Prospects for global inflation[*] [**]

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1. Introduction

This paper argues that after a decade or more of mainly negative inflation surprises (actual inflation below what was expected by the markets and targeted by the monetary authorities), we are likely to see a run of years, worldwide, of positive inflation surprises. I do not anticipate rampant global inflation, or even global inflation in double digits. I do, however, predict inflation above the two percent annual rates of consumer price inflation that most central banks appear to have adopted, formally or informally, as their operational price stability targets. The four percent CPI inflation rates seen today in countries as far apart as the US and New Zealand are likely to be persistent in both these countries; they are also likely to be observed in other parts of the industrial world during the rest of the decade.

My argument is based on the assumptions (1) that in a fiat money world inflation is, in the medium and longer terms, made by the monetary authorities, and (2) that some of the world's key monetary authorities will respond either too late or too little to ongoing or near-future economic developments that have clear (to me) implications for national and global inflation rates. What then causes inflation?

The well-known statement that "inflation is always and everywhere a monetary phenomenon" is neither particularly deep nor especially illuminating (see

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Friedman (1974)). On the 'deep - to - trite spectrum' it is on a par with the statement that "the price of bananas is always and everywhere a banana phenomenon" – true but not necessarily helpful. However, the statement is obviously correct, so it is as good a place to start as any.

The price of money – the reciprocal of the general price level – is determined by the demand for and the supply of money. In a world of *fiat money*, this means that the supplier of the fiat money, the central bank, represents one half of the two blades jointly determining the general price level. The other half, the demand for fiat money, is determined by economic agents other than the central bank, mainly by the domestic private sector, but also potentially by foreign demand, both private and official.

As long as there is a determinate, finite demand for real fiat money balances, the general price level will be determinate. If that demand for real fiat money balances is stable (that is, if it is a stable function of a few not excessively volatile variables that can either be observed directly by the central bank or about which the central bank can make reasonable inferences), the central bank can generate a price level path that is reasonably stable, at any rate in the medium and long term. This is, just about, the world we (still) live in.

Most discussions of the causes of inflation and disinflation involve going through a lengthy laundry list of local or global real supply shocks (including shocks resulting in changes in key relative prices), and local or global real demand shocks (other than those associated with past, current and anticipated future monetary policy): a representative sample for the past 20 years would include the following: globalisation, the new economy, the ITC revolution, electronic payment systems and funds transfer, cash-on-a-chip, China's entry into the global markets for 'core' and 'non-core' goods and services, trade liberalisation, other changes in the domestic and

international competitive environment (including the Walmart effect), OPEC, commodity booms, asset market bubbles and busts, global pandemics or global warming. In addition to these real demand and supply shocks, some exogenous nominal cost-push shocks – shocks to the level of nominal costs and prices – are often mentioned.

In this essay I will espouse the monetary 'hard hat' position that al these real supply and demand shocks affect inflation in the medium to long term only if and to the extent that they either change the demand for real fiat money balances or cause the central bank to change the current and anticipated future supply of nominal fiat money. In the short run, real demand and supply shocks (holding constant current and anticipated future monetary policy) will affect inflation through the output gap – the gap between actual and potential output or its labour market counterpart – the gap between the actual and the natural rates of unemployment.

Nominal cost and price shocks are concepts I have little time for as fundamental building blocks of a sensible economic model. What it appears to mean, when the intellectual fluff is blown away, is just the expression in terms of the numéraire, of the effect of real demand and supply shocks on some important relative price. Consider the following example: workers become better organised and demand and get a higher real wage. We live in a monetary economy, that is, in a world where contracts are written using fiat money as the numéraire. This is an unexplained primitive assumption for monetary theory and an empirical fact. Except in the most centralised, corporatist wage and price setting environment, workers and unions will take the general price level as given. A higher real wage is therefore negotiated through a higher money wage rather than through the unions bargaining down the money prices of all goods and services in the household consumption basket.

Increased union strength therefore produces what looks like a nominal wage shock. Wage contracts tend to be non-contingent (or at any rate incompletely contingent) on current and future price developments and they can last up to a year or more. If wage contracts are staggered and overlapping, and if relative nominal or real wages matter in the wage bargain, the 'nominal wage shock' becomes persistent. It is clear that this discussion is much more illuminating when the words 'nominal wage shocks' are never used.

I will argue in what follows that there are threats to global price stability in part because of past, present and anticipate future monetary policy errors by a number of key central banks, notably the Fed. These errors are in part a failure to diagnose properly some real supply and demand shocks – the Fed's wild goose chase after 'core inflation' is an leading example. In part these errors are a function of inadequate central bank institutional design and legislative framework. Here too the Fed is a leading example: a good case can be made that the Fed has become the global worst-practice central bank as regards institutional features and legislative design (see Buiter (2006b)).

There also have been serious errors of monetary policy design and implementation. In part these mistakes are caused by the widespread adoption of inappropriate central bank objectives, first and foremost the *flexible inflation targeting* advocated by Svensson (1999, 2005), Woodford (2003) and many others. This framework is an open invitation to for a monetary authority lose track of the inflation target and to drift away from price stability. It has resulted in inflation drift for countries as different as the USA and New Zealand. Furthermore, the adoption of this dangerous objective function for the monetary authority has frequently been coupled with the re-emergence in the so-called New-Keynesian dynamic stochastic general

equilibrium models (DSGEM) of a core weakness of the Old-Keynesian models: the existence of an exploitable, long-run output-inflation trade-off or unemployment inflation trade-off. The best known and most influential examples of such Old-Keynesian wine in New-Keynesian bottles are the New-Keynesian Phillips curves of Calvo (1983) and Woodford (2003).

Once again, I do not anticipate inflationary disasters, or even double-digit inflation, in the industrialised countries as a result of defective monetary policy institutional frameworks and monetary policy errors. I do, however, expect inflation rates for the rest of this decade to be well north of the 2 percent per annum inflation targets for CPI-type price indices that most central banks seem to have adopted or hinted at. Headline CPI inflation in the US has been running at around 4 percent for the past year - the Fed has manifestly let inflation get away from it. Headline CPI inflation in the world's first inflation targeter, New Zealand, has also crossed the 4 percent level. In Section 3, I shall show how the inflation genie got out of the bottle, and why it will not be put back inside immediately. Before that, in Section 2, I will try to guide the reader from the fundamental monetary framework, which focuses on the demand for real money balances and the supply of nominal money balances, to the modern operational framework of monetary policy, in which the quantity of money is neither seen nor heard, but nominal interest rates rule the roost. I will also use this Section 2 to argue that central banks are unlikely to lose their ability to influence the nominal economy in the long run and the real economy in the short run.

2. The stability of the demand for money and the control of inflation in a world with or without money

The stability of the demand for any real-world monetary aggregate, from the narrowest - currency and M0 (the monetary base) to the broadest like M3 and, M4 or the liquidity-weighted aggregates like Divisia money leaves much to be desired. Instability in the demand for money has been such that nowhere in the world is a monetary aggregate used as the (or an) *instrument* of monetary policy. Even more strikingly, most central banks in the leading industrial countries no longer single out monetary aggregates as particularly useful indicators of current or future inflationary pressures. The statement attributed to Governor Gerald Bouey of the Bank of Canada that *"In Canada, we did not abandon money supply targets, they abandoned us"*, pretty will summarises monetary policy thinking everywhere except in Frankfurt. The Bank of England gave up setting a reference value for the growth of Sterling M3 shortly after gaining operational independence over monetary policy in 1997. The Federal Reserve Board has signalled its disdain for the informational value of M3 by ceasing publication of the series altogether – a rather extraordinary (not to say ill-advised) step. Only the ECB still pays (or professes to pay) serious attention to the behaviour of a monetary aggregate, M3, which is given separate Monetary Pillar status, alongside the Economic Pillar (which contains everything else) (see Buiter, Nielsen and Vernazza (2006)). In the ECB's monetary policy framework, there is even a reference value for M3 growth (4.5 percent per annum), which has remained the same since the start of EMU in 1999, despite being overshot consistently since then except during the period July 2000 – May 2001.

Monetarism in the strong sense of using some monetary aggregate as the instrument of monetary policy is dead everywhere; monetarism in the weaker sense of attributing special significance to the behaviour of some monetary aggregate(s) as a guide to future inflation is dead everywhere outside Frankfurt. What is very much

alive however is the belief that through the control of the short risk-free nominal rate of interest (that is, the short-term interest rates on default risk-free securities denominated in the central bank's monetary liabilities), the monetary authority can, at least in the medium and longer term, control the rate of inflation, that is, the growth rate of the price level in terms of the central bank's monetary liabilities. This belief makes sense only if the real demand for the monetary liabilities of the central bank, while perhaps volatile and not expressible as a stable function of a few observables, is nevertheless determinate and positive.

