The AW Phillips memorial lecture to the New Zealand Association of Economists: Monetary Policy — should it move onto a price level target?

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1 Introduction

I am most honoured to have been invited to give this lecture.

Professor Bill Phillips, in whose memory this lecture is given, was already a legend at the LSE when I was a graduate student there in the 1970s; by then of course he had been back in New Zealand for some time. In the LSE basement there was also the Phillips hydraulic machine with its coloured water flows. How did Phillips think of his famous curve? I suppose that as an early modeller he saw that, in the phrase I first heard from Harry Johnson at the LSE, there was a 'missing equation'; prices and inflation were economically indeterminate in the Keynesian models of Phillips' days at the LSE. They had to be specified exogenously. So Phillips formulated in a practical engineer's way his Curve. Irving Fisher had also had a sort of Phillips Curve; but then his Curve was one for the Classical Model — where its role was quite unclear (was it a supply curve or an adjustment relation and if the latter why was it needed in a world of flexible prices?) and it had died with that model, sped to its end by Fisher's disastrous forecast that the US economy would quickly recover after 1929. So the Curve when it took root was named after Bill Phillips; and then of course there was the massive empirical effort that went with Phillips' Curve, making it more than just a theory. So today it is still there at the heart of monetary economics and my own talk will inevitably be full of it too — as it would have been even if it had not been the A. W. Phillips Memorial Lecture. That New Zealand boy done good!

Though I have never been to New Zealand before, it is a country I feel I know well — not only because of the Lord of the Rings and the recent Test series! But mainly because of the large scale liberalisation of the economy that you undertook here, soon after the similar liberalisation of the UK began under Margaret Thatcher. There is much one could say about the parallels and

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differences of those two programmes on the supply side. But today I want to focus on monetary policy, where again there are strong parallels: today both your central bank and ours carry out inflation targeting. This has been an extremely successful policy. It owes its origins to the relentless campaign undertaken by monetarists in the 1970s and 1980s to restore the central role of money in controlling inflation; if one thinks back to the policies of those times, one recalls that it was the job of fiscal and monetary policy to maintain full employment, and that of incomes and price controls to hold down inflation. We are fortunately a long way from such ideas today; inflation targeting has fulfilled in practice the key objectives of monetarism without using explicit monetarist methods. Central bankers today are all monetarists in inspiration even if they are using models that have progressed well beyond those used by the original monetarists.

Both our economies have experienced much greater stability since inflation itself was stabilised by this policy: the variance of GDP growth has fallen since 1992 by 85% in the US, 82% in the UK, and 59% in New Zealand. It is almost as if the effective anchoring of inflation expectations has removed a major cause of instability in real variables as well, illustrated in Figures 1–4. Given this success, it may seem churlish to say that we could do better. But that is my theme today. I am going to argue that we now have within our grasp the possibility of returning the world to one with long-term price level stationarity, such as for centuries existed under the rule of Gold, which I will for simplicity call the gold standard. Only whereas the price level under gold could depart from its long-run level for a decade or more, under today's fiat currencies the price level could be stabilised close to its long-run level over the shorter term as well. Additionally this deterministic level could be designed to rise steadily along some path — say 2% a year as with today's inflation target. The difference from inflation targeting would be that it would always return to this path whereas of course under inflation targeting, whatever happens to prices in one period is rolled over into the next as the new base for next period's inflation. To use the language of time-series the price level would be I(0) whereas under inflation targeting it is I(1), even if they shared a common deterministic trend.

Why would it be a good thing to have a stationary price level? Let me start with some quite general observations based on the shared common sense of economists — perhaps a dangerous concept! — before going on to talk about model-based explorations of this policy.

The price level is the exchange value of money for goods; the objects of people's utility are however goods. If the price level is expected to return to some stable value then plans for goods purchase and supply over time can be priced in money terms with the certainty that this prices them intertemporally as well (up to the variability associated with future current errors). Hence the real interest rate, the real price of intertemporal substitution, has less uncertainty surrounding it. But committing to this future price level is costless if people incorporate the commitment rationally into their expectations; it simply ties down a free variable, the nominal anchor so to speak. Under inflation targeting the variance surrounding future prices rises the further in the future the period.

This uncertainty affects in an extreme way the issuing of long-term nominal contracts, such as long term bonds or wage contracts. Now one can say in reply that the absence of such nominal contracts does not obviously matter since indexation can allow people to deal with real variables directly and since these

