How Robust is the New Conventional Wisdom in Monetary Policy?

The surprising fragility of the theoretical foundations of inflation targeting and central bank independence[*] [**]

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Introduction

A commitment to price stability through the pursuit of an inflation target by an operationally independent central bank has become the canonical model of monetary policy in an open economy with a floating exchange rate. The Reserve Bank of New Zealand led the way with inflation targeting in 1989 and 1990. The United Kingdom was an early convert in 1992 (see King (1997)). The European Central Bank has an inflation target that dare not speak its name. Japan, exiting at last from many years of quantitative easing with the short nominal interest rate at zero, has adopted a target range for the CPI inflation rate. Norway has adopted an inflation target, and so have Sweden and Iceland.[1] Of the leading central banks only the Fed has not adopted inflation targeting, and with the changing of the guard from Alan Greenspan, a long-standing opponent of inflation targeting, to Ben Bernanke, a long-standing proponent of inflation targeting, we are likely to see a gradual *de facto* adoption of inflation targeting in the US also.

As regards central bank independence, *operational* independence is now widely considered to be a sine-qua non for medium-term macroeconomic stability. In the EU Treaty, central bank independence has been made a qualifying condition for membership in the Eurozone.

[1] In Norway, the government sets the operational inflation target of 2½ per cent for CPI-ATE, a 'core; measure of inflation. In Sweden, the Riksbank's itself sets the operational price stability objective; it aims is to keep inflation around 2 per cent per year, as measured by the annual change in the CPI. The Central Bank of Iceland's main objective is price stability, defined as a 12-month rise in the CPI (Consumer Price Index) of 2½%.

There now exists a vast literature on inflation targeting. Much of this deals with the "how to's" of inflation targeting.[2] The appropriateness of inflation targeting outside the environment where it was pioneered - advanced industrial countries with functioning market economies and developed financial systems - is a subject of considerable discussion (see e.g. Batini, Kuttner and Laxton (2005) and IMF(2006)). There is a voluminous literature, pioneered by Woodford (2003, Chapter 6, Sections 2, 3 and 4) on the conditions under which inflation targeting can be justified using a conventional welfare economics criterion – the optimisation of a social welfare function that aggregates and respects individual preferences defined over current and future state-contingent consumption, leisure and, directly or indirectly, real money balances.

The literature on central bank independence is also large and growing (see e.g. McCallum (1996), Blinder (1999), Buiter (2004, 2005)).

This paper is part of a venerable scholarly tradition that observes some reasonably well-functioning institutional arrangement or policy rule and comments: "I know it works in practice, but does it work in theory?" I am not the first one to have noticed the tension between the confident practice and rhetoric of modern central banking, and the paucity of anything resembling robust positive microeconomic and sound normative welfare-economic foundations for that confidence. Mervyn King (2005) has reflected on the extent to which the practice of monetary policy now is ahead of the theory. I will elaborate on some of the issues he raised. Specifically, this paper takes aim at two propositions, which I put up here as convenient straw men:

Straw Man 1: There exist robust welfare economic foundations for price stability as the overriding objective of monetary policy.

[2] For an early collection, see Reserve Bank of Kansas City (1996); for a more recent compilation, see Bernanke and Woodford eds. (2005).

Straw Man 2: Central Bank independence is (a) possible; and (b) desirable.

Section II will discuss Straw Man 1 and Section III Straw Man 2. Before turning to the welfare economics of price stability in mainstream New Classical and New Keynesian dynamic stochastic general equilibrium models, however, I will briefly place the issues that can be addressed by these models in the context of a more comprehensive approach to the costs of inflation. The taxonomy in Table 1 is helpful in a discussion of the welfare economics of inflation. In the next Sections, I will concentrate on (3c) and (3d) and pay some attention to (3b). The other entries, other than inflation as moral failure, which is discussed in Section I, are touched on only in passing.

Table 1

A taxonomy of the welfare costs of inflation

1. Inflation as *moral failure* (Bundesbank).	
2. Efficiency costs due to the impact of anticipated inflation on the pecuniary opportunity cost of holding cash	
	2a. *Shoe-leather costs* of active cash management (Allais (1947), Baumol (1952), Tobin (1956), Feldstein(1979)).
	2b. Distortions in the relative price of cash goods and credit goods (Lucas & Stokey (1987))
3. Efficiency costs when the pecuniary opportunity cost of holding cash is independent of the rate of inflation	
	3a. *Menu costs* of anticipated inflation (Caplin & |Spulber (1987))
	3b. *Intertemporal relative price distortions* due to anticipated or unanticipated inflation (imperfect indexation of financial contracts, tax and benefit schedules) (Feldstein (1997), with or without nominal price or wage rigidities.
	3c. *Static relative price distortions* caused by nominal wage and/or price rigidities and imperfect wage and price indexation of incomplete price and wage contracts (Buiter & Jewitt (1981), Calvo (1983), Woodford (2003), Lucas (2000), Blanchard & Gali (2005)); can depend both on anticipated and unanticipated inflation.
	3d. *Absence of the long-run natural rate property*. Long-run output and/or employment gaps that vary with anticipated inflation due to imperfect indexation even in the long run (or comparing deterministic steady states)(Phillips (1958), Samuelson & Solow (1960), Tobin (1968), Woodford (2003), Benigno & Woodford (2004)).

I. Inflation as moral failure

Outside mainstream economics, but inside central banks like the Bundesbank, there exists a view that inflation is undesirable not because it is *inefficient* (it wastes resources in cash management, distorts relative prices and leads consumers and producers to confuse relative price changes and changes in the general price level) or *unfair* (it redistributes resources inequitably), but because it is *wrong*, morally unacceptable, evil or even a sin.[3] This view of inflation as the moral equivalent of counterfeiting, theft or deceit has a long history, and can be traced back to the book of the Law.[4] The terms 'debasing' or 'debauching' the currency convey this notion of immorality. It attaches both to commodity money, such as specie money, and to fiat money.

That the long-standing tradition of rejecting inflation on religious grounds survives is clear from the following quote from the Rev. William J. Larkin Jr. (1982):"*It violates the biblical commands to have just weights and not steal. Its immoral consequences are the oppression of the poor, especially the elderly; the promotion of sloth and covetousness; and the destabilization of society*."

Larry Lindsey puts the issue well: "*Maintaining a currency as a store of value has both pragmatic and philosophical bases. The philosophical arguments can take on a great fervor, at times approaching a religious conviction. Some argue, for example, that money represents a covenant between government and people. In this view, destroying the value of a currency takes on a deep significance verging on immorality with respect to government policy. To adherents of this view, inflation is a form of theft.*" (Lindsey

[3] See e.g. the statements by Hans Tietmeyer and Helmut Schlesinger quoted in Tognato (2004).
[4] Leviticus 19:35-36: *"Ye shall not cheat in measuring length, weight , or quantity. You shall have honest balances, honest weights, an honest ephah and an honest hin: …".* Amos 8: 5:*"We make the bushel small and the shekel great, and practice deceit with false balances,…".*

(1995, p. 5)). The pursuit of price stability through independent central banks, as embodied most starkly in the Bundesbank prior to EMU, has been characterised as a secular religion (Tognato (2004)).

An objection to inflation on moral grounds but from a secular perspective is the proposition that inflation is taxation without representation.[5] Even fully anticipated inflation (which gets translated into market-determined nominal interest rates) constitutes a tax on non-interest-bearing currency.[6] Unanticipated inflation represents a capital levy on holders of fixed interest nominal debt. Both the anticipated and the unanticipated inflation tax are levied without legitimating parliamentary approval.[7] Without such legitimisation through the proper constitutional channels and institutions, the inflation taxes are theft; inflation is a pernicious, illegitimate stealth tax. Henry Wallich, a Governor of the Federal Reserve Board from 1974 till 1986 referred, in an address titled *Honest Money,* to the *"…breakdown in our standards of measuring economic values as a consequence of inflation." "… inflation introduces an element of deceit into most of our economic dealings. Everybody makes contracts knowing perfectly well that they will not be kept in terms of constant values,…*" a "*… condition that is hard to reconcile with simple honesty*." Wallich (1978).

Sometimes the characterisation of inflation as immoral means no more than that inflation is inefficient or unfair. Eugenio Solans, a member of the Governing Council

[5] *"… every new dollar that is created makes every dollar previously in existence worth somewhat less than it was worth before. This is the very heart of inflation. It is also taxation without representation with a vengeance."* Voorhis (1973). Jeremiah Horace (Jerry) Voorhis (1901-1984) was a member of the US House of Representatives.

[6] The terms 'currency' and 'cash' are used interchangeably and refer to the monetary liabilities of the central bank.

[7] One could argue in rebuttal that by setting up and allowing the continued existence of a central bank that has the capacity to impose both the anticipated and the unanticipated inflation tax, the legislature gives its implied consent to the imposition of inflation taxes.

and the Executive Board of the European Central Bank from 1999 till 2004, provides an example of the 'consequentialist' position, that theft through inflation is immoral because is represents undesirable redistribution and because, by undermining the incentives for productive effort and by necessitating the diversion of resources from production to safeguarding property against theft, it causes inefficiencies: *"…I dared to qualify inflation as "immoral", for several reasons. Inflation unfairly deteriorates personal income and wealth. It distorts the proper functioning of public redistributive schemes, such as progressive taxation. It fosters speculation. It harms the weakest and the most vulnerable.* (Solans (1999))*"*. Lenin's famous statements that *"The way to crush the bourgeoisie is to grind them between the millstones of taxation and inflation."* and *"The best way to destroy the capitalist system is to debauch the currency"*, would also seem to fit the consequentialist view of the evils of inflation.

Popular inflation aversion often goes beyond the consequentialist characterisation of the immorality of inflation and appears to view inflation as intrinsically wrong, regardless of its consequences for efficiency and fairness. The survey-based paper by Robert Shiller (1997) on why Germans and Americans disliked inflation makes clear that inflation was deemed to be intrinsically evil in addition to being perceived as having deleterious consequences.

When inflation is viewed as a sin, and when the pursuit of price stability by independent central banks becomes a secular religion, as it was for the Bundesbank and is now for the ECB, the rationale behind the approach of these institutions to a whole range of issues - accountability, openness, transparency, unanimity, dissent and collective responsibility – becomes clearer. A religion requires priests and a temple. In the priestly

tradition, monetary policy is a cult whose high priests perform the sacred rites far from the prying eyes of the non-initiates.

Borrowing from Keynes, I would like to contrast the (high-) priestly view of central banking with the technocratic or dentist approach. Keynes once expressed the hope that economists might someday be thought of like dentists - that they would be regarded as apolitical professionals brought in to resolve technical problems (Keynes [1931, p.332]).[8] I strongly agree with Keynes on this, and would like to see his paradigm of the economist as dentist applied to central bankers in particular.

In a lecture given to celebrate the five-year jubilee of the UK inflation target, Mervyn King (King (1997)) gave the canonical description of what one might call the modern, technocratic view of central banking, that is, central banking as dentistry. His view that "... a successful central bank should be boring ..." (King (1997, p. 14)) is very much in the spirit of Keynes's statement.

Dentists view excessive inflation as an error and a source of inefficient and inequitable economic outcomes. Dentists can have public professional disagreements: drill or extract? Priests cannot. If they do it means schism, heresy, religious wars. Dentists acquire their skills and knowledge through training and research and by trial and error involving live patients. The priest's true faith is revealed to God's chosen. Dentists can make mistakes. The victims choose a different dentist. Priests cannot be seen to make mistakes. Dentists are accountable to their professional association, to their patients and, ultimately, to the courts. Priests are accountable to God alone.

[8] The complete quote is: *"But, chiefly, do not let us overestimate the importance of the economic problem, or sacrifice to its supposed necessities other matters of greater and more permanent significance. It should be a matter for specialists – like dentistry. If economists could manage to get themselves though of as humble, competent people, on a level with dentists, that would be splendid"*.

II. The conventional welfare economic foundations of inflation targeting

This Section leaves morality and sin behind and focuses on models for which it is possible to construct a representative consumer/worker/price setter/shopper/portfolio selector and cash manager whose multi-period utility function is defined over current and future consumption (including leisure) and real money balances. Alternatively, and from the perspective of this paper, equivalently, a role for money is created through a shopping technology that uses real money balances as an input and/or a cash-in-advance constraint (see Buiter and Sibert (2006)). Price setting is according to the discrete time version of Calvo's (1983) model of staggered, overlapping nominal price contracts. Opportunities for freely setting prices arrive randomly for a continuum of monopolistic competitors. Constrained price setters follow a simple rule of thumb or heuristic, which can be interpreted as a simple price indexation rule. The inflation rate generated by the constrained price setters will be referred to as 'core inflation'.