What this rules out, is the cashless economy, or an economy in which there are private financial instruments that are perfect substitutes for central bank money. If technological advances ever take us to the point where central bank money no longer has any unique attractions, that is, properties that cannot be replicated at effectively zero cost by using private instruments, central bank cash would cease to be the nominal anchor of the economy. Without another nominal anchor there would be price level indeterminacy. Monetary policy (the ability of the central bank to set the nominal risk-free rate on its non-monetary liabilities), would have no effect either on real or on nominal variables.

While it may appear that we are getting closer to the cashless economy state of affairs, we are not there yet, and I believe that we never will get there. There are two reasons for the uniqueness of central bank money. The first is the fact that it is a negotiable bearer asset that (a) is legal tender and (b) is free of nominal default risk. It can be issued at essentially zero cost in unlimited amounts. This makes any other financial instrument issued by the central bank and denominated in central bank fiat money effectively free of default risk (see Goodhart (2006)). The second is the

guaranteed existence of a demand for anonymous bearer bonds by the criminal community.

It may seem that the absence of nominal default risk is not a unique property of central bank fiat money (cash). After all, I could issue irredeemable Buiter Bearer Notes (BBNs) – instruments that have the property that a 10 Buiter note is a promise to pay the bearer on demand Buiter Bearer Notes worth 10 Buiters (the numéraire in terms of which the security is measured). As long as my desktop printer works, I can honour that promise and also service other debt instruments denominated in Buiters. If for whatever reason other economic agents decided to hold these and use them as means of payment/medium of exchange, I would have created a default-free financial instrument that would have value.

There are two problems with this happy scenario. First, it would be illegal in most countries. Legal restrictions frequently limit the right to issue negotiable bearer bonds to the monetary authorities. Second, without the aura of legal tender attached to them, any demand for Buiter notes would be likely to be ephemeral. Having legal tender status (being acceptable in settlement of debt and payment of taxes) (creates a natural focal point that may turn an intrinsically valueless fiat money claim into something with positive purchasing power over real goods and services.

So central bank fiat money is likely to remain the only fiat instrument with zero default risk that commands value over real (intrinsically valued) goods and services.[1] The 'legitimate' domestic demand for central bank cash, while shrinking,

[1] As an aside, it follows that a complete contingent market framework is the worst possible framework for analysing the fundamental determinants of the demand for fiat money. That is because there is no default and therefore no default risk in equilibrium in a complete contingent markets framework. The uniqueness of central bank fiat money as a default risk-free instrument is therefore shared by all financial instruments and other stores of value. It is therefore not surprising that a demand for fiat money can only be created through the use of intellectual brute force, such as making fiat money an argument in the direct utility function or in a 'shopping function' or by creating *ad-hoc* constraints on trade (cash-in-advance) which, for reasons unknown, only fiat money can overcome.

will not therefore not vanish to the point that price level indeterminacy becomes inevitable. Even if the demand for central bank fiat money as a store of value/medium of exchange were to go to zero, the demand for (contingent) access to central bank credit would remain finite. The monetary base could be zero, but the demand for overdraft facilities at the central bank would provide the nominal anchor.

The second lasting source of demand for central bank fiat money is the criminal demand. For an open economy, it is possible to derive a third source of lasting demand for central bank fiat money. This is the legitimate foreign or external demand for domestic fiat money. Legitimate external demand for a few leading hard currencies (the US dollar, the euro, sterling, Swiss francs and the yen) comes from economic agents condemned to live and work in countries with high domestic rates of inflation.

Illegitimate demand for central bank cash (from those engaged in tax evasion, money laundering and paying or taking payment for the provision of criminal goods and services) will always be there because central bank cash offers anonymity: it is a negotiable bearer bond.

So price level determinacy will be assured for the foreseeable future, in only because of the demand for central bank money from those operating in the grey and black economies. Monetary policy will retain a handle on nominal variables in the medium and long run (and , if there are nominal rigidities, also on real variables in the short run) thanks to the criminal community.

What would happen if either there were a pandemic of honesty or if central banks retired all their monetary liabilities (as a crime-fighting measure say)? Central bank money would have ceased to exist as a medium of exchange/means of payment and store of value. The central bank would retain its handle over nominal and, in the

short run (if there are nominal wage or price rigidities) also over real variables, as long as (1) the private sector continued to use the former central bank money (now virtual central bank money) as the numéraire in its contracts, and (2) the central bank continued to set the risk-free nominal interest rate on non-monetary securities, that is, the risk-free interest rate on securities denominated in the former (late, lamented) central bank money (see Woodford (2000, 2003). Monetary policy, with central bank no longer serving as means of payment/medium of exchange or store of value would become pure numerairology (see Buiter (2004, 2005)).

Would the former central bank money continue to be the unit of account of the private sector, that is, the unit in terms of which contracts are written and invoices made out. Woodford (2003) asserts yes. In his view the central bank determines what is used as the numéraire in an economy. I have argued elsewhere that Woodford's position is wrong, historically and logically (Buiter (2004, 2005)). It is *possible* that 'virtual' central bank cash would continue as numéraire even after central bank cash has ceased to exist as a means of payment/medium of exchange and store of value, but that what serves as the numéraire is the outcome of a collective (often decentralised, uncoordinated) set of choices.

The central bank may be able to insist that in its contracts with the private sector, virtual central bank cash be used as the numéraire. It may be able to convince the Treasury that taxes should be paid using financial instruments (e.g. bank deposits), denominated in virtual central bank money. It may even be able to encourage the use of virtual central bank money as the numéraire in transactions among private agents, if it can convince the domestic courts that only contracts denominated in virtual central bank money can be enforced by the courts, but this would be viewed by most as a bridge to far. What the central bank cannot do is insist that its virtual currency be

used as the numéraire in transactions between private parties. That is a decision made by private parties each time a contract is signed or a price is posted.

If, for whatever reason, central bank virtual money continues to be used as the numéraire in a cashless economy, the central bank can control the rate of inflation in terms of that numéraire, by controlling the short risk-free interest rate on securities denominated in that numéraire. The price *level* would, however, remain indeterminate, unless there were nominal wage or price rigidities. Without such nominal rigidities there would be inflation determinacy but not price level determinacy. Price *level* determinacy requires nominal wage or price rigidities. This proposition of course holds also when there is a positive demand for real central bank cash and the authorities freely supply any amount of central bank cash demanded at the policy-determined short nominal interest rate.

3. How the global inflation genie crept out of the bottle

Overestimating potential output

Since (at least) the early 1990s, most of the surprises as regards the growth rate of global potential output have been positive. The successful integration of the BRICS into the global economy was one such positive surprise. The rapid adoption of ICT first in the US economy and a few small European economies (including Finland and Sweden) but later throughout the (post-) industrial world and increasingly also in the most dynamic emerging markets was a second positive supply shock. Further trade liberalisation was a third. It is interesting to note that despite the globalisation and New Economy growth promoting factors at work in the world economy, there is not much evidence of an upward shift in the trend growth rate of world real GDP (see Chart 1),

Chart 1 here

There can be no doubt, however, about the massive deceleration of global prices since the seventies, and especially since 89/90, as shown in Charts 2a and 2b.

Chart 2a here

Chart 2b here

Chart 2c, tracking commodity price inflation and oil price inflation as well as CPI inflation suggest to me that there is no lasting effect of the massive relative price changes we have seen between the core and non-core components of the consumer price index, on headline inflation.

Chart 2c here

The impact of such supply-side surprises on monetary policy and inflation can be clarified with the help of a very simple model, consisting of the Taylor rule, the canonical descriptive model of central bank behaviour, an eclectic New-Keynesian Phillips curve and a simple aggregate demand function or IS curve. Here i_t is the short nominal interest rate, E_t is the expectation operator conditional on information available at the beginning of period *t*, π_t is the period *t* inflation rate, r_t^* (exogenous) is the natural or neutral real interest rate in period *t*, $\hat{\pi}$ is the (constant) target rate of inflation, y_t is real output in period *t* and y_t^* (exogenous) is potential output in period *t*.

$$i_t = E_t r_t^* + E_t \pi_t + \gamma(E_t \pi_t - \hat{\pi}) + \delta E_t (y_t - y_t^*) \qquad \gamma, \delta > 0 \tag{1}$$

The Taylor rule ensures that the short nominal interest rate (the central bank's instrument) moves in such a way that the short real interest rate, $r_t = i_t - E_t \pi_t$, rises when the output gap increases and when expected inflation increases relative to the inflation target. When the output gap is zero and inflation is at its target level, the

short real interest rate according to the Taylor rule equals the natural or neutral real interest rate, the real interest rate that would prevail with output at potential and a sustainable current account balance.