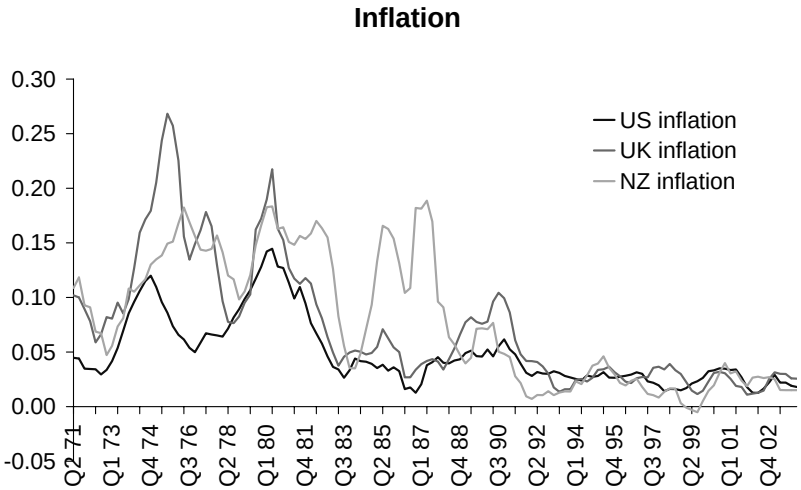


Figure 1: Inflation in the US, the UK and New Zealand

Figure 2: US Real GDP Growth

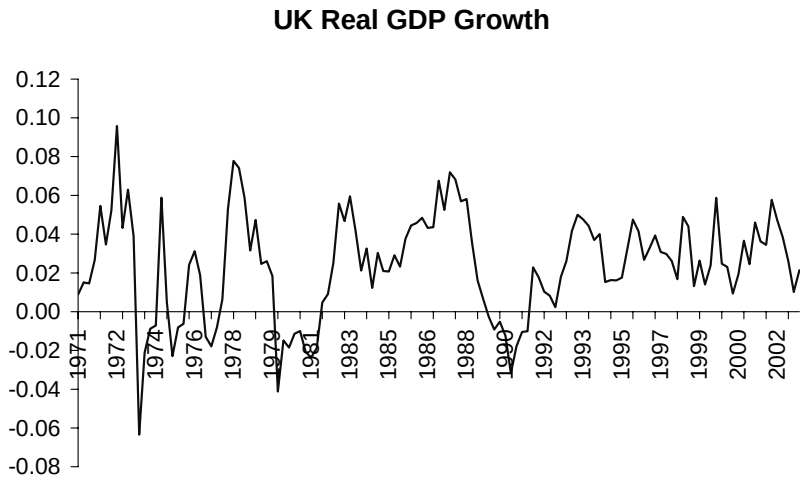


Figure 3: UK Real GDP Growth

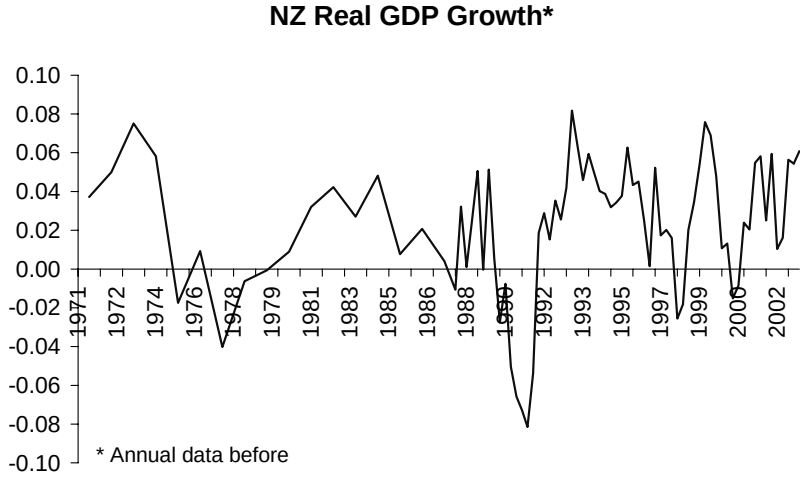
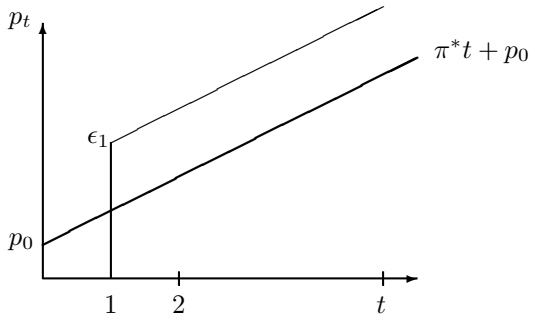
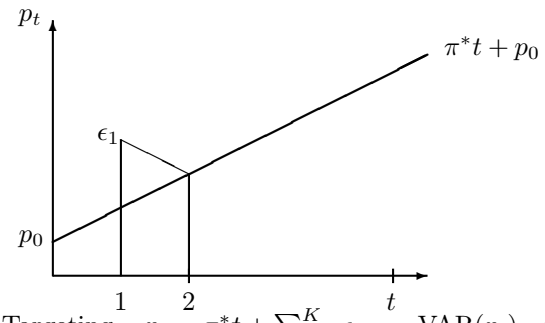


Figure 4: New Zealand Real GDP Growth

π–Targeting $\quad p_t = p_{t-1} + \epsilon_t + \pi^*$



p–Targeting $\quad p_t = \epsilon_t + \pi^* t$



Under π–Targeting $\quad p_t = \pi^* t + \sum_{i=0}^{K} \epsilon_{t-i} \quad \mathrm{VAR}(p_t) \to \infty,\ K \to \infty$
(K: How long since policy was started)

Under p–Targeting $\quad p_t = \pi^* t + \epsilon_t \quad \mathrm{VAR}(p_t) = \sigma_\epsilon^2$

Figure 5: Comparison of Inflation- and Price-targeting

are what they care about, there is just as much market completeness. However indexation has imperfections, both of timing and of exactness; hence indexed contracts seem unlikely to be as efficient as nominal ones in effecting a swap of future for present purchasing power.

