BANK FOR INTERNATIONAL SETTLEMENTS

BIS Working Papers

No 227

Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation

by Claudio Borio and Andrew Filardo

Monetary and Economic Department

May 2007

JEL Classification Numbers: E31, E52, E58, F02, F41
Keywords: Globalisation, Phillips curve, inflation, monetary policy

Copies of publications are available from:

Bank for International Settlements
Press & Communications
CH-4002 Basel, Switzerland

E-mail: publications@bis.org

Fax: +41 61 280 9100 and +41 61 280 8100

This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)

ISSN 1682-7678 (online)

Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation

by Claudio Borio and Andrew Filardo*

Abstract

There has been mounting evidence that the inflation process has been changing. Inflation is now much lower and much more stable around the globe. And its sensitivity to measures of economic slack and increases in input costs appears to have declined. Probably the most widely supported explanation for this phenomenon is that monetary policy has been much more effective. There is no doubt in our mind that this explanation goes a long way towards explaining the better inflation performance we have observed. In this paper, however, we begin to explore a complementary, rather than alternative, explanation. We argue that prevailing models of inflation are too "country-centric", in the sense that they fail to take sufficient account of the role of global factors in influencing the inflation process. The relevance of a more "globe-centric" approach is likely to have increased as the process of integration of the world economy has gathered momentum, a process commonly referred to as "globalisation". In a large cross-section of countries, we find some rather striking prima facie evidence that this has indeed been the case. In particular, proxies for global economic slack add considerable explanatory power to traditional benchmark inflation rate equations, even allowing for the influence of traditional indicators of external influences on domestic inflation, such as import and oil prices. Moreover, the role of such global factors has been growing over time, especially since the 1990s. And in a number of cases, global factors appear to have supplanted the role of domestic measures of economic slack.

* Email: Claudio.Borio@bis.org and Andrew.Filardo@bis.org.

Contents

"Over the past two decades, inflation has fallen notably, virtually worldwide, as has economic volatility. Although a complete understanding of the reasons remains elusive, globalization and innovation would appear essential elements of any paradigm capable of explaining the events of the past ten years". *Alan Greenspan (2005)*

Introduction[1]

Since at least the early 1990s, there has been mounting evidence that the inflation process has been changing. Inflation is now much lower and much more stable around the globe. And its sensitivity to measures of economic slack and increases in input costs appears to have declined. To a considerable extent, these developments have caught policymakers by surprise, as reflected in a certain tendency to overestimate actual inflation. In contrast to the tendency for inflation to exceed forecasts in the early 1970s, this has been a pleasant surprise. Nevertheless, systematic surprises have a habit of being symptoms of limitations in our understanding. This, in itself, is less reassuring.

Several explanations have been put forward to account for these developments. Probably the most widely supported is that monetary policy has been much more effective. A heightened focus on inflation control, underpinned by institutional reforms such as central bank independence and by a keener awareness of the need to be pre-emptive, has resulted in a better and more credible monetary policy.

There is no doubt in our mind that this explanation goes a long way towards accounting for the better inflation performance we have observed. In this paper, however, we explore a different hypothesis, which should best be interpreted as a complementary, rather than alternative, one. The conjecture is that a significant missing element in the puzzle relates not to what we already know, but to limitations in our current knowledge.

More specifically, we begin to explore the hypothesis that prevailing models of inflation are too "country-centric", in the sense that they fail to take sufficient account of the role of global factors in influencing the inflation process. Moreover, the relevance of a more "globe-centric" approach is likely to have increased as the process of integration of the world economy has gathered momentum, a process commonly referred to as "globalisation".

We find some rather striking prima facie evidence that this has indeed been the case. In particular, proxies for global economic slack add considerable explanatory power to traditional benchmark inflation rate equations in a large set of countries. This is true even allowing for the influence of traditional indicators of external influences on domestic inflation, such as import and oil prices. Moreover, the role of such global factors has been growing over time, especially since the early 1990s, and in a number of cases it appears to have

[1] We are particularly grateful to Jeff Amato, David Archer, Giancarlo La Cava, Todd Clark, Rob Dobson, Dietrich Domanski, Gabriele Galati, Hans Genberg, Stefan Gerlach, Paolo Giordano, Már Gudmundsson, Jakob de Haan, Craig Hakkio, Steve Kamin, Deb Lindner, Will Melick, Benoit Mojon, Julius Moschitz, Stephen Murchison, Tony Richards, Silvia Sgherri, Pierre Siklos, Paolo Surico, John Williams, Mark Wynne and seminar/conference participants at the Bank for International Settlements, the Federal Reserve Bank of Kansas City, the Hong Kong Monetary Authority, the National Bank of Poland and De Nederlandsche Bank for helpful comments. We also would like to thank CEPR and ESI on the selection of this paper for the 2006 CEPR/ESI Prize for the best research paper on the topic of "Globalisation and Monetary Policy", which was presented at the National Bank of Poland. Magdalena Erdem and Les Skoczylas provided excellent research assistance. An earlier revised version of the paper was presented at the autumn central bank economists meeting on "The evolving inflation process", which the BIS hosted on 28-29 October 2005. Any errors and omissions are our sole responsibility. The views expressed are our own and should not be interpreted as those of the Bank for International Settlements.

supplanted the role of domestic measures of economic slack. No doubt this evidence is suggestive and is based on simple reduced-form regressions (simple conditional correlations). Even so, we find it sufficiently intriguing to conclude that the hypothesis is worthy of greater attention than it has received so far and that it deserves further serious investigation.

The paper is divided into two sections and a conclusion. In section I we lay out the conceptual framework, explaining from first principles the potential role of country-specific and global factors in the determination of the inflation process. As a heuristic device, in order to highlight the implied differences in how to think about the inflation process, we set out two intentionally very stylised polar approaches, which differ in terms of the role they assign to country-specific and global factors – the "country-centric" and the "globe-centric" approaches, respectively. In section II we then explain the design of the statistical tests and describe the main results. In the conclusion, we summarise the key findings, sketch the policy implications and suggest possible directions for future work.

I. The conceptual framework: two perspectives on the inflation process

Inflation determination: the interaction of real and monetary factors

There is a wide consensus in the economic profession that in the long run, when prices are allowed to adjust, inflation is a monetary phenomenon. At the least controversial level this simply means that, as a first approximation, in a long-run equilibrium (a) real (relative) prices are independent of the aggregate price level or its rate of change and (b) the aggregate price level is ultimately "pinned down" by a vector of nominal quantities with which it will be associated. In a more causal sense, it is often taken to mean that it is monetary policy that ultimately determines inflation, by influencing directly or indirectly the rate at which the monetary side of the economy expands.

This distinction between relative prices, ultimately set by real factors, and absolute prices, ultimately set by monetary forces, can be taken to imply that developments in the real economy do not uniquely determine the inflation rate, at least over sufficiently long horizons. If so, whether productivity growth is high or low, labour markets competitive or monopsonistic, and the global economy integrated or fragmented are not relevant considerations. By implication, economic globalisation, real or financial, should not be expected to have a material impact on the trajectory of inflation.

There are reasons, however, why this strict dichotomy need not hold.

First, the inflation rate that the monetary authorities consciously aim at may not be independent of the real structure of the economy. For example, more flexible labour markets and nominal wages may lower the costs of bouts of deflation, and hence allow the authorities to aim for more conservative inflation rates. Likewise, more competitive goods and services markets may reduce the incentive for monetary authorities to resort to "surprise inflation" as a means of keeping output or employment above its "equilibrium" level. This possibility has been provocatively, albeit perhaps unpersuasively, noted as a possible subtle way in which globalisation forces have led to global disinflation (Rogoff (2003)).[2] Alternatively, and

[2] This hypothesis is similar in spirit to those developed by Romer (1993) and Lane (1997), in which the degree of openness of the economy increases the cost of surprise inflation and hence reduces the incentive to inflate. More recently, Razin and Loungani (2005) derive a similar result based on trade and capital account openness in a micro-founded model from the welfare function of the representative household.

perhaps more realistically, unexpected positive supply developments ("shocks") associated with globalisation may have made it easier for central banks to gradually guide inflation lower from rates that were perceived as being uncomfortably high, consistent with the so-called "opportunistic approach" to disinflation (eg, Aksoy et al (2003)).[3]

Second, the authorities may have less than full control over the inflation dynamics over short- and even medium-term horizons. Central banks may not have the appropriate "model" of the economy, may be unable to identify accurately the sources of the forces affecting it and/or may be unable to offset them completely. The thick veil of uncertainty conditioning policy decisions makes this possibility particularly realistic, especially at times of rapid structural change. Under these conditions, the influence of real developments such as increases in productivity growth or potential output could result in inflation coming in below forecasts, and possibly below desired rates. With respect to globalisation, systematic underestimation of the influence of growing global capacity on domestic prices could lead to systematic overprediction of inflation and, as a result, a downward trend in policy rates to counteract it.

Third, across currency areas, exchange rates may fail to fully reflect inflation conditions. In steady state, as a first approximation, differences in desired inflation rates by those central banks setting policy in the various areas will translate into differences in the rates of change of exchange rates across them. For given inflation objectives, however, real factors can have an impact over horizons over which inflation is less controllable. And they can interact with the authorities' preferences to affect the size of the de facto currency areas, by influencing the independent weight assigned to the exchange rate in policy decisions. At one end of the spectrum, a high degree of trade and possibly financial integration may lead a country to decide to peg its exchange rate to that of a larger currency area. In the absence of capital controls and impediments to arbitraging trade, it would thereby allow its domestic inflation to be determined residually by that aimed at in the dominant area. Any differences in inflation would be largely determined by differences in the composition of output and productivity trends. For intermediate regimes, the outcome would be somewhere in between. For instance, if a large country, by pursuing a more expansionary policy than elsewhere, put upward pressure on other countries' exchange rates and these countries resisted the appreciation, they would be partly importing the monetary conditions of the large country.[4]

Against this background, in what follows we explore the hypothesis that greater economic integration (ie globalisation) may have contributed to the lower inflation environment observed over the past decade or so. We focus in particular on the potential shift in the drivers of the inflation process away from country-specific towards global factors. We recognise that the associated decline in inflation may have resulted from both conscious decisions of policymakers to accommodate it and ex post decisions not to fully offset unforeseen influences. We do not, however, make an in-depth attempt to distinguish between these two possibilities and leave this for future research.

In order to better understand what we mean by the relative role of global and country-specific factors in the inflation process, it is worth setting out two alternative and highly stylised modelling approaches, defined by the way they treat these two sets of factors. One approach, which is much closer to the traditional way of modelling inflation, is heavily focused on country-specific factors; its polar opposite, by contrast, assigns much more

---

3 One could imagine virtuous circles developing. By helping to reduce inflation, globalisation can help underpin central bank credibility, which in turn makes it easier for the central bank to control inflation.

4 More generally, real and financial globalisation could help control inflation by disciplining the policymakers. In effect, this perspective would see country-specific policy regimes as at least in part endogenous with respect to the globalisation process.

importance to their global counterparts. For ease of exposition, they will be referred to, respectively, as the "country-centric" and "globe-centric" approaches.

It is important to stress that the two approaches do *not* differ in their fundamental view of the inflation process and hence, a fortiori, of the role of exchange rates within that process. Rather, they vary exclusively in the way that "national borders" are treated in the analysis. Moreover, we fully acknowledge that, as discussed later, richer frameworks can and have overcome these extreme setups. Even so, they are a useful starting point to help establish some basic ideas.

The country-centric approach

The country-centric approach has three related key features.

First, measures of excess demand and slack that determine inflation are entirely country-specific; inflation in a given country is exclusively influenced by excess demand in that country.

Second, to the extent that a wage channel is formally included, be this directly (in markup type models of an older Keynesian tradition) or indirectly (as determinants of the natural or non-accelerating rate of unemployment), the channel is purely a function of the corresponding country's specific economic conditions (eg, productivity growth in that country, etc).

Third, international influences are fully captured through exchange rate effects (which can affect both demand and supply in the country) and import prices.

Implicitly, such an approach is predicated on a number of assumptions and approximations.

For one, it assumes that goods are primarily differentiated in terms of the country where they are produced. In other words, the key distinction is between domestic and foreign goods, seen as only very imperfect substitutes. For a given supply, this helps to justify a clear and unambiguous mapping between country-specific demand pressures and domestic inflation, regardless of global conditions for the goods and services in question.

In addition, the approach assumes very limited substitutability between domestic and foreign labour inputs. For a given domestic demand for products, this is what helps to justify ignoring foreign influences on domestic supply conditions. For a fixed capital stock, the most common way of rationalising this is to assume that labour is immobile across borders although it may be highly mobile within borders. As a result, labour flows could relieve any sectoral bottlenecks within countries but could not do so internationally.[5] Over horizons over which the capital stock is not fixed, the approach implicitly makes similar assumptions for this factor of production. Consequently, for instance, the relocation of production facilities cannot substitute for the relocation of labour.

The globe-centric approach

The globe-centric approach starts from opposite premises. For one, it sees goods produced in different countries as very close substitutes. In addition, it assumes that labour characteristics and capital mobility are such that factor input markets are closely integrated globally. Indeed, the possibility of shifting capital, and hence also "country-specific" know-

---

[5] Another way of rationalising this would be to think of labour as having a high degree of good-specificity, with goods differing across countries. In this case, however, even within countries, sectoral labour constraints, as opposed to aggregate ones, would matter.

how,[6] across borders helps to underpin the greater substitutability among goods produced in different locations.

This view has several modelling implications, which are the mirror image of those of the country-centric approach.

First, fundamentally, it implies that a mapping between country-specific excess demand and a country's price inflation is not fully justified. It is global excess demand for the goods in question that is relevant. For a given product, it would make little sense to infer excess demand conditions from those in specific countries, as the tightness or slack could be offset by conditions elsewhere. Low demand in one country could be offset by high demand in another; limited supply in one by more ample supply in another. And what is true for a given product is also true, by implication, for any subset of products. The only difference is that mobility of labour and possibly capital across the subset can help to relieve sectoral price pressures, regardless of borders. In fact, in the limit, with country-specific factors irrelevant, but with imperfect substitutability across products, a globe-centric approach would point to aggregation of excess demand by products rather than by country.[7]

Second, as a corollary, the globe-centric approach implies that domestic wages as well as their relationship to domestic prices depend on supply conditions elsewhere.

Third, as another corollary, it implies that, for a given exchange rate, import prices need not be a sufficient statistic for foreign influences. Not least, they would fail to capture the impact of global conditions on the export side and hence on competing domestic goods markets whenever the export and import compositions differ. And, from a global perspective, failure to model import prices endogenously would, in effect, leave much of the inflation process unexplained, with the risk of misspecification.

To sum up, the stylised country-centric approach explains inflation in a bottom-up fashion, plays down international and global factors and, when explicitly considered, treats them as exogenous (eg, via the inclusion of import prices). By contrast, the globe-centric approach explains inflation in a more top-down fashion, focuses on global factors, with domestic ones seen as providing an incomplete picture of the inflation process (ie, as not being "sufficient statistics" for it), and treats many influences on country-specific developments as endogenous.

Confronting the approaches with the "real world" and globalisation

Where does the world lie along the spectrum of the stylised assumptions that justify the use of the two approaches? Clearly, it has characteristics of both. And by and large, the country-centric approach has served well in explaining and thinking about the determinants of inflation. On balance, however, the process of economic globalisation could be expected to have increased the relevance of the aspects highlighted in the globe-centric perspective.

Borders do matter, although they obviously matter differently for different types of goods. And substitution between similar outputs across countries can be much higher than for outputs within countries. This is the very basis for the tradables/non-tradables distinction that was formalised in the 1960s for the analysis of current account issues and which has since then become so popular (eg, Corden (1960) and Swan (1960)). In the approach, it is

---

6 We think here of managerial and technological know-how as "embodied" in the capital stock.

7 Vega and Winkelried (2005) argue, for example, that in an optimizing New Keynesian Phillips curve framework, globalisation makes global prices increasingly more important determinants of domestic price-setting behaviour for non-tradable goods. For a recent review of stylised models that build in international linkages, see Feyzioğlu and Willard (2006).

assumed that the substitutability between tradable goods across countries is much higher, in the limit infinite, than that between tradable and non-tradable goods within countries.[8]

This key distinction was first specifically applied to the study of inflation in the so-called Scandinavian approach with reference to small countries, seen as unable to influence the price of their tradables internationally (eg Aukrust (1977) and Lindbeck (1979)). In this case, under a fixed exchange rate and perfect capital mobility, foreign prices would determine tradable prices via purchasing power parity. Given this, the overall inflation rate would be determined residually by the restriction that relative prices between the two sectors would, over time, move in line with differential productivity growth, given perfect labour mobility within the country. Domestic excess demand pressures would only be relevant in the non-tradable sector and help explain the short-run evolution of inflation; by contrast, it would be global excess demand pressures, if modelled, that would be more relevant for the tradable sector.[9]

This approach has been applied, with varying degrees of success, to the inflation process in small open economies. It has also underpinned the study of the Balassa-Samuelson effect, which explains long-term differential inflation rates across tradables and non-tradables through differential productivity growth in the two sectors.

Borders matter even more for labour and, less so, capital. Labour mobility across countries is clearly inhibited by cultural, legal and regulatory factors. And the transfer of physical capital or, equivalently, financial capital plus managerial and technological know-how, is also far more constrained across borders than within them.

At the same time, these constraints on factor mobility have become weaker (Graph 1). Advances in communications technology have greatly facilitated the geographical relocation of production and the break up of production processes into their constituent components (Scheve and Slaughter (2003)). By the same token, they have broadened the range of products that can be traded and increased the substitutability between those produced in different countries. Increasingly, services are being affected too. Likewise, the gradual breakdown in trade and financial regulatory barriers has allowed economic agents to reap the benefits of these technological innovations. Both output and input markets have become more contestable. Physical as well as political geography have become less relevant.

In addition, this broad shift has gone hand in hand with a major longer-term increase in the production potential of the global economy. Its production frontier has shifted outwards. This is because the globalisation process has coexisted with the integration into the market system of previous command economies such as China and the former Soviet Union and with a greater acceptance of market principles across many developing countries, not least India. This has freed previously untapped resources. In particular, the effective increase in the labour force directly and indirectly "plugged into" the global economic system has been enormous (Freeman (2005)). Especially in China, the concrete possibility of shifting the corresponding underemployed resources to more productive uses at little additional cost implies "soft" supply constraints on potential output, especially over medium-term horizons. Moreover, the fact that China has not had a floating exchange rate vis-à-vis the world prime currency area has meant that price developments in tradable products there should have been more directly transmitted elsewhere, without the cushion that a flexible exchange rate might provide (see below).