The appearance of the output gap in the Taylor rule need not imply that the policy maker cares intrinsically about the output gap. Even when the authorities do not, in their objective function, trade off inflation for output, the output gap could appear in the decision rule or reaction function of the monetary authority because the output gap helps predict future inflation.

I sprinkled expectations liberally on the right-hand-side of the Taylor rule (1). This serves as a reminder that virtually all the arguments in the function - the neutral real interest rate, the actual inflation rate, actual output and potential output - have to be estimated or predicted. In the case of the US, we don't even know what the target inflation rate is, and it is not clear that the Fed does either.

The Phillips curve, a mixed backward-looking and forward-looking New Keynesian construction, takes the following form:

$$\pi_t - \tilde{\pi}_t = \alpha\left(\pi_{t-1} - \tilde{\pi}_{t-1}\right) + \beta E_t(\pi_{t+1} - \tilde{\pi}_{t+1}) + \phi(y_t - y_t^*) \qquad 0 \le \alpha, \beta \le 1, \phi > 0 \tag{2}$$

As is common in the New-Keynesian literature, nominal price and/or wage rigidities are introduced by assuming there are two kinds of wage or price setters, one of which may (for reasons that are not explained) be subject to nominal rigidities in its price or wage setting behaviour. Consider price setting. One group consists of fully informed and fully rational monopolistically competitive price setters, who set prices to maximize the present discounted value of their profit stream given their cost function and their perception of current and future market demand curves. The other group follows a very simple rule of thumb or *heuristic* for setting its prices. The

inflation rate chosen by this group of constrained price setters is denoted $\tilde{\pi}$. The inflation heuristic adopted by this group may exhibit price level inertia or inflation inertia.

The aggregate demand equation a partially forward-looking IS curve, where demand depends also negatively on the real interest rate. The variable f stands for anything else that shifts real demand, including fiscal policy and, in an open economy, the real exchange rate.

$$y_t = \eta y_{t-1} + \theta E_t y_{t+1} + f_t - \kappa E_t(i_t - \pi_t) \qquad \eta, \theta, \kappa > 0 \tag{3}$$

I consider it likely that future potential output surprises will be on the downside. China and India will not enter the global economy a second time. What is left as regards countries that have not yet become part of the global economy is limited (North Korea!), although a fair number of developing countries could raise the growth rates of their potential output significantly through far-reaching institutional and structural reforms.

I am also not convinced that China will be able to sustain its current growth rates for much longer. This judgement is based in part on my belief that the 10 percent per annum GDP growth rates reported for the past 10 years represent serious overestimates of the true growth rates of net national income. This is because they fail to record the massive destruction of environmental capital that has been an integral part of the Chinese growth miracle. I am not even referring to aesthetic costs and damages felt only or primarily by tree-huggers. What we are seeing in China are accelerating depletion of fresh water resources (both surface water and underground aquafers) and the poisoning of much of the remaining fresh water resources, wide-spread pollution/poisoning of the soil (agricultural, residential and

commercial/industrial), desertification on the edges of the Gobi desert, de-forestation and erosion of top-soil almost everywhere and air pollution in much of the coastal regions of such severity that it constitutes a public heatlh hazard (and a serious additional challenge to those intending to run the Marathon in the 2008 Olympics) – and all this on a globally unprecedented scale.

Not only does this unrecorded depletion of environmental and ecological capital (callen 'natural capital' in Arrow et. al. (2004)) make the growth of true real national income (or of any reasonable measure of economic welfare (see e.g. Nordhaus and Tobin (2004)) lower than the growth rate of recorded GDP, it will, starting soon, show of in the behaviour of recorded GDP, even if this remains as poorly a measure of value added as it always was. Growing water scarcity will reduce industrial growth. The public health implications of decades of environmental neglect (combined with an aging population) will lower the growth rate of labour productivity (even as conventionally measured); declining agricultural soil quality will depress agricultural productivity growth; poisoned industrial and residential land will become a business cost, as well as a drag on the quality of life.

With ICT now having reached even the most remote corners of the service economy, US productivity growth is unlikely to equal that achieved over the past 10 years. Even past US productivity growth figures have been revised downwards.

If the authorities are likely to over-predict potential output, interest rates will be too low, and inflation will turn out to be higher than planned and expected. In due course, interest rates will rise to bring inflation back to target, but there will be an interval, possibly of several years' duration, during which inflation will be higher than planned

Underestimating the importance of the global output gap for domestic inflation

A further complicating factor is that the output gap measure on the RHS of (1), should probably be some weighted average of the domestic and global output gaps, because the output gap measure in the Phillips curve (equation (2)) has become some weighted average of the domestic and global output gaps. With outsourcing and offshoring gaining in importance, costs and mark-ups in any national economy will reflect the influence of output gaps in foreign countries to which activities have been offshored or outsourced (see Rogoff (2006) and Bean (2006). These influences are not necessarily fully captured by import prices, which are of course part of the price indices targeted by most central banks. If cost and inflation pressures in key emerging markets (destinations for much outsourcing and offshoring) are likely to be higher during the next decade than during the last one, industrial country central banks using a Taylor-rule framework that ignores global output gaps could again fall behind the curve, and inflation would end up temporarily higher than expected.

Overestimating the slope of the short-run Phillips curve

Another way of putting the point that the relevant output gap measure in the Phillips curve is not just the local, national output gap but includes the global output gap is that globalisation and increased openness have made the short-run Phillips curve flatter than in the past, that is, in equation (2) the coefficient ϕ has become smaller. (see Rogoff (2006) and Bean (2006)). There are of course reasons other than globalisation why the Phillips curve could have become flatter; Lucas's (1973) Phillips curve model has the slope of the Phillips curve in inflation-output space decreasing (flattening) as the ratio of the variance of the general price level to the variance of relative price changes falls, because the yeoman farmers in his model

view an observed increase in their local price as more likely to represent a relative price shock (which requires an output response) than a general price level shock, which requires none. With nominal demand more stable in recent years, the Phillips curve would flatten.

With some significant countries well above any reasonable estimate of their inflation targets (including the US), and few below it, this creates a risk that excessive inflation will last longer than expected, if the authorities don't realise the short run Phillips curve is as flat as it is. They will underestimate the degree to which the output gap will have to fall, or the actual unemployment rate will have to increase relative to the natural rate, and thus raise interest rates by too little. Assuming learning does ultimately take place, inflation will in due course return to target, but average inflation during the traverse will be higher than expected.

Underestimating the neutral interest rate

As is apparent from Chart 3, medium and long-term real interest rates have been extraordinarily low since, at least, 2003. Other countries for which there is a reasonably liquid market for index-linked securities (France, the US) tell a similar stories, although there is a UK-specific component to the low real yields shown in Chart 3. The US Treasury long-term average (over 10 years) rate on index-linked securities was 2.54% for 2003, 2.21% for 2004 and 1.94% for 2005.[2]

Chart 3 here

[2] This is based on the unweighted average bid yields for all TIPS with remaining terms to maturity of more than 10 years.

While part of this may reflect global fundamentals, such as the entry of China, a country with an extraordinarily high saving rate, into the global economy, much of it is, I suspect, an anomaly, possibly a bond market bubble, that will be corrected. If the neutral real rate rises but the monetary authorities do not perceive this immediately, short nominal interest rates would be too low to achieve the inflation target and inflation would, for a while, be higher than planned and expected.

The Fed's mesmerized stare in the distorted rear-view mirror of core inflation

It is clear to all but the FOMC and the staff of the Federal Reserve Board, that the Fed has lost the plot. It has let inflation get away from it. The true inflation picture is much worse than the Fed's focus on core inflation permits them to see. Chart 4 shows the behaviour of headline inflation and core inflation (headline inflation stripped of its food and energy components) for the Personal Consumption Expenditure deflator. It shows headline inflation running at around 3.5% per annum for the past 12 months or so. Core inflation on the PCE deflator definition has been running at just over 2 % per annum for the past two years or so, edging up recently towards 2.5%.

Chart 4 here

Chart 5 shows the behaviour of headline inflation and core inflation for the CPI, a better proxy for the cost of living index than the PCE deflator in my view. Headline CPI inflation has averaged 4% for the past year. Core CPI inflation is creeping up towards 3%.

Chart 5 here

How did the Fed, with its excellent staff and a number of first-rate applied monetary economists get mesmerized by core inflation? As William Safire put it, core

inflation is a great measure of inflation if you don't eat and drive. I take it as axiomatic that what the authorities are interested in (or ought to be interested in) is headline inflation over the medium term, or the underlying rate of headline inflation going forward. Clearly, to target expected or predicted headline inflation over a medium-term horizon, you have to filter out the volatile and transitory components of the headline inflation process. Volatility and transience/persistence are quite distinct properties of a time series process, but I will not go into these technicalities here.