In addition to this argument from uncertainty and markets there is the practical question of the 'zero bound' on nominal interest rates. In this era of low inflation it has worried central bankers considerably that a serious recession could require large interest rate cuts; yet these might be limited by the zero bound at which the demand for money becomes essentially indeterminate, so that we are caught in a liquidity trap and unable to help the economy recover. The problem is at its worst when prices are falling — a deflation — since then at the zero bound real interest rates remain positive. This concern has led policy authorities to choose inflation targets away from zero — typically 2% as we know — so that there is 'room' for nominal interest rates to fall. If normal real

interest rates are 3%, then normal nominal interest rates would be $3 + 2 = 5\%$. Under inflation targeting an interest rate at the zero bound would then be a real interest rate of -2%, the minimum it could reach. However under price level targeting the implied future inflation is the deterministic inflation path element, again 2%, plus any current deviation of prices below the path. Hence taking the worst case, if an economy in recession suffered from deflation and current prices fell 2% in the past year against a target rise of 2%, then at the zero bound the real interest rate would be -6%.Today we have the example of Japan over the last decade and a half to instruct us in the dangers of deflation and the zero bound. Had Japan had a price level target it could well have got out of its recession sooner; as it is we are not yet sure if its current recovery will end its deflationary malaise.

It is worth dwelling on this point in the context of the gold standard. One should be able to find useful data bearing on the effectcs of price-level stability from this era. However it is pretty clear that the nineteenth century was a period of some fairly large booms and slumps, in which prices both fell and rose for a decade or more at a time, price level stability was there in the long term but it was very long term. Price-level stability in the sense intended here is much shorter term; indeed in the experiments I will report later it is immediate. So at this stage it is hard to know what lessons we can extract from the era of gold.

Now I must hasten to say that I am not in a position to convince you finally of the arguments I have just advanced. They are just conjectures in the absence of all the hard work that would need to be done to establish them, either theoretically or empirically. But this is a talk not a paper and in a talk — as perhaps in a bar! — we should unbend and let our minds float a little. Furthermore I hope to offer some bits of theory and evidence that I think point the way.

What I want to do now is talk about some of the other issues that arise in the targeting debate and also discuss work that has been done to assess the optimality of price level targeting.

2 Related Issues

Other considerations involved in price level targeting

Two aspects of this policy debate essentially concern the deterministic element in either an inflation or a price level target rather than the question of which of these should be targeted.

Money as a transactions technology medium is costless to create and so its marginal use cost (the rate of interest) should be equated with its zero creation cost — this led Friedman to argue for a zero nominal interest rate, implying a rate of deflation equal to the real rate of interest. If applied strictly this would imply a constant deflation target equal to the real rate of interest; however in practice one would get most of the benefits if the deterministic element in the price level target were fixed as a rate of deflation rather than of inflation. Plainly the Friedman argument cuts across the stabilisation argument from the zero bound..

Money growth generates the inflation tax as a source of government revenue. In public finance, different taxes create different distortions; it is optimal, on its

own, that the marginal distortion per unit of revenue be equated across taxes. Thus the inflation tax should be raised on this view until the marginal distortion on a unit of revenue be equal to that from general income tax. This argument might point to a positive deterministic rate of inflation; however in practice the size of money holdings are so small in most developed countries that the yield of the inflation tax is trivial.

Other aspects concern the use of monetary policy to affect the macro economy.

Thus there are other distortions in the economy due to market imperfections. Money growth and consequent inflation may help to alleviate these; for example in a sticky-price world higher inflation may reduce excess price margins. However this argument relies on the use of price shocks to affect real variables systematically; sticky-price setting would come to anticipate such policy behaviour and create an inflation bias in the manner of Barro and Gordon's model.

Then money is of course the major instrument of stabilisation; price level targeting is a part of feedback policy used in stabilisation. From this viewpoint it is not obvious that price level targeting is helpful in the normal course of the business cycle (other than in zero bound conditions). Some have argued that the implied reversal of price errors could be a source of GDP variability. As noted by Svensson (1999a), the consensus of earlier authors (Hall, 1984; Duguay, 1994; Bank of Canada, 1994; Fischer, 1994) has been that targeting prices rather than inflation (and presumably also by implication money rather than its growth rate) would lower long-term price variance at the expense of higher short-term inflation and output variance. As he puts it 'The intuition is straightforward: in order to stabilize the price level under price-level targeting, higher-than-average inflation must be succeeded by lower-than-average inflation ... (apparently implying) ... higher inflation variability ... (which) ... via nominal rigidities ... would then seem to result in higher output variability.'