---

8 One potential offsetting force of globalisation could be increased specialisation of production. Here we take the view that the other effects dominate.

9 See, for example, Engel et al (2004) for a discussion of the apparent importance of national borders in helping to account for deviations of purchasing power parity for tradables.

Thus, on a priori grounds the likely end-result of this globalisation process is the confluence of two effects.

One effect is the increased sensitivity of domestic economic relationships to external influences, consistent with a more globe-centric approach to inflation. This could manifest itself in a number of ways, including an apparent lower sensitivity of inflation to traditional indicators of domestic excess demand pressures and cost conditions and a corresponding greater sensitivity to those prevailing elsewhere and at a global level.[10]

A second effect is a possible tendency for inflation to drift lower or to be underpredicted, as the influence of increased global supply makes itself felt *to the extent that this is not fully factored in, or is accommodated, in monetary policy decisions over the relevant horizon.* On the production side, this tendency could result from greater wage moderation, as the actuality and perceived threat of relocation to lower-wage countries or of stronger immigration flows materialises (OECD (2004)).[11] It could also reflect other cost-efficiency gains associated with a better organisation of production processes. On the demand side, it could result from greater contestability in output markets. Other things being equal, this would tend to reduce price markups by increasing the elasticity of demand for the corresponding products.

To this broad pattern, one could add two additional, more subtle considerations.

First, *unless offset by a desire to run a more independent policy for unrelated considerations,* globalisation could actually enlarge the size of de facto currency areas.[12] On the one hand, financial globalisation and the associated greater capital mobility would tend to reduce the independent room for manoeuvre in national monetary policies. On the other hand, globalisation of output and factor markets could tend to increase the independent weight that monetary authorities give to exchange rate considerations. Greater trade intensity and concerns with competitiveness in a context of potentially large nominal exchange rates could play a role here, arguably a larger one than traditional optimal currency areas considerations, which would also work in the same direction. As a result of these factors, monetary conditions would tend to become more uniform across countries.

Second, globalisation *in conjunction with the establishment of an environment of low and stable inflation* may have a rather paradoxical impact on the role of exchange rates in price differentials across countries and on its perceived role in the inflation process. On the one hand, *for a given exchange rate*, in a cross-section globalisation means that price differentials for similar goods should be expected to narrow. Arbitrage opportunities increase and location matters less for the production of specific goods and even services as production is delocalised. On the other hand, changes in exchange rates *over time* may tend to reflect less purely nominal influences, such as persistent and large inflation differentials, and more other factors, of both a real and a financial nature. Under such conditions, they may be seen as more reversible and hence may have a smaller impact on the corresponding

---

[10] Blanchard (2006) also points out that globalisation may have led, all other things being equal, to greater "turbulence" in labour markets in those countries facing these forces, in the sense of greater job destruction and job creation. Labour market institutions may, as a result, become ill-suited to the new environment and contribute to a rise in the natural rate of unemployment. These considerations may become even more relevant in low inflation environments, as Akerlof et al (1996) have argued. However, evidence of greater "turbulence" in the above sense, as Blanchard points out, has been somewhat difficult to find.

[11] Freeman and Oostendorp (2003) argue that the initial impact of the expansion of the global workforce by China and India was to cause a wider gulf in wage rates for related occupations between developed and less developed countries. As skill sets in the latter countries increase, as is already occurring, wage rate equalisation between high and low wage economies is likely to progress.

[12] This argument was taken to the extreme under Bretton Woods by the school of thought known as "global monetarism", in which only global monetary forces played a role (eg, McKinnon (1982) and, for a critique, Willett (1983)).

prices, at least in the short run. Financial globalisation and the greater opportunities for hedging could add to this effect.

The bottom line is twofold. Exchange rate fluctuations could come to play a smaller role in the inflation process. In particular, despite higher competition in goods markets, the exchange rate pass-through could decline even for similar goods.[13] In addition, for much the same reasons, the influence of global factors on inflation could rise. The reason is that, given greater monetary convergence and stability, exchange rates would be a less effective cushion to offset country-specific nominal impulses.

A quick look at the data does support the prima facie case that globalisation may have had a role to play in the observed inflation dynamics (Graph 2 and Statistical Appendix). Inflation has clearly become much lower across the globe. This has occurred alongside an intensification of globalisation trends during the nineties. And the trend has affected a broad range of countries, regardless of differences in underlying institutional structures and the specifics of monetary regimes.

But in order to explore the role of globalisation we clearly need to go well beyond this prima facie case.

II. Testing for the impact of global factors

How can the relevance of a more globe-centric (equivalently, less country-centric) view of the inflation process be tested? Our strategy is to extend the traditional Phillips curve specifications to include various measures of global economic slack, controlling also for a variety of foreign influences, such as import prices and oil prices. Before outlining the tests in detail, however, we first relate our work to previous studies.

Related studies

Ours is not the first attempt to explore the implications of globalisation for inflation. Those which have done so directly, however, are rather few.

In terms of methodology, Tootell (1998) is closest in design to our work. He uses an augmented Phillips curve specification for the United States, with a trade-weighted foreign output gap. The foreign gap, however, is limited to the G–7 trading partners. He finds no relationship between foreign measures of slack and US inflation. Our paper considers the inflation performance of a much wider set of countries, a more broadly defined set of global output gaps, and a longer data series. This last point may be significant because, in his regression results with data from 1984–1996, the coefficient on the foreign output gap has the correct sign and is fairly large, although it is statistically insignificant. The addition of another decade of data may help to improve the statistical power of the tests; our cross-country approach may improve our ability to pick up subtle trends that are less apparent in a single country study; and our broader measures of global economic slack may be more appropriate. Finally, his paper focuses on the direct trade channel of inflation transmission.[14]

---

[13] See BIS (2005) and Sekine (2006) for recent evidence. Also see Gagnon and Ihrig (2004) and Devereux, Engel and Storgaard (2003) for evidence about declining pass-through to consumer prices, and Campa and Goldberg (2002) about pass-through to import prices.

[14] A recent paper by Matheson (2006), while not focusing on globalisation per se, offers an alternative approach to isolating the trade effect. He estimates tradable and non-tradable sector Phillips curves, with proxies for sectoral capacity constraints. He finds that accounting for (domestic) sectoral differences between tradables and non-tradables in Australia and New Zealand boosts the predictive power over aggregate Phillips curves.

We go beyond this direct trade channel by also entertaining the possibility that contestability may play a more important role.[15]

Recent research efforts to investigate the impact of global factors on inflation trends have used other types of methods, with pros and cons vis-à-vis our approach.

Ciccarelli and Mojon (2005), for example, use a dynamic factor model to first identify global inflation for 22 OECD countries from 1960 to 2003; in contrast, we start with a list of global determinants of domestic inflation. Then they search for domestic and global (real and nominal) variables that are correlated with the global inflation factor. Our procedure does not impose a common inflation tendency across countries. In theory, there is no particular reason why this constraint would hold, even though in OECD countries it may be a good approximation. One drawback of their procedure, as Ciccarelli and Mojon rightly point out, is that it is not clear whether this global inflation factor is truly global in the sense of being driven by global factors or whether domestic monetary policy behaviour in OECD countries is subject to a common way of thinking about the policy tradeoffs. Their evidence concerning the correlation between global inflation, on the one hand, and commodity prices, the global business cycle and global liquidity, on the other, suggests that global factors may be important. Mumtaz and Surico (2006) corroborate and extend this empirical analysis by exploring the temporal cross-country variation in inflation volatility. They find evidence that inflation volatility appears to have become increasingly driven by a common global factor, especially when compared to the 1970s and early 1980s.

Morimoto et al (2003) look at this issue from yet another perspective. They estimate a global supply shock by extracting the first principal component of the residuals from a set of New Keynesian Phillips curve regressions for seven countries (which include South Korea and Taiwan, China). They find that this component shows a systematic pattern since the mid-1990s, which is consistent with rough measures of globalisation, such as global import penetration by emerging market economies. In addition, based on a structural VAR, they find further statistical support for the view that the global supply shock could be interpreted as a proxy for the rapid expansion of production capacity in emerging market economies. The authors' interpretation of the results emphasises the role of direct trade channels from the emerging market economies to industrialised economies to explain the disinflationary pressures. While consistent, the globe-centric view goes beyond this channel to consider global capacity constraints as a general feature of the current environment. As such, it is possible that by using only domestic measures of slack (or marginal costs) in the New Keynesian Phillips curve, the first principal component may have identified an underlying misspecification. The globe-centric view would suggest that global capacity proxies might be the missing variable.

[15] The empirical literature on the correlation between inflation and openness across countries is also relevant here, to the extent that one associates globalisation with greater openness. The results have been somewhat mixed (eg, Romer (1993, 1998), Lane (1997), Terra (1998) and Temple (2002)). More recently, however, Gruben and McLeod (2004) find that trade openness is clearly associated with lower inflation, albeit only in the 1990s. This would in principle be consistent with a stronger effect of openness during this period, possibly linked to greater contestability and relocation possibilities. In addition, based on micro data, Chen et al (2004) find corroborating evidence, indicating that increased openness has indeed reduced markups, raised productivity and put downward pressure on sectoral prices in EU manufacturing. Using disaggregated data from 1988-2000, they estimate the direct impact on inflation from lower import prices to be much smaller than the indirect effect from central bank incentives to lower their preferred rate of inflation.

Extended Phillips curve approach: the methodology

There are three fundamental ways of thinking about the effect of globalisation on empirical inflation models. At one extreme, globalisation may have fundamentally changed the inflation dynamics, effectively rendering existing models irrelevant. At the other extreme, globalisation may be seen as a sequence of favourable supply "shocks" which can be tacked on to existing domestic Phillips curve specifications in the conventional way, such as by including import prices. The compromise approach that we adopt is that globalisation may have led to structural instability but that these global forces can be captured by changing some of the key parameters and considering alternative measures of economic slack. In particular, we interpret the globe-centric view as suggesting that global measures of slack may be supplanting the relevance of domestic measures.

Thus, to investigate the potential impact of global factors, we augment a mainstream model of inflation. Our benchmark inflation model is

$$\pi_t - \pi_t^U = c + \beta Gap_{t-1}^D + \phi Gap_{t-1}^{G_i} + \eta X_{t-1} + \varepsilon_t \,, \qquad (1)$$

where π is the inflation rate, π^U is the underlying inflation rate trend (used largely as a proxy for slowly changing inflation expectations),[16] Gap^D is the conventionally defined domestic output gap, X is a set of proxies for other factors normally included in empirical Phillips curves (eg, oil, import and other commodity prices and unit labour costs) and ε is a random error. Gap^{G_i} is a global measure of economic slack.[17]

The function of π^U is essentially designed to help isolate, in an admittedly crude way, the effect of economic slack at *cyclical* frequencies from that of other proximate factors affecting the inflation *trend*, such as sluggish inflation expectations.[18] This is important, because during the period under consideration a tougher anti-inflation stance by central banks tended to occur roughly at the same time as globalisation forces were gathering pace. We would not like to attribute the effect of this regime change solely to globalisation.

This reasoning also makes clear that, if anything, our specification is likely to underestimate the possible impact of globalisation. By focusing only on the cyclical aspects of the inflation process, it abstracts from any direct or indirect effect that globalisation may have had on the inflation trend. For instance, as argued earlier, globalisation may have made it easier for central banks to reduce inflation, gain credibility and hence also anchor expectations more firmly. Other various potential factors could have been at work too, but disentangling their contributions appears to be rather complicated; these factors are reviewed in BIS (2006). We leave for future research an exploration of the relationship between global factors and changes in the persistence of inflation and inflation expectations.

---

16 The underlying inflation trend is approximated by a Hodrick-Prescott trend of core inflation.

17 This Phillips curve specification is of the backward-looking variety. While Lucas critique concerns may be relevant over the time periods that we are examining, recent empirical research (eg Estrella and Fuhrer (2003), Levin and Piger (2003), O'Reilly and Whelan (2004) and Stock and Watson (2005)) suggests that backward-looking models in many respects may be more structurally stable than forward-looking models during this period. Moreover, such backward-looking specifications are important in the exploration of optimal monetary policies (eg Rudebusch and Svensson (1999)).

18 See the discussion of finding 1 below. For a review of recent modelling efforts to address the issue of sluggish updating of inflation expectations, see Ball et al (2005). Ball (2000) shows that sluggish updating helps to account for the good fit of accelerationist Phillips curves and that the model is consistent with traditional views of the transmission mechanism of monetary policy. Our specification can also be thought of as being consistent with the empirical approach of Stock and Watson (1999).

We have chosen to suppress a potential autoregressive component for statistical reasons. There are several ways to think about this choice. First, in a simple statistical sense, the presence of autocorrelation in the residuals should not bias the coefficient estimates on the output gaps, even though in large samples the estimators would be asymptotically inefficient. We confirm in the Appendix this unbiasedness property for the coefficient on the global gap in small samples. Second, recent literature has emphasised the tendency for the autoregressive component to dominate the persistence of the inflation process, which could obscure the "inherited" persistence coming from the slack measures. Fuhrer (2005), in the context of the New Keynesian Phillips curve, illustrates how joint estimation of the autoregressive term and the slope coefficient on slack can be very difficult to parse with data over the past few decades. We explore this possibility in the Appendix and find strong evidence in favour of our specification over the conventional forecasting-based Phillips curve specifications typically used in the literature. The simulation evidence in the Appendix confirms that the conventional approach exhibits potentially large biases that would adversely affect inferences about the role of the global factors.[19]

Our featured measure of global economic slack is a weighted average of international output gaps. The global output gap, Gap^{G_i}, in this paper is assumed to have a very general structure:

$$Gap_j^{G_i} = \sum_{k \in K} w_{j,k}^i Gap_k^D, \; G_i \in \{W1, W2, W3, W4, WG\} \qquad (2)$$

where w is an appropriately defined weight and Gap_j^D is the conventionally defined domestic output gap for country j. We investigate five versions: a trade (exports and imports)-weighted gap, an import-weighted gap, an exchange rate-weighted gap, a mix of the trade- and exchange rate-weighted gap and a GDP-weighted gap. The first four are country-specific in the sense that the weights depend on the constellation of bilateral trade and/or exchange rate linkages. By contrast, the global GDP-weighted gap is not country-specific.

We next motivate the choice of weights, *w*.

(i) Weights for the trade-weighted global output gap (W1)

$$w_{j,k}^{W1} = \frac{\text{import}_{j,k} + \text{export}_{j,k}}{\text{total imports and exports}_j}$$

The trade weights emphasise the role of trade competition. This measure assigns a larger weight to those countries with which the country in question competes most, in the sense of trading most intensely. It is the typical choice when calculating effective exchange rates.

---

[19] In addition, the specification of underlying inflation helps to eliminate the need to control for structural breaks in the constant and the autoregressive terms. Breaks could complicate inferences about the size of the autoregressive parameter (ie the intrinsic persistence) and lead to spurious correlations between slack and inflation. In an earlier draft of this paper, this possibility led to robustness problems that tended to overemphasise the role of the global factors in some data samples; the fragility of the preliminary results led us to this more robust specification. Moreover, in this paper we are not interested in forecasting but rather in investigating whether global slack measures might help drive domestic inflation. Forecasting would naturally motivate the use of a more elaborate autoregressive specification with the possibility of time-variation in the parameters (eg Atkeson and Ohanian (2001), Stock and Watson (2005), Mumtaz and Surico (2006)).

In a narrow sense, this structure of weights seeks to capture the role of foreign slack in the pricing of tradables. Even so, correlations with inflation might also be consistent with the impact of tradables on import-competing industries (and related factor markets) and on contestability pressures for sets of goods and services on the extensive margins, ie the ability to displace existing production lines in certain countries if costs were to rise relative to others (either through off-shoring or plant closures).

Note, however, that this measure has some limitations. First, unfortunately, it does not factor in third-market effects. That is, in the limit, if countries i and j exported a lot to the same markets but did not trade with each other, they would not be considered as competing for current purposes. Second, more generally, as the weights correspond to bilateral flows, they do not measure directly the degree of overall economic slack in the relevant markets. This would depend on overall production by all the relevant producers in the world.

The trade weights are calculated for each country's 10 largest trading partners. As the ranking of partners changes over time, the trade weights are updated annually.

(ii) Weights for the trade-weighted global output gap (W2)

$$w_{j,k}^{W2} = \frac{\text{import}_{j,k}}{\text{total imports}_{\text{j}}}$$

By comparison with W1, this weight structure lets us isolate the importance of import channels. The weights are calculated for each country's 10 largest import partners.

(iii) Exchange rate-weighted global output gap (W3)

$$w_{j,k}^{W3} = \frac{f_{j,k}}{\sum f_{j,k}} \text{ where } f_{j,k} = 2 * \frac{\exp\left(\frac{\rho_{j,k}-1}{m}\right)}{1+\exp\left(\frac{\rho_{j,k}-1}{m}\right)} \text{ and}$$

$$\rho_{j,k} = correlation(\text{US bilateral exchange rate for countries j and k}).$$[20]

The exchange rate-weighted weights emphasise the role of the exchange rate regime in "exporting" inflation from one country to another. The tighter the link between a pair of currencies, the greater the relevance of the corresponding measure of economic slack. Thus, this measure is trying to capture the relevance of (quasi-) currency areas. The specific weighting function assumed is just one way of calibrating the effect (Graph 3). The f function is designed to have its maximal value of one for bilateral correlations equal to one. The function monotonically falls for values less than one. Graph 3 illustrates its shape for *m* equal to 0.2.[21] In other words, at one end of the spectrum, if the bilateral exchange rate was fully pegged, then the corresponding weight would be one. If the exchange rate was fully flexible, the weight would be close to zero.

---

[20] For pairings with the United States, $f_{us,j}$ = 1/(1+(standard deviation of the bilateral exchange rate with country *k*)).

[21] In the analysis in this paper, *m* is treated as a known constant with a value of 0.2. In future research, we could treat *m* as a free parameter and estimate it jointly using nonlinear least squares.