When will the 'trend' future behaviour of the headline inflation index be best captured by dropping from the index a bundle of commodities (non-core commodities like food and energy in the case of the Fed) whose prices are historically highly volatile and whose inflation rates may, historically, show little persistence? I will not elaborate the point that the volatility of headline inflation, as measured by the variance of the headline inflation index, is the variance of core inflation (multiplied by the square of the share of core goods in the headline index), plus the variance of non-core inflation (multiplied by the square of the share of non-core goods in the headline index), plus the covariance between core inflation and non-core inflation, multiplied by twice the product of the shares of core goods and non-core goods.[3] Thus even if non-core inflation is a lot more volatile than core inflation, the headline inflation could therefore be less volatile than core inflation, if core and non-core inflation are sufficiently negatively correlated. A quick-and-dirty calculation (assuming that non-core goods are 18.4% of the CPI index in each period) confirms that core and non-core CPI inflation are indeed negatively correlated – the correlation coefficient is -

[3] Let $\pi = s\pi_c + (1-s)\pi_n$, where π, π_c **and** π_n are headline inflation, core inflation and non-core inflation respectively and s , is the (constant) share of core goods and services in the headline price index. Then $\sigma_\pi^2 = s^2\sigma_{\pi_c}^2 + (1-s)^2\sigma_{\pi_n}^2 + 2s(1-s)\rho_{\pi_c\pi_n}\sigma_{\pi_c\pi_n}$, where σ_x denotes the standard deviation of *x* and ρ_{xy} the correlation coefficient between *x* and *y*.

0.22; for the PCE deflator the correlation between core and non-core inflation is -0.17

Of course, the correlation between core and non-core inflation is not, in general, a deep structural parameter that one would expect to remain near-constant over time. One set of circumstances under which a negative correlation would be a deep structural feature would be when the monetary authorities were successful in stabilising inflation perfectly. Since

$$\rho_{\pi_c \pi_n} = \frac{\frac{\sigma_\pi^2}{\sigma_{\pi_c}\sigma_{\pi_n}} - \left[s^2 \left(\frac{\sigma_{\pi_c}}{\sigma_{\pi_n}} \right) + (1-s)^2 \left(\frac{\sigma_{\pi_n}}{\sigma_{\pi c}} \right) \right]}{2s(1-s)}$$

if follows that if $\sigma_\pi^2 = 0$ (completely successful stabilisation of the general price level), the correlation between core and non-core inflation will have to be negative unless there is complete relative price stability: $\sigma_{\pi_c} = \sigma_{\pi_n} = 0$.

I also will not belabour the implications of the statistical finding that in the US, core inflation does not 'help predict' future headline inflation once the information contained in past headline inflation has been used fully. Core inflation, that is, does not *Granger-cause* headline inflation: it has no incremental predictive content as regards headline inflation (or vice-versa, for that matter).

More important for understanding the nature of the Fed's core inflation whopper is that fact that you don't try to predict medium term headline inflation from core inflation alone, even when core inflation is historically more persistent and less volatile than both headline and non-core inflation, if there is information (beyond what is contained in past price behaviour), which suggests that there is a persistent and long-lasting relative price change under way between the non-core goods and the core goods and services.

And such a relative price change is exactly what globalisation has been bringing us since the end of the last century, and especially during the global boom that started in 2002/3. The entry of China and other BRICS countries into the world economy lowered the relative price of core goods. The rate of inflation of manufactured goods fell way below the headline rate of inflation as several hundred million newcomers to the global labour market moved from agriculture into manufacturing. The counterpart of this (relative) disinflation of the goods the BRIC countries are producing, is the high inflation of the goods they are importing: energy and commodities, including commodities that have food as one of their alternative uses.

Globalisation therefore brought us high global inflation of commodities and energy (non-core goods) and low inflation, even deflation for a while, for core goods. The Fed's focus on core inflation led it to miss half of what globalisation was doing to global inflationary pressures. By looking at the past and current behaviour of core inflation, the Fed is looking in a distorted rear-view mirror to try and predict the behaviour of headline inflation in the medium term, the horizon over which current interest rate decisions will have a significant effect on headline inflation. The mistake is as serious as it is incomprehensible, especially its persistence in the Bernanke Fed, which is groaning under the weight of some very highly qualified empirical monetary economists.

This critique of the Fed's use of core inflation to predict the underlying medium-term trend of headline inflation can be generalised. I don't believe that any insight is gained about the future path of headline inflation in the medium and long term, by looking at the inflation behaviour of the components of the headline price index. My favourite oversimplication is the following: headline inflation can be fully

understood by considering only monetary policy (past, current and anticipated short nominal interest rates) and the behaviour of some economic aggregates (e.g. the output gap, past headline inflation and medium term inflationary expectations). Relative price changes (not explained by the headline inflation framework nor playing any role in it), then determine, recursively, the behaviour of the inflation rates of the components of the headline index (core, non-core, imported, domestically generated, whatever). I realise this is too simple for an open economy, unless you include nominal exchange rate behaviour under 'monetary policy', but I find it a lot more useful than modeling core inflation and non-core inflation separately and then adding to two together. In principle the top-down and bottom-sup approaches can be conducted in such as way as to give the same (correct) answer. In practice, however, the bottom-up approach does not build into the analysis the constraint(s) that ensure(s) that inflation is a monetary phenomenon.

The siren song of flexible inflation targeting

Some of the world's leading central banks have been seduced by the siren song of 'flexible inflation targeting', as advocated by Svensson (1999, 2005), Woodford (2003) and many others.[4] The objective function of the monetary authority in this approach is represented by the discounted sum of expected future squared deviations of inflation from its target level and of expected future squared output gaps. The flexible inflation targeting monetary authority therefore minimizes:

$$\Lambda_t = \sum_{i=0}^{\infty} \beta^i L_{t+i} \qquad 0 < \beta < 1 \tag{4}$$

[4] For a more extensive discussion of these points, see Buiter (2006a).

$$L_{t+i} = E_t\left[\left(\pi_{t+i} - \pi^*\right)^2 + \lambda(y_i - y_i^*)^2\right], i \geq t; \lambda > 0 \qquad (5)$$

where λ is the weight put on output gap stabilisation; the weight on inflation targeting is normalised to 1.

The flexible inflation targeting period loss function (5) is a poor choice of objective function for a monetary authority. First, it has no welfare economic foundations. From the point of view of established welfare economics, it is not compatible, except in a single practically irrelevant special case, with the optimisation of a social welfare function that respects individual preferences over current and future consumption. Woodford's argument to the contrary (Woodford (2003)) has been shown by Buiter and Sibert (2006) to be generically incorrect (again except in a single practically irrelevant special case) for the class of New-Keynesian dynamic stochastic equilibrium models analysed by Woodford (see also the next subsection).

Equation (5) is also a poor choice of objective function, because it is incompatible with the legal mandate given to many of the leading central banks, including the European Central Bank and the Bank of England. These central banks are assigned price stability as their primary or overriding objective. Only subject to, or without prejudice to, the price stability objective being met, can the authority legitimately pursue other objectives such as employment, output or happiness. Such mandates imply lexicographic or hierarchical inflation targeting, not flexible inflation targeting. Any positive weight λ on the output gap in the period loss function would be too large, because it would imply a trade-off in preferences between inflation and output stabilisation (relative to their target levels). The lexicographic point of view rules out such a trade-off. A zero weight λ would, however, also not be right, because output gap stabilisation is valued, as long as it does not come at the expense of price stability.

The only central bank whose legally mandated fundamental objectives are not lexicographic in price stability is the Fed. It has three co-equal fundamental objectives, that is, objectives, that must be traded off each against the other because none is accorded lexicographic priority. The three objectives are maximum employment (a real economy objective), price stability, and moderate long-term interest rates (an asset market objective). By analogy with the flexible inflation targeting period loss function (5), the period loss function, the Fed would be:

$$L_{t+i} = E_t\left[\left(\pi_{t+i} - \pi^*\right)^2 - \lambda_y y_i + \lambda_l (i^L_{t+i} - i^{L*})^2\right], i \geq t; \lambda_y > 0,\ \lambda_l > 0 \tag{6}$$

where i^L is the long nominal interest rate and i^{L*} is target value. Note that the Fed's loss function is decreasing in employment (proxied by output in (6)) for all values of employment.