With such a wide range of considerations bearing on money it is not surprising that the literature is widely spread in usually non-intersecting groups. Typically each group has taken one aspect of money and explored optimal money behaviour for that aspect alone. Thus for example Friedman himself talks of optimal deflation in one place while proposing money supply growth rules (for stabilisation) in another.

My aim is to examine the merits of price-level targeting in a variety of theoretical set-ups. I begin by reviewing, extremely succinctly, the recent literature that has urged the desirability of price level targeting.

3 The Literature of price-level targeting

'Orthodox macro' models

The first strand has been what we will call 'orthodox macro'. If one partitions a model into aggregate demand and aggregate supply components, the latter can be thought of as a Phillips Curve with a 'supply' shock. Then monetary policy can be thought of as reacting to supply shocks and demand shocks — see Minford and Peel (2003) for an account.

The main argument to come out of this group of papers has been that, with a standard expectations-augmented Phillips Curve, with some sort of overlapping

wage or price contracts, the introduction of a price level target acts to 'discipline' discretionary monetary policy in the absence of feasible Walsh contracts adding linear state-dependent penalty terms. Thus this literature treats targeting as a contract with the Central Bank set by government in order to deal with time-inconsistency biases. These biases are both steady-state inflation bias and excess-stabilisation bias.

Because there are rational expectations and the contracts' overlap expires effectively within a fairly short period, this contract extension comes with little cost in terms of output instability from having to claw back excess price movements in future periods. In fact in Svensson's original one-period contract setting there is a 'free lunch' (in the manner of Sargent and Wallace) because feedback policy has no effect on output. Empirical explorations of various forms of price level rules have all tended to find minimal output stability cost but gains in bias due to the fettering of discretion.

A further strand has been added by those examining the regime responses of parameters of contracts, held constant in the above literature. There is a large earlier literature due to Fischer and Gray on the optimal indexation parameter. Building on this Minford et al (2003) find that a price level regime tends to reduce indexation (implicitly lengthening nominal contracts) because it reduces the persistence of price shocks that would disturb the real outcomes of long-lived nominal contracts. Reduced indexation also notably flattens the Phillips Curve which increases the economy's stability in response to supply shocks. Adding this effect of price level targeting greatly enhances its macro desirability.

These contributions are fairly robust to the exact specification of the macro model used, provided it remains close to the expectations-augmented Phillips Curve set-up with overlapping contracts creating a degree of finite persistence from nominal shocks. Thus for example Minford and Peel (2003a) report that if the same indexation response was allowed for in the Liverpool forecasting model of the UK the results were broadly similarly favourable to price level targeting to those from a calibrated representative-agent model. I shall return to these results later as perhaps not surprisingly it is this type of model that I want to back here today. These models ignore the related issues above on the grounds that the *deterministic* of the price-level target as as tax/subsidy policy can be used to address them: the deterministic component has to be chosen to trade off inflation tax, the optimal use of money and the zero-bound issues.

3.1 New neo-Keynesian Synthesis models

Side by side with this orthodox macro model literature has sprung up in the past decade a New Neo-Keynesian Synthesis (NNS) model literature where the Phillips Curve is derived from Calvo contracts where the nominal rigidity is extremely persistent, because the chance for a firm to change its price is limited and it may therefore never get to change its price at all. Therefore any movement in the general price level implies that relative prices between producers are being pushed away from their optimum (flex-price) equilibrium.

In these models the causation runs from output to prices, unlike in the orthodox curve where it runs from price shocks to output. Prices when changed by those with the chance reflect their expectations of future marginal cost, proxied with rising cost curves by future capacity utilisation (the output deviation from the 'normal' or 'natural' or 'trend' rate). Properly speaking there is no 'sup-

ply shock' in this relationship. It follows pretty obviously that if policy-makers can fix the output level so as to prevent prices from moving at all, it will stop the disequilibrium from mis-set relative producer prices. Thus in these models, provided there are no other distortions to worry about, the optimal monetary policy is to stabilise the price level perfectly.

A number of papers have examined how robust this result is to adding in such other distortions — Collard and Dellas (2003). The answer so far seems to be that it is pretty robust in numerical terms for the usual calibrations; effectively the relative price distortion dominates the effects of the others quantitatively.

One can criticise the NNS models for a variety of reasons — see Minford and Peel (2003a and b). One concern is whether such a price level rule could be adhered to in the face of mistakes of policy that allowed prices to depart from the price level target; once a mistake has occurred it is then optimal to fix prices at the new level because those whose prices are out of equilibrium will not necessarily be brought back by price reversal while others as yet undisturbed may be pushed out of equilibrium.[1] Thus there is a fundamental time-inconsistency problem with the optimal price level rule in NNS models; and in effect it should best be thought of as a zero-inflation targeting rule It does not in practice support a price level target in the sense meant here.

Nevertheless this approach has commanded a large following; the usual reasons given have been that a) variants of it work well empirically (Christiano, Eichenbaum and Evans, 2002) and that b) bounded rationality supports price-setting of the Calvo sort as a reasonable rule of thumb procedure, especially if backward indexing to general inflation is added in. Again I shall return to these models below and explain why I do not think they are reliable guides to policy.