(iv) Exchange rate adjusted trade-weighted global output gap (W4)

$$w_{j,k}^{W4} = \frac{\dfrac{\text{import}_{\text{j,k}} + \text{export}_{\text{j,k}}}{\text{total import} + \text{export}} \cdot f_{j,k}}{\sum(\textit{numerators})}$$

This set of weights adjusts the impact of the exchange rate tightness by the trade intensity between the corresponding pair of countries. It is a natural combination of the purely trade-weighted global gap (i) and of the previous purely exchange rate-weighted one (iii).

(v) GDP-weighted global output gap (WG):

$$w_j^{WG} = \frac{\text{GDP}_j}{\text{World GDP}}$$

The GDP-weighted output gap is the broadest proxy for global slack conditions and is not country-specific. Just as domestic output gaps are proxies for aggregate inflation determinants in individual diverse economies, so the global output gap could be thought of as the closest equivalent for the world economy. It has the merit of not relying heavily on bilateral trade or exchange rate linkages. It has the limitation of not making adjustments for country-specific characteristics, although these might be indirectly captured by the sensitivity to this factor. Graph A.1 illustrates how the global output gap compares with domestic output gaps.

Extended Phillips curve approach: the results

The data for this study cover both industrial and emerging market countries. The Phillips curves are estimated for 16 advanced economies, as well as for the euro area, where possible. However, the measures of global slack include information for an additional 12 emerging market economies, including the largest ones. The list of countries, data sources and data availability can be found in the Statistical Appendix.

We present our findings in various stages. First, we illustrate how purely domestic measures of domestic slack have been losing significance in traditional country-centric Phillips curve relationships. Second, we consider the performance of global gaps in pooled regressions. The reason for pooling the data is to gain efficiency in estimation, given the postulated global nature of the phenomenon. Third, we examine the phenomenon on a disaggregated country-by-country basis, so as to ensure that our results are not biased by any failure of the pooling restrictions to hold. Fourth, we assess the robustness of the findings to the inclusion of a number of additional control variables. Fifth, we investigate the performance of other possible measures of global factors. Finally, we see what further information can be gained by disaggregating between manufacturing and service prices, as admittedly rough proxies for tradable and non-tradable products.

Our findings are broadly consistent with a more globe-centric view of the inflation process. They suggest that global factors have become more important relative to domestic factors, and that in some countries the explanatory power of global factors has actually superseded that of domestic output gaps as one of the key determinants of domestic inflation.

Finding 1: Declining sensitivity of inflation to domestic output gaps

Consistent with anecdotal evidence and recent country studies (see Galati and Melick (2006), Stock and Watson (2005)), the sensitivity of inflation to changes in economic slack has generally fallen across a wide range of industrialised countries. Graph 4 summarises the quantitative size of the change by comparing the sensitivity during the first and second halves of the sample period (1980-2005). The finding is based on regressions that allow for an autoregressive component in the inflation process, as described in Table 1. This specification is consistent with a more conventional modelling approach to inflation (Dew-Becker and Gordon (2005)) and serves as a benchmark to motivate our preference for the use of equation 1 in the rest of the paper (see below). The decline in the average one-year impact of a change in the gap on inflation has been sizable.

This finding, in and of itself, is consistent with the potential role of global factors. The global nature of the decline suggests a global explanation. And it is precisely in the second half of the sample that global forces have been stronger (BIS (2005)). On that basis, one might expect a weakening of the relationship with domestic measures of economic slack in that sub-period.

At the same time, the finding is broadly consistent with other hypotheses, too. In particular, it has been commonly argued that greater credibility of monetary policy, coupled with lower and stable inflation, should be expected to moderate the self-reinforcing process by which rising inflation expectations beget rising inflation. For example, both prices and wages would tend to react less if economic agents expected a more pre-emptive and tougher policy reaction. Moreover, it is not surprising that at low inflation rates nominal adjustments are likely to be less frequent and reactive to “shocks” (Goodfriend (1993), Orphanides and Williams (2003)).

Is it changes in expectations formation or in a more structural sensitivity to domestic measures of slack that may be at work? Evaluating the empirical importance of the various hypotheses is fraught with difficulty in a single-equation setup. However, one possible way to gain some insight into the relative contributions of the different channels is to examine changes in the autoregressive inflation coefficient and in the slope coefficient on the output gap (ie the impact coefficient). One could then interpret the change in the autoregressive coefficient as reflecting changes in the persistence of inflation expectations and in central banks’ emphasis on inflation control.[22]

Based on this very rough approach, there is some evidence that both channels have been at work (Table 1). In the second half of the sample, alongside the decline in the output gap coefficient, there is also a decline in the autoregressive inflation parameter. This decline is statistically significant for several countries (one-sided hypothesis tests), despite the small number of observations. Possibly more important is the tendency for the coefficient to decline in nearly all the countries. While the small sample precludes a more definitive statistical evaluation of the two channels, the broad similarities shared in the cross-country dimension reinforce the general thrust seen country-by-country.

In order to focus on the economic slack channel, we next proxy the expectations channel – or any other factor affecting the low-frequency inflation trend – by the Hodrick-Prescott filter on core inflation (equation 1). Imposing some more statistical structure on the slow-moving component of inflation helps to avoid the well-known pitfalls in estimating jointly the autoregressive structure and the coefficient on the output gap. This tends to produce results that are not robust, indicating a flat likelihood function. This problem is potentially severe for inferences about the factors driving inflation and, in our case, the Appendix shows just how daunting this is.

---

[22] These econometric challenges and conclusions are largely consistent with the links between monetary policy and the slope of the Phillips curve studied in Roberts (2004) for the United States.

Finding 2: Rising importance of global measures of economic slack

Given the similarity of inflation trends across industrialised countries, we first pool cross-country experiences, ie assuming common regression coefficients for equation 1 across countries and estimating them jointly. This can help to mitigate the statistical uncertainty that may arise in small samples. Moreover, the globe-centric perspective emphasises the common factors that may be driving domestic inflation across countries. This possibility suggests that significant gains may be realised from pooling cross-country data as a means to uncover statistically the role of global factors in the determination of domestic inflation.

The results from the data sample 1985–2005 provide some evidence that global measures of economic slack may be important.[23]

First, coefficient estimates on the various global measures of economic slack (W1, W2, W3, W4, WG) are statistically significant (diagonal in Table 2). This suggests that the global measures of slack provide significant explanatory power above and beyond that contained in domestic measures when the data are pooled together.

Second, the inclusion of the global slack measures tends to reduce the economic significance of the domestic output gap, as reflected in the size of the corresponding coefficient (column 1 vs other columns). In addition, the coefficient on the global measures tends to be larger than that on the domestic output gap.

The results do not appear to reflect obvious misspecifications. One standard statistical concern when using pooled data is that the residuals from the country regressions could exhibit systematic patterns, eg u-shapes and outliers, which could indicate bias in the coefficient estimates. Graph 5 dispels such concerns, as the (conditional) residuals appear to represent a textbook pattern of a well-behaved residual scatter plot. The superimposition of the estimated regression line, with its clear positive slope, supports the general notion that as global slack is reduced, domestic inflation pressures build.[24]

The time-varying nature of the correlations is also consistent with the increasing role of global factors. For one, when estimated over the 1972–1992 period, the global measures of slack show much less statistical significance (Table A.2 in the Appendix). The analogous scatter plot for the corresponding sample confirms that the conditional correlations with the global factors are generally insignificant and in several cases negative (Graph A.2 in the Appendix). In addition, rolling regressions estimated over a 20-year moving window indicate a noticeable rise in the estimated coefficient on the global slack variables (Graph 6). The pickup begins in the sample that ends in the early 2000s, which is broadly consistent with the anecdotal evidence of the acceleration in globalisation.

These pooled regression results, while insightful, should be interpreted with caution. Strictly speaking, the statistical assumptions justifying estimator unbiasedness in a pooled regression setting do not appear to be satisfied. The null of parameter constancy across countries can be rejected at the 1% confidence level. The same is true of the constancy of the slope coefficients on the domestic output gap and of the various global slack

---

[23] We estimate the model using GLS with White standard error corrections for cross-sectional heteroskedasticity. The regression coefficients are assumed to be common across countries. This assumption finds some support in the panel approach of DiNardo and Moore (1999).

[24] Note, in addition, that the constant is not statistically different from zero (at conventional confidence levels). This is consistent with the assumption that the deviations of inflation from our measure of underlying inflation are unbiased.

measures.[25] The failure of the pooling tests indicates that country-by-country regression analysis may provide more accurate point estimates of slope coefficients on the measures of domestic and global slack.

We thus next examine the empirical fit of equation 1 country-by-country. We start by checking the performance of the restricted country-centric specification, excluding global factors. The fit serves as a benchmark to interpret the role of the global measures.

Table 3 confirms the conventional story that domestic output gaps are correlated with inflation dynamics in this specification of the Phillips curve. Once we allow for the slow-moving trend, the coefficients on the domestic output gap have the correct sign and are highly statistically significant for all countries.

By introducing global gaps into the regression, we offer an alternative perspective on the relevant measures of economic slack. Table 4 shows the results of this augmented Phillips curve for the sample 1985–2005. The "model" column refers to the version of the global gap used in the regression. To economise on space, we report only the version of the global gap that best fits the data; the models in brackets indicate other versions of the global measures that are also statistically significant.

The results are quite striking. It is apparent that the global measures are statistically significant for nearly all the countries in the sample. It is global measures of slack rather than domestic measures of slack that seem more highly positively correlated with domestic inflation dynamics. Possibly more importantly, the global gap completely displaces the domestic output gap in terms of statistical significance in many of the cases. And in those cases where the domestic gap is statistically insignificant, the size of the coefficient is generally reduced.[26] Graph 7 offers a graphical summary of the results: the changes in the global gap and domestic gap coefficients, on average across countries, confirm the pattern seen in the pooled results. This suggests that the potential statistical biases associated with pooling are not severe enough to distort the main thrust of the evolving inflation behaviour.

Which measure of global slack works best? The results indicate that no particular measure dominates for all the economies. Some models, however, tend to stand out from the others (Table 4). Models W1, W2 and W4 are statistically significant for 12 countries in the sample. Models W3 and WG show up 5 times in the table. Ranking the models that appear to be most important for each country, the W2 model far exceeds the alternatives with 7 first place rankings. Taken at face value, this would suggest that the trade channel plays a very important role, especially via direct and indirect import competition.

Finding 3: Results robust to the inclusion of traditional control variables

We next augment the globe-centric Phillips curve with other domestic and external country-specific factors that might help to capture other inflation pressures. Consideration of such factors has traditionally been an important aspect of Phillips curve estimation, especially after the experience of the oil shocks in the 1970s (Dew-Becker and Gordon (2005)). It is well known now that supply shocks, such as oil price changes, can affect the "structural" stability of estimated equations. Investigating whether their inclusion can overturn our earlier findings

---

[25] We test for poolability using an F-statistic, $F_p = \dfrac{(e'e - \sum e_i'e_i)/(n-1)K}{\sum e_i'e_i / n(T-K)} \sim F_{(n-1)K,\, n(T-K)}$, where $e'e$ is the sum of squared residuals from the pooled regression, $e_i'e_i$ is the sum of squared residuals from country i's regression, n is the number of countries, T is the sample size and K is the number of estimated regressors.

[26] The regression results for versions of the global measures which are not shown display similar evidence of the global measure displacing the domestic measure. And, for many of the regressions in which the global measures are not significant at conventional levels, the p-values are still respectable.

is important as a check of the robustness of our findings. It is quite possible that global slack measures may simply be capturing the hidden influence of omitted variables.

We consider import prices, oil prices and domestic unit labour costs. The analysis is done by adding each variable, one at a time, to our baseline globe-centric specification in Table 4.

Overall, while these variables help to improve the fit of the Phillips curve, they do not knock out the statistical significance of the global slack measures (indicated in the column labelled ϕ) for most of the countries under investigation (Table 5). Nor do they have a large effect on their economic significance, ie, on the size of the corresponding coefficient.

The variables that work best are import and oil prices, both consistent with the role of international competition and global factors in inflation determination. The 4-quarter percent change in import prices is an important factor influencing domestic inflation. The coefficient on import prices is positive in most cases and is statistically significant in 9 cases. The coefficient on the 4-quarter percent change in oil prices is uniformly positive, as one might expect, and is statistically significant in 11 countries.

The performance of (nominal) domestic unit labour costs (4-quarter growth) is more mixed. As many as 6 out of the 16 coefficients are actually negative, although in general only the positive coefficients are statistically significant. The attention to unit labour costs in the New Keynesian literature has led to renewed interest in the importance of labour cost channels in determining domestic inflation. Our evidence is squarely on the side of a traditional wage cost channel of inflation.

Finding 4: Some relevance of speed limit constraints for China

The relevance of our results partly depends on the accuracy of the output gap in China as a good measure of economic slack. The accuracy of the output gap may be particularly questionable for economies in transition, which have been undergoing significant structural changes. In these cases, the gap may be poorly measured because of data quality issues. In addition, it may be an unreliable measure of capacity constraints.

In the light of the significant and growing global importance of China, we investigate whether speed limits (as measured by the change in the estimated output gap) may improve our ability to pick up global forces relevant for inflation. By all estimates, the labour supply in China is highly elastic and capital levels are far below those associated with steady-state long-run growth. This means that the *level* of potential output may be a rather “soft” and hard-to-measure constraint. Over the very shortrun, however, the inability to redeploy the workforce from the countryside to the centres of production without rising shortrun marginal costs may create bottlenecks that could be associated with rising inflation pressures. To the extent that this is true, the acceleration and deceleration of economic activity may be a much more useful measure of short-run capacity constraints than output gaps.[27]

The results provide some weak confirmation of the view that China’s speed limit is a potentially significant factor influencing domestic inflation trends (Table 6). The coefficient on the speed limit variable is only statistically significant (and of the correct sign) for 3 economies. The modest potential role of China inflation developments on domestic inflation in other countries is consistent with previous findings by Feyzioğlu and Willard (2006) and Kamin et al (2004).

Moreover, regardless of the relevance of the speed limit, the global slack measures still play a key role. Thus, while the results suggest that the China-factor has had an effect, global

---

[27] This is roughly consistent with the autoregressive structure in inflation equations found by Gerlach and Peng (2006)).

influences are best captured by global developments, as opposed to those in particular, if at the margin very influential, countries. This is consistent with the globe-centric view. Whether a more empirically and theoretically satisfying measure of speed limits for China and other important emerging market economies could alter this conclusion is a question that deserves further research.

Finding 5: Complementary information from other measures of global price pressures

Could other globe-centric measures of inflationary pressures play a role in addition to those of global slack?

In nearly all economies, wages comprise a large proportion of production costs. As such, to the extent that global factors matter, one might also expect global unit labour costs to play a significant role in short-run inflation dynamics. Also, price pressures in the global pipeline in the form of wholesale price inflation may provide useful information about future headline inflation developments.

To test these possibilities, we first added a global unit labour cost (ULC) gap variable and a global wholesale price (WPI) gap variable to the benchmark specification. These global measures are defined as deviations of GDP-weighted averages of countries' unit labour costs and wholesale price inflation, respectively, from a Hodrick-Prescott trend. Partly because of data limitations, we rely on unit labour costs in manufacturing only.

The results for the global ULC gap suggest that the global output gap remains an important measure of global inflationary pressures (Table 6). The relevance of this slack measure is hardly affected by the inclusion of the global ULC variable. In turn, the ULC gap is not particularly useful in accounting for inflation developments in industrialised economies, although for those countries for which coefficients are statistically significant, the sign is positive and consistent with conventional wisdom. We leave for further research the exploration of global measures of cost channels.[28]

The results for the global WPI gap indicate that this variable has relevant complementary explanatory power, underscoring the relevance of global factors. It is statistically significant across a large set of countries but, on the whole, does not much affect the information content of the global output gap.

We finally tried another proxy for global price pressures, using the survey-based JPMorgan PMI manufacturing price index. In this case, we take the 4-quarter rate of change. This series, however, is only available starting in 1998, which drastically reduces the degrees of freedom available.

The results are decidedly mixed, with little evidence of statistical significance and a varied sign pattern (same table). The reasons for this are unclear. Possibly, the very limited length of the series makes any statistical significance hard to find. In fact, the series does appear to lead global inflation developments in a clear way (Graph A.3 in the Graphical Appendix).

---

[28] One caveat to this discussion is that measurement of the global unit labour costs may be biased because of data limitations. Notably, the global unit labour gap does not incorporate data from China, India or much of eastern Europe. Given that these regions have accounted for most of the increase in the effective global workforce and are often cited as a source of significant globalisation pressures, their absence suggests that the global unit labour cost results should be interpreted with great care. In addition, there may be an important role for forward-looking wage expectations in unit labour cost fluctuations. The New Keynesian Phillips curve literature has emphasised the fact that above-trend unit labour costs may indicate that cost pressures, and hence inflation, might be expected to recede. Such channels are discussed in Sbordone (2005); for a more sceptical reading of the empirical relevance of such models, see Rudd and Whelan (2005). Notwithstanding this line of inquiry, understanding the drivers of wage and price expectation formation would help to enrich our evaluation of the role played by global factors in determining domestic inflation dynamics.

Finding 6: Corroborating evidence from goods and services price inflation

To investigate the additional implications of a more globe-centric view, we look at sectoral inflation rates. To be sure, as discussed above, aggregate inflation rates tend to diverge systematically from sectoral inflation rates and our interest is ultimately with aggregate rates. For example, manufacturing price inflation typically has been lower than service sector inflation, not least reflecting differential productivity growth. At the same time, if globalisation forces have their largest direct impact on manufacturing industries, we would expect the global measures of slack (as a proxy for a global manufacturing measures of slack) to be more correlated with goods price, than with services, inflation.

Preliminary estimation yields some supporting evidence. For goods price inflation, global measures of slack generally have a positive coefficient for those estimates that are statistically significant (Table 7). At the same time, the global output gap also matters for services price inflation, although somewhat less so than for goods (Table 8). In the case of services inflation, the domestic gap tends to be relatively more important in some cases; in the table, the negative coefficients on the global gaps are generally associated with large and statistically significant coefficients on the domestic gap.

How surprising should it be that the global output gap also matters for services? To be sure, services are becoming more tradable. However, the extent of services trade is still comparatively small. A more plausible explanation of the correlation is related to labour market dynamics. Even if goods are primarily tradable and services are not, sectoral labour supply flows, actual and potential, would link the fortunes of the two. A rise in global demand for tradables would tend to raise wages, and hence costs, first in manufacturing, and this could then spread to other sectors such as services, through various arbitrage linkages. Broadly consistent with this, the coefficient estimates are generally smaller for the services price inflation than the manufacturing price inflation regressions.