For this class of models Woodford (2003) shows that the loss function of the representative consumer can be approximated by

$$\Lambda_t = E_t \sum_{j=t}^{\infty} \beta^{j-t} L_j \qquad 0 < \beta < 1 \tag{1}$$

with

$$L_j \approx \left(\pi_{j,j-1} - \omega_{j,j-1}\right)^2 + w_1 (y_j - y_j^*)^2 + w_2 (i_{j+1,j} - i_{j+1,j}^m)^2 \qquad w_1 > 0, w_2 \geq 0 \tag{2}$$

Here $\pi_{j,j-1}$ stands for period *j* producer price inflation, $\omega_{j,j-1}$ is period *j* core producer price inflation (the indexation rule used by constrained price setters in the Calvo model), y_j is the logarithm of period *j* real output, y_j^* is the logarithm of the efficient level of period *j* real output, $i_{j,j-1}$ is the one-period risk-free nominal rate of interest on non-monetary financial claims ('bonds') between periods *j* and *j-1*, $i_{j,j-1}^m$ is the one-period risk-free nominal rate of interest on cash (money) between periods *j* and *j-1* and E_t is the conditional expectation operator at time *t.*

For that same class of models, Woodford (2003) also shows that the following New-Keynesian Phillips curve can be obtained from a log-linear approximation to the equilibrium at a deterministic steady state:

$$\pi_{t,t-1} - \omega_{t,t-1} \approx \kappa(y_t - \hat{y}_t) + \lambda(i_{t+1,t} - i_{t+1,t}^m) + \beta E_t(\pi_{t+1,t} - \omega_{t+1,t}) \qquad (3)$$
$$\kappa > 0;\ 0 < \beta < 1$$

Here $\hat{y}_t$ stands for the logarithm of the natural level of real output in period *t*, that is, the level of output that would prevail under full price flexibility. When there are real distortions (such as monopoly power or distortionary taxes), the natural level of output, $\hat{y}$ need not equal the efficient level of output y^*. A full analytical statement of the arguments that follow in the next Section can be found in Buiter and Sibert (2006).

IIA. The welfare economics of inflation when the pecuniary opportunity cost of holding money is non-zero, with or without nominal price and wage rigidities

In what follows, money or cash means the monetary base: currency plus commercial bank balances held with the central bank. The nominal interest rate on

money, i^m, is in practice zero for currency. It can be anything for balances with the central bank. Since money is assumed to yield non-pecuniary services, in addition to being a risk-free store of value, bonds will only be held if $i \geq i^m$. I assume in what follows that this condition is satisfied. I assume that *i* is an instrument of the central bank and that i^m is either an instrument or exogenously set equal to zero. While the monetary base and, in an open economy the nominal exchange rate, are alternative instruments, in practice, under a floating exchange rate regime, central banks use i as the policy instrument. The pecuniary opportunity cost of holding money is $i - i^m$.

When $i > i^m$ private agents are encouraged to economise on their holdings of cash. Active cash management uses up real resources, as noted by Allais (1947), Baumol (1952) and Tobin (1956). Efficiency requires eliminating the pecuniary opportunity cost of holding money by setting

$$i_{t+1,t} = i^m_{t+1,t} \quad \text{for all } t \tag{4}$$

There is a second distortion associated with a positive pecuniary opportunity cost of holding cash. In cash-in-advance models such as Lucas and Stokey (1987), there are both cash goods and credit goods. When $i > i^M$ the relative cost of producing and supplying cash goods is raised relative to that of credit goods (and relative to goods such as leisure, that are not traded at all but instead are consumed by the original owner of the endowment of time). This static relative price distortion too is eliminated when (4) holds.

Expected inflation matters for welfare, even with perfectly flexible nominal prices and wages, because it may affect the pecuniary opportunity cost of holding cash. That effect will be absent if the demand for real balances is independent of its pecuniary opportunity cost. This will be the case when the velocity of circulation of money is

constant, as it is, for instance, in the simple cash-in-advance model where all goods are cash goods. The opportunity cost of cash channel through which inflation affects welfare can also be cut off by the authorities setting the nominal interest rate on bonds equal to the nominal interest rate on cash. This is a non-trivial task because currency is a negotiable bearer bond whose holders are anonymous. To pay interest, at a positive or negative rate, on currency requires either a mechanism like the one Gesell proposed for taxing currency (Gesell (1949), Goodfriend (2000), Buiter and Panigirtzoglou (2001, 2003) and Buiter (2005a)), or the introduction of a second, virtual currency, as proposed by Eisler (1932) and discussed by Buiter (2005b).

If neither option is feasible, and the rate on currency is zero ($i^m = 0$), then the opportunity cost of holding cash can only be reduced to zero by setting the short nominal interest rate on bonds equal to zero – that is by implementing Friedman's Optimal Quantity of Money (OQM) rule:

$$i_{t+1,t} = 0 \quad \text{for all } t \tag{5}$$

While pursuing a zero nominal interest rate strategy will certainly eliminate the opportunity cost of holding cash, it may cause the authorities to lose control of the rate of inflation. Let r be the period t real interest rate, defined in terms of the private consumption bundle whose market price in period t is P_t. The rate of inflation of the consumer price index is defined by $\pi_{t+1,t} = \frac{P_{t+1} - P_t}{P_t}$, so

$$1 + r_{t+1,t} = \frac{1 + i_{t+1,t}}{1 + \pi_{t+1,t}} \tag{6}$$

Therefore, by setting the nominal interest rate equal to zero, the rate of inflation of consumer prices equals minus the real interest rate (measured in terms of the composite

consumption good).[9] The optimal rate of producer price inflation (the inflation rate that matters from the point of view of minimizing static relative price distortions) is not in general equal to minus the real interest rate. There remains a way out of this dilemma, however. The consumer price index is linked to the producer price index through the indirect tax rate ζ, that is,

$$P_t = (1+\zeta_t)P_t \tag{7}$$

so,

$$\pi_{t,t-1} = \left(\frac{1+\zeta_t}{1+\zeta_{t-1}}\right)\pi_{t,t-1} \tag{8}$$

where $\pi_{t,t-1} = \frac{P_t - P_{t-1}}{P_{t-1}}$ is the rate of inflation of producer prices. Thus, through appropriate use of the tax wedge between consumer prices and producer prices, the government can, in principle, set the nominal interest rate equal to zero, which is required to implement the OQM rule, without at the same time pegging down the rate of producer price inflation, which will have to be free to implement the rule that minimizes relative price distortions.

From the point of view of the welfare economic foundations of price stability as the overriding target of monetary policy, it is clear that the OQM property will not be satisfied when the consumer price inflation rate is zero, unless $i^m_{t+1,t} = (1-\beta)\beta^{-1}$ for all *t*. If the nominal interest rate on cash is zero, the OQM rule prescribes a negative rate of consumer price inflation in the deterministic steady state. As will be shown in Section IIC, zero producer price inflation also, generically, is not optimal.

[9] For instance, if the real rate of interest is independent of the rate of inflation (as will be the case in the model of Section III where it equals the rate of time preference $\rho = (1-\beta)\beta^{-1}$), then the authorities would, by setting the nominal interest rate equal to zero, peg the rate of consumer price inflation at $\pi = -\rho$.

IIB. The welfare economics of inflation when the opportunity cost of holding money does not affect welfare

IIB1. Menu costs

Even if the pecuniary opportunity cost of holding cash is zero (or if the real stock of money held is independent of its pecuniary opportunity cost), menu costs - fixed real costs of changing prices in terms of the numéraire - make inflation costly even when the frequency with which prices are adjusted can be optimally chosen by private price setters. Such menu costs should be interpreted broadly to include the time, effort and inconvenience, in a world with bounded rationality, of measuring, computing and calculating with an inconvenient yardstick whose length varies from period to period.

The implications of menu costs for the optimal rate of inflation depend crucially on the details of how menu costs are modeled. It makes a difference whether a real sunk cost is incurred every time a nominal price is changed, or only when a new contract (which may involve indexation clauses that apply for many periods) is negotiated. Nominal price changes that are the result of the mechanical implementation of an invariant indexation rule may have lower menu costs than those that are the result of bargaining between buyers and sellers or the outcome of an auction. If menu costs are assumed to be particularly important for the goods and services that make up the cost-of-living index, this would drive the optimal inflation rate of the cost of living index closer to zero. If, as seems more plausible, menu costs are especially important for money wages (negotiating and bargaining over wages, whether bilaterally or through organised labour unions and/or employers associations is costly and time-consuming), a zero rate of money wage inflation would be the natural focus of monetary policy. With positive

labour productivity growth, zero wage inflation would imply a negative rate of inflation for the cost of living, consumer and producer price indices.[10]

IIB2. Tax and benefit distortions and other failures of indexation in the public and/or private sectors.

Real-world tax and benefit systems are not inflation-neutral. Nominal interest paid often can be deducted from taxable profits as a business cost. Progressive income tax systems do not have the bands corresponding to different marginal tax rates indexed to the rate of inflation, causing 'real fiscal drag' (see Feldstein (1997) for a discussion of the issues involved). Both these features mean that even fully anticipated inflation will have real effects. Most private debt contracts are not index-linked, so unanticipated inflation will redistribute resources from creditors to debtors.

Incomplete index-linking constitutes an argument for price stability, provided the cost of introducing the necessary indexation to make the real economy inflation-neutral exceeds the cost of achieving and maintaining price stability. Parts of the tax and benefit system (e.g. social security benefits in the US) are index-linked, apparently at no great cost to the authorities or the tax payers and benefit recipients. It continues to be something of a mystery why there are so few inflation-linked contracts and financial instruments issued in the private sector.[11]

Departures from full indexation in private or public contractual arrangements or price setting procedures can have serious efficiency consequences when the rate of inflation becomes very high. The efficiency losses associated with historical

[10] Holding constant producer taxes and indirect tax rates.
[11] For at least the past 20 years I have asked my banks (in the US and the UK) for an index-linked home mortgage – so far without success. The typical explanation was of the "we don't offer it because we have never offered it" variety.

hyperinflations were often dramatic. The remarkable recoveries in output and employment following the end of hyperinflations is evidence of the destructive potential of hyperinflation.

Incomplete indexation can likewise have major redistributive consequences during periods of very high inflation. The destruction of the savings of the German Mittelstand during the hyperinflation under the Weimar republic in 1922-23 may well have been a contributing factor to the receptiveness of this socio-economic group to the ideas of Nazism.

IIB3. A Caveat

All inflationary distortions considered thus far, or rather, all sources of absence of super-neutrality of money and inflation, can occur even without any nominal wage or price rigidities. The failure of *superneutrality* of money through the effect of inflation- on the opportunity cost of holding money in models with perfectly flexible money wages and prices is not to be confused with a long-run non-vertical Phillips curve caused by non-homogeneities in the wage and price setting mechanism. Policy-relevant long-run inflation-unemployment trade-offs are those that are present when the demand for real money balances is independent of the rate of inflation. Such independence can be present because the opportunity cost of holding money is invariant under alternative rates of inflation, or because the demand for cash in unresponsive to its opportunity cost (a limiting case of which is the cashless economy).

Lucas's famous 2-period OLG model with money (Lucas (1972a)) generically exhibits absence of superneutrality of money. Even in the deterministic version of this model, a higher growth rate of the nominal money stock is associated with a higher rate

of inflation and a level of output/employment that can be either higher or lower. There are no nominal wage or price rigidities. Money is not superneutral because money bears a zero nominal interest rate. It is also the only store of value. A higher rate of inflation therefore means a lower real rate of return to saving. Depending on the strength of the income effect and the intertemporal substitution effect, a lower real rate of return can either raise or lower the supply of labour. It would make no sense to regard a negative or positive association in the Lucas (1972) model between the rate of inflation and the level of employment/output, as theoretical support for the existence of a long-run exploitable inflation-(un) employment trade-off of the kind that Samuelson and Solow (1960) and Tobin (1968) had in mind.

Such a claim is made in a recent paper by Wright et. al. (2005), which, like Lucas (1972), analyses a model without nominal wage or price rigidities.[12] The absence of superneutrality of money is once again due to the fact that the nominal interest rate on money is exogenous (zero). The cash-in-advance model has cash-goods and (de-facto) credit goods.[13] A higher rate of inflation raises the nominal rate of interest and thus the opportunity cost of holding money and the relative price of cash goods. Depending on the relative strengths of income and substitution effects, higher inflation can be associated with a higher or a lower level of employment. Any policy that eliminates the financial opportunity cost of holding money (such as paying interest on money at the same rate as on non-monetary credit instruments) will eliminate this 'long-run Phillips Curve'. In what follows, I consider as long-run exploitable inflation-unemployment

[12] This paper was presented at an LSE seminar with the bold subtitle "Or, There is a Long-Run Exploitable Trade off Between Investment and Unemployment After All".
[13] In the model, leisure is non-traded, so from a transactions technology point of view, it is like a credit good.

trade-offs only those systematic associations between inflation and output, employment or unemployment present even when the pecuniary opportunity cost of holding money is zero (or held constant) or if the demand for cash in independent of its pecuniary opportunity cost.