3.2 Learning and robustness

A third class of models involves learning (producing forms of adaptiveness in expectations) — and like the orthodox macro it ignores the related issues of inflation tax etc. for the same reasons. An example is Aoki and Nikolov (2003) who add central bank learning about the economy's parameters. They find that in this context adding an 'integral' control term in the form of price level targeting — such rules, they say, 'automatically undo past policy mistakes'. Such integral control was found in an earlier literature pre-rational expectations to be generally helpful for stabilisation in complex dynamic structures. This set of models are attractive for dealing with situations where policy is in flux; however here I am arguing about a settled long term policy regime, evolving rather easily and naturally from our current inflation targeting regime, and for this experiment learning does not seem appropriate.

[1] The best thing to do strictly depends on the chances of being allowed to change your price. If it is low (the usual assumption), then it is best to keep the new price level as there is a low chance of those who already changed their price being allowed to change it back. If it is high (over 50%), then reversal could be worthwhile as there is a good chance that those who already changed could change back. The break-even chance is 50%; below this it is optimal to keep the new price level.

4 Reactions — how should one proceed to evaluate the price-level rule for money?

4.1 The NNS model's failings

As we have seen the Calvo-style models do not actually support *price-level* targeting — effectively they make a case for inflation targeting. The learning models do; but we are interested in the price rule as a steady-state rule where it is reasonable to assume people have learnt about it. So this support is not of much use unless one believes that people continuously learn and never converge. This leaves the 'orthodox' models described above, which do give some support and which I want to explore further below.

But first I need to spend some time on the NNS models which have in recent years come to be very widely used; McCallum has referred to them as 'canonical' which presumably implies they have received some sort of professional blessing. As we have seen they essentially oppose price level targeting for the simple reason that once prices have been set at a new level, certain producers (those who could not change) have their prices out of line with fundamentals which is costly in lost surplus. Allowing prices to change again would cause yet more producers to have prices out of line with fundamentals. So it is best to stop prices changing further from wherever they are — an inflation target. This is done by manipulating the fundamental so that there is no incentive for those who can change price actually to do so.

Under the NNS model this is a powerful result and as we have seen robust to other considerations. Recently Canzoneri, Cumby and Diba have found that rather large social costs emerge when the inflation target rule is violated; in fact if there is wage-setting as opposed to price-setting, the costs emerge when a wage inflation rule is violated. These costs are large because as prices (or wages) change those who are left behind and cannot change become more and more out of line with fundamentals. As the change accumulates the lost surplus associated with these outlier agents becomes very large.

Yet there is something inherently absurd about the idea that some price — or wage-setters are completely unable ever to 'catch up' with fundamentals due to general inflation. What became of the idea of indexing? Various authors have proposed ad hoc indexing, either to 'core' inflation or to lagged inflation. However the natural and optimal thing to index to is the rationally-expected inflation rate. In a recent paper David Peel and I have shown that this entirely stops the misallocation and mispricing involved, except in the period of an unanticipated shock to the fundamental; once that is over everyone works out how to reset their price appropriately because the movement of those who can reset relative prices is anticipated by those who cannot, so built into expected inflation and thereby effectively frustrated.

The key point is that inflation — a nominal variable — cannot logically cause relative price distortions for any length of time. For those involved the cost would be prohibitive and surely induce some sort of indexing scheme. However in their literal use without indexing these models create huge costs from nominal rigidity. which are highly implausible for this reason.

It follows that these models are unlikely to give us much of a guide to the costs of different monetary policies, popular as they are.

The main reason macroeconomists seem to remain attached to the NNS model, ignoring its blatant theoretical shortcomings, is in fact empirical. It seems to match the facts of inflation persistence, especially in the version with lagged indexation which yields the version with both expected future and lagged inflation. Furthermore monetary economists feel that the macroeconomic facts support Friedman's hump-shaped response of output and inflation to a monetary shock; models with this Phillips Curve can be set up (for example Christiano, Eichenbaum and Evans) to generate such responses. However this empirical matching is, I believe, misleading.

Begin with inflation persistence. If you look at quite recent facts, this persistence has very largely disappeared. Just take a look at the recent deviations of US, UK and NZ inflation from their mean (Figure 1 again). Transparently they are nearly random; in fact the first order autocorrelation parameters since 1992 are respectively 0.19, −0.36 and 0.28, a lot lower than the 0.5–0.7 range of the 1970s and even negative in the case of the UK. Yet if the source of persistence was a stable Phillips Curve of this sort, the persistence should be stable. If one wants to account for inflation persistence, one can more likely look to two main sources; one is the persistence of output, investment and other real variables in the face of productivity shocks, the other — probably the main one — is the persistence of monetary regimes generating inflation itself. Have we not lived through periods of high and persistent inflation produced by governments and central banks themselves? Have we not had endless discussions when we were trying to bring inflation down of how 'core' inflation could only be brought down cautiously, gradually, opportunistically etc? Ordinary private people could be forgiven for having persistent inflation expectations based on such policies. Nowadays it has all changed; inflation was painfully broken and the new regime of inflation targeting put in place with independent central banks to embed and solidify the new environment. Put this new regime in place with a standard surprise Phillips Curve and you will get very little persistence, in line with recent facts.