I will argue below that flexible inflation targeting risks giving rise to inflation drift above the inflation target. In practice, flexible inflation targeting has specialised the period loss function (5)to:

$$\mathrm{Var}_t\, \pi_{j,j-1} + \lambda\, \mathrm{Var}_t\, y_j \tag{7}$$

where Var_t denotes the variance conditional on information available at time *t.*

In fact (5) implies not (7) but

$$\begin{aligned} &\mathrm{Var}_{\mathrm{t}}\, \pi_{j,j-1} + \lambda\, \mathrm{Var}_{\mathrm{t}}\, y_j \\ &+\lambda\, \mathrm{Var}_{\mathrm{t}}\, y^*_j + \left(\mathrm{E}_{\mathrm{t}}\, \pi_j - \pi^*\right)^2 + \lambda\left(\mathrm{E}_{\mathrm{t}}\, y_j - \mathrm{E}_{\mathrm{t}}\, y^*_j\right)^2 - 2\lambda\, \mathrm{Cov}_{\mathrm{t}}(y_j, y^*_j) \end{aligned} \tag{8}$$

where $\mathrm{Cov}_{\mathrm{t}}$ denotes the covariance conditional on period *t* information. It follows that for (7) to represent a period loss function for the monetary authority that is equivalent to (5) or (8), the following assumptions have to be made:

(1) $\mathrm{E}_{\mathrm{t}}\, \pi_j = \pi^*$: there is no inflation target bias.

(2) $\mathrm{E}_t\, y_j = \mathrm{E}_t\, y_j^*$: there is no output gap bias: the actual and optimal levels of output are the same on average (or the output gap bias is independent of monetary policy).

(3) $\mathrm{Cov}_t(y_j, y_j^*) = 0$ (or the conditional covariance is independent of monetary policy).

(4) $\mathrm{Var}_t\, y_j^* = 0$ (or the conditional variance of the efficient level of output is independent of monetary policy).

Assumption (4) is pretty standard. Assumption 3 is highly unlikely to be satisfied in most Old- or New-Keynesian models. Assumption 2 is satisfied in the long run if the economy has the long-run natural rate property; that is, if there is no unemployment inflation trade off or output inflation trade off across deterministic steady states. It is not necessarily satisfied in the short and medium term.

Assumption (1) is a necessary condition for effective inflation targeting, at any rate in the long run. To assume that it is automatically satisfied, as replacing (5) by (7) implies, is to assume away all the technical problems, commitment problems and other political problems associated with inflation targeting. It is true that for many of the most popular New-Keynesian and Old-Keynesian models used to address inflation targeting, there are few technical obstacles to meeting the inflation target on average. Indeed, these models all share the property that, when the inflation rate is, on average, equal to the constant target rate of inflation, the output gap is, on average, equal to zero. So, with the 'first moment' problems of inflation targeting and output gap targeting solved, the monetary policy maker is left with just the problem of choosing the optimal combination of the conditional second moments of inflation and output.

This trivialises the central problem of inflation targeting, which is meeting the inflation target on average, going forward, that is, achieving a zero inflation bias. When $E_t\pi_j = \pi^*$, the key problem of the inflation targeting monetary authority, that of creating a credible nominal anchor, is solved. This is difficult to achieve in practice, and can never be taken for granted: the first moment problem is also the first-order problem. Monetary authorities in the UK, in the Eurozone, in the US, in New Zealand and in Turkey are concerned, as this paper is being written, about the upward drift of inflation expectations above their inflation targets, comfort zones or tolerance ranges. The second-moments period loss function (7), which assumes that there is no first-moments problem, is an extremely misleading and dangerous construct to dangle in front of the monetary authorities: the second moments are really of second order importance unless the first order first moments problem has indeed been solved.

The apparent similarity of Assumption 2, $\mathrm{E}_t\, y_j = \mathrm{E}_t\, y_j^*$ (no output gap bias) and Assumption 1, $\mathrm{E}_t\, \pi_j = \pi^*$ (no inflation target bias) hides an important difference which can come back to haunt policy makers. For models with the (long-run) natural rate property, the servo-mechanisms of the market economy will tend to drive actual output towards potential output, at any rate in the long run, even without any policies designed to achieve that. There is no such built-in mechanism for ensuring that the actual rate of inflation will be driven towards the target rate of inflation, unless the policy authorities adopt rules (like the Taylor rule) that ensure that this will be the case: there may be a natural rate of unemployment, a natural level of output and a natural real rate of interest but there is no natural rate of inflation; the long-run equilibrium inflation rate is decided by the monetary authorities.

The hubris that has led most central banks other than the ECB and the Bank of England to believe that monetary policy can systematically trade off inflation stability for output stability will be shattered as surely as the older belief that monetary policy can trade off expected inflation for the expected output gap. Indeed, I believe that this is already happening. Until monetary authorities in the US, New Zealand, Sweden, Norway, Canada and key emerging markets like Turkey and Brazil move from flexible inflation targeting to lexicographic inflation targeting, an inflation bias is likely to persist.

Old-Keynesian wine in New-Keynesian bottles: the delusions and dangers of the New-Keynesian Phillips curve.

Consider the simple New-Keynesian Phillips curve given in (2). Across deterministic steady states, this implies the following trade-off between inflation and the output gap. All deterministic steady state values are denoted by overbars.

$$\overline{y - y^*} = \phi^{-1}\left[1-(\alpha+\beta)\right](\overline{\pi - \tilde{\pi}}) \tag{9}$$

Therefore, unless $\alpha+\beta=1$, or $\overline{\pi-\tilde{\pi}}=0$, there is a long-run, exploitable, inflation-output gap trade off. In the canonical New-Keynesian Phillips curve proposed by Calvo (1983) and further developed by Woodford (2003), $\alpha=0$ and $0<\beta<1$. The original Calvo model has the further property (since disowned by Calvo (see Calvo Celasun and Kumhof (2003))), that the constrained, ad-hoc price setters keep their nominal prices constant, regardless of the economy-wide rate of inflation, that is, they assume that $\tilde{\pi}_t = 0 = \overline{\tilde{\pi}}$. This specification has also been prominent in Woodford's work (see Woodford (2003) and Benigno and Woodford (2005). Woodford also favours an alternative specification of the inflation heuristic, whereby the constrained price setters update their prices using a partial lagged

indexation rule: $\tilde{\pi}_t = \mu\pi_{t-1}$, $0 < \mu < 1$. However, even under this rule $\overline{\tilde{\pi}} = 0$ and there is a long-run non-vertical, exploitable Phillips curve:

$$\overline{y} = \overline{y^*} + \phi^{-1}\left[1-\left(\alpha+\beta\right)\right]\overline{\pi} \tag{10}$$

The deterministic steady state level of real output is perfectly controllable through the control of the rate of inflation. For instance, if there are real inefficiencies (monopoly power, tax distortions) that make the efficient level of steady state output $\overline{y^*}$ higher than the natural steady state level of output $\overline{\hat{y}}$, say, the authorities could choose to set real output equal to its efficient level by choosing the appropriate rate of steady state inflation:

$$\overline{\pi} = \left(\overline{\hat{y} - y^*}\right)\phi\left[1-\left(\alpha+\beta\right)\right]^{-1} > 0 \tag{11}$$

Woodford points out that, even if it were possible to keep actual output above its natural level, it will not be optimal to raise it all the way to its efficient level, because the welfare losses caused by the relative price distortions that occur whenever actual inflation differs from the inflation heuristic. These have to be balanced against the welfare gains of getting actual output closer to the efficient level of output.

The assumption that even in a deterministic steady state, the inflation rate of constrained price setters can be systematically below that of the unconstrained price setters is baffling. I thought this argument had been debunked, theoretically and empirically, over 30 years ago.

To argue that it is possible to keep actual inflation systematically above or below the inflation heuristic, even when comparing deterministic steady states, is to argue that the economy does not have the long-run natural rate property: there is a stable long-run trade-off between inflation and real output and, in richer models

containing labour markets as well as product markets, between inflation and employment or unemployment.

Key to the existence of a long-run inflation-output trade-off in the New-Keynesian Phillips curve model is the relationship between the inflation heuristic and actual inflation - the re-incarnation of the relationship between expected and actual inflation characteristic of 1960s style expectations-augmented Old-Keynesian Phillips curves like the Samuelson-Solow (1960) and Tobin (1968) models - or even Phillips' original contribution (Phillips (1958)). The work of Phelps (1967) and Friedman (1968) undermined the plausibility of a stable Phillips curve trade-off and menu for policy choice in the long run. Lucas (1972b) convinced much of the profession that the long-run was only as long as it took for expectations to filter out the systematic components of the inflation process (and of the decision rule of the policy maker driving the inflation process).

