RELATIVE PRICE SHOCKS, INFLATION EXPECTATIONS, AND THE ROLE OF MONETARY POLICY*

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ABSTRACT

The aim of this paper is to rely on a wide variety of forecasts and survey based estimates of inflationary expectations since the early 1990s for a group of 9 economies, 5 of which explicitly target inflation, and ask: to what extent are disagreements over forecasts of inflation driven by movements in relative prices? The empirical evidence leads to the following conclusions. First, there is little doubt that IT has contributed to narrowing the forecast differences vis-a-vis U.S. inflation forecasts. Second, there is some evidence that, at least since 1990, inflation forecasts in the economies considered that deviate too far from U.S. forecasts show signs of converging towards U.S. expectations. Third, examining the mean of the distribution of forecasts potentially omits important insights about what drives inflation expectations. Finally, commodity and asset prices clearly move inflation forecasts although this is a phenomenon of the second half of the sample. Prior to around 1999 relative price effects on expectations are insignificant.

Keywords: inflation expectations, forecasts, inflation targeting, forecast disagreement

JEL Classification codes: E31, E37, E58, E65

1. Introduction

The last two decades have seen a remarkable convergence in inflation rates around the world. The role that monetary policy plays in achieving this outcome continues to be debated. There is, of course, a long tradition in the profession linking inflation performance to monetary policy. For example, during the depths of the Great Depression, in a landmark 1932 study of commodity prices covering two centuries of data, Warren and Pearson (1932) remarked: "Any price level that is out of adjustment with the monetary situation should not be expected to be maintained permanently." (op. cit., p.67) A look at any recent Inflation Report published by several central banks would doubtlessly produce very similar sentiments about the behaviour of inflation. Yet, there is also a case to be made that economists have yet to fully grasp the dynamics of inflation (e.g., Bernanke 2008). This state of affairs also carries over to our understanding of what moves inflation forecasts. Adding to the mix, sharp movements in both commodity and asset prices in recent years (see section 3 below) raise a host of questions about what factors drive expectations of inflation (also see Reis and Watson 2009).

The financial and economic crisis that began in July-August 2007 only deepens the mystery about what influences inflation rates around the world since aggregate price level movements have been relatively benign over the past two years, at least in the industrial world. There has been no shortage, however, of commentary by central banking officials and other analysts over prospects of a spiralling inflation or deflation.[1] As Trichet (2009) remarked concerning the conduct of monetary policy in turbulent times: "…the evidence supports the view that a central

[1] Worries over whether the fiscal stimuli in place in many part of the world will work has led to suggestions that a 'little' inflation (e.g., 2 to 3%) is preferable to near zero current levels. Others worry that inflation, once unleashed, cannot be controlled with such precision.

bank's ability to ease monetary conditions – and thereby support the stabilization of inflation and output – is significantly enhanced by its ability to anchor private expectations." However, what explains this ability to anchor expectations, as well as the role played by the monetary policy strategy in place, remains open to debate and more research. Therefore, studying the determinants of inflation and, in particular, how relative price shocks interact with inflationary expectations, remains an important task.

Adding to the difficulties in our understanding of the inflationary process is that observers of inflation forecasts normally have very little information about the model, or models, that were used to generate a forecast nor the extent to which certain economic variables (e.g., commodity prices), as opposed to informed judgment, drives changes in forecasts over time. The problem of identifying the signal from the noise is, of course, an old one.

This paper is relies on a wide variety of forecasts and survey based estimates of inflationary expectations since the early 1990s for a group of 9 economies, 5 of which explicitly target inflation, and asks: to what extent are disagreements over forecasts of inflation driven by movements in relative prices? As there has been considerable interest about whether inflation has been driven by global factors, it is equally important to examine to what extent inflationary expectations are idiosyncratic or driven by factors common to all the economies considered. A variety of subsidiary questions also emerge from the issues this paper sets out to explore. For example, small changes in commodity prices may have no significant effects on inflation forecasts while larger changes substantially influence these same forecasts. As we shall see, there is some truth to this argument. In this connection, it is also of interest to determine the

extent to which large shocks have permanent or transitory effects on inflationary expectations. Moreover, it is also natural to consider whether answers to the foregoing questions are influenced by the adoption of inflation targeting.

Disagreements about inflationary expectations are almost always defined in terms of a distribution of forecasts prepared in individual countries and presumably focused on the determinants of the domestic inflationary experience.[2] In the present study I depart from this norm to consider disagreement relative to a different benchmark, namely the U.S. experience. This is done for at least three reasons. First, on both historical and economic grounds, the U.S. experience with inflation remains the 'gold standard' that many countries aspire to. Needless to say, there is considerable debate about the role played by the institutional environment the U.S. Federal Reserve (Fed) operates under. While Fed officials have long defended the dual responsibility implicit in the central bank's mandate, the recent fashion in central banking and policymaking circles has been to adopt a form of inflation targeting (e.g., see Siklos 2008, and references therein). The extent to which this distinction matters is an ongoing research topic. Finally, the decade of the 1990s and early 2000s marks the high watermark period of the era of globalization, in both finance and trade. Hence, it is reasonable to posit that inflationary expectations also contain a global element. Consequently, if U.S. inflation and inflation expectations represent a global benchmark and provide an indication of the future direction of monetary policy then it is sensible for forecasters, businesses, and households, to take this information into account perhaps in a more explicit fashion than has heretofore been the case.

[2] In related work I am investigating disagreement in inflation expectations across a wider set of countries than considered here relying on a more conventional benchmark. In addition, I consider whether there are cross-country divergences depending on whether or not the economy in question is an emerging market.

An additional contribution of the present study is to generate evidence about the behaviour of inflation expectations by exploiting data from each economy in the sample over as large a number of forecasts or forecasters as I was able to collect. Thus, for example, for the U.S., Japan, and the euro area, inflation expectations from almost a dozen sources are considered. Although the resulting dataset is not, strictly speaking, akin to a density forecast the information collected here does provide us hopefully with some new insights into the behaviour of inflation expectations over time.

The rest of the paper is organized as follows. In the following section I provide a brief overview of the literature linking relative price shocks and central bank strategies to inflation and expectations of inflation. Section 3 introduces the data and provides a bird's eye view of the stylized facts. Section 4 presents some econometric evidence which relies on a variety of techniques each of which is aimed at providing evidence about the various questions raised in this study. Section 5 concludes.

2. Relative Price shocks, inflation, and monetary policy

It is perhaps surprising that some prominent economists claim we do not sufficiently understand the dynamics of inflation. Nevertheless, we have learned a great deal about the determinants of inflation over the past decade or so, no doubt assisted by the spread of inflation targeting around the world.[3] What follows then is a concise summary of the existing consensus about some stylized facts.

[3] Cecchetti et. al. (2007) provide a comprehensive overview of what drives inflation in a cross-section of countries.

First, while inflation is persistent, it appears to have fallen substantially in many parts of the world (Benati 2008), possibly more so in inflation targeting economies than elsewhere (e.g., Siklos 1999a). Whether the combination of lower and more stable inflation has led to expectations of inflation becoming better anchored remains unsettled (e.g., Bernanke 2007, Mishkin 2007, and references therein). Two sets of issues arise here. Can we say whether certain monetary policy strategies (e.g., inflation targeting) are better able to hold down inflation expectations than others? If this is the case what are the sources of disagreements in expectations? It may be that an unstable economic environment leads to persistent deviations in inflation expectations from a path that the monetary authority plans to adhere to. Alternatively, it is possible that inflation expectations react excessively to relative price shocks, particularly ones that are large and believed to contain a significant permanent component. A relevant consideration here is that the literature has not come to a definitive understanding over how such disagreements are to be measured (e.g., see Lahiri and Sheng 2008, and references therein).[4] It should be emphasized at this stage that data limitations pose a serious constraint on the information that can be extracted from inflation forecast and survey data.[5] In particular, it is typically the case that point forecasts are used. However, other than for a very few economies (e.g., the U.S., the U.K.), researchers generally do not have access to the distribution of forecasts. This consideration can be crucial since, as shown by Mankiw, Reis, and

[4] In what follows, the paper uses the expression "forecast disagreement" to define what is essentially one of the moments in the distribution of inflation forecasts. However, it is unclear whether this term is the appropriate one since, for example, forecasters may all agree on the principal determinants of inflation but disagree on the relative weights attached to them.

[5] There is another important type of data limitation that is the subject of ongoing research with the dataset used in the present study, namely the difficulties posed in forecasting inflation because of disagreement over the measurement of the output gap and the resort to revised data, as opposed to the real time data that is more germane to the information set that would be used by forecasters in preparing forecasts over time. Clearly, these are important considerations but space limitations prevent further discussion here.

Wolfers (2003), the information content of mean or median forecasts can mask considerable underlying forecast disagreements.[6]

Second, the notion that expectations are rational, which leads to the testable implication they are both correct, on average, and are efficient and unbiased, does imply that there is little additional information that could have been brought to bear to improve on them. It can be fairly said, rather charitably, this view has received mixed support.[7] In any event, the view that forecasts are rational and/or unbiased contradicts the increased emphasis placed by central banks on improving and intensifying their communication function (e.g., Blinder et. al. 2008). Then there is the literature that points out fairly convincingly not only that learning takes place in any economic environment but that the policy regime itself can assist in the learning process (e.g., Sargent 1999, Orphanides and Williams 2007).

Third, contrary to what one might believe *a priori*, the low and stable inflationary environment of the past 15 years or so has not necessarily made inflation easier to forecast. Indeed, arguably the most widely used inflation model in the profession, namely a New Keynesian style Phillips curve, performs rather poorly (e.g., Stock and Watson 2007, Rudd and

[6] In recent years there has been a burgeoning interest in so-called density forecasts, namely an estimate of the probability distribution of possible future values, here of inflation. For a recent survey, see Tay and Wallis (2000). An example of a distribution of forecasts is the Survey of Professional Forecasters in the U.S.. Part of their appeal is that such forecasts capture an asymmetry that could be of considerable interest to policy makers. In particular, short-run expectations of inflation are higher than the mean inflation rate, forecasts are negatively skewed while the opposite holds when inflation is below its historical mean.

[7] Testing such hypotheses requires estimation of the following specification: $a_t = \alpha_0 + \alpha_1 f_{1,t-1} + e_{t|t-1}$, where *a* is the realized value of the variable of interest, here inflation, and *f* is, say, the one year ahead inflation forecast, conditional on information available at time *t-1*. Unbiasedness requires the non-rejection of the null $\alpha_0 = 0, \alpha_1 = 1$. Efficiency also requires that no additional useful information can be used to improve upon existing forecasts. This implies that, if $\mathbf{X_t}$ represents a vector of omitted variables, this could not statistically explain $a_{t+1} - f_{1|t}$, that is, the forecast error. Given the form in which most forecasts are presented (see below) there are potentially additional econometric problems stemming from serial correlation in the errors to name just one hurdle with this testing framework.

Whelan 2007) in spite of its strong micro-foundations (e.g., Kiley 2007). Finally, there continues to be a wide ranging debate about the linkages between inflation and inflation expectations, and the relative weight that ought to be placed on certain factors over others. For example, for a time, there was increasingly prominent discussion devoted to the influence of price developments in China as a source for global disinflation (e.g., Rogoff 2003, Ball 2006, Borio and Filardo 2007, Ihrig et.al. 2007, Côté and de Resende 2008). However, it proves to be extremely difficult to identify a separate role for China from the impact of the global consensus in favour of the desirability of lower inflation or, for that matter, the role played by institutional mechanisms that ensure that such conditions remain in place (e.g., Acemoglu et.al. 2008, Siklos, Bohl, and Mayes 2009). Beyond these considerations is the apparent tenuous connection between expectations and actual inflation rates (e.g., Blinder 1999) which must be contrasted with the view that the public does care very much about inflation (e.g., Shiller 1997). The relationship between these two crucial variables to policy makers is further complicated by the evidence that pass-through effects, either via the exchange rate, or through the influence of changes in commodity prices, have diminished considerably in recent years (e.g., Hooker 2002, Gagnon and Ihrig 2004). Interestingly, investigations of the behaviour or commodity prices, for example, and how their movements are linked to ones in aggregate price levels, generally fail to exploit the possibility that the appropriate relationship is asymmetric in nature.[8] Hence, a rise

[8] Of course, asymmetries, for example, in oil prices are well known (e.g., see Hamilton 2009, and references therein). What is less well understood is whether changes in commodity prices also feed into the aggregate price level in an asymmetric fashion.

in oil prices might feed into inflation rates more quickly, and remain more persistent, than a reduction in the price of oil.[9]

Brief mention also ought to be made about the horizon over which expectations are evaluated and how these are constructed. Only a handful of industrial countries have developed inflation indexed bond markets which provide researchers with a source of data on long-run inflationary expectations. Moreover, the extent to which these markets are liquid, and the length of time they have been in place, also pose additional constraints for a cross-country study of the kind undertaken here. It is also the case that there is a paucity of survey or other longer horizon forecasts, again for a large cross-section of countries.[10] This is unfortunate since this information directly pertains to the role of the monetary policy strategy that is in place.[11] Accordingly, the empirical evidence that follows focuses on short-term forecasts. If there is a significant probability that the current regime will change – a likelihood that may well have risen in light of the ongoing crisis though there are few outward signs that policymakers are contemplating changing their monetary policy strategy – then one factor that explains what drives inflation expectations will have been omitted. Otherwise, the empirical evidence below does provide some evidence about the role of central banks, their policies, as well as the influence of relative prices, on the evolution of inflationary expectations.

[9] This type of asymmetry may not, however, always have operated in this fashion. For example, in a well-known study (Warren and Pearson (1932)), the asymmetry went in the other direction in the period over which commodity prices were examined (1814-1931).
[10] Consensus Forecasts do exist for the 10 year horizon for a relatively small number of countries.
[11] There is some evidence that inflation contains a long memory component (e.g., see Hassler and Wolters (1995), Baillie, Chung, and Tieslau (1996), and Siklos (1999)).