IIC. Relative price distortions and inefficient output gaps due to nominal rigidities: Old-Keynesian wine in New-Keynesian bottles.

Some of the strongest claims that, in the presence of nominal wage and/or price rigidities, price stability (zero inflation going forward) can be shown to be the inflation objective implied by conventional micro-based welfare economic criteria, can be found in Woodford's work (see e.g. Woodford (2003)). The refutation of this proposition in what follows will make use of the same Calvo-style price setting mechanisms as used by Woodford. A detailed and more technical analysis can be found in Buiter and Sibert (2006).

Consider in some greater detail the price setting rule-of-thumb adopted by the constrained price setters in the Calvo (1983) model.[14] Each constrained price setter, *j*, follows an indexation rule that satisfies equations (9) to (15); P_t^j is the price set by producer *j* at time *t*; as before, P denotes the aggregate producer price level and π is rate of inflation. Deterministic steady state values of variables are denoted by overbars.

$$P_t^j = \Omega_{t.t-1}^j P_{t-1}^j \tag{9}$$

[14] There is monopolistic competition between profit maximising price-setting firms. Each firm produces one commodity and there is a continuum of perishable consumption goods on the unit interval. There is a constant common static substitution elasticity $\eta > 1$ between the different consumption goods. Each period, a constant fraction σ of randomly selected firms can choose to set its price freely and optimally; σ is also the constant per-period probability that a firm will be able to choose its price freely. The remaining fraction 1-σ of firms is constrained to update last period's price using a simple *indexation rule* that satisfies (9) to (15).

with

$$\Omega^{j}_{t_1,t_0} = \Omega_{t_1,t_0} \quad j \in [0,1] \tag{10}$$

$$\Omega_{t_2,t_1}\Omega_{t_1,t_0} = \Omega_{t_2,t_0} \tag{11}$$

$$\Omega_{t_1,t_0} = \Omega^{-1}_{t_0,t_1} \tag{12}$$

$$\Omega_{t,t} = 1 \tag{13}$$

$$\Omega_{t_1,t_0} > 0 \tag{14}$$

$$\overline{\Omega} = 1 + \bar{\pi} \tag{15}$$

For the moment, I impose only weak restrictions on the indexation function of the constrained price setters. Equation (10), the assumption that the indexation function is the same for all constrained price setters, permits a significant simplification of the argument. In addition the indexation function is assumed to be recursive (11), symmetric (12), to have an identity transformation (13), to be positive (14) and to have the property (15) that in the non-stochastic steady state, the actual rate of producer price inflation $\bar{\pi}$, equals the steady-state inflation rate, $\overline{\Omega} - 1$, implied by the indexation rule. This requirement, that the indexation rule is rational (at least) in steady state is a weak one, but has the implication that there is no deterministic steady-state inflation-output (or, in richer models with labour markets and well as output markets) inflation-unemployment trade-off across deterministic steady states. Surprisingly, some of the best-known New-Keynesian wage and price setting mechanism fail this very weak long-run rationality test. I will refer to (15) as the '*sure thing*' principle that must be satisfied by any acceptable indexation rule of thumb (or expectation formation heuristic).

When choosing their price in period *t*, the unconstrained firms allow for their current and future monopoly power and for the fact that, if they are constrained in the future, they will follow the indexation rule given in (9) through (15).

In general, $\hat{y}$, the level of output that would be produced if there were no nominal rigidities need not equal the efficient level of real output, y^*. In the model under consideration, the efficient or command optimum level of real output is the level of output that would be produced if there were no nominal rigidities, no monopoly power and no distortionary taxes.

I approximate the rate of inflation of the price of producer *j*, $\pi^j_{t,t-1} \equiv \frac{P^j_t - P^j_{t-1}}{P^j_{t-1}}$, by $\pi^j_{t,t-1} \approx \ln P^j_t - \ln P^j_{t-1}$. Also let $p^j_t \equiv \ln P^j_t$ and $\omega_{t,t-1} \equiv \ln \Omega_{t,t-1}$. I will refer to $\omega_{t,t-1}$, the inflation rate generated by the indexation rule of the constrained price setters, as *core inflation*. The indexation rule can now be written as:

$$p^j_t = \omega^j_{t.t-1} + p^j_{t-1} \tag{16}$$

with

$$\omega^j_{t_1,t_0} = \omega_{t_1,t_0}, \quad \forall j \tag{17}$$

$$\omega_{t_2,t_1} + \omega_{t_1,t_0} = \omega_{t_2,t_0} \tag{18}$$

$$\omega_{t_1,t_0} = -\omega_{t_0,t_1} \tag{19}$$

$$\omega_{t,t} = 0 \tag{20}$$

$$\overline{\omega} = \overline{\pi} \tag{21}$$

From now on I consider only the case where optimal inflation policy can be determined without reference to the pecuniary opportunity cost of holding cash. This

requires that one of the following three conditions is satisfied. First, the interest rate on cash can be set freely, and is therefore set to satisfy $i = i^m$; second, the demand for real money balances is independent of the rate of inflation (this includes the cashless economy as a special case); or third, the indirect tax rate is used to make the consumer price inflation rate associated with $i = i^m$ consistent with a producer price inflation rate that minimises static relative price distortions and ensures an inefficient output gap. This means that both the term $w_2(i_{j+1,j} - i^m_{j+1,j})^2$ in the loss function (2) and the term $\lambda(i_{t+1,t} - i^m_{t+1,t})$ in the New-Keynesian Phillips curve (3), are equal to zero. The loss function now becomes

$$\Lambda_t \approx \sum_{j=t}^{\infty} \beta^{j-t} E_t \left(\pi_{j,j-1} - \omega_{j,j-1} \right)^2 + w_1 (y_j - y_j^*)^2 \qquad (22)$$
$$w_1 > 0$$

and the New Keynesian Phillips curve can be written as follows:

$$\pi_{t,t-1} - \omega_{t,t-1} \approx \kappa(y_t - \hat{y}_t) + \beta E_t(\pi_{t+1,t} - \omega_{t+1,t}) \qquad (23)$$
$$\kappa > 0;\ 0 < \beta < 1$$

This class of models also has the property that, for given values of the parameters and other fundamentals governing the distortion in the output market, the ratio of the natural to the efficient level of output is constant, that is,

$$\hat{y}_t = y_t^* - \delta \qquad (24)$$

Welfare-reducing relative price distortions occur whenever $\pi_{t,t-1} \neq \omega_{t,t-1}$ for all *t*. If, for instance, actual inflation exceeds core inflation, the relative prices of the constrained price setters will fall relative to those of the unconstrained price setters. However, if the natural level of output is below the efficient level of output, that is,

$\hat{y}_t < y_t^*$, because of, say, the presence of monopoly power and the absence of correcting production subsidies, there will be welfare gains associated with policies that keep actual inflation $\pi_{t,t-1}$ above core inflation $\omega_{t,t-1}$, if this is possible.

For instance, consider the case where the gap between the actual rate of inflation and the core rate of inflation can be set at any constant value v, that is, $\pi_{t,t-1} - \omega_{t,t-1} = v$ for all *t*. This is the case, for instance, in Calvo's original version of this New-Keynesian Phillips curve, which has $\omega_{t,t-1} = 0$ for all *t*, that is, constrained price setters keep their nominal prices constant regardless of the average rate of inflation or deflation of their competitors (see Calvo (1983)). Assume for simplicity that the natural and the efficient levels of output are constant, with $y^* > \hat{y}$, that is, $\delta > 0$. Since

$$y_t = \hat{y} + (1-\beta)\kappa^{-1}v,$$

the deterministic steady state level of real output is perfectly controllable through the control of v, the wedge between actual and core inflation. For instance, the authorities could choose to set real output equal to its efficient level, y^*, even through the efficient level of output exceeds the natural level, by choosing an appropriate positive value v^* for v, given by

$$v^* = \kappa(1-\beta)^{-1}(y^* - \hat{y}) = \kappa(1-\beta)^{-1}\delta > 0$$

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 $v \neq 0$, have to be balanced against the welfare gains of getting actual output closer to the efficient level of output.

To argue that it is possible to keep actual inflation systematically above or below core inflation, 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. This trade-off exists even across deterministic steady states.

Key to the existence of a long-run inflation-output trade-off in the New-Keynesian Phillips curve model is the relationship between core inflation 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 the *sure thing principle* given in (15) - 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 core inflation, $\omega = 0$, has 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.

A few prominent examples of alternative specifications of core inflation, taken from the literature, are the following:

- Calvo's model of core inflation (Calvo (1983)): zero indexation or constant nominal prices for the constrained price setters (this is also the assumption made for both wage and price setters in Benigno and Woodford (2005)):

$$\omega_{t,t-1} = 0 \tag{25}$$

- Yun's model of core inflation (Yun (1996)): full indexation to long-run average inflation.

$$\omega_{t,t-1} = \bar{\pi} \tag{26}$$

where $\bar{\pi}$, the long-run average rate of inflation, is identified with inflation in the deterministic steady state.

- Christiano et. al. (2001), Smets and Wouters (2002), Woodford (2003) and Giannoni and Woodford (2003): (one-period) lagged indexation (partial if $\gamma < 1$); Gali, Gertler and Lopez-Salido (2001) used the $\gamma = 1$ case.

$$\omega_{t,t-1} = \gamma \pi_{t-1,t-2} \tag{27}$$

- Buiter and Sibert (2006): current or contemporaneous indexation (partial if $\gamma < 1$)

$$\omega_{t,t-1} = \gamma \pi_{t,t-1} \tag{28}$$

- Buiter and Sibert (2006): indexation to one-period past expectation of current inflation (partial if $\gamma < 1$)

$$\omega_{t,t-1} = \gamma E_{t-1} \pi_{t,t-1} \tag{29}$$

Unlike Calvo's original model, Yun's model of core inflation obeys the *sure thing principle*. All the other indexation heuristics respect the sure thing principle only if there is full indexation: $\gamma = 1$.

If the natural level of output equals the efficient level of output ($\hat{y} = y^*$),the optimal inflation policy is the one that sets actual inflation equal to core inflation. As noted earlier, this can be achieved either through an appropriate nominal interest rate rule (if either the demand for money does not depend on the financial opportunity cost of holding money, or if there is a separate nominal interest rate on cash which can be used to achieve the OQM rule $i = i^M$ while leaving the nominal interest rate on bonds free, or if the economy is cashless), or through the appropriate use of the indirect tax rate. By setting actual inflation equal to core inflation, *whatever core inflation happens to be*, static relative price distortions are minimized. I summarise this discussion as a short proposition:

Proposition 1. In the generalised Calvo model of nominal rigidities, when the natural level of output is efficient ($\delta = 0$), the optimal inflation policy is to fully accommodate (validate) core inflation. Letting π^* denote the optimal rate of inflation, we have:

$$\pi^*_{t,t-1} = \omega_{t,t-1}$$

If the natural level of output is different from the efficient level, this Proposition will not hold, as explained earlier. However, if we require weak steady-state (or long-run) rationality of the indexation rule, that is, the *sure thing* condition (15) holds, the welfare gains from driving actual output towards its efficient level rather than towards its natural level will be ephemeral rather than permanent. The first-best policy would be to use fiscal or regulatory instruments (producer taxes/subsidies and anti-trust measures) to equate the natural and the efficient levels of output and to use the accommodation of core

inflation rule of Proposition 1 to minimize relative price distortions and equate actual output to the common natural and efficient levels of output.

When will the optimal inflation rule - core inflation is fully accommodated - imply that zero inflation is optimal? One example, obviously, is Calvo's orginal indexation rule, given in (25), since this has core inflation always equal to zero. The Calvo rule (which is also used in Benigno and Woodford (2005)) is, however, not a rule that makes sense in world with a sustained non-zero rate of inflation, because it violates the *sure thing principle* given in (15).