While the statistical significance of these regressions is lower than that for aggregate inflation ones, the quality and breadth of coverage of goods and services inflation data are poorer. More research into the impact of globalisation on goods and services price inflation is needed, both at the macro level, along the lines set out in this paper, and at the micro level. A focus on tradables and non-tradables might possibly yield even more definitive conclusions. However, as Burstein et al (2005) point out, such data are not easily inferred from readily available inflation indexes.[29]

Conclusion

The evidence in this paper is broadly consistent with the conjecture that the world has edged closer to a configuration that highlights the elements present in a globe-centric view of the inflation process. The findings support the hypothesis that global factors are becoming empirically more relevant for domestic inflation determination across a broad range of countries.

The evidence, of course, is just preliminary. The robustness of the findings should be assessed further and their relationship to other specific hypotheses, such as the role of changes in monetary policy regimes, should be examined more closely. The results also raise some intriguing questions, such as about the precise role of global unit labour costs.

[29] For a narrow set of tradable commodities, however, such data can be created. For example, see De Gregorio et al (1994). How well correlated this set might be with tradable capacity measures is an open empirical question.

And, ultimately, some of the details of the globe-centric view cannot be tested directly without better information about tradable and non-tradable goods and services, better measures of the contestability of markets and more micro-data that could cast light on how global competition is influencing price markups, wages and price setting.

Moreover, our results rely critically on a specification that filters out the disinflationary trend from the data. Economically, this means that we are in fact to a large extent abstracting from the more secular potential disinflationary impact of globalisation, not least interacting with monetary policy choices. Econometrically, we have argued that this specification may actually be an improvement over more traditional, if looser ones, in which the autoregressive inflation component is allowed to play an unconstrained role. Our simulation exercises based on industrialised country data over the past two decades suggest that this traditional approach may result in sizable biases in small samples and seriously mask the role of global factors. All this puts a premium on careful econometric design, based on tighter theoretical priors. It also highlights the distinction between exercises aimed at forecasting, for which atheoretical unconstrained autocorrelation processes are quite useful, and those aimed at understanding the underlying forces behind economic outcomes. On both economic and econometric grounds, further work is clearly needed to identify the best specifications, assess the robustness of the results and identity more precisely the channels through which globalisation may have an impact on the inflation process. This would also cast light on the extent to which the global measures of slack may act as proxies for some of these channels.

Even so, the purpose of this preliminary investigation was simply to begin to explore the validity of the conjecture. Judged against this benchmark, we would argue that the evidence indicates that the hypothesis is worthy of further serious investigation, both theoretical and empirical. This dimension of the inflation process has received too little attention so far.[30]

If the growing relevance of a more globe-centric view of the inflation process was indeed correct, what would be the implications for monetary policy? We would highlight three.

First, the growing importance of global factors would call for more intensive monitoring of external developments. To be sure, data such as tradable prices are useful sources of information, but they would not be sufficient. Given the lags of monetary policy, it might be important for central banks to respond to developing trends before they show up at the borders and become embedded in price and wage setting behaviour. Likewise, just as "soft" information about local conditions has been an integral part of policy deliberations, greater emphasis on "soft" information of a more global nature would take on greater significance. At the same time, measuring global slack conditions is likely to be a challenge. The well-known difficulty of measuring real-time domestic output gaps, and economic slack more generally, would be magnified in the case of their global counterparts.

Second, and more speculatively, one should guard against the risk of systematic errors in policy. If, for instance, the downward pressure on inflation resulting from globalisation was underestimated, the result might be a surprisingly subdued inflation rate alongside unusually low policy rates. This, in turn, might have a number of undesirable side-effects, such as the unwitting accommodation of the build-up of financial imbalances, notably "excessive" credit and asset price increases that could raise material risks for the economy further down the road. Indeed, global economic developments in recent years bear a certain resemblance to this perspective.[31] Conversely, failure to appreciate the build-up of global inflationary

---

30 Recent challenges facing monetary policymakers have arguably been driving a renewed research interest in the links between globalisation and inflation. See, for example, Bollard and Smith (2006), Ferguson (2005), Fischer (2006), Gjedrem (2006), King (2006), Kohn (2005, 2006), Papademos (2006), Persson (2005), Rosenberg (2006) and Yellen (2006).

31 For a detailed discussion of this view, see Borio and Lowe (2002) and (2004), Borio et al (2003) or Borio and White (2003) and White (2006). For a more recent analysis, see also BIS (2005). This, in turn, raises

pressures could result in surprisingly strong inflation, with the risk that central banks might fall behind the curve.

Finally, and even more speculatively, questions could ultimately be raised about the very effectiveness of domestic monetary policy. To the extent that, in a proximate sense, domestic inflation became increasingly influenced by global capacity constraints, this could weaken the near-term efficacy of domestic monetary policy levers, because of their limited (ie domestic) reach. Together with a flattening of the slope of the Phillips curve (with respect to domestic slack), while retaining control over the *long term*, central banks might find it harder to control inflation in the *short term* or, at least, may need to adjust their instruments more vigorously. The power of policy could be complicated further by the implications of financial globalisation, which could be weakening the ability of central banks to influence domestic real interest rates, especially longer-term rates, independently of global conditions.

An intriguing new statistical regularity, a broad conceptual perspective rationalising it, and a set of potentially far-reaching policy implications: all the ingredients would seem to be there to justify investigating further the merits of a less country-centric, or more globe-centric, view of the inflation process.

Appendix

The appendix provides simulation evidence to support our specification choice in the paper. It also underscores the potential hazards of using conventional Phillips curve specifications that were designed for forecasting to infer the key factors driving inflation. Indeed, it is shown that the conventional Phillips curves approach that has been the workhorse in forecasting is a particularly poor statistical methodology to identify driving factors for sample periods such as the one focused on in this paper.

This appendix addresses the issue by examining the small-sample distributional properties of the parameters of a conventional Phillips curve specification and of our preferred specification. The small-sample aspect of the issue is critical. Since the mid-1980s, inflation has trended down in industrialised countries. These trends, in small samples, can and will be shown to lead to potentially large statistical bias (type II errors) for some types of specifications. To this end, we use Monte Carlo simulations to illustrate just how wide are the deviations of the statistical properties of the data from classical regression assumptions for the period under investigation.

Experimental design

Step 1: simulating the data. Simulated data are generated from a model that assumes that domestic and global output gaps drive the inflation process: $\pi_t = c + f(t) + \alpha\pi_{t-1} + \beta Gap^D_{t-1} + \phi Gap^G_{t-1=} + \varepsilon_t$, where it is assumed that $c = 0$, $f(t)$ is a nonlinear trend with a shape resembling an HP-filtered series of inflation in the industrialised countries, $\alpha = .0$, $\beta = .1$, $\phi = .3$ and the error term is serially correlated. Serial correlation in the error term is modelled as $\varepsilon_t = \rho_1\varepsilon_{t-1} + \rho_2\varepsilon_{t-2} + \eta_t$, with $\rho_1 = 1.0$, $\rho_2 = -.27$ and $\eta_t \sim N(0,.20)$ (calibrated

questions about the appropriate response to "good" or "bad" deflation (eg, Borio and Filardo (2004) and Bordo and Filardo (2005)). The risk here is responding too vigorously to benign disinflation from low inflation rates. By unwittingly accommodating the build up of financial imbalances, this could in turn risk increasing the probability of a "bad" deflation further down the road, as the imbalances unwind.

loosely to the US data). Without loss of generality, Gap^D_{t-1} and Gap^G_{t-1} are data for the United States and WG, respectively. Twenty thousand simulations are drawn.

Step 2: estimating specifications with the simulated data. Two specifications are estimated. The first specification is a conventional forecasting-based AR(1) Phillips curve specification:

(AR) $\pi_t = c^{AR} + \alpha^{AR}\pi_{t-1} + \beta^{AR}Gap^D_{t-1} + \phi^{AR}Gap^G_{t-1} + \varepsilon^{AR}_t$.

The second is the specification emphasised in the paper:

(B-F) $\pi_t - \pi^U_t = c^{BF} + \beta^{BF}Gap^D_{t-1} + \phi^{BF}Gap^G_{t-1} + \varepsilon^{BF}_t$.

For illustrative purposes, we assume the output gap data are measured with error. Namely, Gap^D_{t-1} and Gap^G_{t-1} are the actual data plus a random error (that is, $N(0,.004)$). In addition, the underlying trend in inflation, π^U_t, is estimated for each simulated series using alternative filtering methods to assess robustness.

Step 3: estimating the small-sample probability densities. To assess the unbiasedness of the parameters, probability densities are estimated using a normal kernel function constructed with 100 equally spaced intervals, which are based on the twenty thousand parameter estimates for each specification.

Results

Several features of the probability densities stand out. First, the autoregressive parameter from a conventional Phillips curve specification is significantly biased away from zero (left panel, Graph A.4). Second, the estimate corresponding to the global gap (right panel, Graph A.4) is unbiased for the B-F specification, but is severely biased towards zero for the conventional Phillips curve specification. It appears that the AR term is doing more than just soaking up the correlation in the error term, but also conflating the correlation properties of the global gap. This result may help to explain why some researchers have not found statistical confirmation of the global gap in earlier studies. Third, the estimate corresponding to the domestic gap (middle panel, Graph A.4) is somewhat biased for the B-F specification, especially when compared to the AR specification. This reinforces our concern that the insignificance of the domestic gap in some of our results should be interpreted with some care.

Table A.4 confirms these graphical impressions from the probability densities and also shows that the results are not a function of the filtering choice. We compare 3 alternative filtering methods – the Hodrick-Prescott, Butterworth and Christiano-Fitzgerald filters.[32]

---

[32] See Christiano-Fitzgerald (2003) for a discussion of the pros and cons of the random walk version of the optimal band-pass filter. One key advantage over the Baxter-King (1999) filter is not having to drop data from the start and end of the already small samples under consideration. See Pollock (2000) for the potential benefits of the Butterworth, or rational square wave, filter over that of the Hodrick-Prescott (1997) filter.

References

Ahmed, S, A Levin and B Wilson (2004): "Recent US macro stability: good policies, good practices, or good luck?", *Review of Economics and Statistics*, August.

Akerlof, G, W Dickens and G Perry (1996): "The macroeconomics of low inflation", *Brookings Papers on Economic Activity*, no 1.

Aksoy, Y, A Orphanides, D Small, V Wieland and David Wilcox (2003): "A quantitative exploration of the opportunistic approach to disinflation", *CEPR Discussion Papers*, no 4073, September.

Andersen, P and W Wascher (2001): "Understanding the recent behaviour of inflation: an empirical study of wage and price developments in eight countries", *BIS Papers*, no 3, August.

Atkeson, A and L Ohanian (2001): "Are Phillips curves useful for forecasting inflation?", *Federal Reserve Bank of Minnesota Quarterly Review*, Winter.

Aukrust O (1977): "Inflation in the open economy: a Norwegian model", in L Krause and W S Salant (eds), *Worldwide Inflation –Theory and Recent Experience*, The Brookings Institution, Washington DC.

Ball, L (2000): "Near rationality and inflation in two monetary regimes", *NBER Working Papers*, no 7988, October.

Ball, L, G Mankiw and R Reis (2005): "Monetary policy for inattentive economies", *Journal of Monetary Economics*, May.

Bank for International Settlements (2005): *75th Annual Report*, July.

Bank for International Settlements (2006): *76th Annual Report*, July.

Baxter, M and R King (1999): "Measuring business cycles: approximate band-pass filters for economic time series", *Review of Economics and Statistics*, November, pp 575–93.

Benati, L and H Mumtaz (2005): "The 'Great Stability' in the United Kingdom: good policy or good luck?", Bank of England unpublished working paper.

Blanchard, O (2006): "European unemployment: the evolution of facts and ideas", *Economic Policy*, vol 21, issue 45, January, pp 7–59.

Bollard, A and M Smith (2006): "Major developments in the new millennium", paper prepared for an address to the Canterbury Employers' Chamber of Commerce, 27 January.

Bordo, M and A Filardo (2005): "Deflation and monetary policy in a historical perspective: remembering the past or being condemned to repeat it?", *Economic Policy*, October.

Borio, C, W English and A Filardo (2003): "A tale of two perspectives: old or new challenges for monetary policy?", *BIS Working Papers*, no 127, February.

Borio, C and A Filardo (2004): "Back to the future? Assessing the deflation record", *BIS Working Papers*, no 152, March. (Abridged version: "Looking back at the international deflation record", *The North American Journal of Economics and Finance*, vol 15, issue 3, pp 287–311.)

Borio, C and P Lowe (2002): "Asset prices, financial and monetary stability: exploring the nexus", *BIS Working Papers*, no 114, July.

——— (2004): "Securing sustainable price stability: should credit come back from the wilderness?", *BIS Working Papers*, no 157, July.

Borio, C and W White (2003): “Whither monetary and financial stability? The implications of evolving policy regimes”, in *Monetary Policy and Uncertainty: Adapting to a Changing Economy: A Symposium sponsored by the Federal Reserve Bank of Kansas City*, Jackson Hole, Wyoming, 28-30 August, pp 131–211. (Also available as *BIS Working Papers*, no 147, February 2004.)

Burnstein, A, M Eichenbaum and S Rebelo (2005): “The importance of nontradable goods prices in cyclical real exchange rate fluctuations”, *NBER Working Paper*, no 11699, October.

Campa, J M and L S Goldberg (2002): "Exchange Rates Pass-Through into Import Prices: A Macro or Micro Phenomenon?," *NBER Working Paper*, no 8934.

Chen, N, J Imbs and A Scott (2004): “Competition, globalisation and the decline in inflation”, *CEPR Discussion Paper*, no 4695, October.

Christiano, L and T Fitzgerald (2003): “The band pass filter”, *International Economic Review*, May, pp 435–65.

Ciccarelli, M and B Mojon (2005): “Global inflation”, unpublished ECB working paper, March.

Clark, T (2004): “An evaluation of the decline in goods inflation”, *Federal Reserve Bank of Kansas City Economic Review*, second quarter.

Cogley, T and T Sargent (2005): “The conquest of US inflation: learning and robustness to model uncertainty”, *Review of Economic Dynamics*, forthcoming.

Corden M (1960): “The geometric representation of policies to attain internal and external balance”, *Review of Economic Studies*, no 28, pp 1–22.

De Gregorio, J, A Giovannini and H Wolf (1994): “International evidence on tradables and nontradables inflation”, *European Economic Review*, June.

Devereux, M, C Engel and P Storgaard (2003): “Endogenous exchange-rate past-through when nominal prices are set in advance”, *NBER Working Paper*, no 9543, March.

Dew-Becker, I and R Gordon (2005): “Where did the productivity growth go? Inflation dynamics and the distribution of income”, *Brookings Papers on Economic Activity*, forthcoming.

DiNardo, J and M Moore (1999): “The Phillips curve is back? Using panel data to analyze the relationship between unemployment and inflation in an open economy”, *NBER Working Paper*, no 7328, August.

Engel, C, J Rogers and S Wang (2004): “Revisiting the border: an assessment of the law of one price using very disaggregated consumer price data”, Board of Governors of the Federal Reserve System International Finance Discussion Papers, no 777.

Estrella, A and J Fuhrer (2003): “Monetary policy shifts and the stability of monetary policy models”, *Review of Economics and Statistics*, February.

Ferguson, R (2005): “Evidence and policy implications”, speech at the Association for Financial Professionals Global Corporate Treasurers Forum, San Francisco, 12 May.

Feyzioğlu, T and L Willard (2006): “Does inflation in China affect the United States and Japan?”, *IMF Working Paper*, WP/06/36, February.

Filardo, A (1998): “New evidence on the output cost of fighting inflation”, *Federal Reserve Bank of Kansas City Economic Review*, third quarter.

Fischer, R (2006): “A new perspective on policy”, a speech at Midwestern State University, Wichita Falls, 4 April.

Freeman, R (2005): “Labor goes global: the effects of globalisation on workers around the world,” transcript of the *2004 Eight Annual Rocco C and Marion S Siciliano Forum: Considerations on the Status of the American Society*. Monograph.

Freeman, R and R Oostendorp (2003): "Is European wage-setting different? Evidence from the Occupational Wages around the World data file", Chap 1 in *Institutions and Wage Formation in the New Europe* (eds. G Fagan, F Paole Mongelli and J Morgan), Conference Volume of the Third ECB Labour Market Workshop, Edward Elgar Publishing for the European Central Bank.

Fuhrer, J (2005): "Intrinsic and inherited inflation persistence", *Federal Reserve Bank of Boston Working Papers*, no 05-8, September.

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

Gagnon, E, P Sabourin and S Lavoie (2004): "The comparative growth of goods and services prices", *Bank of Canada Review*, Winter.

Galati, G and W Melick (2006): "The evolving inflation process: an overview", *BIS Working Papers*, no 196, February.

Gerlach S and W Peng (2005): "Output gaps and inflation in Mainland China", *BIS Working Papers*, No 194, February.

Gjedrem, S (2006): "Economic perspectives", address at the meeting of the Supervisory Council of Norges Bank, 16 February.

Goodfriend, M (1993): "Interest rate policy and the inflation scare problem", *Federal Reserve Bank of Richmond Economic Quarterly*, Winter.

Gordon, R (1997): "The time-varying NAIRU and its implications for monetary policy", *Journal of Economic Perspectives*, Winter.

Greenspan, A (2005): "Globalization", remarks given at the Council on Foreign Relations, New York, New York, 10 March, Federal Reserve Board.

Gruben, W C and D McLeod (2004): "The openness-inflation puzzle revisited", *Applied Economics Letters*, 11, pp 465–68.

Hodrick, R and E Prescott (1997): "Postwar US business cycles: an empirical investigation", *Journal of Money, Credit and Banking*, February, 1997, pp 1–16.

Kamada, K and N Hirataka (2002): "Import penetration and consumer prices", *Bank of Japan Research and Statistics Department Working Paper*, no 02-01, January.

Kamin, S, M Marazzi and J Schindler (2004): "Is China 'exporting deflation'", *Board of Governors of the Federal Reserve System International Finance Discussion Paper*, no 791, January.