Most studies rely on forecast or expectations data from one or a very small number of sources. For example, an analysis of the properties of inflation forecast errors is usually conducted on a single forecast from a public institution (e.g., International Monetary Fund, OECD), a private firm (e.g., Consensus Economics), or a formal survey of forecasters (e.g., Survey of Professional Forecasters). It is interesting to consider, however, whether the source of the forecast provides any additional clues about what drives these forecasts and this study is an attempt to do so.[12] Finally, there has been considerable debate about the desirability of the central bank providing its own forecasts. There is no consensus about this question and it is inappropriate here to delve into the relevant issues (see, however, Mishkin 2007a, Chapter 5). Nevertheless, it is worth considering such forecasts as well as they, together with forecasts from other sources, provide indirect clues about whether, ex post, prior beliefs about differences in information sets that go into producing such forecasts may also help explain how well expectations are thought to be anchored and how sensitive they may be to the different pressures on inflation over time, including those stemming from relative price changes, the monetary regime in place, as well as some of the other factors noted above.

3. **A Bird's Eye View of the Data**

A separate data appendix provides the details of the data sources and definitions used in this study. All tests and estimates are based on data converted to the quarterly frequency. Forecasts are monthly, quarterly, or semi-annual. Generally, the sample covers the period 1990Q1 to 2008Q4. Inflation is defined in terms of the headline rate for all the economies

[12] Alternatively, one might examine forecast dispersion among the forecasters surveyed by a particular firm, such as Consensus Economics. A recent example is Dovern, Fritsche, and Slacalek (2009).

considered and all data are in annualized rate form. The empirical evidence shown below examines the experience of 5 inflation and 4 non inflation targeting economies. The inflation targeting economies are: Australia, Canada, New Zealand, Sweden, and the United Kingdom. The non inflation targeting economies in the data set consist of the euro area, Japan, Switzerland, and the United States. The expectations data are time series of current year and one year ahead forecasts. Three types of forecast data are used, namely professional forecasts (e.g., Survey of Professional Forecasters, The Economist), forecasts derived from survey data (e.g., European Commission surveys), as well as any available central bank forecasts (e.g., RBNZ or the Bank of England).

There are several difficult issues that arise when resorting to these data. First, most of the forecasts are for the calendar year. For example, each month (usually around the third week of the month) The Economist's Poll of Forecasters publishes private sector forecasts of inflation (and real GDP growth) for the current and following calendar years (one year ahead forecasts). Other forecasts are presented in a similar manner (e.g., Consensus Forecasts). Some forecasts (e.g., OECD) are published semi-annually while others (e.g., Reserve Bank of New Zealand) release forecasts on a quarterly basis.[13] As a result, there is both an issue of timing and the horizon over which the forecast pertains to. Studies that rely on these data are aware of the problem but adjustments to correct for the problems just mentioned are often *ad hoc* or are said to have little influence on the outcome of empirical tests. Given the persistence properties of inflation it is conceivable that calendar year forecasts pose little difficulty. In what follows no

[13] The RBNZ, for one, does publish one quarter ahead forecasts so there are forecasts that are not presented on a calendar year basis.

special adjustments are made to the data. While some experiments were conducted to determine how large the resulting biases might be it appears, in line with other studies, I find that they do not appear to be large.[14]

In the case of survey data the researcher faces the additional difficulty that the data are not always presented in the form of an inflation rate. Instead, many surveys (e.g., European Commission, ZEW) report an index. Generally, the literature has adopted two approaches to convert the data into usable form. Smith and McAleer (1995) provide a nice survey of the methodologies originally due to Carlson and Parkin (1975), and Pesaran (1984, 1987). The former is generally referred to as the probability approach whereas the latter is a regression based technique used to convert an index into an estimate of inflation expectations. Both techniques were implemented in this study and readers are referred to the relevant papers for additional details.

A final comment concerning forecasts is also in order. While the measurement of forecast disagreement used in this study treats all forecasts on an equal footing the researcher does not, of course, observe the loss function implicit in the construction of these forecasts. The implications are not formally explored in this study but should be borne in mind in future extensions of the present research.

Consider first overall inflation performance, as shown in Figure 1. The top and bottom figures show CPI inflation in the inflation and non inflation targeting economies, respectively.

[14] Put differently, the issue concerns the implications of relying on fixed event versus fixed horizon forecasts. In the present application, as will be explained below, the averaging that is implemented to investigate cross-country differences in inflation forecasts may also contribute to mitigating any biases from the timing and horizon problem.

There is little evidence of notable differences between IT and non IT economies' inflation rates in the period since this strategy was adopted. Prior to 1994, however, one does clearly see the rapid disinflation that took place in the IT camp of countries.[15] As will be seen below, appearances can be deceiving as some persistent differences in overall inflation performance as between the IT and non IT economies can be observed. The figure also highlights why there is continuing debate not only about the relative superiority of an inflation targeting strategy but also whether forces more global in nature, including a role for commodity prices, are driving inflation rate around the world.

Figures 2A and 2B plot a variety of commodity and asset prices.[16] These do not exhaust the set of relevant commodity prices that may have impacted inflation expectations over time in each of the economies considered. Nevertheless, the various series shown are fairly representative of the data that various authors in the relevant literature have used, for example, to investigate the macroeconomic role of commodity and asset prices.[17] The series displayed in the figure consist of individual commodity price indexes (e.g., type of oil or energy prices) as well as aggregate commodity price indices that some of the central banks in our sample (viz., Australia, Canada) publish and monitor on a regular basis. The variability of commodity prices (Figure 2A) is quite apparent in the figure. Nevertheless, it is usually the case that broader indices of commodity prices are relatively less volatile that many of the individual

[15] The dating of the IT period as beginning in 1994 is adopted purely for visual purposes. In some of the tests that follow actual adoption dates are used (e.g., see Bernanke et. al. (1999), Siklos (2002) or Rose (2007), for the exact dates).

[16] Commodity prices are expressed in U.S. dollars before transforming them into growth rates. All asset prices are in index form, again prior to computing rates of change.

[17] Whether these are the "right" prices to consider is another matter entirely. For example, Reis and Watson (2009) find that conventional relative price indicators are less informative than, for example, a linear combination of them (obtained via principal components analysis).

commodity prices sampled (e.g, food or oil prices). In addition, most of the series appear to be mean reverting and there is also a visual hint at least of some asymmetry in commodity price movements. Formal testing of the statistical properties of these series follows below.

Figure 2B plots the rate of change in the BIS's aggregate price index (Borio and Lowe 2004) for the inflation and non inflation targeting group of countries in our example. One can interpret fluctuations in these indices as a relative price of sorts of current versus future consumption. Alternatively, movements in these indices may provide clues about imbalances in the economy to which monetary policy and, presumably, expectations, might react to. The plots suggest considerable variability in assets prices in all the economies considered though, on balance, volatility appears relatively larger in the inflation targeting group of countries. Also notable is the asymmetry in growth rates of asset price movements with positive growth rates typically the norm, with the exception of the Japanese experience.[18]

Figure 3 plots an estimate of the real interest rate based on the difference between the nominal long-term government bond yield and a three year moving average of inflation. Needless to say, there is considerable debate about the proper measurement of real interest rates let alone how to proxy longer term expectations of inflation. Nevertheless, while precise estimates of the real interest rate may vary, it is likely that the series shown in Figure 3 offer a fair portrayal of how the stance of monetary policy has evolved across the economies

[18] The apparent differences in variability between IT and non IT economies and the asymmetrical behaviour of commodity and asset price movements also seems to be reflected in real exchange rate and output gap data (not shown).

considered since 1990.[19] During the first half of the decade of the 1990s, real interest rates were relatively higher in the inflation targeting group of countries. As several authors have suggested, this stylized fact captures both the adjustment towards a lower inflation state the newly inflation targeting countries were aiming for at the time, as well as an expression of these central banks attempt, given their historical experience with inflation, to establish their *bona fides* in delivering inflation control. However, by the late 1990s it becomes difficult to distinguish the stance of monetary policy in inflation versus non inflation targeting economies. This feature of the data also captures the stalemate in the debate between supporters of inflation targeting and others who have found it difficult or are sceptical of the superiority of this type of policy regime.

I now turn to some stylized facts about inflation expectations. Figure 4 plots CPI inflation in the IT countries on the horizontal axis against various available measures of one year ahead inflation expectations (see the appendix for the details).[20] The same plots are generated for the non-IT economies in Figure 5. To assist in interpreting the results 95% confidence ellipses are also displayed. As noted previously, it is useful to distinguish between a general disinflationary phase versus a period when inflation remained relatively low and stable. Clearly, it is not straightforward to identify any such 'break' over the period examined. Moreover, it is likely to be difficult to pinpoint a common break across the 9 economies considered in this study.

[19] An obvious alternative, other than using surveys of long-term expectations or index-linked bonds, not a feasible option for the collection of economies examined here, is to estimate a policy rule (e.g., a Taylor rule). It is unlikely, however, that the conclusions drawn from such an exercise would yield substantively different results. It is now becoming widely accepted that monetary policy in recent years has become looser over time (e.g., see Taylor 2008, Siklos 2009, and reference therein).

[20] The plots for current year inflation expectations (not shown) reveal broadly similar patterns. There are too few series for forecasts two years ahead, or more, to conduct the same experiment as shown in Figures 4 and 5.

Hence, I choose to compare the full sample (1990-2008) to a sub-sample consisting of observations for the 1999-2008 period.[21] Most observers would agree that, by that time, all IT regimes were in place long enough by then to avoid problems arising from initial conditions biasing the results in favour of IT. Accordingly, the left hand side plot for each economy displays the evidence for the full sample while sub-sample results are summarized in the right hand side plots. There are three notable features about the simple relationship between inflation and inflation expectations graphically displayed here. First, with the possible exception of New Zealand, the country that first adopted inflation targeting in 1990, rising current inflation generally leads to a rise in one year ahead inflation rates. The same relationship is somewhat less apparent among the non IT countries, except for Switzerland and Japan. Second, the relationship between inflation and one year ahead expectations is considerably more compressed after 1999 in the IT group of countries. This phenomenon is less apparent among the non IT economies, except for Switzerland. Switzerland is not an inflation targeting country but it does target a forecast for inflation. The apparent clustering of inflation and forecasts of inflation is suggestive of the anchoring of inflation expectations and the change is most visible among the IT group of countries. Whether IT alone, or in combination with other factors, can explain the difference is, of course, an empirical question. Finally, regardless of the characterization of the monetary policy strategy, there are fewer 'outliers' after 1999 in the various scatter plots shown. This suggests that the era since 1999 is, broadly speaking, defined by fewer inflation surprises.

[21] Later in the empirical section I also consider the 2001-08 sub-sample as this may also represent a useful dividing line between the period of disinflation and stable inflation.

Finally, Figures 6A and 6B provide visual evidence of the range of inflation expectations across economies and sources of data. As noted previously, it is customary to examine inflation forecasts or surveys relative to some domestic benchmark. However, since this study partly aims to assess the role of global forces on inflation, as proxied by the U.S. experience, the figures show differences in expectations relative to a U.S. benchmark.[22] Examination of the record of inflation targeting economies suggests, that in at least 3 of the 5 IT economies (Australia, Canada, and Sweden), the differences vis-à-vis one year ahead U.S. inflation forecasts have somewhat diminished over time while a similar pattern is less apparent for the U.K. and New Zealand. Equally interesting is that inflation expectations are persistently below those of the U.S., especially beginning in the mid-1990s, except possibly for the U.K. In a sense then the scenario wherein there is a global element to the determination of inflation expectations, what one might loosely speaking call a trend component, while a domestic component suggestive of the decoupling of these expectations relative to the U.S., perhaps due to the adoption of inflation targeting, both play roles. As seen in Figure 6B, no such interpretation is evident for the non-IT economies in the sample. The idiosyncratic experience of Japan is evident while there is seemingly little change in the behaviour of expectations in Switzerland relative to the U.S. Only the euro area begins to resemble the U.S. experience and this may point toward the fledgling central bank's success in anchoring expectations to levels comparable to ones exhibited in the U.S.

[22] Namely, the U.S. one year ahead inflation forecast from the Survey of Professional Forecasters, often thought to be the most accurate of the forecasts over time. Clearly, other U.S. benchmarks could have been used and it is possible that the results may be sensitive to this choice.

Finally, Figure 7 plots our measure of forecast disagreement for each of the 9 economies examined in this study. The shaded areas highlight, where relevant, the period before inflation targets were introduced.[23] As noted previously, there is no universally agreed upon measure of forecast disagreement. However, some researchers typically resort to the following definition

$$d_{th} = \frac{1}{N-1}\sum_{i=1}^{N}(F_{ith} - \bar{F}_{\bullet th})^2 \qquad (1)$$

where *d* is the measure of disagreement, F_{ith} is the *i*-th forecast for horizon *h* at time *t*, while $\bar{F}_{\bullet th}$ is the mean across various *N* available forecasts.[24] To highlight the evolution of disagreement over time equation (1) is evaluated in a 5 year rolling sample.[25] In what follows *h* is always set at 1 to indicate that the focus on one year ahead forecasts. The results indicate that in all IT economies, disagreement tended to rise in the early phases of the monetary policy strategy. Nevertheless, the rise is typically very brief in duration with the possible exception of New Zealand where disagreement increases over a 5 year period. In contrast, disagreement rises over a 4 year period in Australia, 2 years in Great Britain, and 1 year in Canada and Sweden. Arguably, the 'shock' inherent in the change in monetary policy strategy was greatest for New Zealand. It is notable as well that disagreement tends to fall sharply in some cases following the adoption and adjustment to an IT policy.