As for this model matching those hump-shaped responses, this is a put-up job. The hump-shaped responses themselves have been 'found' in VARs by a process of identification informed by the very desire to find such responses. It is just not clear that the model in its entirety fits the unrestricted VAR facts. We know that the model can be made to reproduce this one response found under the restrictions on the VAR; but we do not know whether the model replicates the other implied parameters of the VAR. The identification of the VAR has forced the facts to produce a hump-shaped response which the model can replicate: but can it replicate the *other* facts this identification implies? What one would like to know is whether the unrestricted VAR can reject the model or not. This can be done by bootstrapping the model, generating the distribution of the implied VAR coefficients and checking whether the actual estimated VAR coefficients lie within the implied 95% confidence limits. This would be a generalisation of the RBC methodology of matching unconditional moments, cross-correlations at different lags and so forth. I am honestly not sure what it would produce as it has not yet to my knowledge been used on these or other macro models. But until it is done we really cannot say that we should abandon rationally-based models in favour of this NNS one. My guess, based on extension of the argument above about inflation persistence, is that the orthodox rational expectations models, as I have termed them (embodying the

real business cycle with some finite wage contract overlap to provide a degree of nominal rigidity), would be at least as capable as this one of capturing the facts of the business cycle and inflation.

As they say in the north of England, "you cannot refute owt wi' nowt." As long as there is no alternative, the canonical model may continue to rule supreme. Thus it is necessary to come up with a model that can estimate the costs of different monetary rules, which in practice means a model of nominal rigidity so that money has real effects. For this we revert to what I called earlier the orthodox macro model. Let us now examine it a bit more carefully.

4.2 Reexamining the orthodox macro model

It is my basic contention that we have not yet got to the stage where we have to scrap fairly straightforward optimising models with rational expectations in favour of relationships with explicit irrationality (or limited rationality) like the NNS one we have just been discussing. The methods we now have access to in order to specify these models, identify their error processes (including such ideas as periodic regime switching) and then use them stochastically to test whether they are rejected by the unvarnished facts do not yet appear to have been used. So what I am now going to set out is a basic model of this type that I hope will be an early candidate for this sort of testing.

The most basic model one can write down that satisfies full rationality and has no ad hoc elements is the real business cycle model. This model is deeply satisfying as an account of cycles in say the nineteenth century when the supply of money (gold) was rather stable and cycles appear to have been driven to a large extent by technological changes. The basic RBC mechanism is that of Harrod and Domar applied to a model of voluntary unemployment; for example a permanent productivity shock raises permanent income and so consumption but also unleashes a rise in investment to raise the capital stock in line. This drives up real interest rates to ration demand to the available supply of output; also real wages to ration demand for labour to the available supply. One might add that in an open economy it also drives up the real exchange rate to satisfy uncovered interest parity consistently with long run requirements of current account balance. This mechanism has a beautiful simplicity and power.

To make money matter, which seems to me at least a reasonable requirement, we need a source of nominal rigidity But we have just considered and I hope rejected the NNS one. Then there are Taylor contracts, in a wide variety of forms. All of these also create very long nominal lags and cause a violation of the strong natural rate hypothesis (as do the Calvo ones) — viz that it should be impossible to change real variables by a fully-anticipated change in the money supply. However the idea of nominal overlapping wage contracts is attractive, does have some obvious factual basis from common observation of industrial practice and can be justified theoretically as a form of worker insurance against income/consumption variation. A simple way of operationalising the idea without violating the strong natural rate hypothesis is to allow these contracts to vary wages within the contract period in a precommitted way: this seems entirely reasonable since if prices are rising at 10% a year it makes sense in a three-year contract to pre-set wages to rise by 10% a year and not to be fixed throughout. In addition it makes sense to allow a degree of indexation, to be chosen endogenously according to the monetary regime. To this I would add

an element of 'spot' wage contracting, where some part of the labour market receives the current equilibrium or free market wage. I explored a model of this type in my recent EJ paper.

4.3 Price-level targeting — some results

Let us now examine whether within some such model as I have sketched out above it is beneficial to target the price level. I shall look at the issue entirely in terms of 'stabilisation' which I take to be the central issue of monetary macro (as opposed to supply-side macro). I mentioned various other issues — mostly optimal tax questions. But I shall assume for the purpose of our analysis that these are separable and can be dealt with by a combination of tax/subsidy policy and suitable selection of the deterministic target path for prices, so freeing monetary policy to set a regime optimal for stabilisation. Furthermore in dealing with stabilisation I shall also assume that the zero bound is somehow not a problem; implicitly I am assuming that it is taken care of by a combination of setting the deterministic path for prices sufficiently steeply over time and the price-level target's automatic stabilising effect close to the bound.