King, M (2006): "Globalisation and relative price changes", speech at dinner for Kent Business Contacts, Ashford, 16 January.

Kohn, D (2005): "Globalisation, inflation and monetary policy", speech at the College of Wooster, Wooster, 11 October.

——— (2006): "The effects of globalization on inflation and their implications for monetary policy", remarks at the Federal Reserve Bank of Boston's 51st Economic Conference, Chatham, 16 June.

Lane, P (1997): "Inflation in open economies", *Journal of International Economics*, vol 42, issues 3-4, pp 327–47, May.

Levin, A and J Piger (2003): "Is inflation persistence intrinsic in industrial economies?", *Federal Reserve Bank of St. Louis Working Paper Series*, no 2002-023E, November.

Lindbeck A (ed) (1979); *Inflation and Employment in Open Economies*, essays by members of the Institute for International Economic Studies, University of Stockholm.

Matheson, T (2006): "Phillips curve forecasting in a small open economy", *Reserve Bank of New Zealand Discussion Paper*, DP2006/01, March.

McKinnon, R (1982): "Currency Substitution and Instability in the World Dollar Standard", *American Economic Review*, June.

Morimoto, Y, W Hirata and R Kato (2003): "Global disinflation", *Bank of Japan Research Papers*, no 2003/06/13, June.

Mumtaz, H and P Surico (2006): "Evolving international inflation dynamics: world and country specific factors", unpublished Bank of England working paper, April.

OECD (2004): "Wage setting institutions and outcomes", chapter 3 in *OECD Employment Outlook*.

——— (2005): "China", *OECD Economic Surveys*.

O'Reilly, G and K Whelan (2004): "Has euro area inflation persistence changed over time?", *ECB Working Paper Series*, no 335, April.

Orphanides, A and J Williams (2003): "Inflation scares and forecast-based monetary policy", in B Bernanke and M Woodford (eds) *Inflation Targeting*, Chicago: University of Chicago Press.

Papademos, L (2006): "Globalisation, inflation, imbalances and monetary policy", speech at a conference on "The euro and the dollar in a globalized economy", St. Louis, 25 May.

Persson, K (2005): "Monetary policy in a low-inflation economy", speech at the Stockholm Strand Rotary Club, Stockholm, 18 February.

Pivetta, F and R Reis (2004): "The persistence of inflation in the United States", unpublished Princeton University working paper, February.

Pollock, D S (2000): "Trend estimation and de-trending via rational square-wave filters", *Journal of Econometrics*, December, pp 317–34.

Razin, A and P Loungani (2005): "Globalisation and disinflation: the efficiency channel", *CEPR Discussion Paper*, no 4895, February.

Roberts, J (2004): "Monetary policy and inflation dynamics", *Board of Governors of the Federal Reserve System Finance and Economics Discussion Paper*, no 2004-62, October.

Rogoff, K (2003): "Globalisation and global disinflation", in *Monetary policy and uncertainty: adapting to a changing economy*, a symposium sponsored by the Federal Reserve Bank of Kansas City, 28-30 August, Jackson Hole, pp 77–112.

Romer, D (1993): "Openness and inflation: theory and evidence", *Quarterly Journal of Economics*, CVII(4), November, pp 869–904.

——— (1998): "A new assessment of openness and inflation: reply", *Quarterly Journal of Economics*, CXII(2), May, pp 649–652.

Rosenberg, I (2006): "Assessment of monetary policy", speech at the Norges Bank conference on "Evaluating monetary policy", Oslo, 30 March.

Rudd, J and K Whelan (2005): "Modeling inflation dynamics: a critical survey of recent research", *Board of Governors of the Federal Reserve System working paper*, September.

Rudebusch, G and L Svensson (1999): "Policy rules for inflation targeting", in J Taylor (ed), *Monetary policy rules*, Chicago, The University of Chicago Press.

Salter, W E G (1959): "Internal and external balance: the role of price and expenditure effects", *The Economic Record*, August, pp 226–38.

Sbordone, A (2005): "Do expected future marginal costs drive inflation dynamics?", *Federal Reserve Bank of New York Staff Report*, no 204, March.

Scheve, K and M Slaughter (2003): "Economic insecurity and the globalisation of production", *Yale University working paper*, July.

Sekine, T (2006): "Time-varying exchange rate pass-through: experiences of some industrial countries", *BIS Working Papers,* no 202, March.

Stock, J and M Watson (1999): "Forecasting inflation", *Journal of Monetary Economics*, October.

——— (2005): "Has inflation become harder to forecast?", forthcoming in *Journal of Money, Credit and Banking*.

Swan, T W (1960): "Economic control in a dependent economy", *The Economic Record*, March, pp 51–66.

Temple, J (2002): "Openness-inflation and the Phillips curve: a puzzle", *Journal of Money, Credit and Banking*, 34, pp 458–68.

Terra, C (1998): "Openness and inflation: a new assessment", *Quarterly Journal of Economics*, CXIII, pp 641–48.

Tootell, G (1998): "Globalisation and US inflation", *Federal Reserve Bank of Boston New England Economic Review*, July/August.

Vega, M and D Winkelried (2005): "How does global disinflation drag inflation in small open economies?", *Central Bank of Peru Working Paper*, no 2005-01, January.

Wagner, H (2000): *Globalisation and unemployment*, New York: Springer-Verlag.

White, W (2006): "Is price stability enough?", *BIS Working Papers,* forthcoming.

Willett, T D (1983): "US monetary policy and world liquidity", *American Economic Review*, vol 73, no 2, May, pp 43–7.

Yellen, J (2006): "Monetary policy in a global environment", speech at a conference on "The euro and the dollar in a globalized economy", Santa Cruz, 27 May.

List of Tables and Graphs

Tables

Graphs

Statistical Appendix

Graphical Appendix

Tables

Table 1 Parameter variation in conventional Phillips curve estimates, 1980-2005

$$\pi_t = c_j + \gamma_j \pi_{t-1} + \beta_j Gap^D_{t-1} + \varepsilon_t, for\ \ j = \{1980-1992, 1993-2005\}$$

	$\gamma_{80-92} \rightarrow \gamma_{93-05}$	$\beta_{80-92} \rightarrow \beta_{93-05}$	$\bar{R}^2_{80-92} \rightarrow \bar{R}^2_{93-05}$	Cumulative impact[1] of Gap^D_{t-1} on π over 1 year	Cumulative impact[1] of Gap^D_{t-1} on π over 2 years
United States	0.92 → 0.82 [0.21]	0.13 → 0.09 [0.31]	0.95 → 0.69	0.46 → 0.27	0.79 → 0.40
Euro area	0.98 → 0.89 [0.15]	0.11 → 0.04 [0.13]	0.98 → 0.80	0.43 → 0.14	0.82 → 0.22
Japan	0.90 → 0.65 [0.03]**	0.07 → 0.15 [0.87]	0.88 → 0.73	0.24 → 0.35	0.40 → 0.41
Germany	0.92 → 0.89 [0.35]	0.07 → 0.06 [0.42]	0.93 → 0.81	0.25 → 0.20	0.43 → 0.33
France	0.99 → 0.83 [0.12]	0.10 → 0.06 [0.31]	0.97 → 0.67	0.39 → 0.18	0.77 → 0.27
United Kingdom	0.94 → 0.77 [0.16]	0.13 → 0.07 [0.31]	0.92 → 0.63	0.48 → 0.20	0.85 → 0.27
Italy	0.97 → 0.97 [0.51]	0.20 → 0.03 [0.01]**	0.98 → 0.93	0.76 → 0.11	1.44 → 0.22
Canada	0.99 → 0.58 [0.00]***	0.12 → 0.16 [0.75]	0.96 → 0.57	0.47 → 0.34	0.93 → 0.38
Netherlands	0.99 → 0.86 [0.07]*	0.10 → 0.05 [0.11]	0.95 → 0.86	0.39 → 0.19	0.77 → 0.30
Belgium	0.98 → 0.78 [0.04]**	0.12 → 0.00 [0.12]	0.95 → 0.55	0.47 → -0.03	0.90 → -0.04
Sweden	1.00 → 0.81 [0.07]*	0.18 → -0.04 [0.01]***	0.87 → 0.70	0.72 → -0.09	1.44 → -0.13
Switzerland	0.85 → 0.84 [0.44]	0.13 → 0.04 [0.18]	0.87 → 0.80	0.41 → 0.16	0.63 → 0.24
Spain	0.98 → 0.86 [0.11]	0.12 → 0.01 [0.22]	0.96 → 0.77	0.47 → 0.03	0.90 → 0.05
Australia	0.90 → 0.83 [0.22]	0.22 → 0.04 [0.03]**	0.90 → 0.72	0.76 → 0.12	1.25 → 0.18
Austria	0.91 → 0.87 [0.29]	0.23 → 0.21 [0.43]	0.90 → 0.90	0.80 → 0.69	1.35 → 1.09
Norway	0.80 → 0.58 [0.03]**	0.25 → 0.06 [0.00]***	0.95 → 0.36	0.74 → 0.11	1.04 → 0.12
New Zealand	1.00 → 0.83 [0.15]	0.15 → 0.05 [0.16]	0.73 → 0.73	0.60 → 0.15	1.20 → 0.22

Notes: Statistical significance at the 10% (*), 5% (**) and 1% (***) for one-sided hypothesis tests that the relevant coefficient declined from the first sub-period to the second; P-values are in brackets. π is CPI inflation. π^u is HP filtered CPI excluding food and energy inflation. Gap^D is the domestic output gap defined as (real GDP – potential real GDP)/potential real GDP. [1] The cumulative impact is defined as CI(1 year) = $\beta\sum_{k=1}^{4}\gamma^{k-1}$ and CI(2 year) = $\beta\sum_{k=1}^{8}\gamma^{k-1}$.

Table 2 Pooled Phillips curve estimates, 1985-2005

$$\pi_{i,t} - \pi^{U}_{i,t} = c + \beta Gap^{D}_{i,t-1} + \phi Gap^{G_i}_{i,t-1} + \varepsilon_{i,t}$$

	Model					
	Gap^{D}_{t-1} only	W1	W2	W3	W4	WG
Constant	-0.11 (0.07)	-0.03 (0.06)	-0.02 (0.06)	-0.09 (0.07)	-0.05 (0.06)	-0.07 (0.07)
Gap^{D}	0.14 (0.02)***	0.08 (0.02)***	0.08 (0.02)***	0.09 (0.02)***	0.07 (0.02)***	0.11 (0.02)***
Gap^{W1}		0.27 (0.05)***				
Gap^{W2}			0.27 (0.05)***			
Gap^{W3}				0.21 (0.05)***		
Gap^{W4}					0.24 (0.05)***	
Gap^{WG}						0.16 (0.07)**
$\bar{R}^2$	0.06	0.13	0.13	0.09	0.12	0.08

Notes: Statistical significance at the 10% (*), 5% (**) and 1% (***); standard errors in parentheses. Gap^{W1} is a global traded-weighted output gap; the gap for each country is defined as the average of domestic output gaps for its largest trading partners, where the weights are determined by the relative value of bilateral trade (imports plus exports). Gap^{W2} is similar to Gap^{W1} except that the weights only reflect the value of imports. Gap^{W3} is an exchange rate weighted global output gap where the weights depend on the bilateral exchange rate correlation between trading partners. Gap^{W4} is a trade and exchange rate correlation weighted global output gap; it is constructed in the same way as Gap^{W1} except that the weights also reflect the correlation of the bilateral exchange rates with its trading partners. Gap^{WG} is defined as the average of domestic output gaps for countries listed in appendix based on 2000 GDP and PPP exchange rates.

Table 3 Benchmark country-specific Phillips curve estimates, 1985-2005

$$\pi_t - \pi_t^U = c + \beta Gap_{t-1}^D + \varepsilon_t$$

	Sample	No of obs	Constant	Gap_{t-1}^{D}	$\overline{R}^2$
United States	1985Q1 2005Q4	84	0.03 (0.11)	0.22 (0.08)***	0.07
Euro area	1985Q1 2005Q4	84	-0.04 (0.08)	0.18 (0.06)***	0.10
Japan	1985Q1 2005Q4	84	-0.19 (0.09)**	0.20 (0.04)***	0.22
Germany	1985Q1 2005Q2	82	0.09 (0.09)	0.25 (0.04)***	0.35
France	1985Q1 2005Q4	84	0.07 (0.09)	0.25 (0.05)***	0.21
United Kingdom	1985Q1 2005Q4	84	-0.17 (0.13)	0.24 (0.06)***	0.13
Italy	1985Q1 2005Q4	84	-0.02 (0.10)	0.34 (0.06)***	0.30
Canada	1985Q1 2005Q4	84	0.04 (0.10)	0.15 (0.05)***	0.08
Netherlands	1985Q1 2005Q4	84	-0.26 (0.09)***	0.16 (0.04)***	0.14
Belgium	1985Q1 2005Q3	83	-0.46 (0.12)***	0.41 (0.13)***	0.10
Sweden	1985Q1 2005Q4	84	0.13 (0.19)	0.14 (0.06)**	0.04
Switzerland	1985Q1 2005Q4	84	-0.22 (0.09)**	0.48 (0.09)***	0.26
Spain	1985Q1 2005Q4	84	-0.30 (0.10)***	0.20 (0.09)**	0.04
Australia	1990Q3 2005Q3	61	0.19 (0.20)	0.29 (0.08)***	0.18
Austria	1985Q1 2005Q4	84	-0.20 (0.07)***	0.45 (0.08)***	0.26
Norway	1985Q1 2005Q4	84	0.10 (0.11)	0.06 (0.04)*	0.03
New Zealand	1985Q1 2005Q3	79	-0.13 (0.16)	0.21 (0.06)***	0.13

Note: Statistical significance at the 10% (*), 5% (**) and 1% (***); standard errors in parentheses.

Table 4 Country-specific Phillips curve with global measures of slack, 1985-2005

$$\pi_t - \pi_t^U = c + \beta Gap_{t-1}^D + \phi Gap_{t-1}^{G_i} + \varepsilon_t$$

	Sample	No of obs	Constant	Gap_{t-1}^D	$Gap_{t-1}^{G_i}$	$\overline{R}^2$	Model	D-W statistic
United States	85Q1 05Q2	82	-0.03 (0.09)	-0.13 (0.08)	0.61 (0.09)***	0.42	W2 [W1, W3, W4, WG]	0.44
Euro area	85Q1 05Q2	82	-0.01 (0.08)	0.15 (0.06)**	0.18 (0.08)***	0.16	WG	0.24
Japan	85Q1 05Q2	82	-0.18 (0.08)**	0.12 (0.04)***	0.22 (0.07)***	0.31	W3 [W4]	0.52
Germany[1]	85Q1 05Q2	82	0.09 (0.09)	0.26 (0.05)***	-0.04 (0.10)	0.34		0.51
France	85Q1 05Q2	82	-0.03 (0.09)	-0.01 (0.10)	0.38 (0.12)***	0.29	W2 [W1, W4]	0.39
United Kingdom	85Q1 05Q4	84	0.11 (0.14)	-0.00 (0.08)	0.79 (0.19)***	0.28	WG [W1, W2, W4]	0.34
Italy	85Q1 05Q2	82	-0.04 (0.09)	0.11 (0.08)	0.38 (0.10)***	0.4	W2 [W1, W4]	0.25
Canada	85Q1 05Q4	84	0.12 (0.11)	0.05 (0.06)	0.36 (0.13)***	0.15	WG	0.57
Netherlands	85Q1 05Q2	82	0.08 (0.11)	-0.01 (0.06)	0.44 (0.09)***	0.36	W1 [W2, W4]	0.32
Belgium	85Q1 05Q2	82	-0.29 (0.13)**	-0.03 (0.18)	0.43 (0.13)***	0.21	W2 [W1, W4]	0.24
Sweden	85Q1 05Q2	82	0.17 (0.19)	0.05 (0.07)	0.45 (0.16)***	0.11	W2 [W1]	0.44
Switzerland	85Q1 05Q2	82	0.02 (0.10)	0.19 (0.10)*	0.38 (0.09)***	0.39	W4 [W1, W2, W3]	0.39
Spain	85Q1 05Q2	82	-0.09 (0.12)	-0.16 (0.14)	0.45 (0.14)***	0.14	W2 [W1, W4]	0.47
Australia	85Q1 05Q2	82	0.34 (0.16)**	0.02 (0.08)	0.73 (0.15)***	0.31	W3 [W1, W2, W4, WG]	0.43
Austria	85Q1 05Q2	82	-0.01 (0.07)	0.14 (0.09)	0.28 (0.05)***	0.45	W2 [W1, W4]	0.39
Norway	85Q1 05Q2	82	0.17 (0.12)	0.06 (0.04)*	0.17 (0.08)**	0.07	W1 [W2, W4]	0.66
New Zealand[2]	91Q1 05Q2	58	0.08 (0.17)	0.11 (0.06)*	0.31 (0.13)**	0.35	W3 [WG]	0.44

Notes: Statistical significance at the 10% (*), 5% (**) and 1% (***); standard errors in parentheses. Gap^{W1} is a global traded-weighted output gap; the gap for each country is defined as the average of domestic output gaps for its largest trading partners, where the weights are determined by the relative value of bilateral trade. Gap^{W2} is similar to Gap^{W1} except that the weights only reflect the value of imports. Gap^{W3} is an exchange rate weighted global output gap where the weights depend on the bilateral exchange rate correlation between trading partners. Gap^{W4} is a trade and exchange rate correlation weighted global output gap; it is constructed in the same way as Gap^{W1} except that the weights also reflect the correlation of the bilateral exchange rates with its trading partners. Gap^{WG} is the global output gap defined as the average of domestic output gaps for countries listed in appendix based on 2000 GDP and PPP exchange rates. The brackets […] indicate alternative specifications where global gaps are statistically significant at the 10% significance level. [1] For Germany, Gap^{W2} is used. [2] For New Zealand, the shorter sample abstracts from large institutional changes in prices such as the removal of price controls and the increase in the value added tax.