[23] Since IT was introduced in New Zealand at the very start of the available sample there is no shaded area shown.
[24] Alternatively, forecast disagreement can be expressed in terms of forecast errors, as in $\frac{1}{N-1}\sum_{i=1}^{N}(\varepsilon_{ith} - \frac{1}{N}\sum_{i-1}^{N}\varepsilon_{ith})^2$, where ε is the forecast error. Other definitions of forecast disagreement also exist. See, for example, Dorven, Frische, and Slacalek (2009).
[25] This explains why levels cease changing in the last few years of the sample. It was thought to be preferable to show the results in this manner rather than, say, reduce the span of the sample over which *d* was estimated.

Comparisons with the record of forecast disagreement in non-IT economies are particularly instructive. Disagreement in the euro area rises over a 5 year period then permanently falls but what is most notable is that disagreement falls around the start of European Monetary Union (EMU). Contrast this with the Japanese experience which shows a decade long rise in disagreement essentially covering the so-called 'lost decade' before falling since the turn of the century. Similarly, the experience of Switzerland reveals a sharp rise in forecast disagreement during the first half of the 1990s and, in spite of a small dip in the second half of that decade, disagreement remains permanently higher than at the beginning of the sample. There is a less dramatic but equally pronounced rise in forecast disagreement in the U.S. with estimates of *d* for the most part increasing steadily until 2002. Clearly, there is considerable diversity in the forecasting experience across the sampled economies but one should not exaggerate the differences. After all, every single economy in the sample experiences a rise in forecast disagreement sometime during the 1990s precisely when central banks in the industrial world, whether they formally targeted inflation or not, emphasized the desirability of low and stable inflation. No doubt changes in credibility must have played a role, the design of inflation control policies, as well as the international environment. I now turn to some preliminary evidence estimating the significance of some of these factors.

4. Empirical Evidence

Table 1 provides some summary statistics about the stationarity property of the key series under investigation. To economize on space the top portion of the Tables presents panel unit

root tests. The two most widely used tests, namely those of Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS) are reported.[26]

Both panel tests are essentially versions of the well-known Augmented Dickey-Fuller (ADF) test that would be applied to time series data for individual countries. The test equation in a panel setting (omitting constants and deterministic components) is written

$$\Delta y_{jt} = \alpha_j y_{jt-1} + \sum_{j=1}^{k}\sum_{i=1}^{p} \beta_{ij} \Delta y_{jt-1} + \varepsilon_{it} \qquad (2)$$

where *j* identifies the particular economy in the sample and all other terms were previously defined. The unit root test statistic then consists of the sample mean of the ADF *t*-statistics.

Im, Pesaran and Shin (2003; IPS) provide the critical values. The ADF tests tend to have a downward bias, which is corrected for when a panel test is used. Generally, if all independent parameter estimates are unbiased, then the mean of these estimates is also unbiased (Enders (2004), p. 225). Notice that the test based on (2) estimates a unit root test statistic for each cross-section, as well as a country specific lag augmentation term. In contrast, if the hypothesis that $\alpha_j \neq \alpha_{j'}$, where $j \neq j'$, cannot be rejected then an alternative formulation of the test specification (2), where α and β are fixed across all countries results in the so-called Levin, Lin, and Chu (2002; LLC) panel unto root test.[27] Since the panels considered refer to the differential between domestic forecasts and a U.S. forecast, the test also amounts to asking

[26] There are other panel unit root tests that have been shown to be more powerful in a statistical sense. Siklos (2008), also see references therein, considers some of these. Given the results reported below it is unlikely that the conclusions will be much changed. Moreover, the extant literature is more familiar with the tests reported here.

[27] LLC advocate removing the overall mean of the series (i.e., $\bar{y}$) prior to running the test. It is not immediately obvious that this is necessary when the series under investigation is a differential between two existing series.

whether the cointegration property holds between the various individual forecasts and the representative U.S. forecast. Panels are also sub-divided according to whether the forecast is survey based or not.

In the case of the threshold cointegration test attention focuses on the stationarity property of the individual series of mean domestic forecasts versus the benchmark U.S. forecast. While the benefits of panel estimation are lost one gains the opportunity to determine whether cointegration is a feature of the data once we permit the error correction term to adjust in an asymmetric fashion.[28] Again this is done to conserve space as well as because the potential number of pairings would become extremely large. The remainder of the table presents various unit root and panel unit root tests for commodity and asset prices. Asymmetric unit root tests are omitted as the discussion in the previous section made clear the presence of asymmetric behaviour in these time series.

The null of no cointegration is rejected in most cases. In the case of IT regimes the only exception is for New Zealand forecasts that are not survey-based. The results are mixed for non-survey based forecasts for Sweden with the LLC test leading to a non rejection, unless of course one wishes to adopt a 5% critical value in which case Sweden's non survey-based forecasts are cointegrated with U.S. forecasts. Turning to the non-IT group countries there are many more rejections of the no cointegration null. This is the case, regardless of the testing

[28] Enders and Siklos (2001) propose a strategy to test for threshold cointegration. The test relies on the ADF form for the test equation where the error correction term is replaced either with two error corrections terms that switch depending on whether the series in question is above or below some estimated threshold resulting in the threshold autoregressive (TAR) formulation. For reasons having to do with the statistical power of such tests, the so-called momentum TAR (M-TAR) is preferred. In this version it is the change in the error correction term vis-a-vis some threshold that switches from a positive to a negative state that adds asymmetry to the conventional ADF-type specification.

procedure employed, for non survey-based forecasts for the euro area and Japan. The results are more mixed for non survey–based forecasts for Switzerland and the U.S. Therefore, there is a little bit of evidence that forecast dispersion behaviour is not the same in IT versus non-IT regimes. It is also interesting to note that the null of no cointegration is never rejected for survey-based forecasts. When the panel stacks together both survey and non-survey based one year ahead forecasts the null of no cointegration is almost always rejected. The only exception is New Zealand although, once again, the results are sensitive to the assumption of a common unit root in the test specification but only for the non-IT economies.

If we permit asymmetric adjustment of the momentum-threshold variety the bivariate cointegration tests suggest that the cointegration property tends to hold. This result holds in 5 of the 9 countries considered but there is no easy distinction in this type of cointegration seen between IT and non-IT economies. Further, in absolute value, the attractor toward cointegration is always stronger from below the threshold than from above. This implies that a negative change in the error correction term, explained either by a rise in U.S. inflationary expectations or a fall in the forecast for domestic inflation, exerts a relatively stronger pull than changes in the other direction. Of course, not all cases are statistically significant and, indeed, there are 4 cases (Canada, Sweden, Japan, Switzerland) where the attractor in the other direction exerts a stronger pull back to equilibrium. It is important to underscore that these results are based on mean forecasts. Consequently, some information is lost and, as shall be seen below, one's interpretation of what moves inflationary expectations may be affected by this choice.

Turning to commodity and asset prices it is not surprising that, individually, these series exhibit the unit root property. This much should have been apparent from our earlier discussion. Stacking all commodity prices in a panel does not change the conclusions. The same conclusion is reached for the BIS's aggregate asset price indices, although the results are somewhat sensitive in the case of non-IT economies, assuming a 10% critical value is adopted.

Since a fairly large number of individual forecasts were retained for each economy[29] a natural question to ask is how important is the relative information content of the individual forecasts. While there are many ways of addressing the issue Table 2 provides summary information of a principal components analysis of the various available forecasts on an economy by economy basis.[30] The first column of Table 2 shows the most important forecasts based on the estimated eigenvalues, measured on the basis of explanatory power (as a % of 100). The second column lists the forecasts that would have the greatest weight if a linear combination of forecasts were used instead of, say, a simple mean of available forecasts. There are at least two notable features in the results. First, in practically all cases, either Consensus, The Economist forecasts, or both, are among the principal components of the forecasts. Second, most forecasts contribute a relatively small fraction of the total variation. Consequently, there is no such thing as a dominant forecast. Indeed, it is often the case that at least 4 to 5 forecasts are needed to explain close to 2/3 of the variation in one year ahead inflation forecasts.

[29] For Australia, a total of 7 forecasts were retained. For the other countries the numbers are provided in parenthesis: Canada (7), New Zealand (8), Sweden (11), U.K. (10), euro area (11), Japan (8), Switzerland (5), U.S. (11).

[30] Space constraints prevent a full discussion. However, the object of the exercise is to find the highest eigenvalues from the eigenvectors estimated from the covariance matrix that describes the relationship between the series of interest. Additional details can be found in, among other sources, Maddala (1977, pp. 193-4), and Joliffe (1986).

Finally, we turn to some regression estimates of the determinants of the forecast differential. Once again, to conserve space, only a selection of results is displayed in Table 3.

The estimated specification is a straightforward one and, as such, does impose restrictions that future research will need to consider. I am interested in the determinants of the differences between forecasts of one year ahead inflation in economy *i*, at time *t,* generated by forecaster *j*. The resulting relationship can be expressed as

$$fd_{jit} = \mathrm{A}_i + \mathrm{B}_t + \kappa \mathbf{X}_{jit} + \delta \mathbf{I}_{it} + \xi_{jit} \qquad (3)$$

where *fd* represents the difference between forecaster *j*'s one year ahead forecast and the representative U.S. forecast (SPF), for economy *i*, at time *t*. A and B are fixed effects, **X** is a vector of control variables and, since are interested in, among other questions, the impact of inflation targeting, **I** represents the impact of such a policy 'intervention'. One immediate difficulty, noted earlier, is that we are unlikely to have ample information on controls at level *i*. Moreover, as discussed in Bertrand, Duflo, and Mullainathan (2004), standard errors from OLS estimation of (3) can be distorted. Among the possible solutions is to estimate (3) at the economy-wide level where, in addition, many more covariates are available. This is the strategy adopted below. In addition, as pointed out previously, there is potentially a loss of information when focusing only on the mean value of *fd*. Hence, three set of results are shown in Table 3. Estimates of equation (3) for the mean, the highest (MAX) and lowest (MIN) forecast differential are presented. One may view the MAX estimates as proxying the reactions of the least optimistic about future domestic inflation while the MIN estimates capture the most

optimistic forecasts.[31] In addition, two sets of sub-sample estimates are provided as it is likely, based on the stylized facts, that the behaviour of inflation and inflation expectations may well have undergone a change around 1999 to 2001.[32] Sub-sample estimation also permits the addition of another type of intervention that is labelled 'news'. Dummy variables were constructed (see the appendix for details) that are set to 1, and are otherwise set to 0, when the headline , primarily in the financial press, highlights a rising fear of *future* inflation, *future* rises in the policy interest rate, a *future* recession, and a depreciation of the U.S. dollar.

If **I** represents the dummy variable for inflation targeting, the vector **X** consists of the following variables. Oil and commodity prices are proxied by the world price of Brent crude and a world index of non-fuel prices. Both series are in H-P filtered form.[33] Asset prices, namely housing and equity prices that exceed or fall below some H-P filtered trend are also permitted to influence the chosen dependent variable. Next, for reasons discussed above, I allow for asymmetric type of adjustment by creating a variable that is set to 1 when the *change* in the mean differential is greater than zero and is zero otherwise. This gives the opportunity to ascertain whether large positive or negative movements in domestic inflation forecasts relative to those in the U.S. have a separate impact on *fd*. Then the specification permits uncertainty, proxied here by the kurtosis (KURT) in the distribution of forecast differential, as well as

[31] An alternative approach, currently the subject of ongoing work, consists in estimating a version of equation (3) via quantile regressions in order to better exploit the information contained in the distribution of forecasts.

[32] A Hausman test (results not shown) does suggest that the full sample model may be mis-specified. What is unclear is the form of the mis-specification. It could be that the null that κ is constant across cross-sections is incorrect or it could also be the case that it is inappropriate to pool all the economies in our sample together. For example, one might consider a separate pool involving IT countries versus non-IT economies. This extension is left for future research.

[33] Using rates of change in these series does not appear to make much difference. However, in line with the earlier discussion, it seems preferable to think in terms of a measure of disequilibrium in relative prices. Needless to say, there are well-known drawbacks in using the H-P filter but it is so widely applied that whatever is lost in terms of precision comparability with the relevant literature is maintained. The default smoothing parameter of 1600 is used in all H-P filtered estimates.

disagreement in the forecasts (DIS), to influence *fd*.[34] These variables have the effect not only of capturing the role of second and third moments but, in so doing, permit some distributional information, omitted in the process of aggregation, to capture the outcome. Finally, other than a lagged dependent variable, included to measure persistence in *fd*, a variable that measures how long a country has been in an IT environment is also included (ITDUR).

It is clear from the estimated coefficients that our suspicion that something changed around 1999 to 2001 is borne out.[35] For example, the asymmetry found for the 1990-2008 sample, where a rise in the inflation forecast differential is reversed but not the other way around, disappears in the most recent period. Second, uncertainty about future inflationary expectations are statistically significant in the sub-samples but not in the full sample. Finally, and perhaps most interestingly, relative prices, as proxied by oil, housing and equity prices, are not statistically significant in the full sample but have a clear impact in the sub-sample estimates shown.

If the results for the highest (MAX) and lowest (MIN) differential are examined there are some rather interesting and important differences vis-a-vis the panel estimate based on the mean. First, notice that the IT dummy is statistically significant in both cases. In addition, at both ends of the distribution, as it were, we find that the introduction of inflation targeting reduces the differences in one year ahead inflation forecasts by 0.17 percent. This is only trivially offset by the length of time the country in question has targeted inflation (ITDUR). Next, it is clearly the case that the high level of persistence found for the mean based estimates is

[34] The variance of *fd* was also considered but was generally found to be statistically insignificant. Hence, it was omitted from the final specification.
[35] All specifications include fixed effects A_t and this version of (3) could not be rejected.

more a feature of the 'pessimists' among the group of forecasters than for the 'optimists', with the latter specification yielding significantly lower persistence in the forecast differential (0.59 versus 0.75). In contrast, optimistic forecasters are relatively more worried about future uncertainty which tends to narrow inflation forecast differentials. Similarly, disagreement among forecasters has twice as large an effect on the forecast differential when the forecast is a relatively optimistic one.