It is ironic that after more than 30 years of disrepute, the behavioural anomalies that support a long-run non-vertical Phillips curve – indexation rules or expectation formation heuristics that violate what I have called the *sure thing principle* , that expectations should be correct in deterministic steady states and that indexation rules should reproduce actual inflation in deterministic steady states, are once again central to the debate about optimal inflation policy. I consider this to be is a clear example of technical regress. The Calvo specification for the inflation heuristic, $\tilde{\pi}_t = 0$, and Woodford's indexation rule $\tilde{\pi}_t = \mu\pi_{t-1}$, $0 < \mu < 1$ produce a deterministic steady state Phillips curve that is indistinguishable, except for the convexity of Phillips's original relation, from Phillips's (non-expectations-augmented) unemployment-wage inflation trade-off, translated into price inflation - output gap space. This undesirable feature of Calvo's original model was noted in

Buiter and Miller (1985). They proposed an alternative for which price setting is characterised by both price level inertia and inflation inertia, and which satisfies 'sure thing principle' and therefore has the long-run natural rate property.

With a long-run exploitable Phillips curve once again part of generally acceptable monetary policy discourse, it is not surprising that inflation has been drifting upwards.

4. Conclusion

Global inflation that is both higher than expected and higher than desired by the monetary authorities, is likely for the remainder of this decade. The causes are: (1) the slow response to unforeseen (by most monetary policy makers) developments in the global economy; (2) the adoption of an inappropriate operational objective function by some key central banks; and (3) the re-emergence of influential but sub-standard monetary analysis supporting the existence of a long-run exploitable trade-off between inflation and the output gap.

The global economic developments likely to make for higher inflation are the delayed response of central banks to (1) a lower than expected trajectory for global potential output; (2) greater importance of the global output gap for domestic inflation; (3) a flatter short-run Phillips curve; (4) a higher neutral real interest rate.

Specific monetary policy errors include the misplaced focus of the Fed on core inflation. The siren song of flexible inflation targeting has caused a number of central banks to lower their anti-inflationary guard. In these countries, which include the US (which has 'ultra-flexible inflation targeting plus') and New Zealand, flexible inflation targeting threatens to undo much of the good achieved since the birth of inflation targeting in New Zealand in 1989. The unfortunate resurrection from a well-

earned grave of the long-run exploitable Phillips curve trade-off by some prominent New-Keynesians threatens to put monetary theory and policy back almost 40 years, to the pre-Phelps-Friedman and Lucas days. It is to be hoped that the learning process will be faster this time than the last time this misguided notion ruled the roost.

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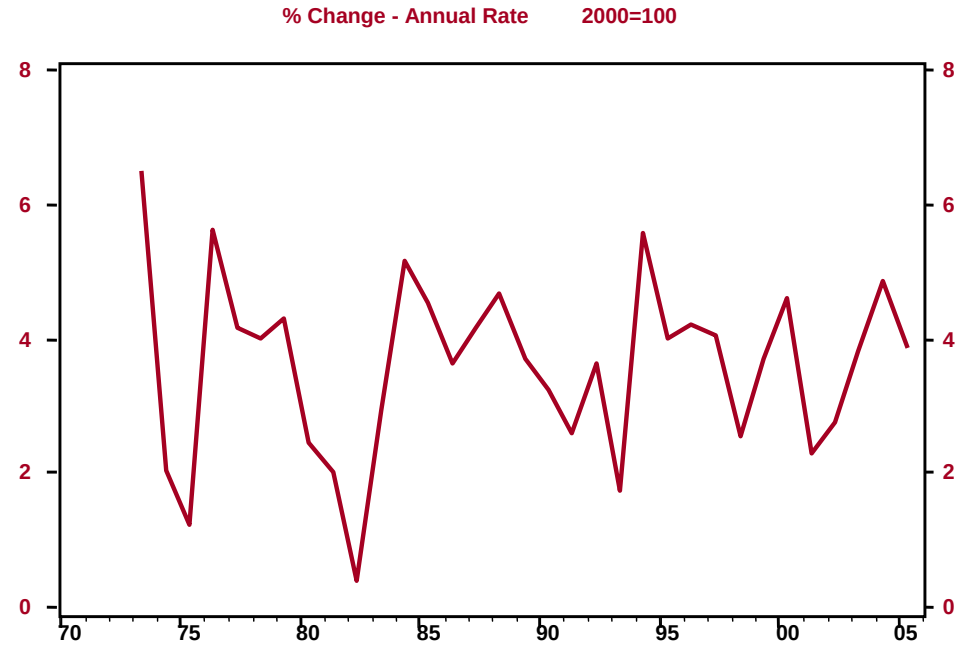
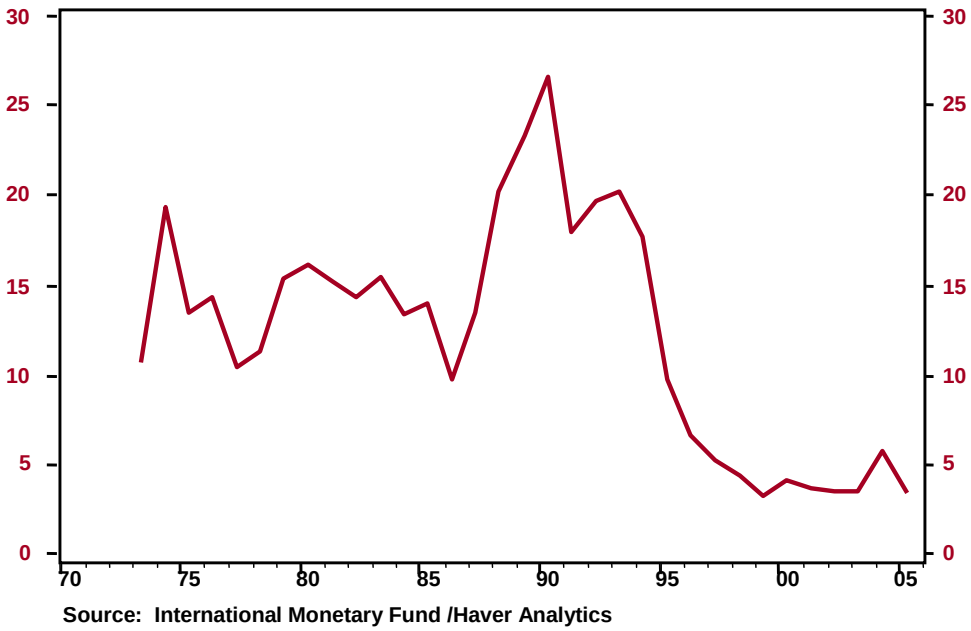
Chart 1
World: Gross Domestic Product at Constant Prices



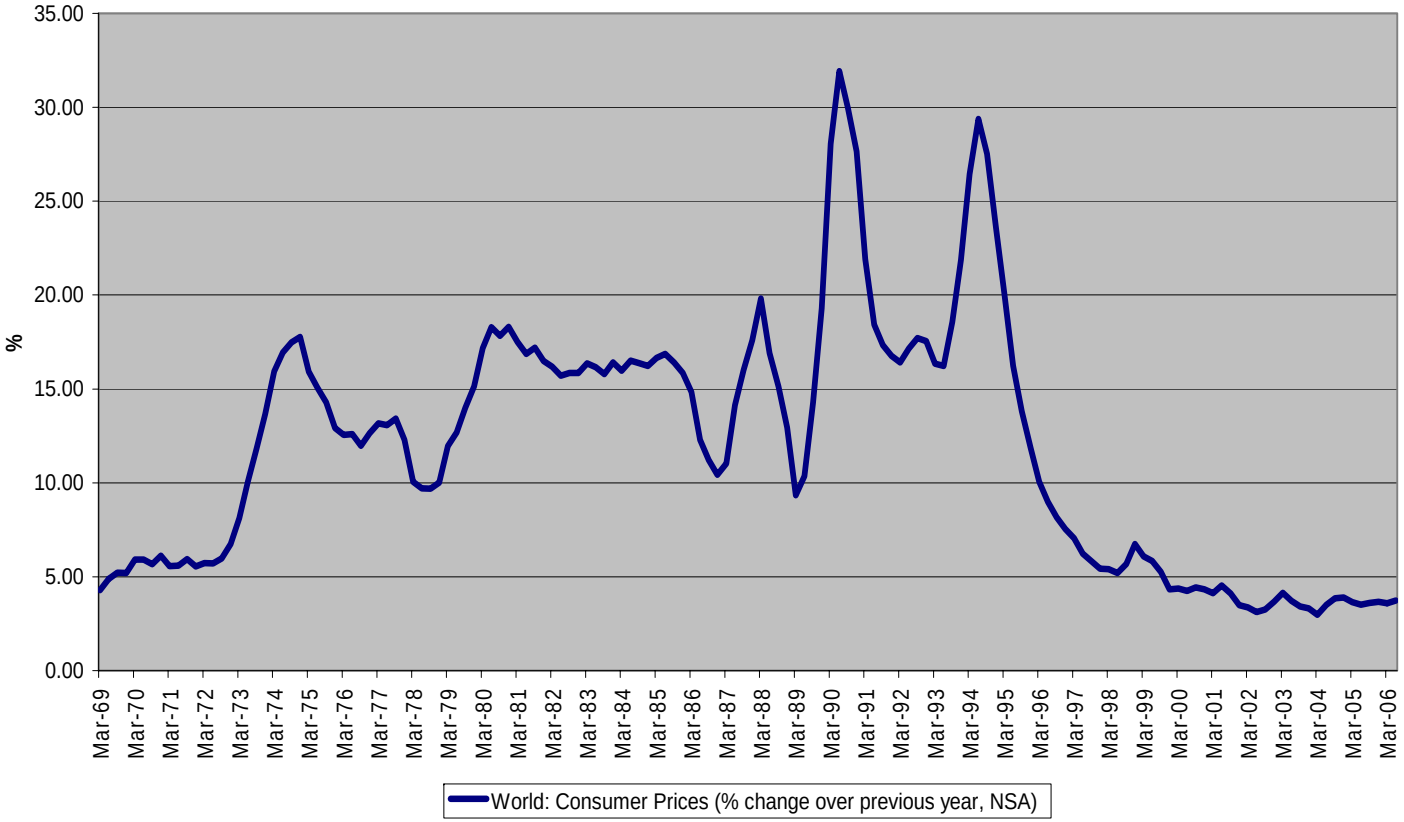
Source: International Monetary Fund /Haver Analytics