I cannot pretend that either of the two models whose results I am going to offer you have passed the test I described earlier. One (Table 1) is a forecasting model — an early vintage rational expectations model that has been used with moderate success to forecast the UK for two and a half decades — the Liverpool Model of the UK. It approximates, in the manner argued by McCallum and Nelson, to the structure set out above. But it is not that exact structure explicitly.

The other is close to the structure set out above and is purely calibrated, not estimated or tested in terms of its ability to fit the dynamic facts (Table 2.) Its main difference from the structure above is that consumers are prevented from borrowing to smooth their consumption; this is to motivate them strongly to sign wage contracts that smooth consumption instead, as the main focus of the model is on this wage contract structure. In later work we hope to relax this strong constraint in favour of some borrowing-arrangement-cost motivation. But notice one thing that our framework implies: the optimal world is not the flex-price equilibrium because workers want to insure themselves against all disturbances to their consumption. This is why they sign wage contracts; in the Calvo-contract world by contrast the flex-price equilibrium is best, the inability to change prices is an obstruction of what people would like best to do — viz change prices flexibly — and the aim of monetary policy is somehow to circumvent the effect of this obstruction. In our world here the inability to change wages is something put in place in order to increase expected utility; the contracts enhance welfare compared with the flex-price world of no contracts — they have an explicit rationale.

The models by no means being what one would ideally like in either case, the results I will show you are illustrative of what price-level targeting can do, I would claim no more. What they illustrate is the power of regime change to affect the behaviour of people — as in the Lucas critique. I started out by observing that we seem to have much more stable macro economies since inflation targeting had settled down; this suggests that behaviour has responded in a beneficial way to this new regime. I have not been able to give you a worked-out understanding of just how: our models suggest stabilising inflation

standard error in parenthesis[+] Inflation-target = 100	Indexation (%)	Welfare #1	#2	Var (cons.)	Var (unemp.)
Inflation-targeting	80	100	100	100	100
			(1.3)	(1.3)	(1.3)
Price-level targeting (holding indexation fixed)	80	102.3	120**	71**	91**
Price-level targeting (indexation endogenous)	0	102.4	120**	70**	92**

[+]standard error of Montecarlo sample variance = est. variance $\times\sqrt{\left(\frac{2}{n}\right)}$ where n is the number of sample observations (here 12078) — source Wallis, 1995

Definition: #1 is the standard CRRA formula in the text; #2 is the weighted average (weight on consumption $= 0.7$, on unemployment $= 1.0$) of the two (inverted) variances.

* significant at 5% level

* significant at 1% level

Table 1: Inflation- and price-level targeting within the Liverpool Model

standard error in parenthesis[+] Money–growth-target = 100	Indexation (%)	Welfare #1	#2	Var (cons.)	Var (unemp.)
Money–growth-targeting (=inflation targeting in this model)	71	100	100 (3)	100 (3)	100 (3)
Money-level targeting (holding indexation fixed)	71	100	100	102	93*
Money-level targeting (indexation endogenous)	37	102	113**	100	56**

[+]standard error of Montecarlo sample variance = est. variance $\times\sqrt{\left(\frac{2}{n}\right)}$ where n is the number of sample observations (here 2000) — source Wallis, 1995

Definition: #1 is the standard CRRA formula in the text; #2 is the weighted average (weight on consumption $= 0.7$, on unemployment $= 1.0$) of the two (inverted) variances.

* significant at 10% level

* significant at 1% level

Table 2: Inflation- and price-level targeting within a calibrated model

may reduce both demand and supply shocks. But in the case of price-level targeting I believe I can suggest how it might well be beneficial.

The mechanism echoes an old one, first set out by Lucas in 1972 when he examined the slope of the Phillips curve under varying inflation regimes which he summarised by inflation volatility. The greater the volatility the steeper the Phillips curve slope. Rather similar ideas were put forward by by Stanley Fischer and Joanna Gray about indexation; higher volatility would induce higher indexation which too would steepen the Phillips Curve. However I would like to suggest a twist on this story. The puzzle about indexation, first noted by Barro, is why it is not comprehensive; plainly if it were costless and perfect it would be since people care about real outcomes. Fischer and Gray postulated an imperfection where people could not deliver a real wage appropriate to the shock because of an inability to observe the shock; hence indexation offers a compromise response to shocks between workers and firms. The imperfection we suggest is different; since firms are risk-neutral and workers want insurance what exactly the shock is does not matter for us. But we have indexation that is inefficient because it is paid with a lag. This is important in the presence of unit root — i.e. totally persistent — shocks, like productivity. When for example productivity changes permanently it changes prices permanently; if you are tied into a purely nominal wage this shocks real wages throughout your contract period. Indexation with a lag is helpful as it offsets the shock to real wages after its lag in arriving.

In the presence of temporary shocks to prices however indexation is actually positively harmful to stability. If you had your purely nominal wage contract the shock would arrive, change your real wage and go away. With an indexed contract the shock would arrive, shock real wages and go away; but then it would be succeeded by a further shock to real wages as indexation kicked in.