Before concluding it is worth delving into the changing persistence properties of the forecast differential and the role of IT in the individual countries in the sample. A version of (3) then is estimate for each country separately (not shown) and Table 4 summarizes what happens to the estimated of persistence as well as the IT dummy. It is rather striking that the full sample sees all coefficients highly significant while every single coefficient in both sub-samples shown are statistically insignificant at the 5% level. This result is to be expected since, as noted previously, much of the disinflation was achieved by the mid-1990s.[36] Just as with headline inflation there is effectively much less persistence in inflation forecasts. While it is plausible to suppose that forecasters are less backward-looking the robustness of this result has yet to be properly tested. To be sure there are differences in the estimates and clearly one can imagine other version of (3) which imposes fewer common coefficients as being equally plausible. However, some of the results in Table 4 do not seem to be greatly at variance with the summary estimates provided in Table 3. Of the 5 IT countries separate estimate of δ can be provided for only 4 cases. The results suggest that the reduction in the forecast differential due

[36] The somewhat arbitrary choice of sub-samples does not address the question whether the reduction in inflation persistence was achieved faster in IT or non-IT economies nor is the precise year when persistence became statistically significant identified for each country.

to inflation targeting is primarily a feature of the Canadian and Swedish experiences but not of Australia and the U.K.

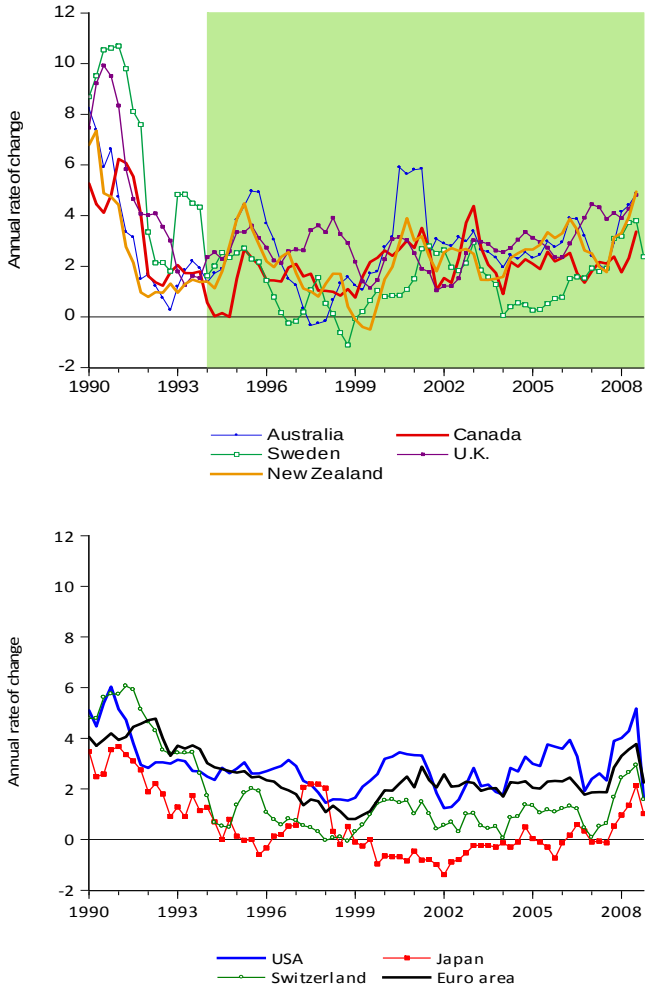
5. Conclusions

This paper began by noting that there is still much to be learned from analyzing the behaviour of inflation expectations. In contrast with most studies of this kind the strategy followed here is to extract information contained in the reasonably large variety of inflation forecasts. I then considered how forecasts in 5 inflation and 4 non inflation targeting economies have evolved since the early 1990s. What can we make of the results? First, there is little doubt that IT has contributed to narrowing the forecast differences vis-a-vis U.S. inflation forecasts. Second, there is some evidence that, at least since 1990, inflation forecasts in the economies considered that deviate too far from U.S. forecasts show signs of converging towards U.S. expectations. Third, examining the mean of the distribution of forecasts potentially omits important insights about what drives inflation expectations. Finally, commodity and asset prices clearly move inflation forecasts although this is a phenomenon of the second half of the sample. Prior to around 1999 relative price effects on expectations are insignificant.

There is clearly scope for more research. It is unclear whether the specification used is the best one for extracting all of the useful information contained in the dataset. In addition, one may wish to examine the behaviour of forecasts using a different metric than the one employed here. Finally, one may consider some interaction effects and add some other omitted variables in specification (3). For example, inflation targeting may operate jointly on reducing inflation forecast uncertainty or disagreement among inflation forecasts. In addition, central banking in the 1990s has been marked by changes in transparency. Explicit accounting for this

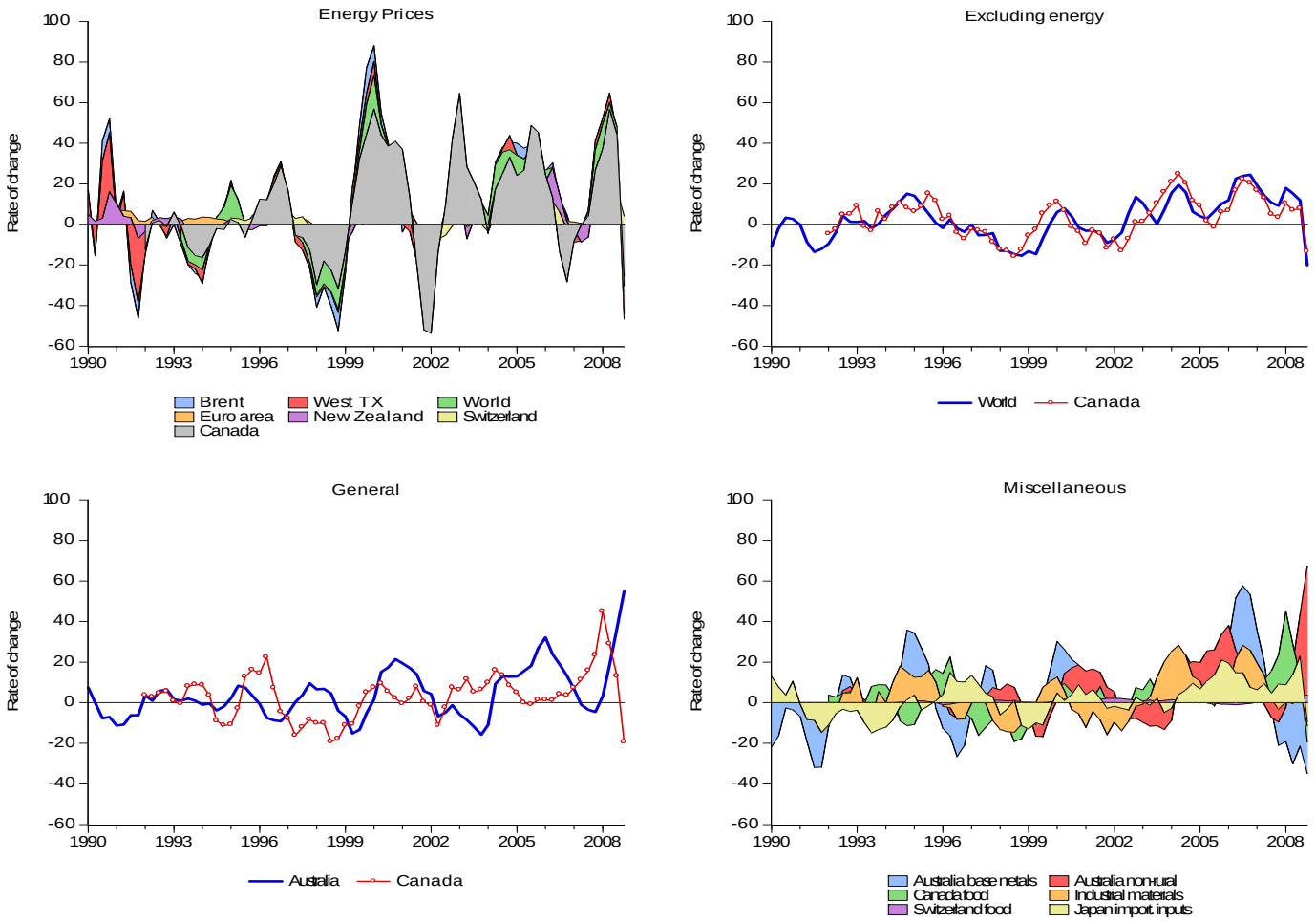
characteristic would be useful. These are only a few of the many avenues open for future research.

Figure 1 Varieties of Inflation Rates



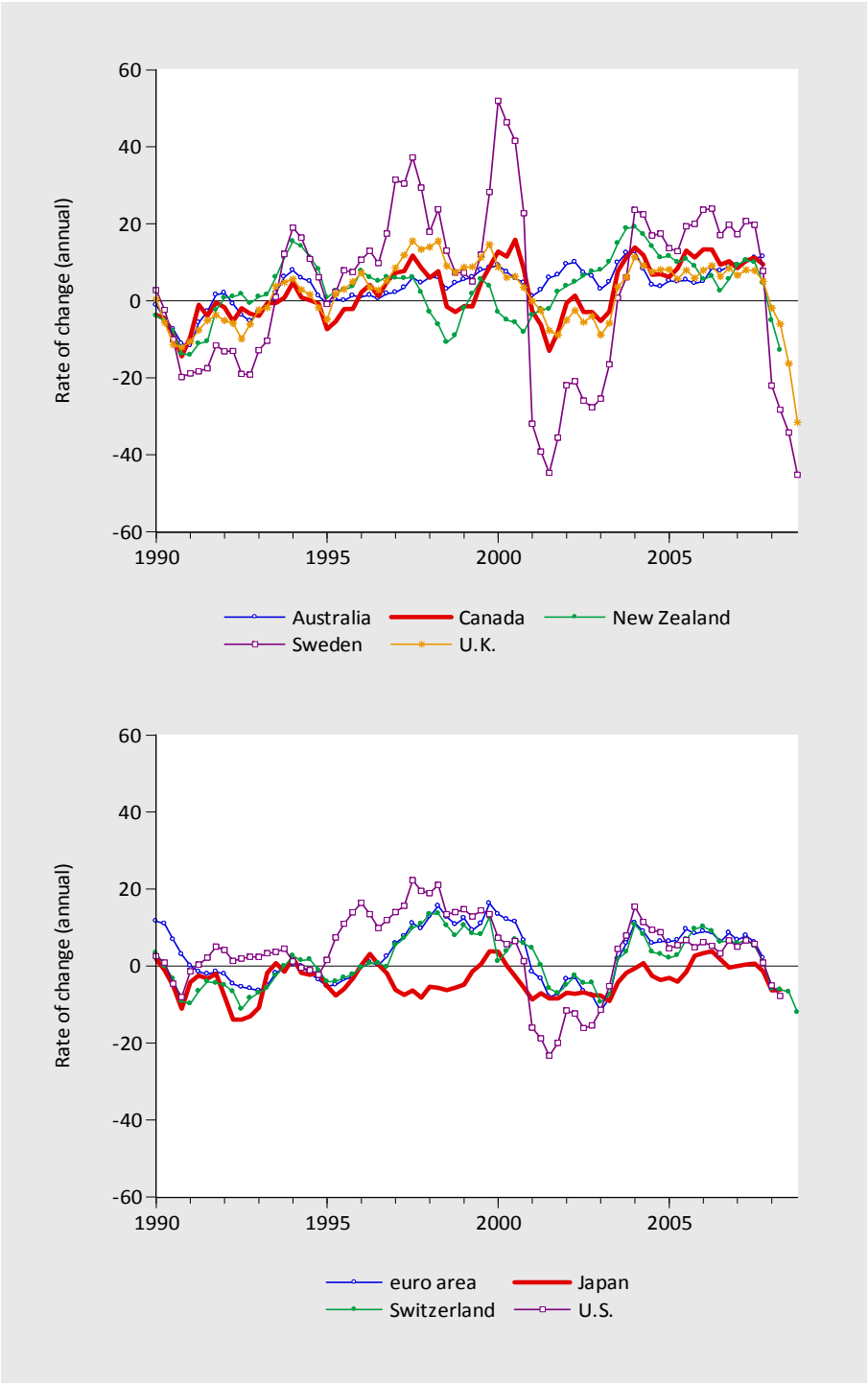
Note: Infation Is defined in terms of the headline CPI. Inflation is the rate of change in CPI calculated as in the series shown in Figure 2A.