Table 5 Augmented globe-specific Phillips curve with supply shocks I, 1985-2005

$$\pi_t - \pi_t^U = c + \beta Gap_{t-1}^D + \phi Gap_{t-1}^{G_i} + \eta X_{t-1} + \varepsilon_t$$

	ϕ	Import price	ϕ	Oil price	ϕ	Unit labour cost
United States	0.53 (0.08)***	0.08 (0.02)***	0.45 (0.07)***	0.02 (0.00)***	0.62 (0.09)***	-0.02 (0.07)
Euro area[1]	-0.09 (0.07)	0.02 (0.01)**	0.03 (0.08)	0.01 (0.00)***	-0.15 (0.11)	-0.09 (0.05)*
Japan	0.23 (0.07)***	0.00 (0.01)	0.13 (0.08)	0.01 (0.00)*	0.22 (0.07)***	-0.02 (0.05)
Germany[1]	0.02 (0.09)	-0.04 (0.01)***	-0.08 (0.10)	0.01 (0.00)**	0.04 (0.21)	0.01 (0.04)
France	0.42 (0.11)***	0.01 (0.00)***	0.23 (0.12)*	0.01 (0.00)***	0.34 (0.12)**	-0.05 (0.06)
United Kingdom	0.86 (0.20)***	0.02 (0.02)	0.71 (0.21)***	0.00 (0.00)	0.66 (0.19)***	0.13 (0.05)**
Italy	0.49 (0.11)***	0.02 (0.01)**	0.33 (0.10)***	0.00 (0.00)**	0.38 (0.10)***	0.03 (0.02)
Canada	0.34 (0.12)***	0.09 (0.03)***	0.24 (0.12)*	0.01 (0.00)***	0.34 (0.13)**	0.05 (0.03)
Netherlands	0.55 (0.09)***	-0.04 (0.01)***	0.44 (0.10)***	-0.00 (0.00)	0.42 (0.07)***	0.11 (0.03)***
Belgium[1]	0.20 (0.14)	0.00 (0.01)	0.33 (0.12)***	0.02 (0.00)***	0.45 (0.12)***	-0.03 (0.05)
Sweden	0.50 (0.17)***	0.02 (0.02)	0.36 (0.16)*	0.01 (0.01)*	0.45 (0.15)***	0.14 (0.05)***
Switzerland	0.35 (0.07)***	0.04 (0.02)**	0.25 (0.09)***	0.01 (0.00)***	0.38 (0.09)***	...
Spain	0.44 (0.15)***	-0.01 (0.01)	0.42 (0.15)***	0.00 (0.00)	0.46 (0.13)***	-0.03 (0.02)
Australia	0.73 (0.15)***	0.05 (0.02)**	0.69 (0.15)***	0.01 (0.00)	0.48 (0.18)***	0.15 (0.06)**
Austria	0.25 (0.04)***	0.09 (0.02)***	0.24 (0.04)***	0.01 (0.00)***	0.24 (0.05)***	-0.07 (0.04)*
Norway	0.17 (0.08)**	0.02 (0.01)**	0.16 (0.08)*	0.00 (0.00)	0.16 (0.07)**	0.09 (0.04)**
New Zealand[1]	-0.20 (0.21)	0.09 (0.03)***	0.24 (0.15)	0.00 (0.00)	0.31 (0.12)**	0.16 (0.06)**

Notes: Statistical significance at the 10% (*), 5% (**) and 1% (***); standard errors in parentheses. The country specifications correspond to those in Table 4. Import price, oil price and unit labour cost are 4-quarter percent changes in domestic import prices, home currency oil prices and nominal domestic unit labour costs, respectively. [1] Data limitations for Belgium: import price growth from 1994:Q2; euro area: import price growth from 1990:Q2; unit labour cost growth from 1992:Q2; Germany: unit labour costs from 1992:Q2; New Zealand from 1991:Q1 for all results.

Table 6 Augmented globe-specific Phillips curve with supply shocks II, 1985-2005

$$\pi_t - \pi_t^U = c + \beta Gap_{t-1}^D + \phi Gap_{t-1}^{G_i} + \eta X_{t-1} + \varepsilon_t$$

	ϕ	China speed limit	ϕ	Gap_{t-1}^{ULC}	ϕ	Gap_{t-1}^{WPI}	ϕ	Mfg price PMI[1]
United States	0.66 (0.11)***	0.02 (0.04)	0.65 (0.09)***	0.08 (0.04)**	0.49 (0.09)***	0.11 (0.03)***	0.21 (0.22)	0.01 (0.00)*
Euro area	0.20 (0.10)*	0.02 (0.04)	0.19 (0.08)**	0.03 (0.04)	0.07 (0.07)	0.13 (0.02)***	0.13 (0.08)	-0.00 (0.00)
Japan	0.20 (0.07)***	-0.06 (0.04)	0.25 (0.07)***	-0.05 (0.05)	0.15 (0.08)*	0.06 (0.04)	-0.17 (0.10)	0.00 (0.00)
Germany	0.30 (0.12)**	0.19 (0.04)***	-0.09 (0.11)	-0.05 (0.04)	-0.03 (0.11)	0.00 (0.04)	0.52 (0.21)**	-0.01 (0.00)**
France	0.44 (0.14)***	0.04 (0.04)	0.23 (0.13)*	0.11 (0.04)***	0.05 (0.11)	0.15 (0.02)***	0.48 (0.17)**	-0.00 (0.00)
United Kingdom	0.58 (0.21)***	-0.16 (0.07)**	0.76 (0.19)***	-0.08 (0.06)	0.57 (0.21)***	0.11 (0.05)**	-0.21 (0.22)	0.01 (0.00)**
Italy	0.41 (0.10)***	0.05 (0.05)	0.35 (0.12)***	-0.02 (0.04)	0.34 (0.10)***	0.09 (0.03)***	-0.18 (0.08)**	0.00 (0.00)
Canada	-0.01 (0.15)	-0.22 (0.05)***	0.39 (0.14)***	0.05 (0.05)	0.21 (0.13)	0.12 (0.04)***	-0.17 (0.23)	0.01 (0.00)
Netherlands	0.52 (0.10)***	0.12 (0.04)***	0.45 (0.09)***	0.06 (0.04)*	0.32 (0.09)***	0.10 (0.03)***	0.40 (0.28)	-0.02 (0.00)***
Belgium	0.59 (0.15)***	0.10 (0.06)	0.45 (0.13)***	0.10 (0.06)	0.33 (0.10)***	0.24 (0.03)***	0.10 (0.18)	-0.00 (0.00)
Sweden	0.21 (0.17)	-0.28 (0.09)***	0.49 (0.19)**	-0.04 (0.08)	0.26 (0.18)	0.16 (0.07)**	1.40 (0.28)***	0.00 (0.00)
Switzerland	0.38 (0.09)***	-0.02 (0.05)	0.37 (0.09)***	0.06 (0.05)	0.25 (0.09)***	0.12 (0.03)***	0.03 (0.12)	0.01 (0.00)***
Spain	0.54 (0.16)***	0.06 (0.06)	0.44 (0.15)***	0.05 (0.05)	0.25 (0.14)*	0.13 (0.04)***	0.57 (0.19)***	0.00 (0.00)
Australia	0.64 (0.16)***	-0.10 (0.07)	0.71 (0.16)***	-0.03 (0.09)	0.78 (0.16)***	0.07 (0.06)	1.11 (0.24)***	-0.01 (0.01)
Austria	0.43 (0.05)***	0.14 (0.03)***	0.28 (0.05)***	0.03 (0.03)	0.17 (0.05)***	0.10 (0.02)***	-0.05 (0.11)	-0.00 (0.00)
Norway	0.07 (0.11)	-0.09 (0.07)	0.20 (0.08)**	0.11 (0.08)	0.17 (0.08)**	-0.01 (0.04)	0.49 (0.41)	0.01 (0.01)
New Zealand[1]	0.38 (0.13)***	0.10 (0.07)	0.29 (0.13)**	0.08 (0.11)	0.10 (0.12)	0.31 (0.07)***	0.65 (0.15)***	-0.01 (0.00)*

Notes: Statistical significance at the 10% (*), 5% (**) and 1% (***); standard errors in parentheses. China speed limit is measured as the change in the Chinese output gap. Gap^{ULC} is a measure of global unit labour costs, defined as the difference between GDP-weighted (nominal) unit labour costs and its Hodrick-Prescott trend. Gap^{WPI} is defined in the same way as Gap^{ULC}. Mfg price PMI is the 4-quarter change in the JPMorgan global manufacturing PMI index (only available since 1999:Q4). The sample for New Zealand starts in 1991:Q1.

Table 7 Goods price inflation and global factors, 1985-2005

$$\pi_{goods,t} - \pi^{HP,U}_{goods,t} = c + \beta Gap^{D}_{t-1} + \phi Gap^{G_i}_{t-1} + \eta X_{t-1} + \varepsilon_t$$

	ϕ	Import price	$\bar{R}^2$	ϕ	Oil price	$\bar{R}^2$	ϕ	Unit labour cost	$\bar{R}^2$	ϕ	China speed limit	$\bar{R}^2$	Models
United States	0.38 (0.13)***	0.14 (0.03)***	0.45	0.28 (0.11)**	0.03 (0.00)***	0.61	0.52 (0.15)***	0.13 (0.11)	0.30	0.64 (0.18)***	0.07 (0.07)	0.30	W2
Euro area[1]	-0.06 (0.05)	0.05 (0.01)***	0.46	-0.05 (0.06)	0.01 (0.00)***	0.26	0.08 (0.13)	-0.00 (0.08)	0.08	0.11 (0.07)	0.07 (0.05)	0.13	W2
Japan	0.18 (0.09)**	0.01 (0.01)	0.29	0.05 (0.11)	0.01 (0.00)**	0.33	0.18 (0.09)*	-0.03 (0.06)	0.29	0.15 (0.09)*	-0.08 (0.05)	0.31	W3
Germany[1]	0.22 (0.18)	-0.02 (0.01)**	0.32	0.06 (0.21)	0.01 (0.00)**	0.29	0.16 (0.20)	-0.06 (0.04)	0.24	0.53 (0.23)**	0.13 (0.07)*	0.28	W2
France	0.36 (0.18)**	0.01 (0.01)	0.15	0.11 (0.17)	0.01 (0.00)***	0.30	0.44 (0.18)**	0.14 (0.08)	0.17	0.42 (0.20)**	0.06 (0.06)	0.15	W2
United Kingdom[1]	0.45 (0.17)**	0.05 (0.01)***	0.17	0.45 (0.19)**	-0.01 (0.00)	0.05	0.18 (0.18)	0.14 (0.04)***	0.15	-0.09 (0.14)	-0.39 (0.05)***	0.52	WG
Italy	0.40 (0.15)***	0.04 (0.01)***	0.19	0.12 (0.14)	0.01 (0.00)***	0.22	0.24 (0.15)	0.03 (0.04)	0.10	0.25 (0.16)	0.01 (0.07)	0.09	W2
Canada	0.45 (0.16)***	0.13 (0.04)***	0.22	0.32 (0.16)**	0.02 (0.00)***	0.30	0.44 (0.17)**	0.15 (0.07)**	0.17	0.22 (0.21)	-0.17 (0.07)**	0.17	WG
Netherlands	0.44 (0.17)***	-0.04 (0.01)***	0.30	0.33 (0.17)*	0.00 (0.00)	0.20	0.33 (0.16)**	0.04 (0.06)	0.21	0.44 (0.18)**	0.14 (0.07)**	0.25	W2
Belgium[1]	0.65 (0.24)**	0.01 (0.02)	0.24	0.10 (0.20)	0.02 (0.00)***	0.30	0.54 (0.22)**	0.12 (0.06)**	0.10	0.63 (0.26)**	0.14 (0.09)	0.08	WG
Sweden	0.52 (0.22)**	-0.01 (0.02)	0.04	0.38 (0.22)*	0.01 (0.01)**	0.09	0.48 (0.22)**	0.07 (0.05)	0.06	0.36 (0.25)	-0.13 (0.10)	0.06	WG
Switzerland	0.31 (0.15)**	0.14 (0.03)***	0.41	-0.07 (0.14)	0.02 (0.00)***	0.57	0.50 (0.17)***	...	0.23	0.54 (0.20)***	0.03 (0.08)	0.22	W3
Spain[1]	0.12 (0.25)	0.02 (0.01)*	0.06	-0.04 (0.23)	0.01 (0.00)**	0.10	0.00 (0.26)	-0.02 (0.05)	0.00	0.06 (0.26)	0.14 (0.10)	0.04	W2
Australia	0.42 (0.11)***	0.05 (0.01)***	0.25	0.38 (0.12)***	0.01 (0.00)**	0.17	0.25 (0.14)*	0.11 (0.05)**	0.17	0.39 (0.13)***	-0.04 (0.06)	0.12	W3
Austria[1]	0.01 (0.08)	0.05 (0.04)	0.41	-0.01 (0.06)	0.01 (0.00)***	0.53	0.08 (0.07)	0.00 (0.03)	0.40	0.12 (0.08)	0.03 (0.03)	0.40	WG
Norway	0.31 (0.18)*	0.05 (0.03)*	0.04	0.11 (0.19)	0.02 (0.01)***	0.10	0.28 (0.19)	0.09 (0.10)	0.01	0.25 (0.26)	-0.05 (0.16)	0.00	W4
New Zealand[1]	-0.30 (0.17)*	0.13 (0.02)***	0.18	0.41 (0.15)***	0.00 (0.00)	0.20	0.47 (0.11)***	0.16 (0.06)***	0.30	0.60 (0.12)***	0.18 (0.06)***	0.32	W3

Notes: Statistical significance at the 10% (*), 5% (**) and 1% (***); standard errors in parentheses. The choice of the appropriate measure of global slack is based on the goodness of fit. A goods inflation equation is estimated for each measure. In several cases where the global measure is significant but with a negative sign, an alternative specification is chosen. Data limitations may distort the inferences; see data appendix for more details on the starting dates of the series. [1] Data limitations for Austria from 1988:Q1; Belgium: import price growth from 1994:Q2; euro area: from 1992:Q2; Germany from 1992:Q2; New Zealand from 1991:Q1 for all results; Spain from 1993:Q1; United Kingdom from 1989:Q1.

Table 8 Services price inflation and global factors, 1985-2005

$$\pi_{services,t} - \pi_{services,t}^{HP,U} = c + \beta Gap_{t-1}^{D} + \phi Gap_{t-1}^{i} + \eta X_{t-1} + \varepsilon_t$$

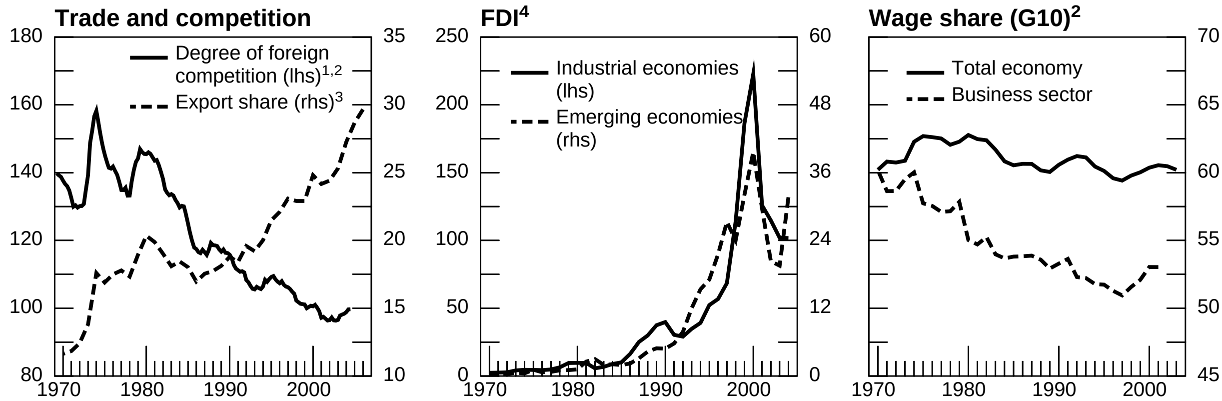
	ϕ	Import price	$\overline{R}^2$	ϕ	Unit labour cost	$\overline{R}^2$	Model
United States	0.25(0.05)***	0.00(0.01)	0.30	0.24(0.04)***	0.11(0.03)***	0.38	W2
Euro area	-0.19(0.05)***	-0.01(0.01)	0.28	-0.19(0.07)**	0.09(0.04)**	0.51	W2
Japan	0.11(0.05)**	-0.01(0.01)*	0.10	0.13(0.05)***	0.09(0.03)***	0.15	W3
Germany	-0.39(0.13)***	-0.03(0.01)***	0.29	-0.42(0.17)**	-0.05(0.04)	0.06	W2
France	-0.31(0.08)***	0.00(0.00)	0.15	-0.34(0.08)***	-0.06(0.05)	0.17	WG
United Kingdom	0.31(0.38)	-0.03(0.05)	0.13	-0.42(0.43)	0.54(0.17)***	0.23	W1
Italy	0.39(0.11)***	0.00(0.01)	0.26	0.37(0.10)***	0.04(0.03)	0.28	W2
Canada	0.27(0.11)**	0.03(0.03)	0.14	0.23(0.11)**	0.11(0.04)**	0.2	WG
Netherlands	0.07(0.12)	-0.02(0.01)*	0.03	-0.07(0.09)	0.25(0.04)***	0.37	W1
Belgium	0.24(0.17)	-0.00(0.02)	0.04	0.08(0.12)	0.10(0.04)**	0.05	W2
Sweden	0.46(0.20)**	0.03(0.02)	0.06	0.37(0.18)**	0.22(0.06)***	0.2	W2
Switzerland	0.11(0.10)	-0.04(0.02)	0.12	0.09(0.10)	...	0.11	W4
Spain	0.09(0.13)	-0.03(0.01)***	0.22	0.12(0.13)	0.09(0.02)***	0.26	W2
Australia	0.99(0.23)***	0.04(0.03)	0.26	0.60(0.27)**	0.24(0.09)**	0.3	W3
Austria	-0.13(0.11)	0.02(0.03)	0.07	-0.11(0.11)	-0.00(0.05)	0.07	W3
Norway	0.24(0.08)***	0.03(0.01)***	0.17	0.20(0.08)**	0.19(0.04)***	0.27	W4
New Zealand	-0.46(0.44)	0.04(0.06)	0.24	-0.22(0.25)	0.13(0.12)	0.25	W3

Notes: See notes in Table 7. For these controls (import prices and unit labour costs), a large negative coefficient on the global gap is generally associated with large and positive (statistically significant) coefficients on the domestic gap. [1] Data limitations for Belgium: import price growth from 1994:Q2; euro area from 1992:Q2; Germany from 1992:Q2; New Zealand from 1991:Q1; United Kingdom from 1988:Q1.

