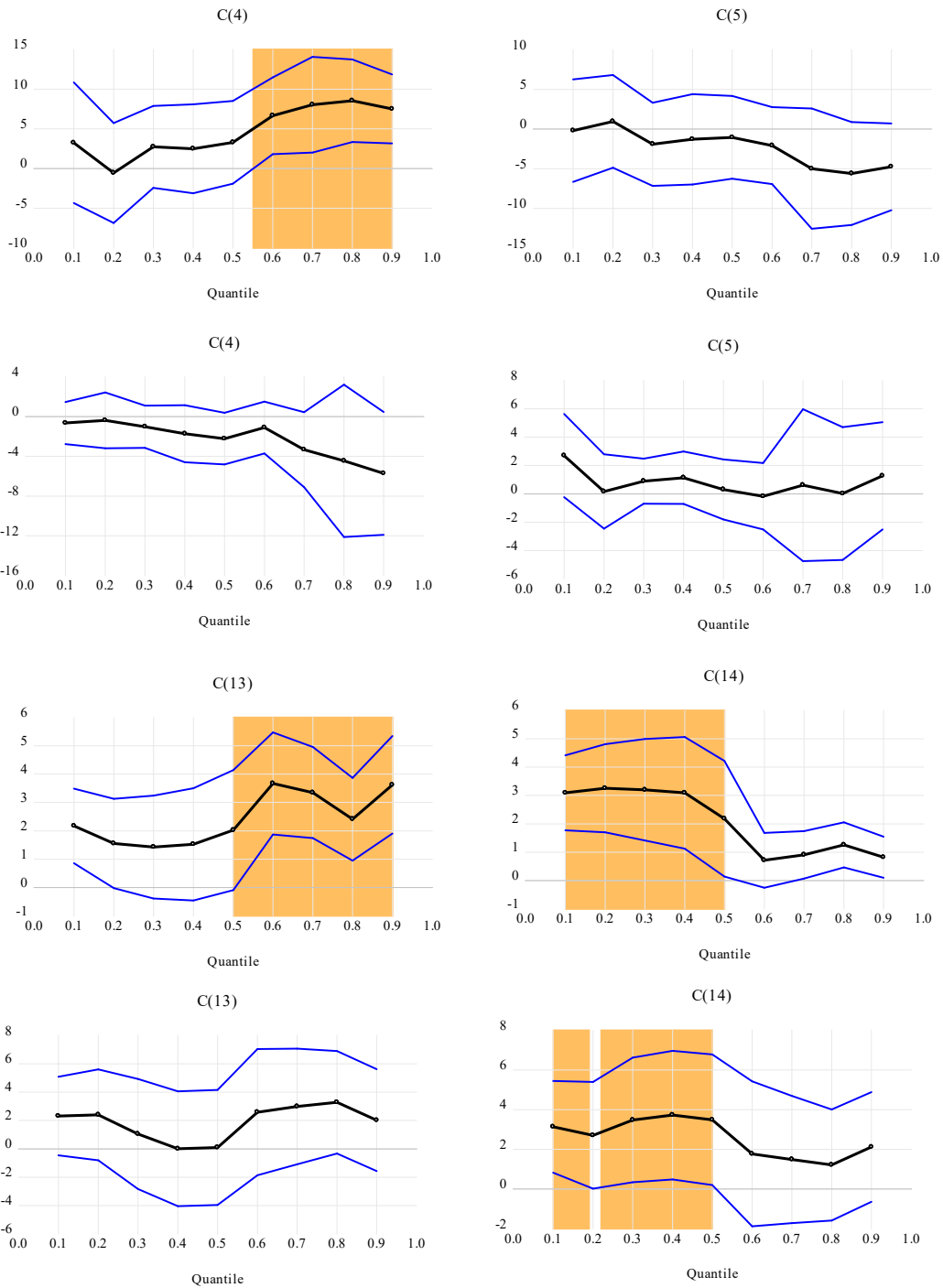
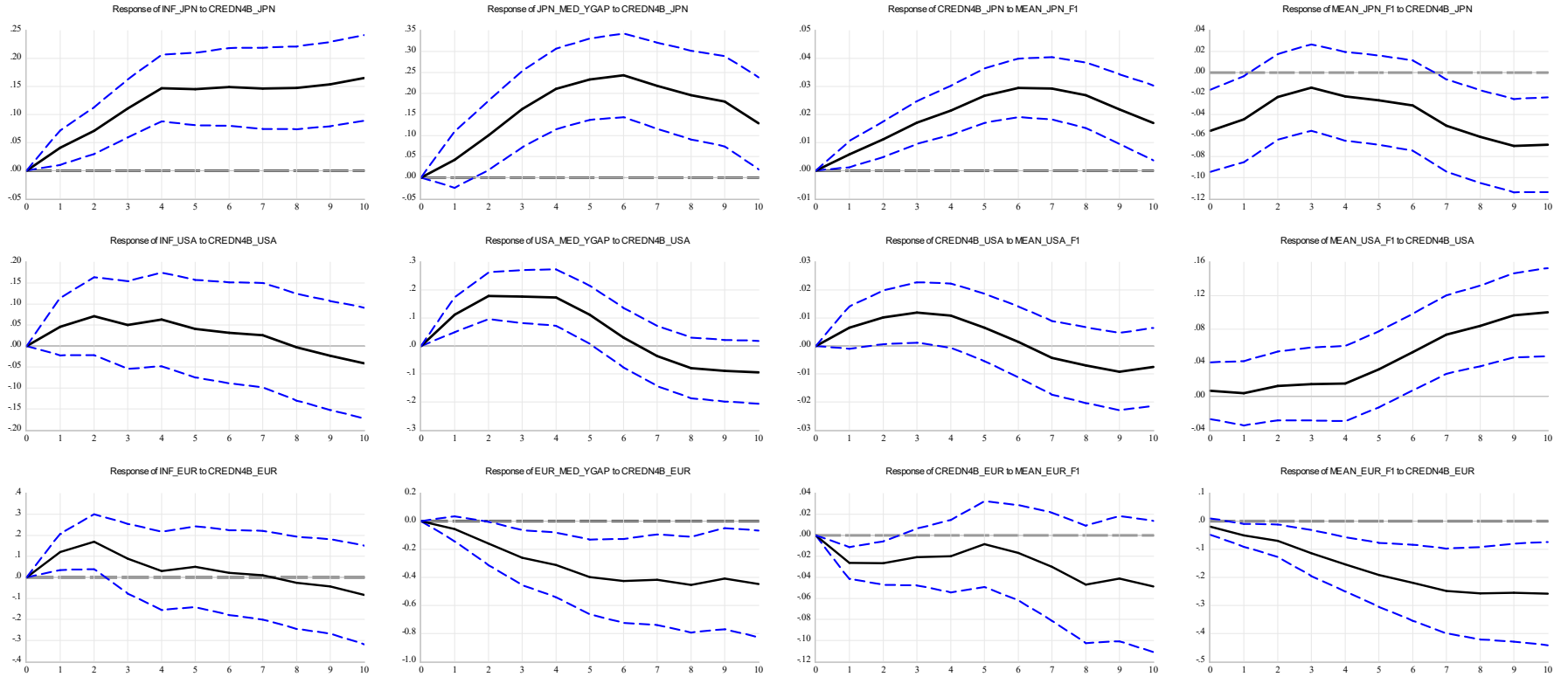


Figure 8
Factor Augmented Local Projection Impulse Responses



Note: impulse responses are based on estimates of equation (7). One lag is used for Japan and the U.S., 2 lags for the Eurozone. JPN, USA, and EUR are respectively: Japan, the U.S., and the Eurozone. MED indicates that a median estimate is used. CREDN4B is the credibility estimate described in the main body of the paper based on the lagged observed inflation version of the credibility proxy since other versions were not very different but provide fewer observations. F1s the PCA generated proxy for financial conditions. YGAP is the (median) estimate of the output gap as described in the main body of the text. Dashed lines are 10% confidence intervals.