Figure 2A Varieties of Commodity Prices



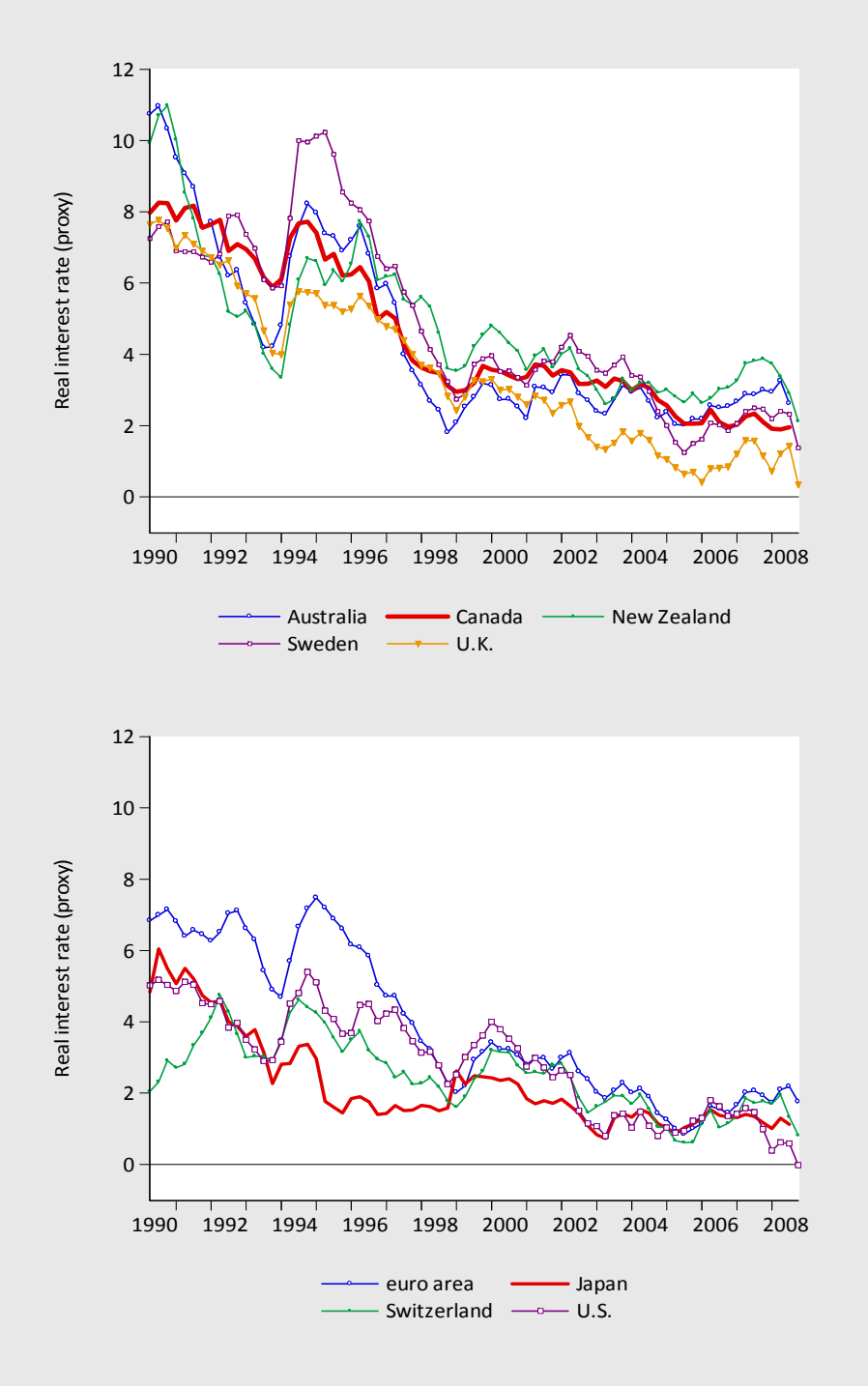
Note: All series are in annual rates of change form (100 time log fourth order difference of the series).

Figure 2B Asset Prices in Inflation and Non-Inflation Targeting Economies



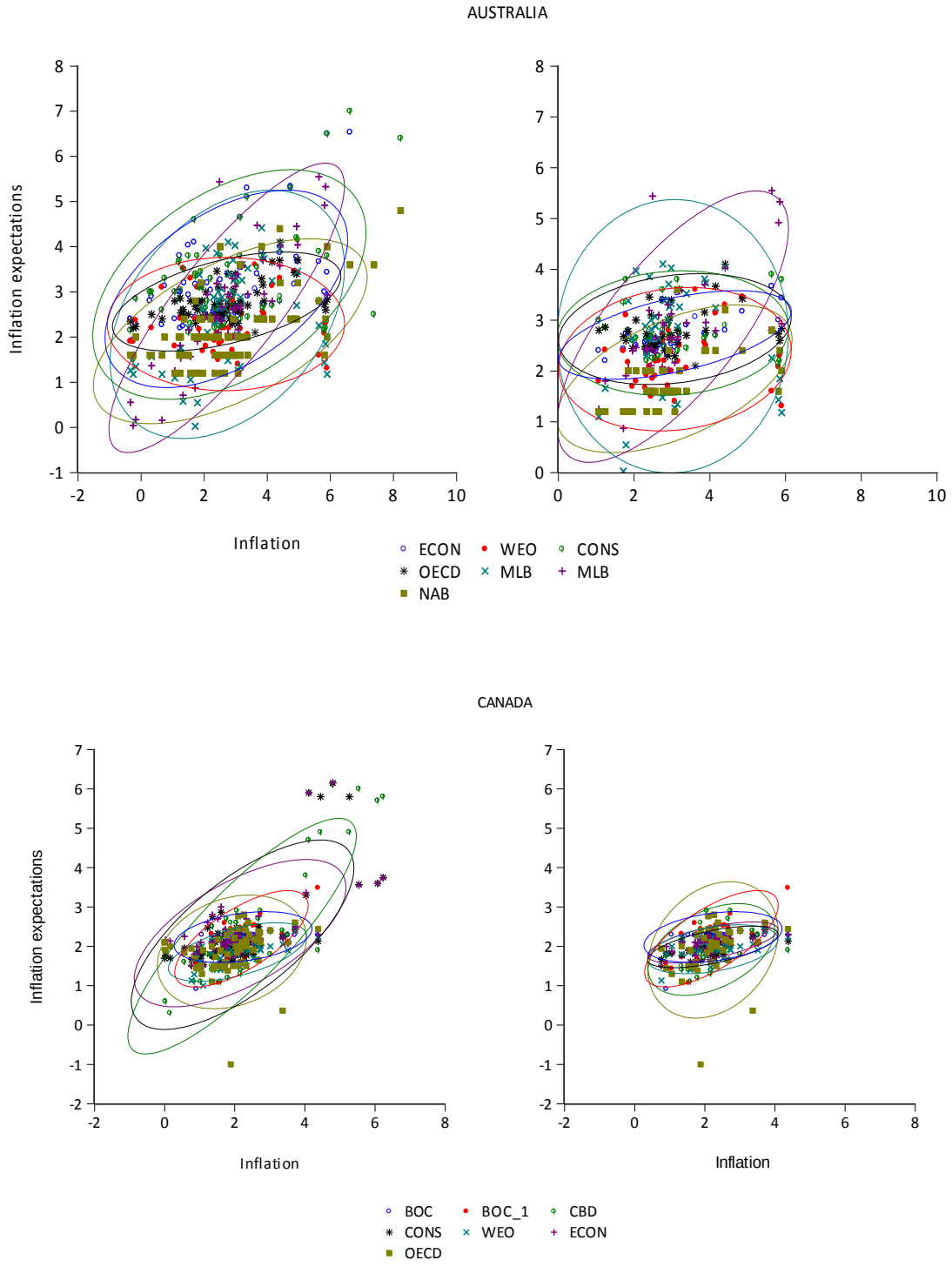
Note: See Figure 2A for series construction. The data are the BIS's aggregate asset price index. See Borio and Lowe (2004).

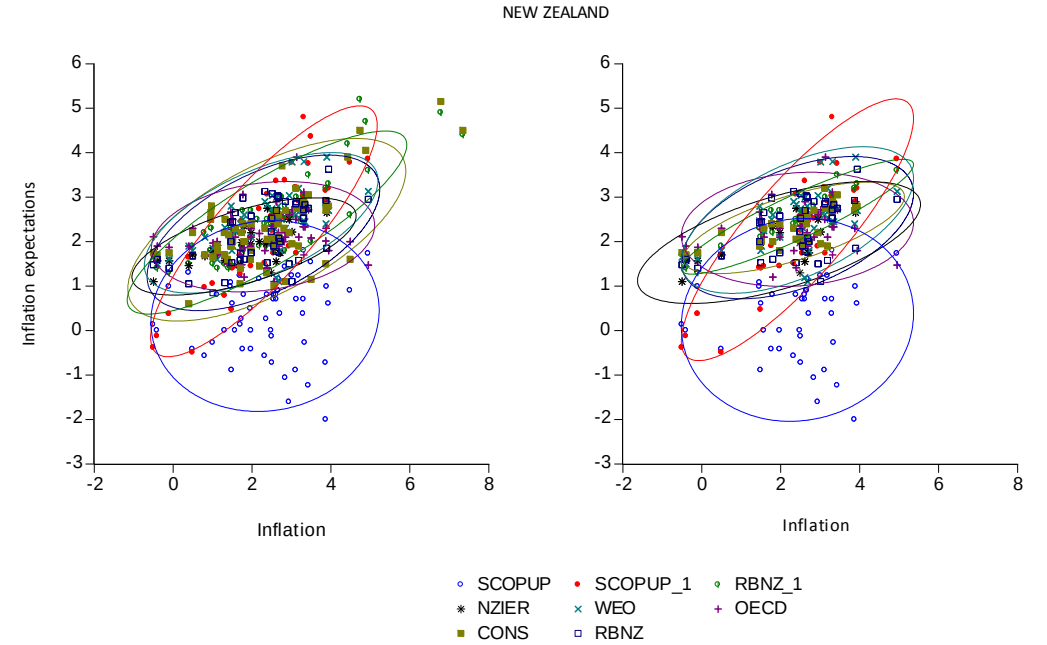
Figure 3 Real (ex post) Interest Rates in Inflation and Non-Inflation Targeting Economies

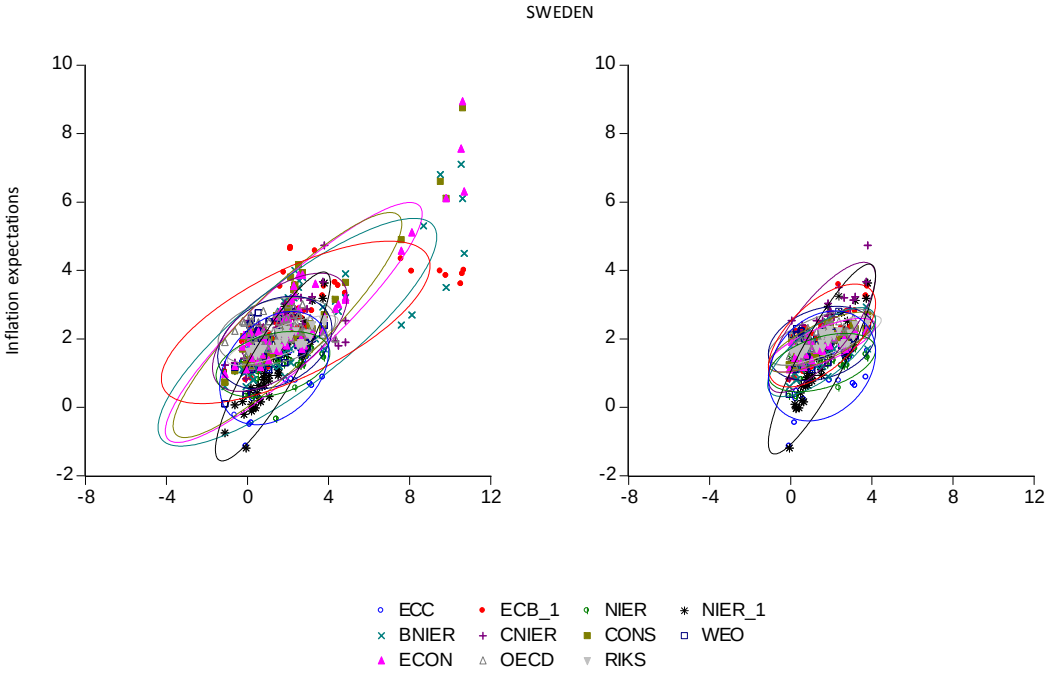


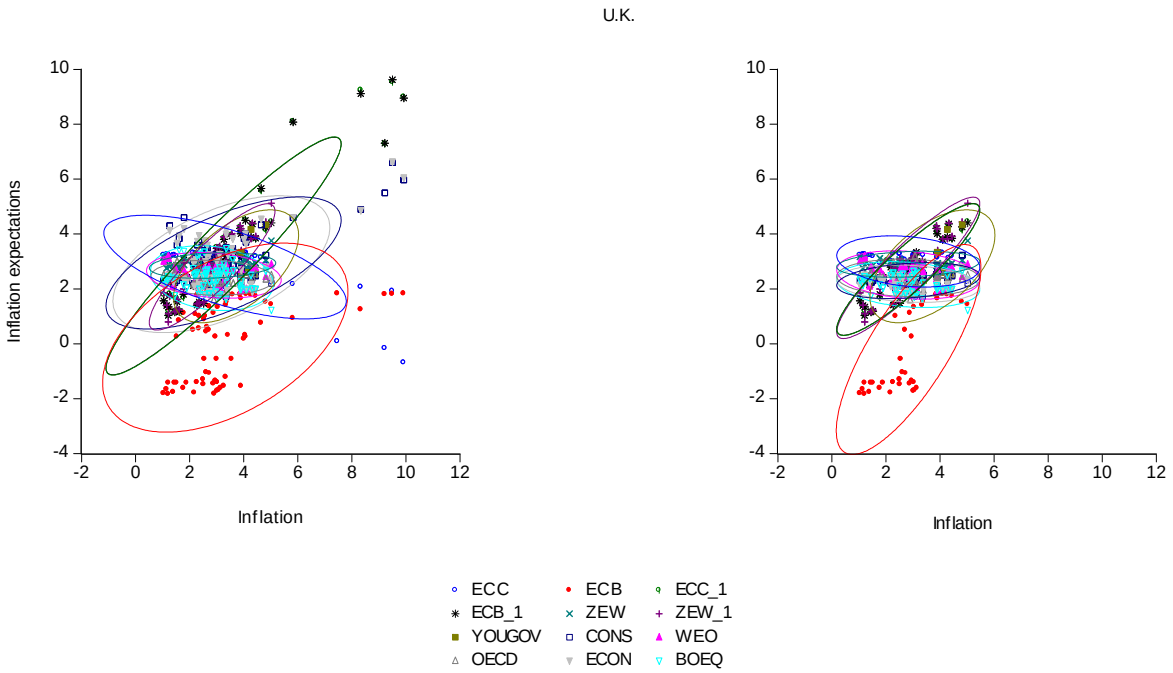
Note: Nominal interest rate (long term government bond yield) less 3 year moving average of inflation. See the text for the sources of data.