Graphs

Graph 1

Indicators of globalisation

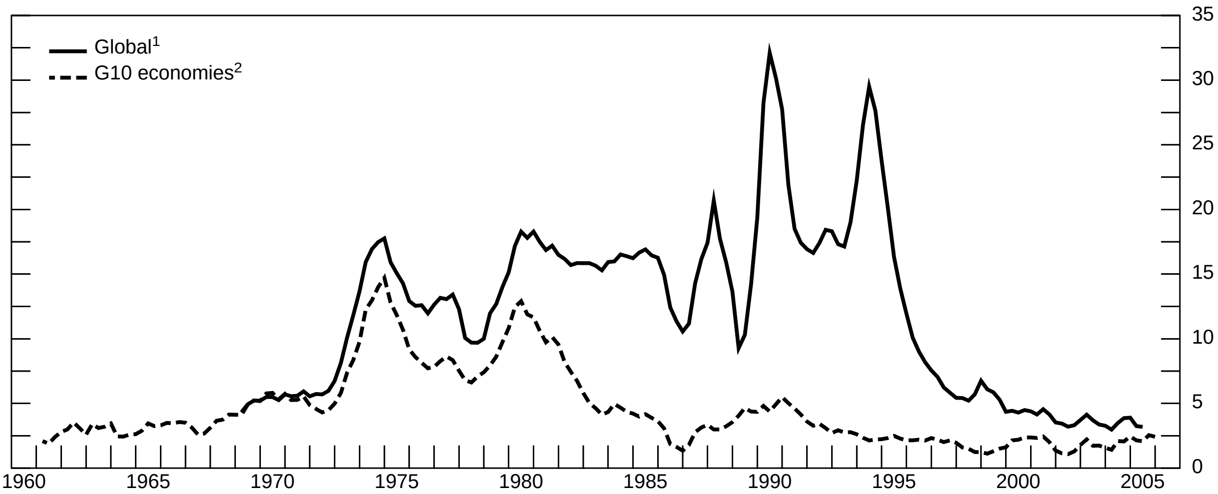


[1] Export prices/GDP deflator in G10 economies. [2] Weighted average based on 2000 GDP and PPP exchange rates. [3] World exports/GDP. [4] Sum of gross foreign direct investment inflows and outflows in 10 billions of US dollars.

Sources: IMF; OECD; United Nations; national data.

Graph 2

Global inflation

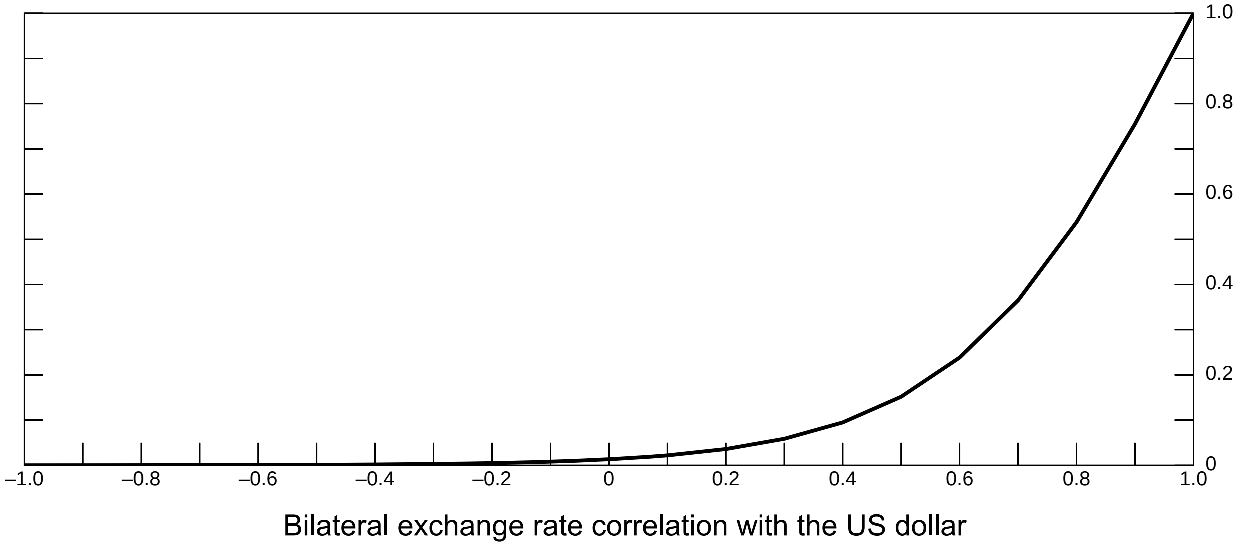


[1] World inflation from IMF. [2] Weighted average based on 2000 GDP and PPP exchange rates.

Sources: IMF; OECD; national data.

Graph 3

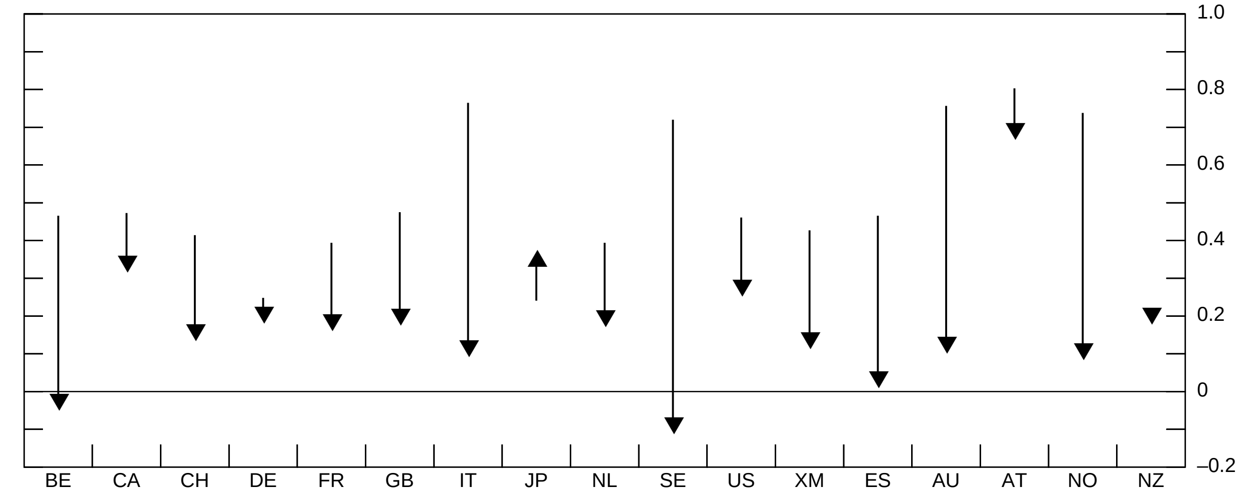
$f_{j,k}$ weights



Note: The parameter m is assumed to be 0.2.

Graph 4

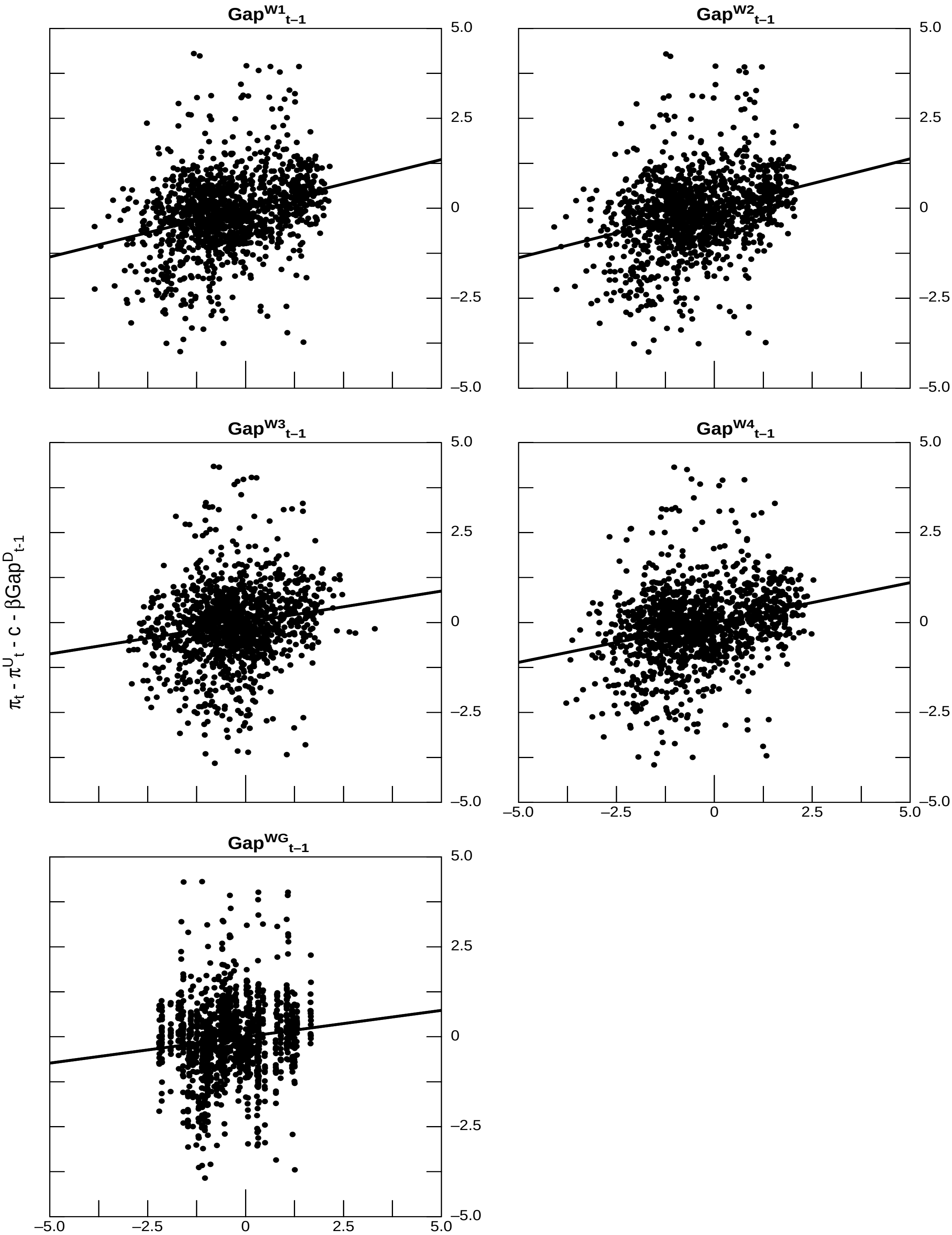
Declining sensitivity of inflation to domestic measures of slack, 1980-2005[1]



Note: AT = Austria; AU = Australia; BE = Belgium; CA = Canada; CH = Switzerland; DE = Germany; ES = Spain; FR = France; GB = United Kingdom; IT = Italy; JP = Japan; NL = Netherlands; NO = Norway; NZ = New Zealand; SE = Sweden; US = United States; XM = euro area. [1] The arrow indicates the one-year impact on inflation of a change in the domestic output gap between 1980-1992 and 1993-2005; the one-year impact is measured as $\beta * (1 + \gamma + \gamma^2 + \gamma^3)$, calculated based on the estimated equation $\pi_t = c + \gamma\pi_{t-1} + \beta Gap^D_{t-1} + \varepsilon_t$. See Table 1 for further details.

Graph 5

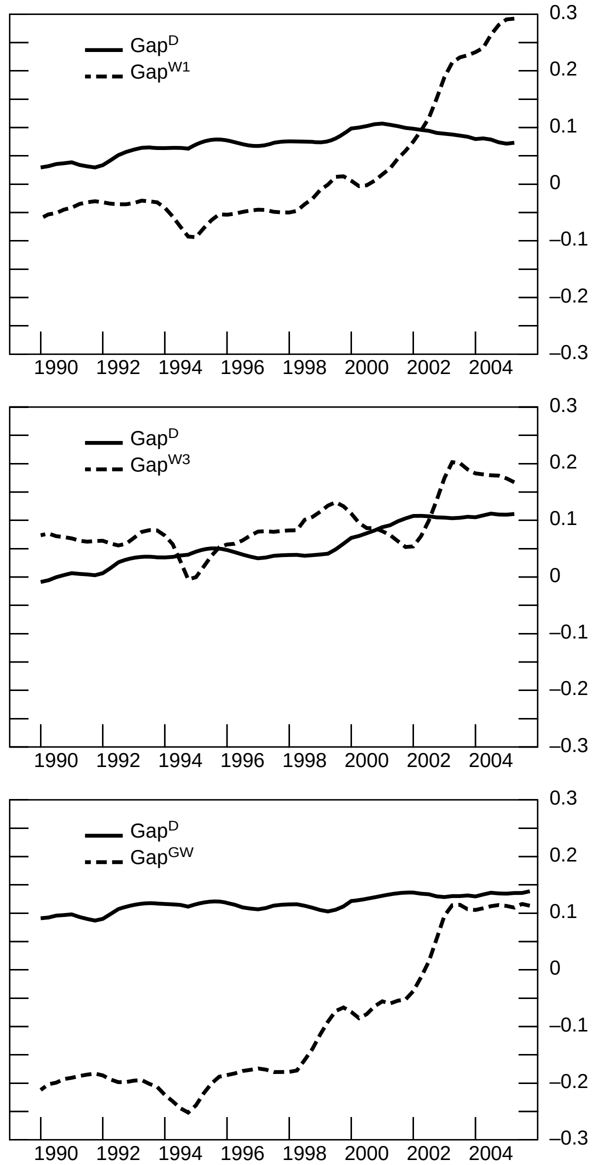
Scatter plot of alternative global gaps against (adjusted) inflation, 1985-2005[1]



Notes: Adjusted inflation is defined as $\pi_t - \pi_t^U - c + \beta Gap_{t-1}^D$, using the estimates from Table 2. For definitions of the variables, see notes in Table 2. [1] The y-axis and the x-axis labels are adjusted inflation and the specified measure of global slack, respectively.

Graph 6

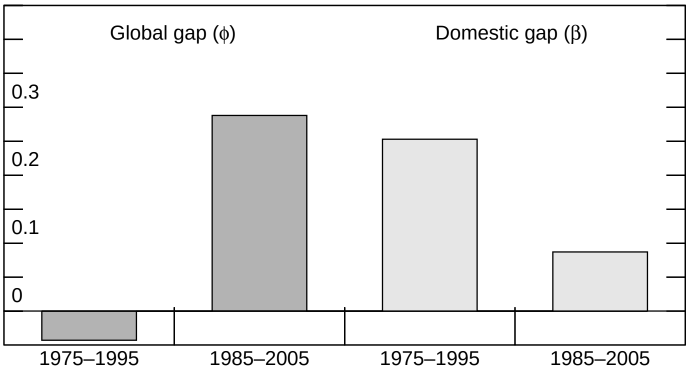
Parameter variation over time using pooled regressions and a 20-year rolling sample window



Note: The point estimates of $\hat{\phi}$ are from the estimated equation $\pi_t - \pi_t^U = c + \beta Gap_{t-1}^D + \phi Gap_{t-1}^{G_i} + \varepsilon_t$ using a 20-year moving sample window.

Graph 7

Average parameter change across time in the country-by-country regressions



Note: The bars represent the simple averages of the country-by-country estimates.

Statistical Appendix

Table A.1 Pooled Phillips curve, 1972-1992

$$\pi_t - \pi_t^U = c + \beta Gap_{t-1}^D + \phi Gap_{t-1}^{G_i} + \varepsilon_t$$

Model	Domestic gap only	W1	W2	W3	W4	WG
C	-0.03 (0.15)	-0.05 (0.15)	-0.05 (0.15)	-0.02 (0.15)	-0.08 (0.15)	-0.10 (0.15)
Gap^D	0.03 (0.03)	0.04 (0.02)*	0.04 (0.02)*	0.02 (0.02)	0.06 (0.02)**	0.08 (0.03)***
Gap^{W1}		-0.04 (0.07)				
Gap^{W2}			-0.03 (0.07)			
Gap^{W3}				0.05 (0.10)		
Gap^{W4}					-0.09 (0.07)	
Gap^{WG}						-0.17 (0.08)**
$\bar{R}^2$	0.001	0.001	0.001	0.001	0.001	0.014

Notes: Statistical significance at the 10% (*), 5% (**) and 1% (***); standard errors in parenthesEs. See notes in Table 2 for variable definitions. For data limitations associated with the output gaps, see Data Sources; for π_T^u , core CPI data begin in Australia (1976:Q3), Belgium (1976:Q2), euro area (1976:Q2), Netherlands (1976:Q1), Norway (1974:Q1), Spain (1976:Q1), Switzerland (1983:Q4) and United Kingdom (1977:Q1).

Table A.2 Average CPI inflation by decade

	1961–1970	1971–1980	1981–1990	1991–2000	2001–2005
G10 economies					
United States	2.8	7.9	4.7	2.8	2.5
Euro area	3.4	9.2	5.9	2.4	2.2
Japan	5.8	9.1	2.1	0.8	–0.4
Germany	2.6	5.1	2.6	2.4	1.6
France	4.1	9.7	6.4	1.7	1.9
United Kingdom	4.1	13.8	6.6	3.1	2.4
Italy	2.9	14.1	9.9	3.8	2.4
Canada	2.7	8.1	6.0	2.0	2.3
Netherlands	4.2	7.3	2.5	2.5	2.5
Belgium	3.0	7.4	4.6	2.1	2.1
Sweden	4.1	9.2	7.6	2.3	1.5
Switzerland	3.3	5.0	3.4	2.0	0.8
Other industrial economies					
Spain	6.1	15.4	9.4	3.9	3.2
Australia	2.5	10.5	8.1	2.2	3.1
Austria	3.6	6.3	3.5	2.3	2.0
Norway	4.5	8.4	7.7	2.3	1.7
New Zealand	3.8	12.5	10.8	1.8	2.4

Table A.3 Unconditional volatility[1] of CPI inflation by decade

	1961–1970	1971–1980	1981–1990	1991–2000	2001–2005
G10 economies					
United States	3.2	11.0	5.2	0.6	0.5
Euro area	0.6	5.3	9.8	1.0	0.1
Japan	2.9	31.9	2.1	1.5	0.2
Germany	0.7	2.0	4.0	2.6	0.2
France	2.4	7.9	15.7	0.7	0.1
United Kingdom	2.4	31.0	7.7	1.9	0.5
Italy	2.9	34.3	26.6	2.6	0.1
Canada	1.8	6.9	8.9	2.1	0.8
Netherlands	3.9	4.2	5.5	0.3	1.3
Belgium	1.6	10.8	7.9	0.6	0.4
Sweden	3.3	6.8	6.5	7.9	1.0
Switzerland	1.3	9.8	3.6	3.3	0.2
Other industrial economies					
Spain	13.9	26.4	12.3	2.2	0.3
Australia	2.2	13.1	4.8	2.7	1.3
Austria	1.5	3.8	3.3	1.3	0.3
Norway	6.7	4.7	8.8	0.5	1.8
New Zealand	3.4	13.0	25.8	1.5	0.3

[1] Defined as average squared deviation of each number in the period from its mean in the period.