Woodford (2003) asserts that zero inflation is optimal even for the partial lagged indexation function (27). However, even with $\gamma < 1$, this indexation function gives $\pi^*_{t,t-1} = \omega_{t,t-1} = \gamma\pi_{t-1,t-2}$ as the optimal inflation rule, not zero inflation. In the body of his book, Woodford makes the erroneous assertion "*If the indexation parameter γ takes any value other than one, only zero inflation is consistent with an absence of price dispersion"* (Woodford (2003, p. 406)). In a footnote following this sentence, Woodford continues as follows: "*To be precise, an absence of price dispersion requires that prices change at a common rate π_t satisfying the difference equation $\pi_t = \gamma\pi_{t-1}$, given some arbitrary initial rate of inflation. But when $\gamma < 1$, this implies zero inflation every period, at least asymptotically. A stationary policy regime that fully eliminates distortions resulting from price dispersion would have to be one with zero inflation at all times."* Woodford (2003, p. 406, footnote 30). The first sentence of the footnote is correct. The second and third are, at best, misleading and, at worst, wrong. The correct version of the second sentence is: "*But when $-1 < \gamma < 1$, this implies zero inflation only asymptotically, unless the initial inflation rate happens to be zero*".

The last sentence of the above quote from Woodford (2003) confuses a *stationary policy regime* with a *constant rate of inflation*. The optimal stationary policy regime when $-1<\gamma<1$ is $\pi_t=\gamma\pi_{t-1}$, not $\pi_t=0$, which will always be sub-optimal unless the initial value of the inflation rate happened to be zero. If anything stationary were to be considered effectively equal to zero, stabilisation policy could not exist - assuming that deviations of output from potential output and of the unemployment rate from the natural rate of unemployment are stationary!

If one evaluates the optimal inflation rule $\pi^*_{t,t-1}=\gamma\pi_{t-1,t-2}$ *at* the non-stochastic steady state with zero inflation (as Woodford does), then, with $\pi_{t-1,t-2}=0$, it follows that $\pi^*_{t,t-1}=0$. This result is, of course, seriously non-robust: any perturbation of the initial position from the (zero) deterministic steady-state inflation rate, will making zero inflation in subsequent periods sub-optimal. Also, if for any reason the inflation target were constrained to be a *constant* rate of inflation, then of course, with $\gamma<1$, the only constant non-stochastic steady state rate of inflation is zero. In any case, the indexation rule (27) has little to recommend it, because with partial indexation, $\gamma<1$, the model violates the long-run rationality requirement (15) and has a long-run (deterministic) output-inflation trade-off.

Thus Woodford's assertion that the desirability of targeting zero inflation can be derived from standard welfare economic considerations is generically incorrect.

If $\gamma=1$ in equation (27) - the case of (one-period) lagged full indexation - any *constant* rate of inflation will be optimal. With $\gamma=1$ and equation (28), we have full current indexation to actual inflation; any sequence of inflation rates can be optimal.

With $\gamma = 1$ and equation (29), we have full current indexation to expected inflation, and any sequence of correctly anticipated inflation rates is optimal.

The result that the optimal inflation policy is for actual inflation to accommodate core inflation, whatever that happens to be, is valid for a wide class of models for which the deviation of output from its (efficient) natural level can be written as a function of current, past and anticipated future deviations of inflation from something that can be interpreted as 'core inflation'. Consider, for instance, the 'sticky information' based New Keynesian Phillips curve of Mankiw and Reiss (2006). In their model, instead of opportunities to set prices freely arriving at random intervals, prices can be set freely in each period, but information relevant to the price setting decision arrives at random intervals. Prices therefore only change when such news arrives. In the simple case where output is linear in the labour input, the Phillips curve for the sticky information model can be written as:

$$\pi_{t,t-1} = \frac{\gamma}{1-\gamma}\left(y_t - \hat{y}_t\right) + \gamma \sum_{j=0}^{\infty} (1-\gamma)^j E_{t-1-j}\left[\pi_{t,t-1} + \Delta\left(y_t - \hat{y}_t\right)\right] \qquad (30)$$
$$0 < \gamma < 1$$

Core inflation for this model is given by $\omega_{t,t-1} = \gamma \sum_{j=0}^{\infty} (1-\gamma)^j E_{t-1-j}\left[\pi_t + \Delta\left(y_t - \hat{y}_t\right)\right]$. When actual inflation is equated to core inflation, $\pi_t = \omega_{t,t-1}$, which ought to be feasible since period *t* core inflation depends only on information and expectations dated period *t-1* and earlier, period *t* output equals its natural level, $y_t = \hat{y}_t$. When this inflation rule is followed consistently, output will be at its natural level in every period. In this model, any rate of inflation, and indeed any sequence of inflation rates can be optimal. An attractive property of the Mankiw-Reis

model is that it does not have an exploitable output-inflation trade-off across deterministic steady states. Letting $\bar{y}$ stand for the deterministic steady state level of actual output and $\bar{\hat{y}}$ for the deterministic steady state natural level of output, the deterministic steady state is given by

$$\bar{y} = \bar{\hat{y}}$$

Blanchard and Gali (2005) extend the basic Calvo model to include real wage rigidity through an ad-hoc first order partial adjustment model for the real wage. They do, however, retain the original Calvo pricing assumption that each constrained price setter keep his nominal price constant – an indexation rule that violates the *sure thing principle*. Generalising this to allow for more general price indexation rules, their Phillips curve can be written as:

$$\pi_{t,t-1} - \omega_{t,t-1} = \beta E_t(\pi_{t+1,t} - \omega_{t+1,t}) + \frac{\sigma}{1-\phi L}\left[\kappa_1(y_t - \hat{y}_t) + \kappa_2 \Delta(y_t - \hat{y}_t)\right] \quad (31)^{15}$$
$$\sigma, \kappa_1, \kappa_2 > 0; 0 < \phi < 1$$

with the gap between the natural and the efficient levels of output given by

$$\hat{y}_t - y_t^* = s_t + \theta(\hat{y}_{t-1} - y_{t-1}^*) \quad (32)$$
$$0 \le \theta \le 1$$

where s depends on changes in the exogenous preference parameter and in the exogenous level of labour efficiency. In the case where the taste and supply parameters are constant, $s_t = s = \theta\delta$, so equation (32) simplifies to:

$$\hat{y}_t - y_t^* = \theta(\hat{y}_{t-1} - y_{t-1}^* + \delta) \quad (33)$$
$$0 \le \theta \le 1$$

[15] ϕ is the coefficient of the lagged real wage in the real wage adjustment equation and σ measures the responsiveness of the average price level to costs.

Because the constrained price setters' indexation rule does not satisfy the *sure thing principle*, the Blanchard-Gali model, like the model without sluggish real wage adjustment, has an exploitable output-inflation trade-off across deterministic steady states:

$$\bar{\pi} - \bar{\omega} = \frac{\sigma\kappa_1}{(1-\beta)(1-\phi)}(\bar{y} - \bar{\hat{y}}) \tag{34}$$

Since $\bar{\omega} = \omega = 0$ in the Blanchard-Gali model, there is an exploitable long-run trade-off between inflation and the output gap.

Given the irrational price indexation rule $\omega = 0$, the optimal rule for the rate of inflation in the Blanchard-Gali model can be quite complex. This is the case even when the natural level of output is efficient.[16] While steady state welfare is maximized by equating actual inflation to core inflation, $\pi_{t,t-1} = \omega_{t,t-1} = 0$ does not characterise the optimum (state-contingent) inflation sequence from arbitrary initial conditions. An interesting subject for future research would be the analysis optimal inflation in the Blanchard-Gali model with an indexation rule that satisfies the *sure thing principle* and makes sense more generally in light of what think we know about the empirics of indexation rules and price expectation formation in a world with bounded rationality.

II. The useful but dangerous myth of central bank independence

II.A. The financial mechanics of central bank dependence

Regardless of the degree of *de jure* and *de facto* operational or goal independence of the central bank, the balance sheet and the profit and loss account of the central bank

[16] This requires both $\delta = 0$ and $\hat{y}_0 = y_0^*$, where period $t = 0$ is the initial period.

are not independent of those of the rest of government. They are part of the balance sheet and profit and loss account of the state, for our purposes the consolidated general government and central bank.[17] The fact that the balance sheet and profit and loss account of the central bank are inextricably, but asymmetrically, intertwined with those of the general government manifests itself in a number of different ways.

There is a key asymmetry in the relationship between the central bank and the general government (which I will call the treasury from now on). The treasury has the power to tax but the central bank does not.[18] Not only does the treasury have the power to tax in general, it has the power to tax the central bank. Typically, the operating profits of the central bank are transferred automatically to the treasury.[19]

A further common but not universal asymmetry in the relationship between the treasury and the central bank is that the treasury is typically the main and majority shareholder of the central bank. In the UK, for instance, the Bank of England is a joint stock company all of whose shares are held by the Treasury. [20] Norges Bank is a separate legal entity owned by the state. However, the fact that the central bank is, from a financial point of view, an integral part of the state, does not depend on the formal legal

[17] From the perspective of macroeconomic management – fiscal-financial-monetary sustainability and macroeconomic stabilisation - the appropriate treatment of state-owned enterprises (SOEs) and similar publicly-owned bits of the enterprise sector is in principle clear but in practice often complicated. If and to the extent that they represent contingent general government liabilities or assets, their accounts should be consolidated with those of the general government.

[18] It is unclear whether most Central Banks have the right/power to make explicit transfer payments to parties outside the government. Since I will consider the ability of the Central Bank to make an (idealised) helicopter drop of money, I will consider the case where the Central Bank can make transfer payments to the public.

[19] The ECB distributes its profits to its shareholders, the National Central Banks (NCBs). The NCBs distribute their profits to the respective ministries of finance.

[20] The Bank of England is a body corporate incorporated by Royal Charter pursuant to the 1694 Act. The Bank was nationalised by the 1946 Act and its capital stock transferred to the Treasury.

niceties of stock ownership.[21] The concept of a financially independent central bank is therefore, in substance, vacuous, whatever the formal legal status of the central bank.

For a central bank to be able to achieve an inflation target without it having the power to tax, two conditions have to be satisfied. First, the inflation target has to be financeable by the state, that is, the consolidated central bank and general government. Second, when monetary policy is institutionally delegated to the central bank, the treasury has to 'stand behind' the central bank. What this means is that resources of the general government, in particular its capacity to tax, now and in the future, can and will be used, if required, to provide the central bank with the resources required to pursue its inflation target effectively. We consider the issue of the treasury recapitalising the central bank further in Section II.A.3.a below.

There is a flip side to this implicit or explicit guarantee of the balance sheet of the central bank by the treasury, which manifests itself when the treasury tries to appropriate (part of) the assets of the central bank. For a while, the central bank may be able to resist a claim on its assets by the treasury. The Bundesbank did this in 1997 when the German Federal Government attempted to raid (the revaluation of) the Bundesbank's gold and official foreign exchange reserves in an attempt to improve its chances of meeting the Maastricht Criteria for EMU membership.[22] The National Bank of Poland successfully

[21] The Federal Reserve System is an independent entity within the US Federal government. The stock of the twelve regional Federal Reserve Banks is owned by (private) member banks. Ownership of a certain amount of stock is, by law, a condition of membership in the System. The stock may not be sold or traded or pledged as security for a loan; dividends are, by law, 6 percent per year.
The ECB is owned by the national Central Banks (NCBs) that make up the EU's European System of Central Banks (ESCB). The NCB's themselves have a variety of formal ownership structures, but their balance sheets and profit and loss accounts all are effectively integral parts of the consolidated financial accounts of the nation state to which they belong. The Bank of Japan's capital is one hundred million yen, subscribed by both the government and non-governmental legal persons, in exchange for subscription certifications (shares), with the government providing no less than 55 million yen.

[22] See Duckenfield (1999) for a most interesting statement by the Bundesbank on this matter.

rebuffed an attempt, in 2003, by the Polish Ministry of Finance to appropriate a part of (the capital gains incurred on) its foreign exchange reserves. Ultimately, a determined treasury will be able to overcome such obstacles, be they conventions, laws or constitutional arrangements, provided there is political support for such depredations.

Because of the exceptional status of certain of the financial liabilities of the central bank (typically currency) as legal tender, the central bank can create any nominal amount of liquidity at negligible cost and virtually instantaneously. The central bank is therefore the agency of the state with the *'short-term deep pockets'*. Such 'short-term deep pockets' are all that is required for a central bank to be able to confront a liquidity crisis (say a run on the commercial banks) that is not expected to turn into a solvency crisis for a significant part of the banking/financial system. It is all that is required for the central bank to be an effective lender of last resort.

However, if in the view of the central bank and the treasury, the banking/financial system requires a permanent capital injection, it may not be possible for the central bank to do this on its own without recourse to monetary injections that would result in excessive inflationary pressures. In that case, provided the comprehensive balance sheet (that is, the intertemporal budget constraint, including future revenue-raising capacity and public spending obligations) of the treasury is sufficiently robust, the treasury can recapitalise the central bank and thus prevent excessive inflation resulting from a financial rescue operation by the central bank. The treasury, the agency of the state with the capacity to tax, has the '*long-term deep pockets'* that complement the short-term deep pockets of the central bank.