Figure 4 Inflation versus Inflation Expectations: Inflation Targeting Economies



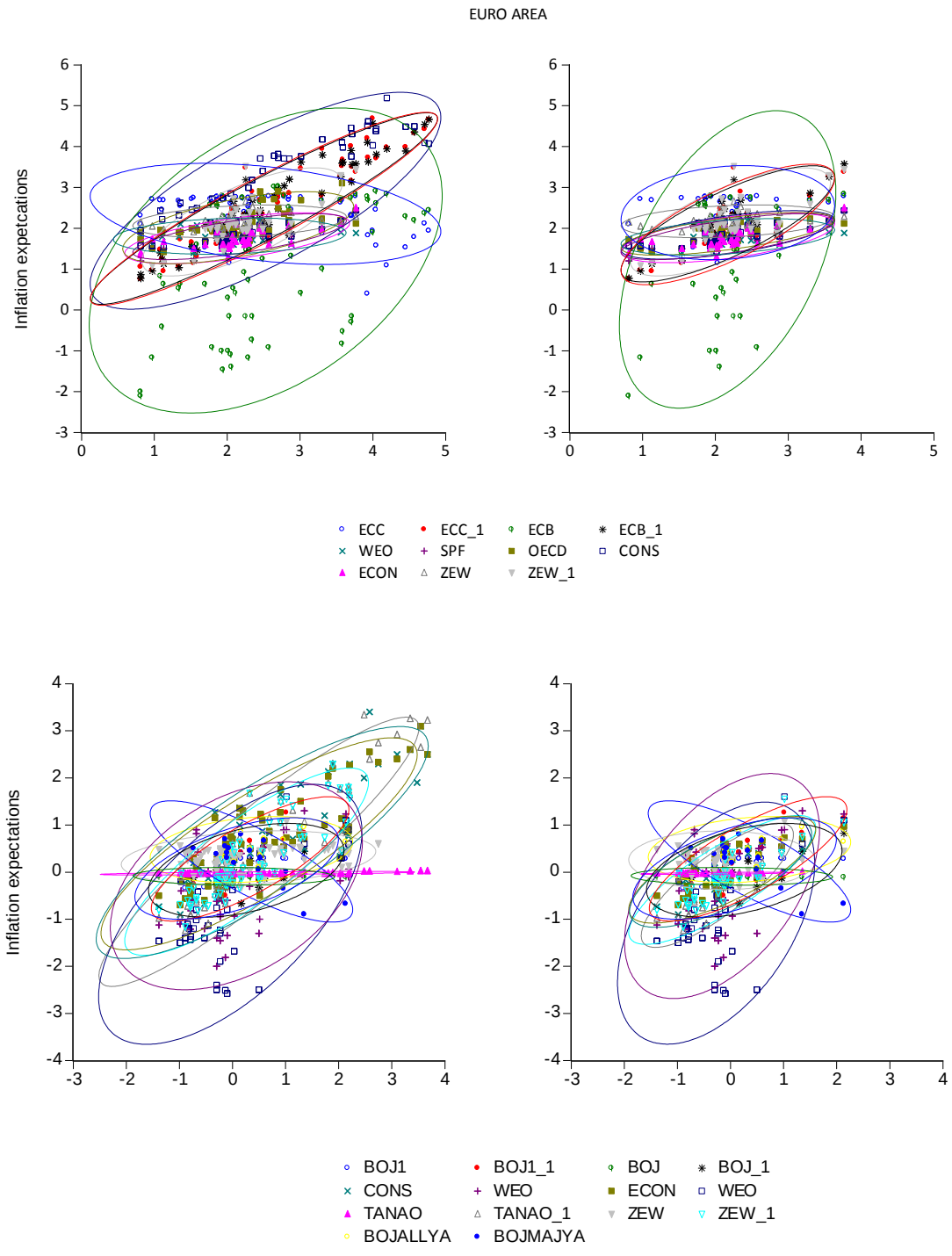

NEW ZEALAND
Inflation expectations
Inflation
Inflation
SCOPUP
SCOPUP_1
RBNZ_1
NZIER
WEO
OECD
CONS
RBNZ

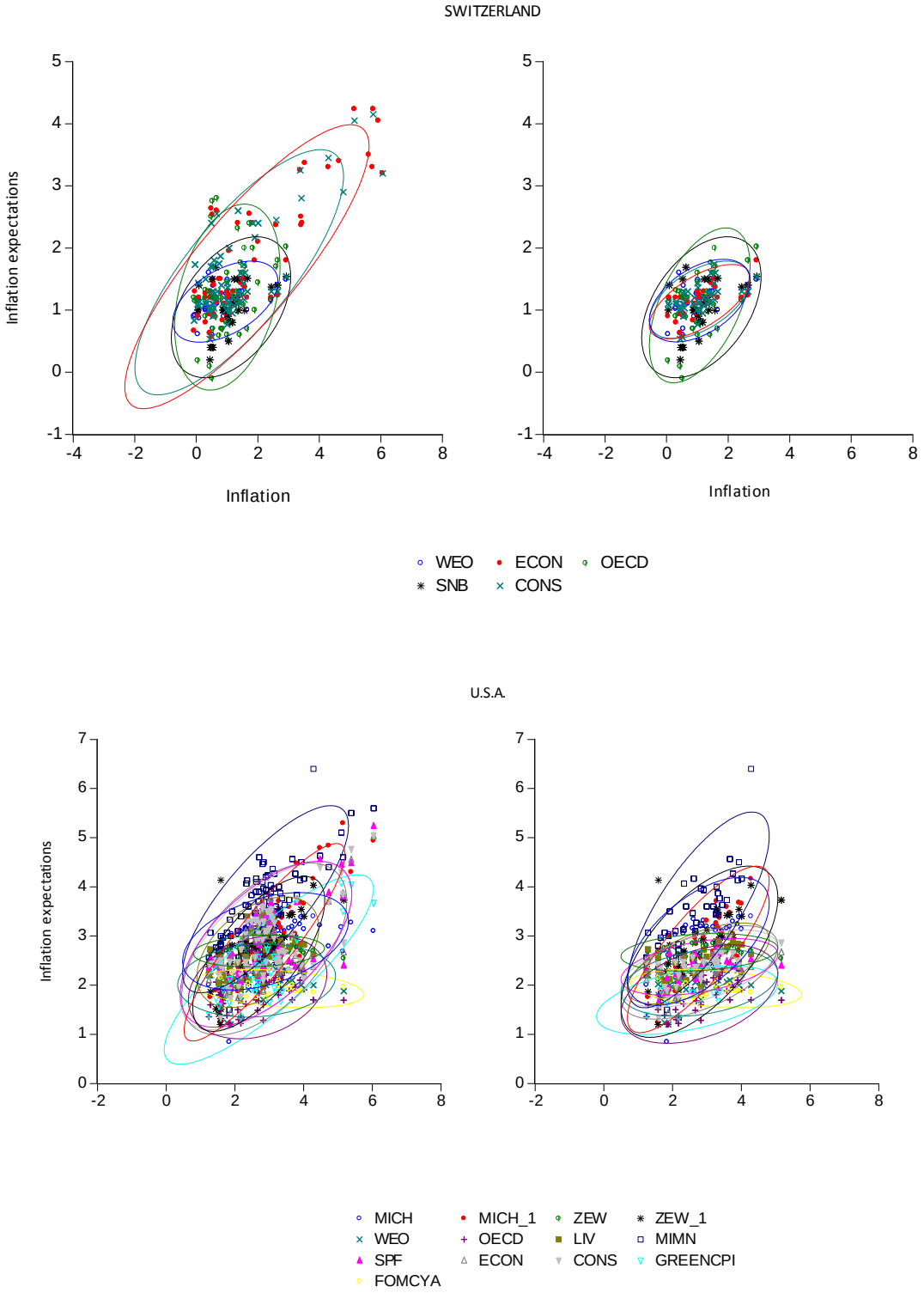

SWEDEN
Inflation expectations
ECC
ECB_1
NIER
NIER_1
BNIER
CNIER
CONS
WEO
ECON
OECD
RIKS



Note: See the appendix for the forecast codes. Inflation expectations are one year ahead forecasts as defined in the text. 95% confidence ellipses (F-distribution based) are shown. The left hand side plot covers the 1990-2008 sample, the right hand side plot is for the 1999-2008 period.

Figure 5 Inflation versus Inflation Expectations: Non-Inflation Targeting Economies





Note: See the appendix for the forecast codes and the Note to Figure 4. Inflation is as defined in Figure 1.

Figure 6A Varieties of Inflation Expectations: IT Economies versus the U.S.