It follows that it is the persistence of shocks to prices that determines the degree of indexation. The more persistent the more indexation and hence also the steeper the Phillips Curve. Apply this to price level targeting; assume that this takes the form of setting interest rates or money supply so as to ensure that next period prices will return to target. (For realism allow this policy to be carried out with a trembling hand so that there is some monetary policy or demand error.) Price-level targeting in effect implies that prices are stationary, so errors are entirely non-persistent. Hence it reduces indexation sharply and flattens the Phillips Curve.

This is welfare-enhancing because it implies that the economy is very stable in response to supply shocks — Figure 6. As for demand shocks these are largely the result of the authorities' own errors. Keep these down, is the moral, and you will have a stable economy if you pursue price level targeting.

This account works well for the calibrated model discussed above. It works poorly, it must be confessed, for the Liverpool Model. This can be seen clearly from Table 1 for the Liverpool Model's results. The gain in stability and welfare occurs between rows 1 and 2, which both retain the same level of (high) indexation. Between rows 2 and 3, indexation drops to zero but there is no further gain to speak of; essentially the stability of both real wages and unemployment are the same between the two rows, even though indexation drops so sharply. What is going on?

First, we can note that the great improvement in stability both for real wages and unemployment between rows 1 and 2 comes about because price-level

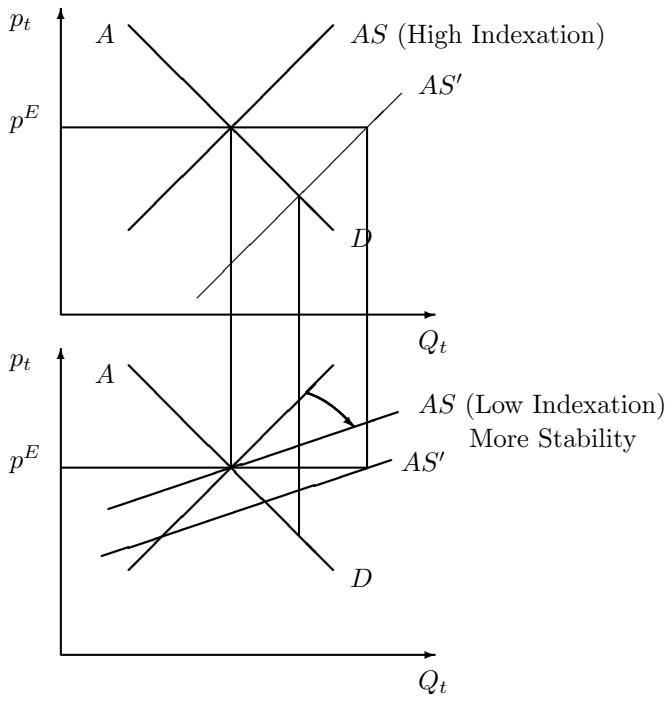


Figure 6: Effect of Indexation on Stability

targeting greatly reduces the variability of private *wealth*: price-level targeting makes the real price of bonds more stable because it makes the variability of the price level so much smaller (thus future bond prices are set in nominal terms by the nominal rate of interest which in turn depends on the real rate plus the expected rate of inflation; but future *real* bonds prices are additionally dependent on the future price level). In the Liverpool Model private wealth has strong demand effects on private consumption and investment; thus dampening its variability dampens an important demand shock.

Second, while the mechanism we describe above in the calibrated model does indeed work to dampen the effects of *supply* shocks which are the main source of shocks in the calibrated model, we must stress that this mechanism in fact exaggerates the effect of demand shocks on output and unemployment. (The mechanism also involves steepening of the aggregate demand curve; and this can lead to a further exaggeration of demand shocks on prices and so on real wages.) Hence between rows 2 and 3 what is happening is that the demand shocks of the Liverpool Model, which are wide-ranging by comparison with the calibrated model, are causing the reduction of indexation to have a negligible overall effect on stability of either real wages or unemployment — basically the dampening effect on supply shocks is being offset by the exaggerating effect on demand shocks.

In sum what the Liverpool Model shows pre-eminently is the importance of wealth shocks to demand and the way in which price-level targeting helps to make the economy more stable by dampening these. It also by the way indicates

the way in which inflation targeting may have made the economy more stable — by stabilising nominal interest rates and so nominal bond prices.

5 Conclusions

I have argued today that, even though monetary policy has made great strides by moving to inflation targeting, by moving to price level targeting it can be improved further. My main argument has been that it would make the world safer for nominal long term contracts. I have illustrated this argument by the case of wage contracts whose formation are rather central to the operation of monetary policy. Essentially I have argued that price level targeting would reduce indexation and so lengthen wage contracts in effect; this in turn would make economies more stable. In setting out this argument I have made some detours into widely popular alternative models, especially that of Calvo contracts, and argued that they are not good guides to this important policy area where indeed they lead to different policy conclusions.

Let me end by apologising for setting out before you a confection made up of bits and pieces — conjectures, models without all the features that would have been desirable and so on — rather than a solid finished construction. But as I said at the start, this has been a talk, as if in a well-stocked bar; this is an activity which I think is both good for us to indulge in and potentially enjoyable! I hope at least my prolonged chat has kept you awake and sufficiently stimulated to provoke some further interaction now.

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