II.A.1 The intertemporal budget constraints of the central bank and the treasury

The argument thus far is easily formalised and made precise with a stylized set of accounts for the central bank and the treasury.

The central bank has the monetary base M, (currency plus commercial bank reserves with the central bank) on the liability side of its financial balance sheet; it carries a zero nominal interest rate.[23] On the asset side it has the stock of international foreign exchange reserves, R^f, earning a risk-free nominal interest rate i^f and the stock of domestic credit, which consists of central bank holdings of nominal, interest-bearing treasury bills, D, earning a risk-free nominal interest rate i, and central bank claims on the private sector, L, with nominal interest rate i^L.[24] The stock of treasury debt held outside the central bank is B; it pays the risk-free nominal interest rate i; τ^P is the real value of the tax payments by the domestic private sector to the treasury; it is a choice variable of the treasury; τ^b is the real value of taxes paid by the central bank to the treasury; it is a choice variable of the treasury and can be positive or negative; $\tau^g \equiv \tau^p + \tau^b$ is the real value of total treasury tax receipts; $h \geq 0$ is the real value of the transfer payments made by the central bank to the private sector ('helicopter drops'); I assume it to be a choice variable of the central bank; $\tau \equiv \tau^p - h$ is total real taxes net of transfer payments received by the state, that is, the consolidated treasury and central Bank; e is the value of the spot nominal exchange rate (the domestic currency price of foreign exchange); c^g is the real value of general government spending on goods and

[23] For simplicity, all of the monetary base is treated as non-interest bearing.
[24] For simplicity, I consider only short maturity bonds. Generalisations to longer maturities, index-linked debt or foreign-currency denominated debt are straightforward. In many transition countries and developing countries the Central Bank also holds private sector debt instruments among its assets and interest-bearing, non-monetary liabilities among its liabilities.

services and c^b the real value of central bank spending on goods and services; P is the general price level; the distinction between producer and consumer price levels is ignored for simplicity, and public spending on goods and services is assumed to be public consumption only.

Equation (35) is the budget identity of the treasury and equation (36) that of the central bank.[25]

$$\frac{B_t + D_t}{P_t} \equiv c_t^g - \tau_t^p - \tau_t^b + (1+i_{t,t-1})\left(\frac{B_{t-1} + D_{t-1}}{P_t}\right) \tag{35}$$

$$\frac{M_t - D_t - L_t - e_t R_t^f}{P_t} \equiv c_t^b + \tau_t^b + h_t + \frac{M_{t-1} - (1+i_{t,t-1})D_{t-1} - (1+i_{t,t-1}^L)L_{t-1} - (1+i_{t,t-1}^f)e_t R_{t-1}^f}{P_t} \tag{36}$$

When there exist complete contingent claims markets, and the no-arbitrage condition is satisfied, the usual solvency constraints, ruling out Ponzi finance by both the government and the central bank, imply the following intertemporal budget constraints for the treasury (equation (37)) and for the central bank (equation (38)).[26]

$$B_{t-1} + D_{t-1} \le E_t \sum_{j=t}^{\infty} I_{j,t} P_j \left(\tau_j^p + \tau_j^b - c_j^g\right) \tag{37}$$

$$-\left(D_{t-1} + L_{t-1} + e_{t-1} R_{t-1}^f\right) \le E_t \sum_{j=t}^{\infty} I_{j,t} P_j \left(-c_j^b - \tau_j^b - h_j - s_j + \frac{\Delta M_j}{P_j}\right) \tag{38}$$

$$P_t s_t \equiv \left(i_t - i_t^L\right) L_{t-1} + \left[1 + i_t - \left(1 + i_t^f\right)\frac{e_t}{e_{t-1}}\right] e_{t-1} R_{t-1}^f \,. \tag{39}$$

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[25] Note that the familiar proposition that the change in the monetary base equals domestic credit expansion plus the value of the change in the stock of foreign exchange reserves is correct if and only if the central bank makes no *after-tax* profits, that is, its before-tax profits, $i_t D_{t-1} + i_t^L L_{t-1} + e_t i_t^f R_{t-1}^f - P_t h_t$, are paid as taxes to the treasury: $\Delta M_t \equiv \Delta D_t + \Delta L_t + e_t \Delta R_t^f$ iff $P_t \tau_t^b \equiv i_t D_{t-1} + i_t^L L_{t-1} + e_t i_t^f R_{t-1}^f - P_t h_t$.

[26] The solvency constraint for the treasury is $\lim_{j\to\infty} E_t I_{j,t}\left(B_j + D_j\right) \le 0$, that for the central bank is $\lim_{j\to\infty} E_t I_{j,t}\left(D_j + L_j + e_j R_j^f\right) \ge 0$.

Here $I_{j,t}$ is the nominal stochastic discount factor between periods *j* and *t* defined by

$$I_{t_1,t_0} = \prod_{k=t_0+1}^{t_1} I_{k,t-1} \quad \text{for } t_1 > t_0$$
$$= 1 \qquad\qquad \text{for } t_1 = t_0$$

The interpretation of $I_{j,t}$ is the price in terms of period *t* money of one unit of money in period $j \geq t$. There will in general be many possible states in period *j*, and period *j* money has a period *t* (forward) price for each state. Provided earlier dated information sets do not contain more information than later dated information sets, these stochastic discount factors satisfy the recursion property

$$E_{t_0}\left(I_{t_1,t_0} E_{t_1} I_{t_2,t_1}\right) = E_{t_0} I_{t_2,t_0} \quad \text{for } t_2 \geq t_1 \geq t_0$$

Finally, the risk-free nominal interest rate in period *t* , the money price in period *t* of one unit of money in every state in period *t+1* is defined by

$$\frac{1}{1+i_{t+1,t}} = E_t I_{t+1,t}$$

For future reference I also define recursively the real stochastic discount factor $R_{j,t}$ by

$$R_{t_1,t_0} = \prod_{k=t_0+1}^{t_1} R_{k,t-1} \quad \text{for } t_1 > t_0$$
$$= 1 \qquad\qquad \text{for } t_1 = t_0$$

where

$$R_{t+1,t} = I_{t+1,t}(1+\pi_{t+1,t})$$

and the risk-free real rate of interest between periods *t* and *t+1* is defined as

$$\frac{1}{1+r_{t+1,t}} = E_t R_{t+1,t}\,.$$

The expression *s* in (39) stands for the real value of the quasi-fiscal implicit interest subsidies made by the central bank. If the rate of return on government debt

exceeds that on loans to the private sector, there is an implicit subsidy to the private sector equal in period *t* to $\left(i_t - i_t^L\right) L_{t-1}$. If the rate of return on foreign exchange reserves is less than what would be implied by Uncovered Interest Parity (UIP), there is an implicit subsidy to the issuers of these reserves, given in period *t* by

$$\left[1 + i_t - \left(1 + i_t^f\right)\frac{e_t}{e_{t-1}}\right] e_{t-1} R_{t-1}^f$$

Summing (35) and (36) gives the budget identity of the state (the consolidated treasury and central bank), in equation (40); summing (37) and (38) given the intertemporal budget constraint of the state in equation (41).

$$M_t + B_t - L_t - e_t R_t^f \equiv P_t(c_t^g + c_t^b - \tau_t) + M_{t-1} + (1 + i_t)B_{t-1} - (1 + i_t^L)L_{t-1} - e_t(1 + i_t^f)R_{t-1}^f \quad (40)$$

$$B_{t-1} - L_{t-1} - e_{t-1} R_{t-1}^f \leq \sum_{j=t}^{\infty} E_t I_{j,t} P_j \left(\tau_j - s_j - c_t^g - c_t^b + \frac{\Delta M_j}{P_j} \right) \quad (41)$$

Consider the conventional financial balance sheet of the central bank in Table 1, that of the treasury in Table 2, and that of the state in Table 3. Loans to the private sector and international reserves are valued at their notional or face values. If the outstanding stock of loans to the private sector were marked-to-market, its value would be $L_t \left(\frac{1 + i_{t+1}^L}{1 + i_t} \right)$ and the marked-to-market value of the international reserves would be $e_t R_t^f \left(\frac{\left(1 + i_{t+1}^f\right) e_{t+1} / e_t}{1 + i_{t+1}} \right)$.

Table 2 **Central Bank Financial Balance Sheet**	
Assets	**Liabilities**
D	M
L	
eR^f	
	W^b

Table 3 **Treasury Financial Balance Sheet**	
Assets	**Liabilities**
	D
	B
	W^g

Table 4 **Financial Balance Sheet of the State (consolidated Treasury and Central Bank)**	
Assets	**Liabilities**
L	B
eR^f	M
	W^s

The central bank's financial net worth, $W^b \equiv D + L + eR^f - M$, is the excess of the value of its financial assets, treasury debt, D, loans to the private sector, L and foreign exchange reserves, eR^f, over its monetary liabilities, M. Note that, in principle, there is nothing to prevent W^{cb} from being negative. Financial net worth excludes the present value of anticipated or planned future non-contractual outlays and revenues (the right-hand side of equation (38). It is therefore perfectly possible, for the central bank to survive and thrive with negative financial net worth. This might, however, require the central bank to raise so much real seigniorage, $\frac{\Delta M_j}{P_j}$, $j \geq t$, through current and future nominal base money issuance, that, given the demand function for real base money, unacceptable rates of inflation would result. The financial net worth of the treasury, $W^g \equiv -(D + B)$, is negative for most governments. The financial net worth of the state, $W^s \equiv W^g + W^b = L + eR^f - B - M$, is also likely to be negative for most countries. None of this need be a source of concern, unless the gap between the outstanding contractual non-monetary debt of the state and the present discounted value of the future primary (non-interest) surpluses of the state, $\tau_j - c_j^g - c_j^b - s_j$, $j \geq t$ is so large, that it either cannot be filled at all at all (the maximum value of the discounted future real seigniorage stream is too low) and the state defaults, or can only be closed at high rates of inflation.

The only intertemporal budget constraint that ought to matter, that is, the only one that would matter in a well-managed economy, is that of the consolidated treasury and central bank, given in equation (41). Its breakdown into the treasury's intertemporal budget constraint (equation (37)) and the central bank's intertemporal budget constraint (equation (38)) is without macroeconomic interest, unless there is a failure of cooperation

and coordination between the monetary and fiscal authorities, that is, between the central bank and the treasury.

II.A.2 Is the inflation target independently financeable by the central bank?

I consider here whether and under what conditions the inflation target is consistent with the central bank's intertemporal budget constraint. Consider a simplified, closed economy macroeconomic model, tagged on to the accounting framework developed in the previous Subsection. There are no international reserves, $R_t^f = 0$, no central bank loans to the private sector, $L_t = 0$, and therefore no quasi-fiscal subsidies by the central bank, $s_t = 0$.

The intertemporal budget constraints of the central bank and of the consolidated central bank and treasury are for this simplified closed economy:

$$-D_{t-1} \leq \sum_{j=t}^{\infty} E_t I_{j,t} P_j \left(-c_j^b - \tau_j^b - h_j + \frac{\Delta M_j}{M_j} \frac{M_j}{P_j} \right) \tag{42}$$

and

$$B_{t-1} \leq \sum_{j=t}^{\infty} E_t I_{j,t} P_j \left(\tau_j - c_t^g - c_t^b + \frac{\Delta M_j}{M_j} \frac{M_j}{P_j} \right) \tag{43}$$

Let the real value of the stock of domestic credit be $d_t = \frac{D_t}{P_t}$ and the real stock of money balances $m_t = \frac{M_t}{P_t}$.

We can re-write the central bank's intertemporal budget constraint as:

$$-d_{t-1} \leq \sum_{j=t}^{\infty} E_t R_{j,t} \left(-c_j^b - \tau_j^b - h_j + \frac{\Delta M_j}{M_j} m_j \right) \tag{44}$$

The rest of the economy is a simple non-stochastic one-commodity endowment economy with a representative infinite-lived household with a time-additive objective function and a subjective discount factor $\beta = \frac{1}{1+\rho} < 1$. Period utility is the natural logarithm of a Cobb-Douglas function of consumption and real money balances. There is full price flexibility. Real money balances are an argument in the household's utility function. The demand for real money balances and the Euler equation for private consumption, c, are as follows:

$$m_t = \alpha\left(\frac{1+i_{t+1}}{i_{t+1}}\right)c_t; \;\; 1 > \alpha > 0, i_{t+1} \geq 0 \tag{45}$$

$$c_{t+1} = \left(\frac{1+r_{t+1}}{1+\rho}\right)c_t \tag{46}$$

where the one-period real interest rate $r_{t,t-1}$ is defined by

$$1 + r_{t,t-1} = \frac{1+i_{t,t-1}}{1+\pi_{t,t-1}}$$

Equilibrium is given by:

$$y_t = c_t + c_t^g + c_t^b \tag{47}$$

I consider a simple stationary benchmark with $y_t = \overline{y} > c_t^g + c_t^b$, $c_t^g = \overline{c}^g$ and $c_t^b = \overline{c}^b$.