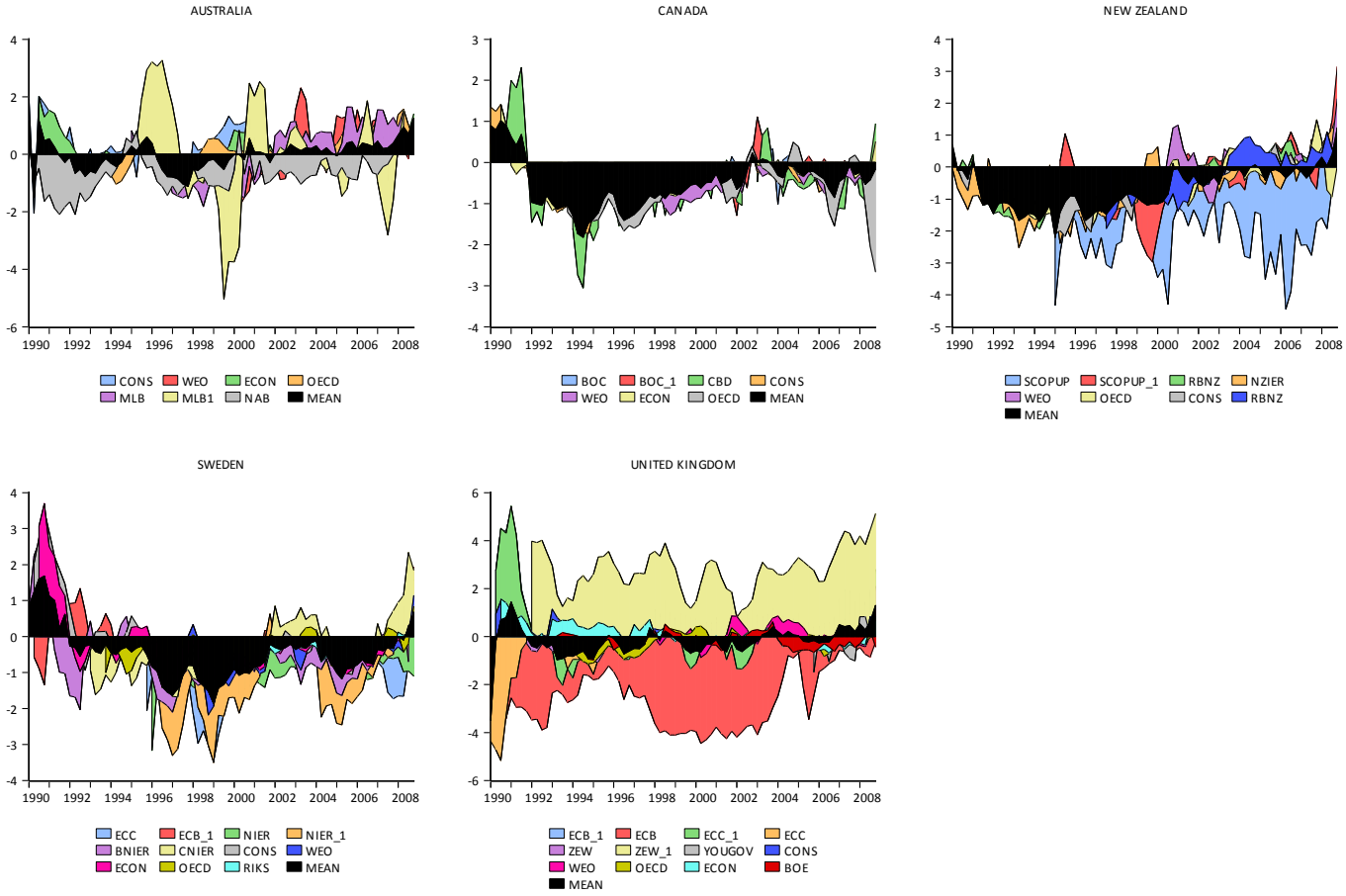
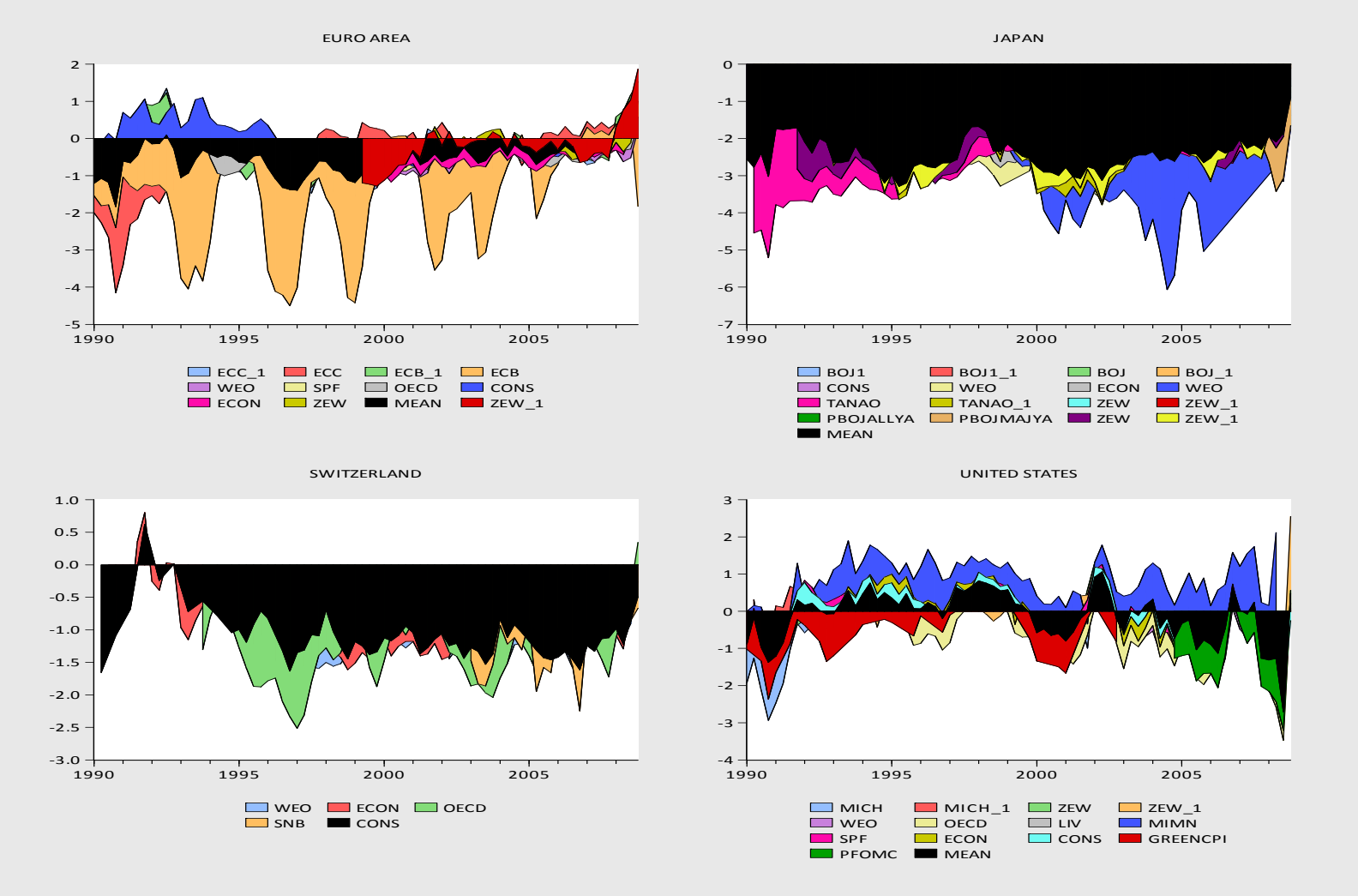
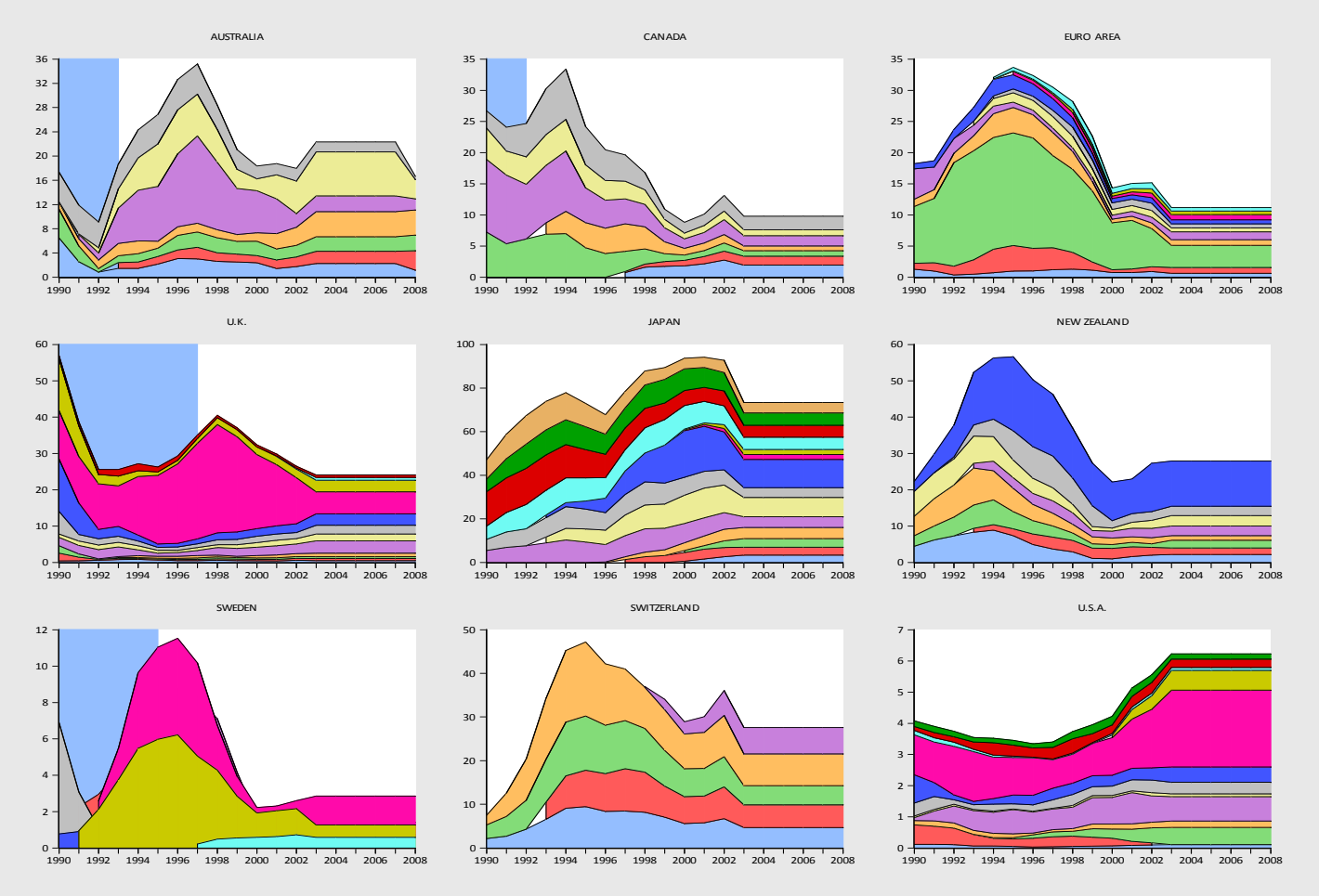


Figure 6B Varieties of Inflation Expectations: Non-IT Economies versus the U.S.



NOTE: See the appendix for the source of the forecast. All forecasts are one year ahead forecasts. The figures are one year ahead forecasts from the sources listed at the bottom of each plot less the benchmark U.S. forecast, namely the one year ahead forecast from the Survey of Professional Forecasters. An appendix lists the various sources of inflation forecasts

Figure 7 Disagreements in Inflation Expectations



Note: The shaded areas represent the period before IT is introduced, where relevant. The legend for each country is not shown. The figure stacks together the one year ahead forecast disagreements for the forecasts shown in Figures 6A and 6B. Quarterly data used were converted into annual figures for convenience. All subsequent econometric tests rely on disagreements measured at the quarterly frequency.

Table 1 Unit Roots, Panel Unit Roots, Cointegration, and Threshold Cointegration

A. Panel Unit Root Test: Cointegration of Domestic and U.S. Forecasts			
	LEVIN-LIN-CHU (LLC)	IM-PESARAN=SHIN (IPS)	OBSERVATIONS
AUSTRALIA I	-2.44 (.01)	-3.47(.00)	425
AUSTRALIA II	-2.55 (.01)	-3.77 (.00)	192
COMBINED	-2.83 (.00)	-3.72 (.00)	
CANADA I	-4.09 (.00)	-5.84 (.00)	375
CANADA II	-3.33 (.00)	-4.72 (.00)	188
COMBINED	-4.10 (.00)	-5.84 (.00)	
NEW ZEALAND I	*0.52 (.70)*	*-0.70 (.24)*	454
NEW ZEALAND II	-3.81 (.00)	-4.70 (.00)	157
COMBINED	*0.53 (.70)*	*-0.70 (.24)*	
SWEDEN I	*-1.36 (.09)*	-3.49 (.00)	621
SWEDEN II	-3.10 (.00)	-3.62 (.00)	174
COMBINED	*-1.36 (.09)*	-3.49 (.00)	
U.K. I	-2.97 (.00)	-4.94 (.00)	746
U.K. I	-4.35 (.00)	-4.53 (.00)	299
COMBINED	-2.97 (.00)	-4.94 (.00)	
EURO AREA I	*0.28 (.61)*	*-1.32 (.09)*	629
EURO AREA II	-3.87 (.00)	-4.03 (.00)	200
COMBINED	*0.28 (.61)*	-1.32 (.10)	
JAPAN I	*0.49 (.69)*	*-1.47 (.07)*	593
JAPAN II	-4.51 (.00)	-4.25 (.00)	283
COMBINED	*.49 (.69)*	-1.47 (.07)	
SWITZERLAND I	*-0.04 (.49)*	-2.82 (.00)	257
SWITZERLAND II	-3.94 (.00)	-5.35 (.00)	213

COMBINED	*-0.04 (.49)*	-2.82 (.00)			
U.S.A. I	*1.24(.89)*	-7.62 (.00)	756		
U.S.A. II	-2.70 (.00)	-7.05 (.00)	504		
COMBINED	*1.24 (.89)*	*-7.62 (.90)*			
B.	**THRESHOLD COINTEGRATION TESTS**				
	ρ_1	ρ_2	F_1	F_2	τ
AUSTRALIA	-0.02 (.05)	-1.74 (.17)	49.55*	89.25*	-0.30
CANADA	-0.09*(.04)	-0.28 (.13)	4.45*	2.02	-0.62
NEW ZEALAND	-0.02 (.06)	-0.53*(.24)	9.47*	6.02	-0.84
SWEDEN	-0.11*(.04)	0.28 (.14)	5.24*	7.03*	-0.65
U.K.	-0.04 (.05)	-1.14*(.10)	60.75*	89.52*	-0.64
EURO AREA	-0.05 (.08)	-0.82 (.17)	12.43*	17.89*	-0.64
JAPAN	-0.19*(.08)	1.06 (1.42)	2.91*	0.77	-2.35
SWITZERLAND	-0.16*(.07)	-1.10 (.45)	5.84*	4.35	-1.05
U.S.A.	-0.09 (.06)	-1.63*(.15)	24.06*	38.94*	-0.85
C.	**UNIT ROOT TESTS: COMMODITY AND ASSET PRICES**				
	ERS (ADF)	LLC	IPS		
ENERGY		*3.13 (.99)*	*1.06 (.86)*		
BRENT	-156 (5)				
WORLD	-1.47 (5)				
WEST TEXAS	-1.50 (5)				
CANADA	-1.68 (4)				
SWITZERLAND	-1.43 (6)				
NEW ZEALAND	-1.06 (3)				
NON-ENERGY		*4.37 (1.00)*	*2.79 (.99)*		
METALS	-2.45 (2)				
NON-RURAL	-0.79 (1)				
CANADA-FOOD	-2.70 (1)				
SWITZERLAND-					

FOOD	-2.17 (3)		
AUSTRALIA-TOTAL	-0.69 (1)		
CANADA-TOTAL	-1.77 (2)		
CANADA-NON ENERGY	-2.32 (4)		
WORLD NON-FUEL	-2.50 (7)		
ASSET PRICES:		*0.001 (.50)*	*-0.09 (.47)*
AGGREGATE		*2.61 (.99)*	*3.50 (.99)*
AUSTRALIA	-0.14 (2)		
CANADA	-1.74 (1)		
NEW ZEALAND	-2.69 (8)		
SWEDEN	-2.34 (2)		
U.K.	-2.42 (1)		
EURO AREA	-2.02 (12)	*-1.12(.13)*	*-1.41 (.08)*
JAPAN	-1.25 (4)	*-1.49 (.13)*	*0.29 (.62)*
SWITZERLAND	-3.17 (4)		
U.S.A.	-2.32 (4)		
EQUITIES		*-1.43 (.08)*	-2.84 (.00)
AUSTRALIA	-1.50 (1)	*-0.87 (.19)*	*-1.16 (.12)*
CANADA	-2.23 (1)		
NEW ZEALAND	-2.51 (11)		
SWEDEN	-1.83 (5)		
U.K.	-1.72 (1)		
EURO AREA	-1.75 (3)	*-0.18 (.43)*	*0.36 (.64)*
JAPAN	-2.01 (3)	*-1.52 (.07)*	*-1.14 (.13)*
SWITZERLAND	-1.26 (1)		
U.S.A.	-1.40 (1)		
HOUSING		*-3.26 (.00)*	-0.49 (.31)

AUSTRALIA	-1.35 (1)
CANADA	-1.83 (8)
NEW ZEALAND	-2.35 (1)
SWEDEN	-1.49 (3)
U.K.	-1.31 (1)
EURO AREA	-2.30 (4)
JAPAN	-1.77 (4)
SWITZERLAND	-0.72 (2)
U.S.A.	-4.04 (4)

NOTE: In part A, the test statistic is shown with p-values in parenthesis. I refers to non survey-based forecasts while II refers to the group of survey-based forecasts. Part B gives the estimates of the error correction terms and the test for asymmetry (F1) and the test for whether both error correction terms are jointly equal to zero (F2). The test specification is from Enders and Siklos (2001). In part C the column labelled ADF gives the lag length used in the lag augmentation portion of the test equation, chosen according to the Schwarz information criterion. Otherwise, p-values are shown in parenthesis in the remaining column along with the test statistic. A trend was not included in the test specifications.