Chart 2a
World: GDP Deflator



Source: International Monetary Fund /Haver Analytics

Chart 2b
World CPI inflation



Source: IMF

Chart 2c
Global CPI, Commodity Price and Oil Price Inflation (%pa)

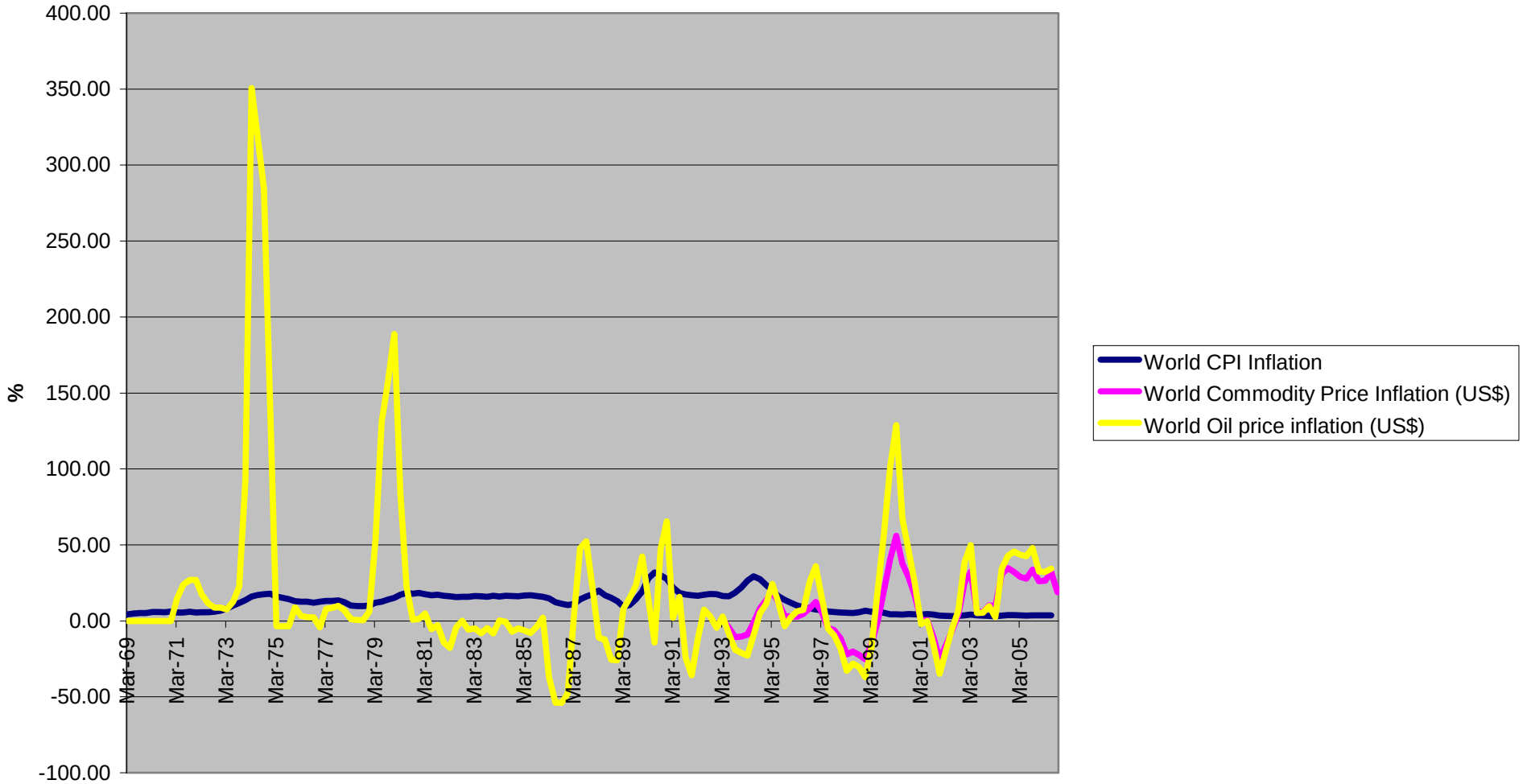


Chart 3
Long term real interest rates in the UK, 1983-2006

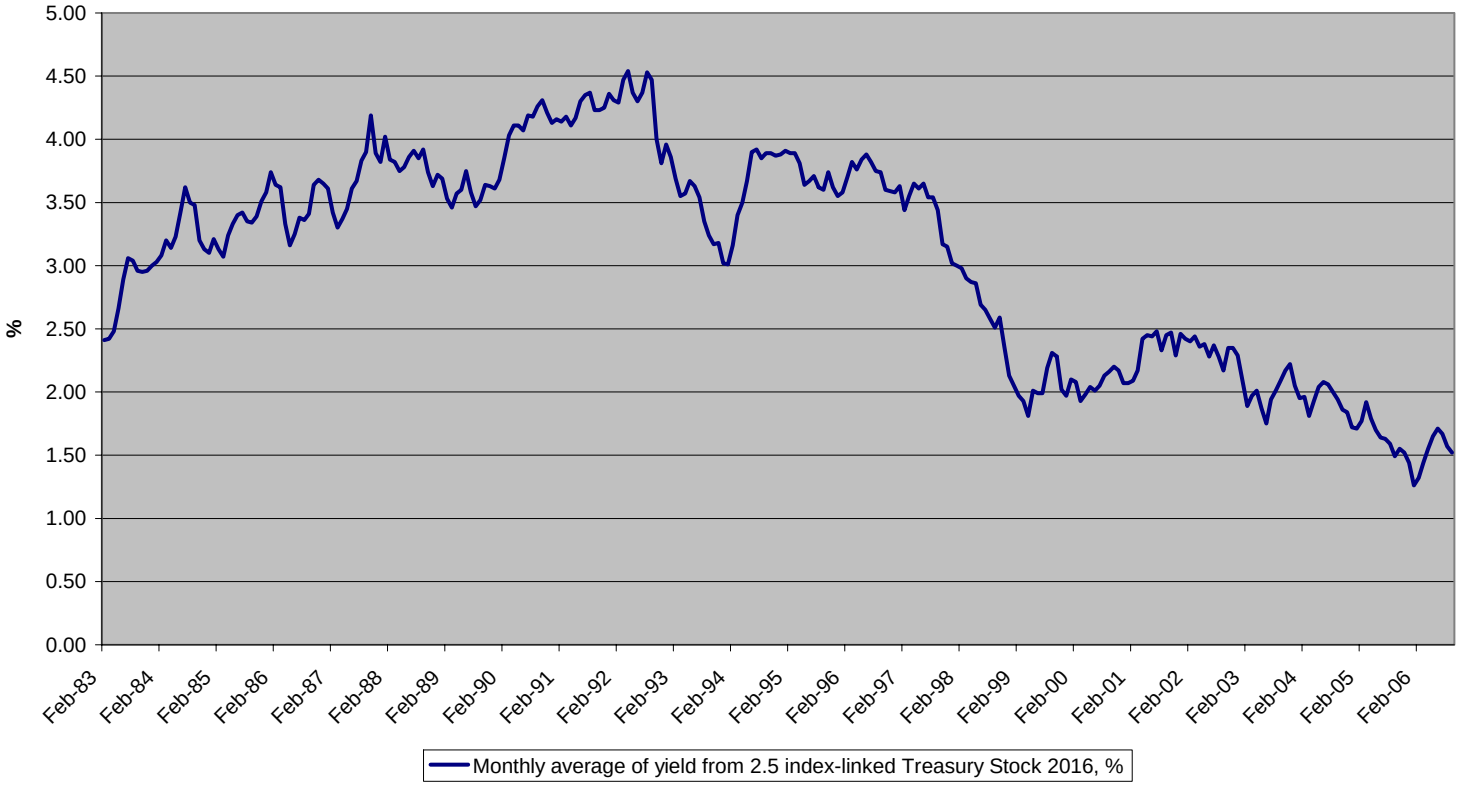
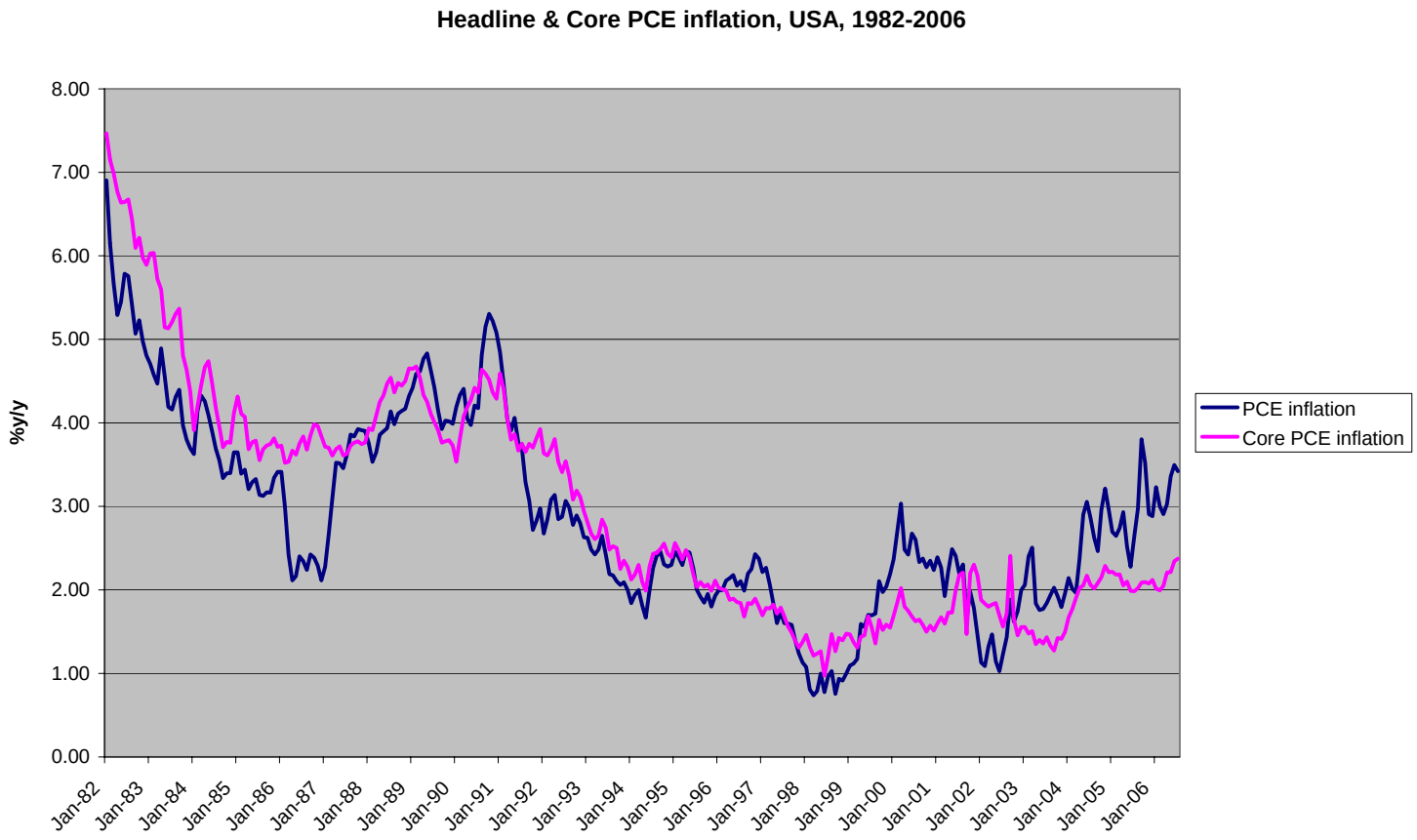


Chart 4