It follows that in equilibrium:

$$c_t = \overline{c} = \overline{y} - \overline{c}^g - \overline{c}^b \tag{48}$$

$$r_{t+1} = \rho \tag{49}$$

$$\pi_{t+1} = \frac{\Delta M_{t+1}}{M_t} \tag{50}$$

I want to consider which constant rate(s) of inflation, $\overline{\pi}$, this economy can support, with a central bank whose intertemporal budget constraint is given by equation (44). Without loss of generality for our purposes, we also assume that the real value of the taxes imposed on the central bank by the treasury is constant, $\tau_t^b = \overline{\tau}^b$ and that the real value of the payments by the central bank to the public is constant, $h_t = \overline{h}$.[27] It follows that the central bank's intertemporal budget constraint can be rewritten as follows:

$$\alpha(\overline{y} - \overline{c}^g - \overline{c}^b)(1+\rho)\overline{\pi}^2 + \left[\alpha(\overline{y} - \overline{c}^g - \overline{c}^b) - (\overline{c}^b - \overline{\tau}^b - \overline{h} - \rho d_{t-1})\right](1+\rho)\overline{\pi} - (\overline{c}^b - \overline{\tau}^b - \overline{h} - \rho d_{t-1})\rho \geq 0 \quad (51)$$

The intertemporal budget constraint of the central bank therefore has to satisfy:

$$-d_{t-1} + \frac{\overline{\tau}^b}{\rho} + \left(\frac{\overline{c}^b + \overline{h}}{\rho}\right) \leq \sigma(\overline{\pi}) \quad (52)$$

where

[27] We can interpret $\overline{\tau}_t^b$ as the permanent value of treasury taxes on the central bank, that is, as that constant real tax whose present discounted value is the same as the present discounted value of the actual (not necessary constant) sequence of taxes. So $\overline{\tau}_t^b \equiv \left[\sum_{j=t}^{\infty}\prod_{s=t}^{j}\left(\frac{1}{1+r_s}\right)\right]^{-1}\sum_{j=t}^{\infty}\prod_{s=t}^{j}\left(\frac{1}{1+r_s}\right)\tau_j^b$. We can also define the permanent or long-run real interest rate in period *t*, $\overline{r}_t$, as that constant real interest rate that satisfies $\frac{1}{\overline{r}_t} = \sum_{j=t}^{\infty}\prod_{s=t}^{j}\left(\frac{1}{1+\overline{r}_t}\right) = \sum_{j=t}^{\infty}\prod_{s=t}^{j}\left(\frac{1}{1+r_s}\right)$, if $\overline{r}_t > 0$. Using this convention, the intertemporal budget constraint of, say, the central bank can always be written as $-d_{t-1} + \frac{\overline{\tau}_t^b}{\overline{r}_t} + \left(\frac{\overline{c}_t^b + \overline{h}_t}{\overline{r}_t}\right) \leq \sigma(\overline{\pi})$, with (constant) permanent flows of revenues being discounted using (constant) permanent discount rates.

$$\sigma(\bar{\pi}) = \frac{\alpha \bar{c}(1+\rho)(1+\bar{\pi})\bar{\pi}}{\rho\left[\rho + (1+\rho)\bar{\pi}\right]}$$

with (53)[28]

$$\sigma'(\bar{\pi}) = \frac{\alpha \bar{c}(1+\rho)\left[\rho(1+2\bar{\pi}) + (1+\rho)\bar{\pi}^2)\right]}{\rho\left[\rho + (1+\rho)\bar{\pi}\right]^2} > 0 \text{ for } \bar{\pi} > \frac{-\rho}{1+\rho}$$

The interpretation of $\sigma(\bar{\pi})$ is the capitalised value of long-run real seigniorage revenue.

If the value of the inflation target, π^*, is less than the value of the lowest constant inflation rate that is consistent with the central bank's intertemporal budget constraint, for given values of $d_{t-1}, \bar{c}^b \geq 0$, $\bar{\tau}^b$ and $\bar{h} \geq 0$, the central bank cannot achieve the inflation target, because doing so would bankrupt it. The most it could do would be to set both $\bar{h}$ and $\bar{c}^b$ equal to zero: there would be no central bank-initiated helicopter drops of money and central bank staff would not get paid. If that is not enough to cause the weak inequality in (52) to be satisfied with $\bar{\pi} = \pi^*$, I will call this a situation where the inflation target is not *independently financeable* by the central bank. The value of the central bank's holdings of treasury debt, d_{t-1}, is determined by history; the net tax paid by the central bank to the treasury, $\bar{\tau}^b$ is determined unilaterally by the treasury.

If the treasury decides to support the central bank in the pursuit of the inflation objective, the inflation target is *jointly financeable* by the central bank and the treasury, as long as the consolidated intertemporal budget constraint of the treasury and the central bank can be satisfied with the seigniorage revenue generated by the implementation of the inflation target. Let the real stock of treasury debt held outside the central bank be $b_t \equiv B_t / P_t$, remember that taxes net of transfers of the consolidated treasury and central

[28] For the 'double logarithmic' money demand function there is no long-run 'seigniorage Laffer curve'. A higher inflation rate will increase steady-state real seigniorage revenue.

bank are $\tau = \tau^p - h$ and assuming for simplicity that treasury spending, like central bank spending is constant, the intertemporal budget constraint of the state is given by:

$$b_{t-1} + \frac{\overline{c}^g + \overline{c}^b - \overline{\tau}}{\rho} \leq \sigma(\overline{\pi}) \qquad (54)$$

If (54) is not satisfied with $\overline{\pi} = \pi^*$, the inflation target is *not financeable*, even with cooperation between treasury and central bank. The inflation target in that case is not feasible. If (54) is satisfied with $\overline{\pi} = \pi^*$, the inflation target is financeable by the consolidated treasury and central bank – that is, the inflation target is feasible with cooperation between treasury and central bank. Note that the feasibility condition for the inflation target, equation (54), is independent of $\overline{\tau}^b$ (which is a transfer payment within the consolidated treasury and central bank) and of d_{t-1} which is an internal liability/asset within the consolidated treasury and central bank. What matters is the net debt of the consolidated treasury and central bank, b_{t-1}, and the taxes net of transfers of the consolidated treasury and central bank, $\overline{\tau}$. If the feasibility condition (54) is satisfied, the treasury can always provide the central bank with the resources it requires to implement the inflation target. All it has to do is reduce taxes on the central bank (or increase transfer payments to the central bank), in an amount sufficient to ensure that equation (52) is also satisfied.[29]

If (54) is satisfied with $\overline{\pi} = \pi^*$, but (52) is not, then the inflation target is only financeable by the treasury and central bank jointly, not independently by the central bank.

[29] This could be achieved through a one-off capital transfer rather than through a sequence of current transfers.

This discussion supports the view that the central bank should not have operational target independence (freedom to choose a quantitative inflation target) even when it has operational independence (the freedom to set the short nominal interest rate as it sees fit), simply because it does no have financial independence. The treasury (that is, the government) should set the inflation target, because only the treasury can make sure that the central bank has enough resources, other than through seigniorage, to make the inflation target financeable by the central bank. The treasury, through its ability to tax the central bank, is effectively constrained only by the consolidated intertemporal budget constrained in (54), even though formally it faces the intemporal budget constraint given in equation .

$$b_{t-1} + d_{t-1} \leq \frac{\overline{\tau}^{p} + \overline{\tau}^{b} - \overline{c}^{g}}{\rho} \tag{55}$$

A problem with leaving the setting of the operational inflation target with the treasury is that it could re-create the problem of opportunistic (ab)use of monetary policy, even with the short nominal rate of interest under the formal independent control of the central bank, through the opportunistic manipulation of the operational inflation target by the treasury. The UK's monetary arrangement, where the inflation target can be set at will by the Chancellor of the Exchequer, is particularly vulnerable in this regard. The power of the Treasury to take back the power to make monetary policy, that is, interest rate setting powers, from the Bank of England under the Treasury reserve powers further accentuate this vulnerability.[30] In the nine years of its existence, the problem has not

[30] The following description of the Treasury Reserve Powers is taken, with minor edits, from the House of Lords, Bank of England Bill, Memorandum by Her Majesty's Treasury, which can be found at: http://www.publications.parliament.uk/pa/ld199798/ldselect/lddereg/066xi/dr1106.htm .

The Treasury reserve powers, are a provision in the Bank of England Act 1998, that ensures that, although Bank has statutory operational responsibility for monetary policy, the Treasury may direct the

arisen, because the same Chancellor who created the framework, Gordon Brown, has also been the only one in charge of the setting of the inflation target. Such self-restraint cannot be take for granted when another incumbent (possibly a representative of another political party) occupies the position of Chancellor of the Exchequer. It would therefore be wise to make a change in the operational inflation target subject to a strongly qualified majority vote (say a 2/3rd or 3/4th majority in both Houses of Parliament).

II.A.3 Other aspects of necessary co-operation and co-ordination between central bank and treasury.

Even if the treasury supports the central bank's inflation target and provides it with the financial resources to implement it, there are at least two other economic contingencies for which active central bank and treasury co-ordination and co-operation is desirable.

II.A.3.a Recapitalizing the central bank

The first case occurs when the (threat of) a serious banking crisis or financial crisis with systemic implications forces that central bank to act as a lender of last resort, and the problem turns out to be (or becomes), for a significant portion of the banking/financial system, a solvency crisis as well as a liquidity crisis. It could happen

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Bank with respect to monetary policy if they are satisfied that such action is required by extreme economic circumstances and is in the public interest.

The rationale is that, in extreme economic circumstances there may be a need to override the Bank's operational responsibility for monetary policy decisions. Because the action required would depend on the nature of the extreme economic circumstances, it is deemed appropriate that this is left to delegated legislation, which can then be tailored to the needs of the particular circumstances which have arisen.

The powers delegated by this provision are exercisable by statutory instrument laid before Parliament after being made. The order will cease to have effect after 28days, unless it has by then been approved by resolution of each House of Parliament. Even if approved, an order will cease to have effect 3 months after the day it was made.

The Treasury argues that, because these reserve powers may only be exercised in extreme economic circumstances, which are likely to necessitate emergency action, it is appropriate that they should have immediate effect. This is balanced to some extent, by requiring that the continued effect of such action should require the approval of Parliament.

that recapitalising the insolvent banks or financial institutions with just the financial resources of the central bank (including a given sequence of net payments to the treasury, τ^b) would require the central bank to engage in excessive base money issuance, which would result in unacceptable rates of inflation. As long as the resources of the consolidated treasury and central bank are sufficient, the treasury should either recapitalise the central bank (if the central bank recapitalised the private banking/financial system in the first instance), or the treasury should directly recapitalise the banking/financial system. In the accounts set out above, this would amount to one or more large negative realisations of τ^b.

Special problems occur when the insolvency of (part of) the financial system is due to an excess of foreign-currency liabilities over foreign-currency assets. In that case the treasury, in order to recapitalise the central bank (or some other part of the financial sector directly), has to be able to engineer both an internal fiscal transfer and an external transfer of resources of the required magnitude. If the external credit of the state is undermined, this may only be possible gradually, if and as the state can lay claim to (part of) the external primary surplus of the nation.

In the usual nation state setting, a single treasury or national fiscal authority stands behind a single central bank. Unique complications arise in the EMU, where each national fiscal authority stands financially behind its own NCB, but no fiscal authority stands directly behind the ECB. The lender of last resort function in the EMU is assigned to the NCB members of the ESCB (see Padoa-Schioppa (1999), Goodhart (1999) and Lastra (2000)). This will work fine when a troubled or failing bank or other financial institution deemed to be of systemic importance has a clear nationality, as most

Eurozone-domiciled banks and other financial institutions do today. Likewise, banks that are subsidiaries of institutions domiciled outside the EMU will be the responsibility of their respective central bank (be it the Bank of England, the Federal Reserve System or the Bank of Japan) and of the national fiscal authority that stands behind each of these central banks.