Table 2 Principal Components of Inflation Forecasts

Economy	Principal Component (Name)	PROPORTION OF TOTAL VARIATION (%)
AUSTRALIA	ECONOMIST, OECD, CONSENSUS, NAB	.37, 18, .16, .09
CANADA	PC1: ECONOMIST, CONSENSUS, BOC, WEO PC2: CBD, BOC, OECD	.39, .20, .14, .12, .07
NEW ZEALAND	RBNZ, CONSENSUS, RBNZ-SURVEY	.47, .16, .14
SWEDEN	PC1: NIER(2), CONSENSUS, ECONOMIST, RIKSBANK PC2:	.52, .15, .10, .07
U.K.	PC1: ECC(2), ECB(2), ZEW(2), YOUGOV PC2: ECONOMIST, BOE, CONSENSUS	.29, .20, .13, .08
EURO AREA	ECB(2), SPF, OECD, ECC(2), CONSENSUS, ECONOMIST	.41, .20, .09, .09, .06, .05
JAPAN	TANAO(2), ZEW(2), CONSENSUS, ECONOMIST	.36, .21, .12, .09
SWITZERLAND	CONSENSUS, ECONOMIST, SNB, OECD	.55, .17, .14, .10
U.S.A.	ECONOMIST. CONSENSUS, SPF, LIVINGSTON	.40, 15, .13, .07, .07

Table 3 The Determinants of Inflation Forecast Differentials

	Mean: Full 1990-2008	Mean: 2001-8	Mean: 1999-08	MIN: Full	MAX: Full
Variable	Coefficient (std. Error)	Coefficient (std. Error)	Coefficient (std. Error)	Coefficient (std. Error)	Coefficient (std. Error)
	Dependent variable: Mean fd_{it}			$fd^{MIN}{}_{it}$	$fd^{MAX}{}_{it}$
Brent	-0.05(.07)	-0.37(.10)*	-0.12(.07)*	-0.16(.13)	0.02(.10)
Nonfuel	0.21 (.22)	0.20(.27)	-0.28(.26)	-0.06(.43)	0.23(.10)
Housing	0.01(.01)	0.01(.005)	0.01(.004)*	0.01(.01)	0.005(.008)
Equities	-0.001(.001)	-0.001(.001)	-0.001(.0008)*	-0.001(.002)	-0.0004(.001)
$\Delta fd_{it-1} * H$	-0.30(.06)*	-0.06(.09)	0.03(.08)	0.11(.11)	-0.31(.09)*
$\Delta fd_{it-1} * (1-H)$	-0.05(.05)	-0.05(.10)	-0.01(.08)	-0.05(.10)	0.02(.07)
KURT	-0.01(.01)	-0.01(.008)*	-0.01(.007)*	-0.20(.02)*	-0.006(.01)
DIS	-0.02(.01)*	-0.12(.04)*	-0.07(.02)*	-0.05(.02)*	-0.02(.01)*
ITDUR	0.003(.001)*	0.007(.002)	0.007(.002)*	0.01(.002)*	0.004(.002)*
IT	-0.07(.05)	NA	NA	-0.17(.10)*	-0.17(.08)*
fd_{it-1}	0.82(.03)*	0.60(.07)*	0.66(.05)*	0.59(.03)*	0.75(.03)*
Inflation-news			-0.01(.01)		
Interest rate-news			0.004(.004)		
Recession-news			0.02(.003)		
U.S. dollar-news			-0.04(.02)		
Constant	-0.05(.05)	-0.02(.13)	-0.14(.10)*	-0.13(.10)	0.10(.07)*
$\overline{R}^2$	0.91	0.95	0.95	0.80	0.87

Note: Variables defined in the text. Cross-section fixed effects not shown. * indicates statistical significance at least a the 10% level. OLS estimation used. Standard errors in parenthesis. H is the Heaviside indicator used to discriminate between positive (H) and negative (1-H) changes in *fd*.

Table 4 Inflation Persistence and the Role of Inflation Targeting:

Summary of Individual Country Estimates

Economy	Full: 1990-2008	1999-2008	2001-2008	IT
		Dependent variable: Mean fd_t		
AUSTRALIA	0.46*	0.05	-0.12	0.03 (.86)
CANADA	0.70*	-0.09	0.22	-0.28(.07)
U.K.	0.46*	0.17	0.15	0.15(.29)
NEW ZEALAND	0.54*	-0.35	0.02	NA[2]
SWEDEN	0.84*	0.29	0.63	-0.18(.10)
EURO AREA	0.55*	-0.26	-0.27	NA
JAPAN	0.78*	0.47[1]	0.44	NA
SWITZERLAND	0.88*	0.18	0.25	NA
U.S.A.	0.39*	0.29	0.36	NA

Note: the first 3 columns give the coefficient estimates and * indicates statistically significant at the 5% level. The last columns gives the estimate of the response to the IT dummy (see equation (3) for the panel version of the same specification). p-values in parenthesis. [1] p-value is 0.10; [2] New Zealand introduced IT in 1990Q1.

REFERENCES

Acemoglu, D., S. Johnson, P. Querubin, and J. Robinson (200*), "When Does Policy Reform Work? The Case of Central Bank Independence", ***Brookings Papers on Economic Activity*** 2 (Spring): 351-417.

Amato, J., S. Morris, and H.S. Shin (2003), "Communication and Monetary Policy", BIS working paper 123.

Baillie, R.T., C-F. Chung, and M.A. Tieslau (1996), "Analyzing Inflation by the Fractionally Integrated ARFIMA-GARCH Model", ***Journal of Applied Econometrics*** 11 (January-February): 23-40.

Ball, L. (2006), "Has Globalization Changed Inflation?", NBER working paper 12687, November.

Benati, L. (2008), "Investigating Inflation Persistence Across Monetary Regimes", ***Quarterly Journal of Economics*** 123 (August): 1005-60.

Bernanke, Ben (2008), "Outstanding Issues in the Analysis of Inflation", speech given at the Federal Reserve Bank of Boston's 53rd Annual Economic Conference, Chatham, Massachusetts, 9 June.

Bernanke, B. (2007), "Inflation Expectations and Inflation Forecasting", speech given at the monetary economcs workshop of the National Bureau of Economic Research, July 10.

Bernanke, B., T. Laubach, F. Mishkin, and A. Posen (1999), ***Inflation Targeting*** (Princeton: Princeton University Press).

Bertrand, M., E. Duflo, and S. Mullanaithan (2004), "How Much Should We Trust Differences-in-Differences Estimates", ***Quarterly Journal of Economics*** 119 (February): 249-75.

Blinder, A.S., M. Ehrmann, M. Fratzscher, J. De Haan, D-J. Jansen (2008), "Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence", ***Journal of Economic Literature*** 46 (December): 910-45.

Blinder, A.S. (1999), ***Central Banking in Theory and Practice*** (Cambridge, Mass.: MIT Press).

Borio, C. and A. Filardo (2007), "Globalization and Inflation: New Cross-Country Evidence on the Global Determinants of Inflation", BIS working paper 227, May.

Borio, C. and P. Lowe (2004), "Securing Sustainable Price Stability: Should Credit Come Back from the Wilderness?" BIS working paper 157, July.

Carlson, J.A., and M. Parkin (1975), "Inflation Expectation", ***Economica*** 42, 123-38.

Cecchetti, S.G., P. Hooper, B.C. Kasman, K.L. Schoenholtz, and M.W. Watson (2007), "Understanding the Evolving Inflation Process", U.S. Monetary Policy Forum, http://www.princeton.edu/~mwatson/papers/USMPF_Report_July_2007.pdf.

Côté, D., and C. De Resende (2008), "Globalization and Inflation: The Role of China", Bank of Canada working paper 2008-35.

Dovern, J., U. Fritsche, and J. Slacalek (2009), "Disagreement Among Forecasters in G7 Countries", working paper, June.

Enders, W., and P.L. Siklos (2001), "Cointegration and Threshold Adjustment", ***Journal of Business and Economic Statistic***s.

Gagnon, J. and J. Ihrig (2004), "Monetary Policy and Exchange Rate Pass-Through", ***International Journal of Finance and Economics*** 9 (October): 315-38.

Giacomini and B. Rossi (2008), "Forecast Comparisons in Unstable Environments", ***Journal of Applied Econometrics*** (forthcoming).

Giannone, D., F. Lenza, and L. Reichlin (2008), "Explaining the Great Moderation: Its not the Shocks", working paper, November.

Hamilton, J.D. (2009), "Causes and Consequences of the Oil Price Shock of 2007-08", ***Brookings Papers on Economic Activity*** (forthcoming).

Hassler, U., and J. Wolters (1995), "Long Memory in Inflation Rates: International Evidence", ***Journal of Business and Economic Statistics*** 13 (January): 37-45.

Hooker, M.A. (2002), "Are Oil Shocks Inflationary?", ***Journal of Money, Credit and Banking*** 34(2): 540-61.

Ihrig, J., S. Kamin, D. Lindner, and J. Marquez (2007), "Some Simple Tests of the Globalization Hypothesis", International Finance Discussion Paper 891, April.

Joliffe, I.T. (1986), ***Principal Component Analysis*** (New York: Springer-Verlag).

Kiley, M. T. (2008), "Monetary Policy Actions and Long-Run Inflation Expectations", FEDS working paper 2008-03, December.

Lahiri, K., and X. Sheng (2008), "Measuring Forecast Uncertainty By Disagreement: The Missing Link", ***Journal of Applied Econometrics*** (forthcoming).

Maddala, G.S. (1977), ***Econometrics*** (New York: McGraw-Hill).

Mankiw, N.G., R. Reis, and J. Wolfers (2003), "Disagreement About Inflation Expectations", in ***NBER Macroeconomics Annual*** (Cambridge, Mass.: The MIT Press), pp. 209-48.

Mishkin, F.S. (2007), "Headline Versus Core Inflation in the Conduct of Monetary Policy", Speech presented at the Business Cycles, International Transmission and Macroeconomic Policies Conference, HEC Montreal, Montreal, Canada. October 20.

Mishkin, F. S. (2007a), *Monetary Policy Strategy* (Cambridge, Mass.: The MIT Press).

Orphanides, A., and J.C. Williams (2007), "Robust Monetary Policy with Imperfect Knowledge", ***Journal of Monetary Economics*** 54 (July): 1406-35.

Pesaran, M.H. (1984), "Formation of Inflation Expectations in British Manufacturing Industries", ***Economic Journal*** 95, 948-75.

Pesaran, M.H. (1987), ***The Limits to Rational Expectations*** (Oxford: Basil Blackwell).

Reis, R., and M.W. Watson (2009), "Relative Goods' Prices, Pure Inflation, and the Phillips Curve Correlation", working paper, Princeton University, January.

Rogoff, K. (2003), "Globalization and the Global Disinflation", papepr presented at the Federal Reserve Bank of Dallas, 2003 Jackson Hole Conference.

Rose, A. (2007), "A Stable International Monetary System Emerges: Inflation Targeting is Bretton Wood, Reversed" ***Journal of International Money and Finance*** 26 (September): 663-81.

Rudd, J., and K. Whelan (2007), "Modeling Inflation Dynamics: A Critical Review of the Literature", ***Journal of Money, Credit and Banking*** 39 (February, Supplement): 155-70.

Sargent, T.J. (1999), ***The Conquest of American Inflation*** (New Jersey: Princeton University Press).

Shiller, R. (1997), "Why Do People Dislike Inflation?", in C. Romer and D. Romer (Eds.), ***Reducing Inflation: Motivation and Strategy*** (Chicago: University of Chicago Press), pp. 13-65.

Siklos, P.L., Bohl, M., and Mayes, D. (2009), "The Quality of Monetary Policy and Inflation Performance: Globalization and Its Aftermath", working paper, February.

Siklos, P.L. (2009a), "As Good As It Gets? The International Dimension to Canada's Monetary Policy Strategy Choices", C.D. Howe Commentary, available at http://www.cdhowe.org, July.

Siklos, P.L. (2009b), "Meeting Maastricht: Nominal Convergence of the New Member States Toward EMU", working paper, Wilfrid Laurier University, August.

Siklos, P.L. (2002), ***The Changing Face of Central Banking*** (Cambridge: Cambridge University Press).

Siklos, P.L. (1999), "Pitfalls and Opportunities in a World of High Frequency Data", ***Information in Financial Asset Prices*** (Ottawa: Bank of Canada), pp. 331-69.

Siklos, P.L. (1999a), "Inflation Target Design, Changing Inflation Performance and Persistence in Industrial Countries", ***Review*** of the Federal Reserve Bank of St. Louis, 81 (March/April): 47-58.

Smith, J., and M. McAleer (1995), "Alternative Procedures for Converting Qualitative Response Data to Quantitative Expectations: An Application to Australian Manufacturing", ***Journal of Applied Econometrics*** 10 (April-June): 165-85.

Stock, J., and M.W. Watson (2007), "Why Has Inflation Become Harder to Forecast?", ***Journal of Money, Credit, and Banking*** 39 (February): 3-34.

Tay, A.S., and K. F. Wallis (2000), "Density Forecasting: A Survey", ***Journal of Forecasting*** 19, 235-54.

Taylor, J. (2008), "Globalization and Monetary Policy: Missions Impossible", in J. Gali and M. Gertler (Eds), ***International Dimensions of Monetary Policy*** (Chicago: University of Chicago Press).

Trichet, J.C. (2009), "Credible Alertness Revisited", intervention at the symposium on "Financial Stability and Macroeconomic Policy", sponsored by the Federal Reserve of Kansas City, Jackson Hole, Wyoming, 22 August.

Warren, G.F., ad F.A. Pearson (1932), "Wholesale Prices for 213 Years, 1720 to 1932: Part I", Cornell University, memoir 142, November.