Headline & Core PCE inflation, USA, 1982-2006
%y/y
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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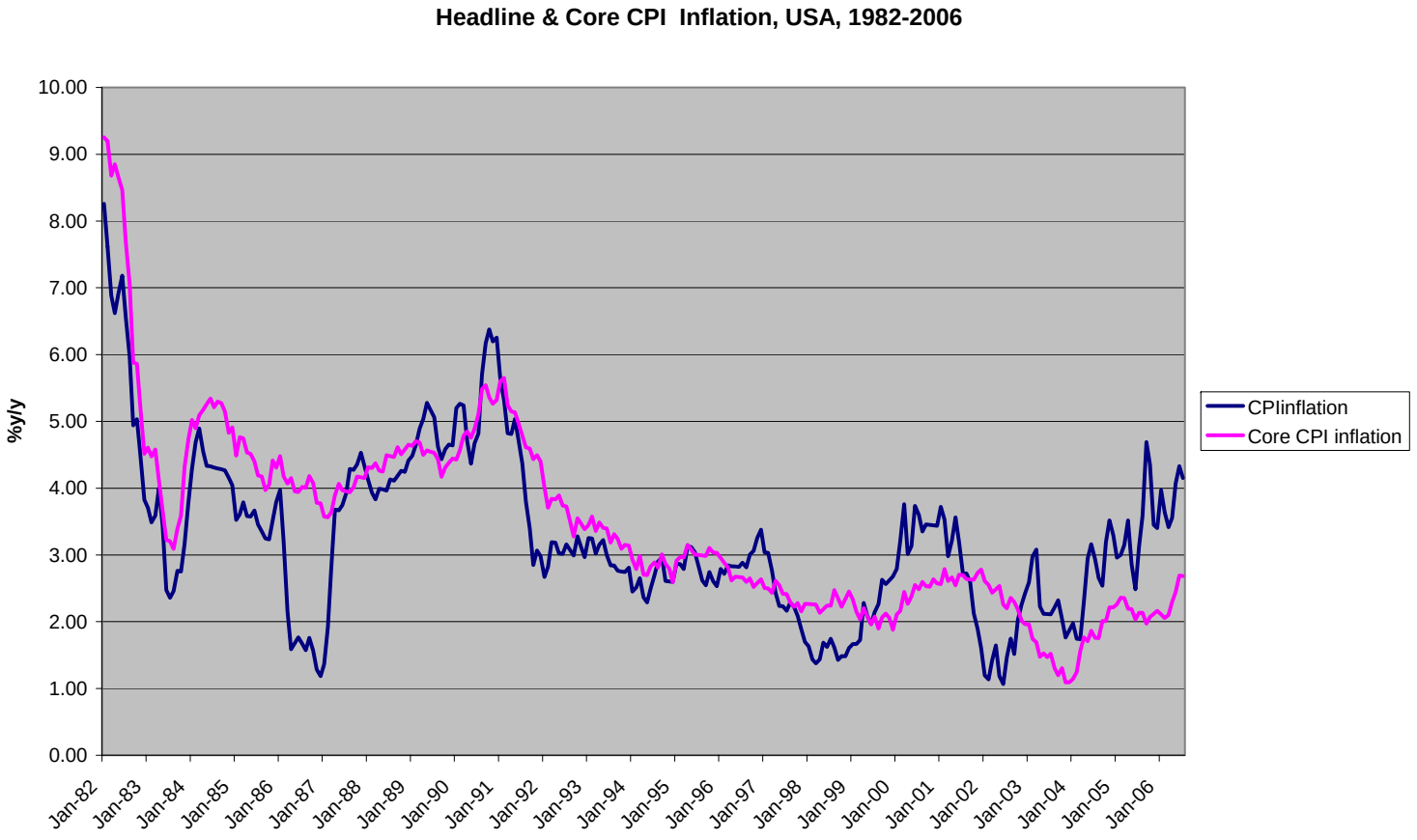
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
PCE inflation
Core PCE inflation

Chart 5


Headline & Core CPI Inflation, USA, 1982-2006
%y/y
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
CPIinflation
Core CPI inflation