Trouble arises when Eurozone-domiciled banks emerge that do not have a clear national identity, say banks incorporated solely under European Law. As there is no fiscal authority, national or supranational, standing behind the ECB, who would organise and fund the bail-out and recapitalisation of such a 'European bank'? Whether this potential vulnerability will in due course be remedied by the creation of a serious supra-national fiscal authority at the EMU level that would stand behind the ECB, or by implicit or explicit agreements between the ECB, the NCBs (the shareholders of the ECB) and the national fiscal authorities is as yet unclear.

II.A.3.b Helicopter drops of money

The second set of circumstances when cooperation and coordination between the monetary and fiscal authorities is essential is when an economy is confronting the need to avoid unwanted deflation or, having succumbed to it, to escape from it. In principle, the potential benefits from cooperation between the monetary and fiscal authority apply to stabilisation policy in general, that is to counter-inflationary as well as to counter-deflationary policies. The issue is particularly urgent, however, when deflation is the enemy and conventional monetary policy has run out of steam.

Faced with deflation, the central bank on its own can cut the short nominal interest rate - the primary monetary policy instrument in most economies with a floating exchange rate. It can engage in sterilised foreign exchange market operations. If there are reserve requirements imposed on commercial banks or other financial institutions, these can be relaxed, as can the collateral standards in Repos and the eligibility requirements that must be met by potential counterparties.

Once the short nominal interest rate is at the zero floor, conventional monetary policy is effectively exhausted. The central bank can then engage in generalised open market purchases, monetising the outstanding stock of non-monetary public debt, of all maturities, nominally denominated or index-linked, held outside the central bank. Once all outstanding public debt has been absorbed by the central bank, it could turn its attention to the purchase and monetisation of private securities, from foreign currency-denominated securities, to stocks and shares, land, property or contingent claims. Clearly, such socialisation of private wealth would be subject to all kinds of moral hazard, adverse selection and governance problems.

Should this too fail to boost aggregate demand and end deflation, the monetary authority on its own has one remaining exotic instrument and the combined monetary and fiscal authorities have one conventional but truly effective instrument. The unconventional instrument is to lower the zero floor on nominal interest rates (which is a result of the zero nominal interest rate paid on currency and often on all base money), by paying a negative nominal interest rate on base money. For commercial banks' reserves with the central bank, paying a negative nominal interest rate is technically and administratively trivial. Imposing a 'carry tax' on currency is administratively

cumbersome and intrusive, but not impossible. Silvio Gesell (1916) recommended it many years ago, and as great an economist as Irving Fisher (1933) thought the proposal had merit (see also Goodfriend (2000) and Buiter and Panigirtzoglou (2001, 2003)).

There is, however, a very conventional policy alternative. Milton Friedman referred to it as (base) money dropped from a helicopter (Friedman (1969)). If the recipients of this largesse do not expect it to reversed (in present discounted value terms) in the future, that is, if they do not expect the helicopter drop of money to be followed by a vacuum cleaner sucking up the currency notes again, this would, at a given price level, represent an increase in the real net wealth of the private sector (see Buiter (2003c). Because base money does not have to be redeemed *ever*, it does not constitute an effective liability of the state. The increase in net private wealth is also in the most liquid form possible.

An example of a helicopter drop, in the UK context, would be for the Governor of the Bank of England issue a £1,000 cheque, drawn upon the Bank of England, to every man, woman and child in the country. On the balance sheet of the Bank this would show up as an increase in the stock of base money and a corresponding reduction in the financial net worth of the Bank. In its budget constraint it would be a one-off transfer payment to the private sector (h in our notation).

Would it work? If the money rain is not expected to be reversed in present value, it surely would. It does not rely on the strength of the intertemporal substitution effect in private consumption or on the interest sensitivity of private investment demand. All that it requires is that aggregate consumption today is a normal good. If the wealth effect is weak and the £1,000.00 cheque does not do the job, the Governor can add zeros in front

of the decimal point on the cheque until the private consumer surrenders and goes out and spends.

Even if the economic mechanism of the helicopter drop of money is straightforward, its practical implementation cannot be done by the central bank alone. The reason is that in reality central banks do not have an instrument like *h* in their arsenals. Making transfer payments to the private sector is not something central banks are legally permitted to do, because they are not fiscal agents of the state. So the economically equivalent action has to be coordinated between the treasury and the central bank. The treasury will implement a tax cut or increase in transfer payments (a cut in τ^p) and will finance this by selling debt to the central bank (increasing *D*). The acquisition of treasury debt by the central bank is financed through the issuance of base money, an increase in *M*.

II.B. The Political Economy of limited central bank independence

Even more important that the issues of central bank resource adequacy and cooperation with the fiscal authorities, is the question of the extent to which key economic policy decisions can be delegated to appointed, that is, unelected, technocrats in a society that values democratic legitimacy and accountability.

Formal accountability is the aspect of responsibility involving giving, ex-post, a statistical or judicial explanation for events and actions. *Substantive* accountability means that, following such reporting and explanations, *judgement may follow*, that is, there can be punishments, sanctions or rewards for those deemed reponsible for events and actions. It is clear from its own website, that the ECB has a minimalist, formal interpretation of

accountability: it is the (written) reporting obligations of the ECB.[31] The same holds for the Bank of England (which also has oral reporting obligations towards the UK Parliament) and all other operationally independent central banks.

It is not surprising that operationally independent central banks have limited formal accountability at best and no substantive accountability at all. Independence *has* to mean that those in charge of monetary policy cannot be fired except for incapacity or gross misconduct, and that financial remuneration and working conditions likewise cannot be used to reward or punish them. Former as well as incumbent monetary policy makers from non-operationally independent central banks have been sued in civil and criminal courts for actions taken in their capacity as monetary policy makers - that is, not for personal financial misdemeanours or felonies, but for (criminal) negligence and dereliction of duty.[32] In the advanced industrial countries we have not (yet) witnessed recourse to the law by those disgruntled with the conduct of monetary policy. The legal immunities and liabilities of central bankers in the performance of their monetary policy making tasks are, however, an uncharted area.

Until now, in any case, in the OECD countries, accountability of the monetary policy makers does not mean judgement-with-consequences of individual or group

[31] See: http://www.ecb.int/ecb/orga/accountability/html/index.en.html. The website states "According to the Statute, the ECB is required to publish quarterly reports on the activities of the Eurosystem as well as a consolidated Weekly Financial Statement. In addition, it has to produce an Annual Report on its activities and on the monetary policy of the previous and the current year. The Annual Report has to be addressed to the European Parliament, the EU Council, the European Commission and the European Council."

[32] Brad Setser's Web Log reported on May 31, 2005, that the "*Former Thai central bank governor Rerngchai Marakanond, who oversaw the country's failed attempt to protect its fixed exchange rate regime on the eve of the 1997 Asian financial crisis, was ordered on Tuesday to pay back the Bt186bn (US$4.57bn) spent in the futile defence of the Baht peg currency. A local court chastised Mr Rerngchai for "grave negligence" for exhausting Thai foreign exchange reserves battling currency speculators."* http://www.rgemonitor.com/blog/setser/91443/ .

actions. There are no penalties or rewards, indeed no consequences other than damage to reputations (shame and embarrassment) and post-central bank term of office honours and career prospects

Such independence and the associated inevitable lack of substantive accountability is only acceptable in a democratic society if the domain over which the independent technocrats exercise discretion is narrow in scope, limited in importance, and well-defined, and if their actions are observable and verifiable.[33] For central banks, setting the value of some short nominal interest rate probably fits that bill. Enhancing the responsibilities and influence of the central bank beyond the narrow responsibility to set some short nominal rate of interest in the pursuit of price stability, and to act as lender of last resort in the case of systemic financial instability, would be a grave constitutional and political mistake.[34]

That mistake has been made in the Treaty of the European Communities, with regards to the ECB, and it is the ECB that will in due course pay the price. It was a mistake to grant the ECB an official, public (albeit only) advisory role in the process governing the admission of new Eurozone members.[35] The institution has neither the

[33] These considerations imply that a Fiscal Policy Council of the kind proposed by Charles Wyplosz and others, could, if it were to be given the power to prescribe or proscribe certain kinds of behaviour, would have to have a very limited mandate for it to be perceived as legitimate.

[34] The phrase 'lender of last resort' or anything resembling it do not occur in the Treaty of the European Communities as it pertains to the ECB. Nor is the ECB explicitly granted a mandate to assume substantive responsibility to act as a lender of last resort during times of financial crisis. This omission is likely to reflect a misplaced fear that just mentioning the possibility of the ECB acting a lender of last resort would create unacceptable moral hazard. Instead, constructive ambiguity is deliberately created by a as to make it

[35] The procedure set out in Articles 122 and 123 of the EC Treaty for the adoption of the euro by a particular Member State provides for the following steps:

- At least once every two years, or at the request of a Member State with a derogation, the European Commission and the ECB report on the progress made in the fulfilment by the Member States of the "Maastricht" convergence criteria in accordance with the procedure established in Article 121 of the EC Treaty.
- On the basis of a proposal by the Commission, and after consulting the European Parliament, the Council decides whether or not the country will adopt the euro.

political legitimacy nor the analytical competence to play such an important part in a quintessentially political and analytical decision.

It is a mistake for central bankers to express, in their official capacities, views on what they consider to be necessary or desirable fiscal and structural reforms. It is not the job of any central banker to lecture, in an official capacity, the minister of finance on fiscal sustainability and budgetary restraint, or to hector the ministers of the economy on the need for structural reform of factor markets, product markets and financial markets. This is not in the mandate of central banks and it is not part of their professional competence. The regrettable fact that the treasury and the ministry of the economy tend to make the symmetric mistake of lecturing the operationally independent central bank on what they perceive to be its duties (which generally amounts to a plea for lower interest rates) does not justify the central bank's persistent attempts at mission creep.

Central bankers do have a duty to explain how their current and future interest rate decisions are contingent on economic developments that may include or may be influenced by, the actions of the fiscal authorities and the success or failure of structural reforms. Central banks should clarify what their reaction function is, given the economic environment in which they operate, which includes the fiscal authorities and the government and 'social partners' engaged in structural reforms. If central banks, treasury ministers and ministers of the economy were to act cooperatively toward each other, and with commitment towards the private sector, good things may well happen.

Setting the short nominal interest rate is a modest, but not unimportant task that can be fulfilled by humble, competent monetary technicians – the dentists Keynes hoped all

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- The Council, after consulting the ECB, adopts the conversion rate at which the euro shall be substituted for the currency of the Member State concerned.

See: http://ec.europa.eu/economy_finance/euro/documents/documents_en.htm#top

economists would eventually emulate. If central banks wish to act in a wider political capacity and choose to operate in a wider political arena than is implied by the pursuit of price stability and financial stability, they cannot expect, as regards these broader issues, the same protection (operational independence) against interference, that they currently enjoy as regards their setting of the short-term nominal interest rate. Indeed, when central banks exceed their narrow price stability and financial stability mandates, they may find that the political backlash against such usurpation could well be the loss of operational dependence in the pursuit of price stability and financial stability itself.

I still believe that the loss of central bank operational independence in the pursuit of the politically mandated objective of price stability would be a serious loss to the cause of price stability, and of macroeconomic stability generally. However, what we are seeing to an increasing extent in the ECB, and to varying degrees also in other operationally independent central banks, is the unacceptable face of central bank independence: arrogance, irresponsibility, and damaging incursions into areas well outside their core mandates of price stability and financial stability - areas where central banks do not have the competence to act effectively - and all this unchecked by any substantive accountability. The fact that, in the case of the ECB, the extension of their mandate into the decision-making process of Eurozone enlargement is mandated by the Treaty of the only shifts and redistributes the ultimate responsibility and blame for this improper enhancement of ECB's role; it does not make it right.

I would urge central banks to return to and stick to their core tasks of maintaining price stability and financial stability. Either the operationally central bank, including the ECB will limit itself or it will not survive as an operationally independent central bank.

Conclusions

There are no conventional welfare economics foundations for making price stability (operationalised as a zero or low rate of inflation going forward) the overriding objective of monetary policy. Welfare effects due to the association of higher inflation with a higher pecuniary opportunity cost of holding cash, and associated shoe-leather costs and distortions in the relative price of cash goods and credit goods, call for a negative rate of inflation, unless interest can be paid on currency. Menu costs are likely to be most significant for wage negotiations and would therefore call for stabilising the nominal wage, not the price level. Inflation-non-neutralities in the tax and transfer system are best addressed by index-linking the relevant parameters of the budget. Undesirable redistribution due to unexpected inflation or deflation is also most readily addressed by expanding the menu of index-linked financial instruments.

The optimal approach to addressing relative price distortions due to nominal wage and price rigidities calls for full accommodation or validation of core inflation, whatever the core inflation process happens to be, not for price stability, unless core inflation happens to be zero.