Table A.4 Robustness results

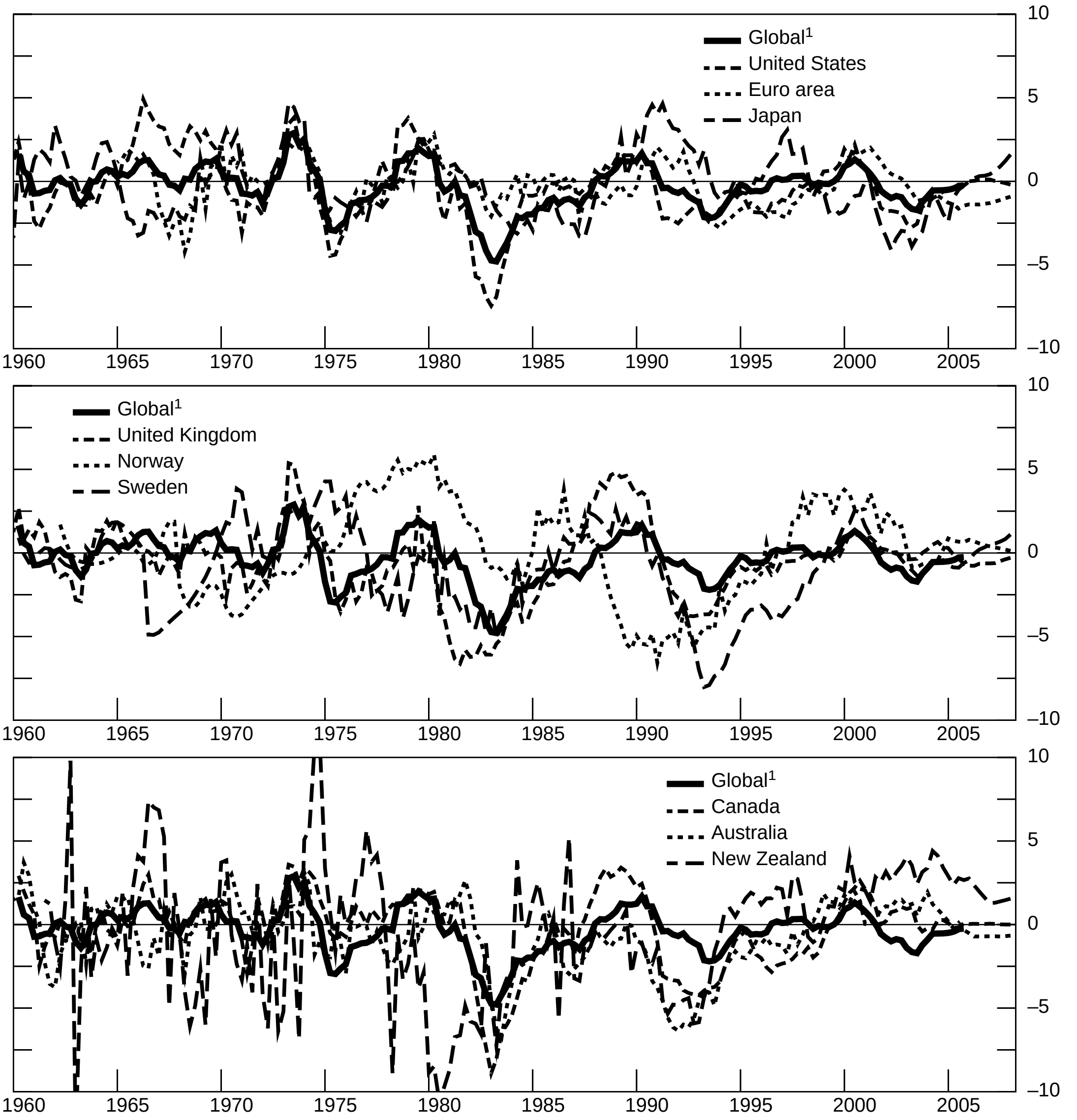
	Alternative filtering methods		
	Hodrick-Prescott	Butterworth	Christiano-Fitzgerald
	AR specification: $\pi_t = c^{AR} + \alpha^{AR}\pi_{t-1} + \beta^{AR}Gap^D_{t-1} + \phi^{AR}Gap^G_{t-1} + \varepsilon^{AR}_t$		
C^{AR}	0.31 (0.08)	0.31 (0.08)	0.33 (0.08)
α^{AR}	0.91 (0.02)	0.91 (0.02)	0.91 (0.02)
β^{AR}	0.11 (0.02)	0.11 (0.02)	0.10 (0.03)
ϕ^{AR}	-0.04 (0.04)	-0.04 (0.04)	-0.02 (0.04)
R^2	0.93	0.93	0.94
	B-F specification: $\pi_t = \pi^U_t = c^{BF} + \beta^{BF}Gap^D_{t-1} + \phi^{BF}Gap^G_{t-1} + \varepsilon^{BF}_t$		
C^{BF}	0.12 (0.02)	0.12 (0.02)	-0.08 (0.02)
α^{BF}			
β^{BF}	0.05 (0.06)	0.05 (0.06)	0.00 (0.07)
ϕ^{BF}	0.30 (0.09)	0.29 (0.09)	0.25 (0.10)
R^2	0.57	0.56	0.36

Notes: By design, the calibrated parameters for the simulation were set to [0, 0, .1, .3] for the constant, the autoregressive parameter and the slope parameter of the domestic and global gaps, respectively. See details of the simulation design in the Appendix.

Graphical Appendix

Graph A.1

Output gaps

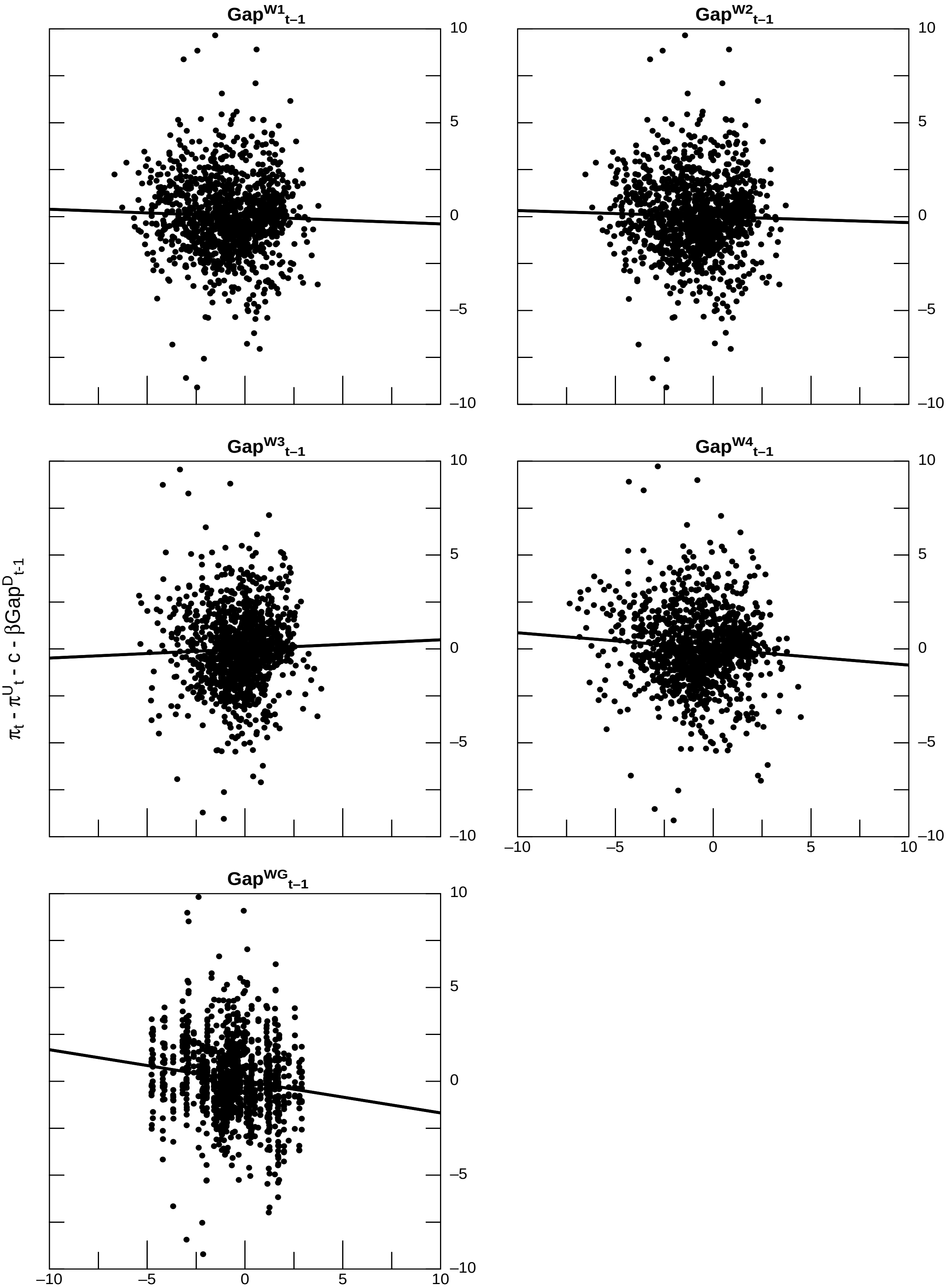


[1] Weighted average of Australia, Austria, Belgium, Brazil, Canada, Chile, China, Czech Republic, France, Germany, Hong Kong SAR, India, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Singapore, Spain, South Africa, Sweden, Switzerland, Thailand, United Kingdom and United States based on 2000 GDP and PPP exchange rates.

Sources: IMF; OECD; national data.

Graph A.2

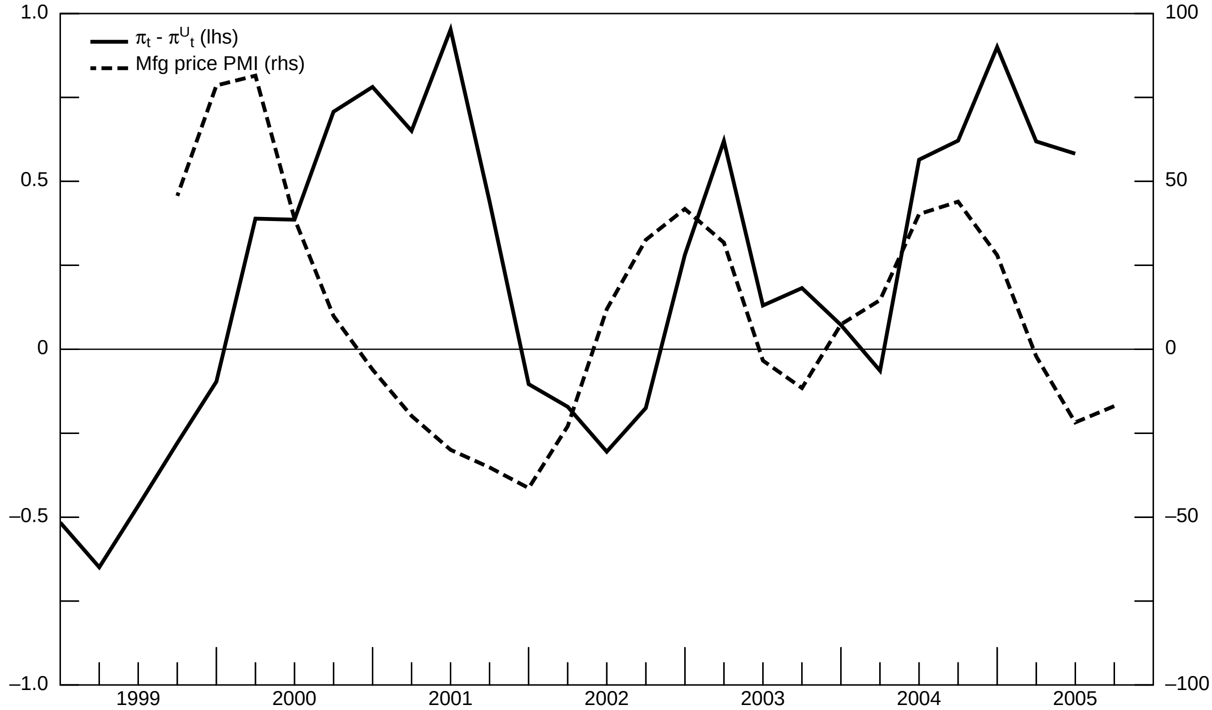
Scatter plot of alternative global gaps against (adjusted) inflation, 1972-1992



Note: See note in Graph 5 for variable definitions.

Graph A.3

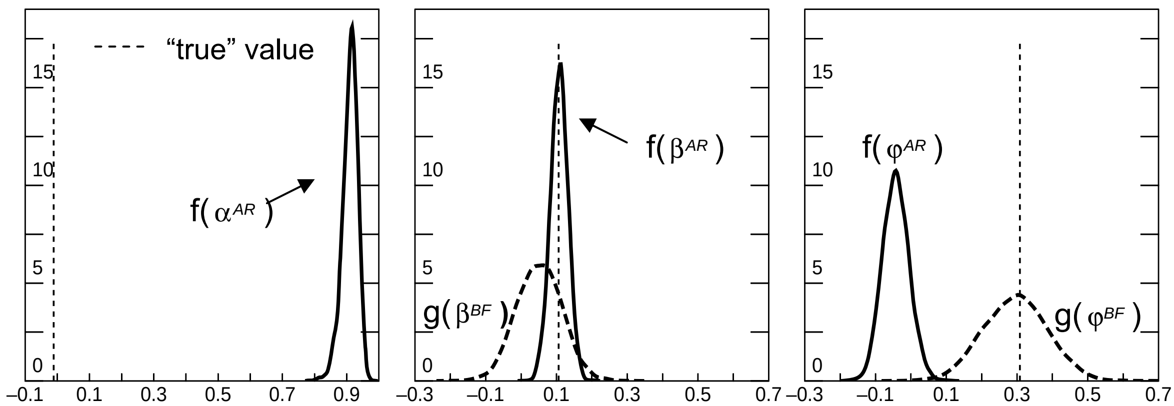
Global inflation and the manufacturing PMI index



Notes: The solid line is a GDP-weighted average of the inflation gap for the industrialised countries in this paper. The dashed line is the 4-quarter growth rate in the JPMorgan PMI.

Graph A.4

Small-sample probability density functions of parameters in conventional AR and B-F specifications



Notes: See the robustness appendix for the details of the simulation results. The distribution *f* represents the small-sample probability distribution from the simulation using the conventional AR specification ($\pi_t = c^{AR} + \alpha^{AR}\pi_{t-1} + \beta^{AR} Gap^D_{t-1} + \phi^{AR} Gap^G_{t-1} + \varepsilon^{AR}_t$) and the *g* from the simulation using the B-F specification ($\pi_t = \pi^U_t = c^{BF} + \beta^{BF} Gap^D_{t-1} + \phi^{BF} Gap^G_{t-1} + \varepsilon^{BF}_t$). Deviations of the mode of the distributions from the "true" value (vertical dashed lines) indicate the size of the bias of the estimators in the small samples which resemble those explored in the paper. The distributions correspond to the simulations using the Hodrick-Prescott filter in step 2 of the experimental design; the other filters produce similar results.

Data sources

Consumer Price Index: national data.

Core CPI (excluding food and energy): OECD Main Economic Indicators database, except for Australia (national data). For euro area prior to 1990, a weighted average of Belgium, France, Germany, Italy, Netherlands and Spain (based on 2000 GDP and PPP exchange rates).

Exchange rates: national data.

Goods CPI: national data, except the United States, France, Italy, the Netherlands and Belgium where the data come from the OECD Main Economic Indicators database.

Import prices: IMF International Financial Statistics database (line 75), except for Switzerland, Austria, Australia and the United States (national data).

Import and exports shares: IMF Direction of Trade database. Trade-weighted and import-weighted global gaps are calculated as follows: for each quarter and for each country (or area), we identify the 10 largest trading partners from our full list of countries (see the data availability table) both in terms of total trade and in terms of total imports. These weights are used to calculate the weighted output gaps as defined in the text. If a country's output gap is not available for a particular quarter, its trade weight is set to zero for that quarter. To calculate euro area import and export shares, we sum the relevant trade statistics for individual euro area member states.

JPMorgan manufacturing price PMI: The composite manufacturing PMI price index from JPMorgan; the series begin in 1998.

Nominal unit labour cost: OECD Main Economic Indicators database, except Australia (national data).

Oil prices: Oil prices in home currency, national data.

Real Gross Domestic Product and potential GDP: OECD Economic Outlook database, except for Belgium, Switzerland, Spain and Austria (national data). If data on potential GDP are not available, missing observations are calculated using Hodrick-Prescott filtered real GDP. Prior to 1993, the output gap for China was constructed from data in OECD (2005).

Output gaps for the following emerging market economies were used in the construction of the global gaps: China from 1979 Q4; India from 1996 Q2; Brazil from 1980 Q1; Mexico from 1972 Q1; Korea from 1972 Q1; South Africa from 1972 Q1; Poland from 1990 Q1; Thailand from 1993 Q1; Hong Kong SAR from 1972 Q1; Czech Republic from 1993 Q1; Chile from 1972 Q1; Singapore from 1975 Q1. The starting dates were dictated by data availability.

Services CPI: OECD Main Economic Indicators database, except for Japan, Sweden, Canada, Norway, United States and euro area (national data).

Wholesale Price Index: national data.

All data are seasonally adjusted. All data start before 1985 unless otherwise indicated in the notes in the tables.