The purpose of the first half of this paper was not to argue that central banks should forget about price stability and inflation targeting. It is merely to point out that these arrangements that appear to work so well in practice have nothing much to recommend themselves from a theoretical point of view. Monetary theory is indeed well behind monetary policy practice, and the profession should not pretend it is otherwise. It is back to the salt mines for the theory of monetary policy and monetary economics generally.

As regards central bank independence, it is clear that, because of the central bank's inability to tax and because of the ability of the treasury to tax everyone and everything, including the central bank, there can be no guarantee that the inflation target is financeable independently by the central bank, even if it is in principle financeable by the consolidated central bank and treasury. In general, only the treasury can ensure that the central bank has the budgetary resources to implement the inflation target.

The fact that the central bank only has short-term deep pockets (unless it is willing to give up on its inflation target) while only the treasury has long-run deep pockets is also a key issue when the central bank is asked to fulfil its key function of lender of last resort. Unless the central bank is backed up with the resources of the treasury, it will not be able to act effectively when a liquidity crisis shows signs of becoming a solvency crisis for financial institutions characterised by important systemic externalities.

Effective policy in a liquidity trap requires money-financed tax cuts or transfer payments (helicopter drops of money). Without cooperation between the treasury and the central bank, such policies cannot be implemented.

central bank operational independence, in the sense that the Treasury cannot instruct the central bank how to set its instrument(s) (or even put material pressure on the monetary policy makers) is probably a good thing. It should not lead to the conclusion, however, that the central bank either can or should try to fulfil its mandate without close cooperation and coordination with the fiscal authorities. Attempts by the central banks to increase the scope of their influence beyond the narrow remit of price stability and lender of last resort, creates the risk of a political backlash that could endanger the operational

independence of the central banks where it is helpful – in the single-minded pursuit of price stability.

References

Alesina, A., Summers, L.H. (1993), Central bank independence and macroeconomic performance: some comparative evidence, *Journal of Money, Credit and Banking* 25, 151-162.

Allais, Maurice [1947], *Economie et Intérêt*, Paris, Imprimerie Nationale.

Batini, Nicoletta, Kenneth Kuttner, and Douglas Laxton (2005), "Does Inflation Targeting Work in Emerging Markets", Chapter IV, *World Economic Outlook*, September, International Monetary Fund, Washington D.C.

Baumol, William J. [1952], "The Transactions Demand for Cash: an Inventory Theoretic Approach", *Quarterly Journal of Economics*, 56, November, pp. 545-56.

Beetsma, R., Bovenberg L.(1997), Central bank independence and public debt policy, *Journal of Economic Dynamics and Control* 21, 873-94.

Benigno, Pierpaolo and Michael Woodford (2005), "Inflation Stabilization and Welfare: The Case of a Distorted Steady State", *Journal of the European Economic Association*, Volume 3, Issue 6, pp. 1185-1236

Bernanke, Ben S. and Michael Woodford eds. (2005), *The Inflation-Targeting Debate*, National Bureau of Economic Research Studies in Business Cycles, Volume 32, The University of Chicago Press, Chicago and London.

Blinder, Alan (1999), Central Banking in Theory and Practice, Cambridge, MA: MIT Press.

Buiter, Willem H. (2004), "Two naked emperors? Concerns about the Stability and Growth pact and second thoughts about Central Bank independence", *Fiscal Studies*, Vol. 25(3), pp. 249-77.

Buiter, Willem H. (2005a), "New Developments in Monetary Economics: two ghosts, two eccentricities, a fallacy, a mirage and a mythos", Royal Economic Society 2004 Hahn Lecture. For an abstract, click here ; *The Economic Journal*, Conference Papers, Vol. 115, No. 502, March 2005, pp. C1-C31.

Buiter, Willem H. (2005b) "Overcoming the Zero Bound: Gesell vs. Eisler; Discussion of Mitsuhiro Fukao's "The Effects of 'Gesell' (Currency) Taxes in Promoting Japan's Economic Recovery" *International Economics and Economic Policy*, Volume 2, Numbers 2-3, November 2005, pp. 189-200.

Buiter, Willem H. and Nikolaos Panigirtzoglou (2001), "Liquidity Traps: How to Avoid Them and How to Escape Them", with Nikolaos Panigirtzoglou, in *Reflections on*

Economics and Econometrics, Essays in Honour of Martin Fase, edited by Wim F.V. Vanthoor and Joke Mooij, 2001, pp. 13-58, De Nederlandsche Bank NV, Amsterdam.

Buiter, Willem H. and Nikolaos Panigirtzoglou (2003), "Overcoming the Zero Bound on Nominal Interest Rates with Negative Interest on Currency: Gesell's Solution", *Economic Journal*, Volume 113, Issue 490, October 2003, pp. 723-746.

Calvo, Guillermo (1983), .Staggered Contracts in a Utility-Maximizing Framework, *Journal of Monetary Economics*, September.

Campillo, M., Miron, J. (1997), Why does inflation differ across countries?, in Romer C.D., Romer D.H. (Eds.), *Reducing Inflation: Motivation and Strategy*, University of Chicago Press, Chicago.

Caplin, Andrew S. and Daniel F. Spulber (1987), "Menu Costs and the Neutrality of Money", *Quarterly Journal of Economics*, 102, November, pp. 703-725.

Cukierman, A., Webb, S.B., Neyapti, B. (1992), Measuring the independence of Central Banks and its effects on policy outcomes, *World Bank Economic Review* 6, 353-398.

Eijffinger, Sylvester (2005), The European Central Bank: Credibility, Transparency, and Centralization, The MIT Press, Cambridge, Massachusetts, 2005.

Federal Reserve Bank of Kansas City (1996), *Achieving Price Stability*; A Symposium Sponsored by The Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 29-31, 1996.

Feldstein, Martin S (1979),. "The Welfare Cost of Permanent Inflation and Optimal Short-Run Economic Policy," *Journal of Political Economy*, vol. 87(4), pages 749-68.

Feldstein, Martin S. (1997). "The Costs and Benefits of Going from Low Inflation to Price Stability," NBER Working Papers 5469.

Fischer, Stanley (1981), "Towards an Understanding of the Costs of Inflation: II", *Carnegie-Rochester Conference Series on Public Policy* 15, pp. 5-42.

Forder, J. (1998), Central bank independence: conceptual clarifications and interim assessments, *Oxford Economic Papers* 50, 307-334.

Friedman, Milton (1968), "The Role of Monetary Policy." *American Economic Review* 58, no. 1, pp. 1-17.

Gali, Jordi, Mark Gertler and J. David Lopez-Salido (2001), "European Inflation Dynamics", *European Economic Review*, 45 pp. 1237 - 1270

Gesell, Silvio [1949], *Die Natuerliche Wirtschaftsordnung*, Rudolf Zitzman Verlag, available in English as *The Natural Economic Order*, Peter Owen Ltd, London, 1958.

Goodfriend, Marvin [2000], "Overcoming the Zero Bound on Interest Rate Policy, *Journal of Money, Credit and Banking*, Vol. 32, No. 4, Pt. 2, November, pp. 1007-1035.

Haan Jacob de, and W. Kooij, "Does Central Bank Independence Really Matter? New Evidence for Developing Countries Using a New Indicator", *Journal of Banking and Finance*, 24, 2000, 643-664.

IMF (2006), "Inflation Targeting and the IMF", Prepared by Monetary and Financial Systems Department, Policy and Development Review, Department, and Research Department, Mimeo, March 16, 2006;
http://www.imf.org/external/np/pp/eng/2006/031606.pdf

Keynes, John Maynard (1931), "Economic Possibilities for our Grandchildren", in John Maynard Keynes, *Essays in Persuasion*, Macmillan Press Ltd. London, pp. 321-332.

King, Mervyn (1997), "The inflation target five years on", Lecture delivered at the London School of Economics, Wednesday 29 October, Bank of England.

King, Mervyn (2005), "Monetary Policy: Practice Ahead of Theory", Mais Lecture, Bank of England.

Larkin, William J. Jr. (1982), "*The Ethics of Inflation: A Biblical Critique of the Causes and Consequences"*, *Grace Theological Journal*, 3:1, Spring, 1982, http://www.apuritansmind.com/Stewardship/LarkinWilliamEthicsInflation.htm .

Lenin, Vladimir Ilyich http://en.thinkexist.com/quotes/vladimir_lenin/3.html .

Lindsey, Lawrence B. (1995) "The Two-Handed Role of Money", *Contemporary Issues Series* 74, August 1995, Center for the Study of American Business Washington University, St. Louis.

Lucas, Robert E. Jr. (1972a), "Expectations and the Neutrality of Money", *Journal of Economic Theory*, 4, pp. 103-124

Lucas, Robert E., Jr. (1972b), "Econometric Testing of the Natural Rate Hypothesis." In *The Econometrics of Price Determination*, edited by Otto Eckstein. Reprinted in Lucas, Robert E., Jr. *Studies in Business Cycle Theory.* 1981.

Lucas, Robert E. Jr and Nancy Stokey (1987), "Money and interest in a cash-in-advance economy", *Econometrica*, 55, Pp. 491-513.

Lucas, Robert E. Jr. (2000), "Inflation and Welfare", *Econometrica* 68, pp. 247-274.

Mankiw, N. Gregory and Ricardo Reis (2006), “Pervasive Stickiness (Expanded Version)”, NBER Working Paper No. 12024, February.

McCallum, B. T. (1995), “Two fallacies concerning central bank independence”, *American Economic Review*, Papers and Proceedings, vol. 85 (May), pp. 207-211.

Ozkan, F.G. (2000), Who wants an independent Central Bank: monetary policy making and politics, *The Scandinavian Journal of Economics* 102, pp. 621-643

Phelps, Edmund S. (1967), "Phillips Curves, Expectations of Inflation and Optimal Employment over Time." *Economica NS* 34, no. 3, pp. 254-81.

Phillips, A. W. H. (1958), "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957." *Economica NS* 25, no. 2 (1958): 283-99.

Posen, A. (1993), Why Central Bank independence does not cause low inflation: there is no institutional fix for politics’ in R O’Brien (ed.), *Finance and the International Economy*, 7, Oxford University Press, Oxford.

Samuelson, Paul A., and Robert M. Solow (1960), "Analytical Aspects of Anti-Inflation Policy." *American Economic Review* 50, no. 2, pp. 177-94.

Shiller, Robert J. (1996), “Why do people dislike inflation?” in *Reducing Inflation: Motivation and Strategy*, edited by Christina D. Romer and David H. Romer, University of Chicago Press, 1997, pp.

Solans, Eugenio Domingo (1999), “Should the ECB have broader objectives beyond price stability? A speech given at the Wilton Park conference on "Emu: Economic and Political Implications for the “Ins” “Outs” and European Business”, at Wiston House, West Sussex, on 24 May 1999;
http://www.ecb.int/press/key/date/1999/html/sp990524.en.html .

Tobin, James (1968), “Phillips Curve Algebra”, in James Tobin, *Essays in Economics, Volume 2, Consumption and Econometrics*, pp. 11-15, MIT Press, 1987, 77, Cambridge Mass; adapted from Tobin’s “Discussion” of papers at a *Symposium on Inflation: Its Causes, Consequences and Control*, 1968, Stephen W. Rousseas ed. pp. 48-54 and from Tobin’s “Comment”, *Brookings Papers on Economic Activity*, 1971:2, pp. 512-14.

Tognato, Carlo (2004), “In the name of money: Central banking as a secular religion”, Manuel Ancizar Lecture, Universidad Nacional, Bogotá, October 30;
http://research.yale.edu/ccs/research/working-papers/tognato_banking.pdf .

Voorhis, J. H. (1973), “The Federal Reserve”, in *The Strange Case of Richard Milhouse Nixon*. New York: P. S. Eriksson, 1972;

http://www.sonic.net/~doretk/ArchiveARCHIVE/ECONOMICSPOLITICS/FEDERAL%20RESERVE/Jerry%20VoorhisFedReserve.html .

Wallich, Henry C. (1978) "Honest Money", commencement address delivered to the Fordham Graduate School of Business on June 28, *Economic Insights* Volume 1, Number 1, Federal Reserve Bank of Dallas, http://www.dallasfed.org/research/ei/ei9601.html#2

Woodford, Michael (2003), *Interest & Prices; Foundations of a Theory of Monetary Policy*, Princeton University Press, Princeton and Oxford.

Wright, Randall, Guillaume Rochetau, Peter Rupert and Karl Shell (2005), "General Equilibrium with Nonconvexities, Sunspots and Money; Or, There is a Long-Run Exploitable Trade off Between Inflation and Unemployment After All", Mimeo, Department of Economics, University of Pennsylvania.