Does Monetary Policy Transparency Reduce Disinflation Costs?*

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Abstract

We examine the relationship between central bank transparency and the costs of disinflation. We provide a model where disinflation efforts imply a higher sacrifice ratio when the public is not fully convinced about the central bank's resolve to reduce inflation and show that information dissemination by the central bank can remedy this problem. To assess the empirical implications we estimate sacrifice ratios based on individual estimates of Phillips curves in 21 OECD economies. Using transparency indices pertaining to both the detail with which central banks publish forecasts and the means by which policy decisions are explained, we find that a higher degree of central bank transparency is associated with lower sacrifice ratios. This result is robust to alternative estimation methods and periods considered.

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1 Introduction

During the 1990s central banks greatly increased their efforts to explain both the policymaking process and policy decisions themselves. In some cases this movement towards greater transparency reflected modification of their statutory objectives designed by the political principal, but often the momentum came from central banks themselves. Whether or not it was central banks who initiated the move, the emphasis on transparency is now considered an important feature of a modern central bank's design. For example, in the survey by Fry et al. (2000), 74% of the central banks recognise transparency as either a vital or very important aspect of their monetary framework. The corresponding proportion in the OECD countries that are the focus of the present study, is 86%.[1] Although an increasing number of theoretical analyses[2] have focused on transparency, little empirical work exists yet on the effects of transparency on various aspects of the macroeconomy. In this paper we consider the role of transparency in disinflations.

Of the different motivations for adopting greater transparency, a major factor for a number of central banks during the 1990s was associated with the desire to improve credibility (for example, see King, 2000). Inflationary episodes and exchange rate or financial crises had undermined credibility in a number of countries making the task of rebuilding credibility arduous. Even when subsequent policy decisions reflected a commitment to maintain low inflation, it was not always easy for the central bank to convince the public about its resolve. Cases during the 1990s where inflation expectations exceeded inflation outcomes can be interpreted as a manifestation of this difficulty.[3] Dahl and Hansen (2001) consider how the switching of policy regimes may drive a wedge between actual and expected inflation. They find that this wedge explains measured ex post bias in expected inflation survey series in Denmark.

Faust and Svensson (2001) show that transparency increases the sensitivity of central bank's reputation to its actions. Svensson (1999) also interprets transparency as an implicit commitment mechanism that reduces the ability of the central bank to pursue discretionary policies. Chortareas et al. (2002a,b), provide empirical support to the above, finding that transparency in publishing forecasts is associated with lower inflation in a broad group of economies with the result being stronger for high-inflation economies. They

[1] The detailed data for the OECD economies are not included in the published version but are available upon request from the authors.

[2] See Geraats (2003) for a survey.

[3] For example, Bakhsi and Yates (1998) provide evidence that inflation expecations consistently overstated realized inflation during the 1990s disinflation in the UK.

attribute this finding to the role of transparency in reinforcing the commitment of the central bank to low inflation.

A perception amongst policymakers may have been that transparency could hasten credibility-building by convincing the public about their resolve to fight inflation and thus bringing inflation expectations more rapidly in line with policy. The inability of private agents to judge whether the policymaker is committed to low inflation has been recognised as a major impediment to a successful disinflation program (Barro, 1983, 1986). This problem may be more acute when policy uncertainty or stochastic shocks may make the central bank deviate from pre-announced monetary policy paths as in Dornbusch (1991). Political uncertainty, often resulting from fragile coalitions, may further challenge the sustainability of disinflation efforts.[4] Thus, the credibility-enhancing potential of transparency becomes more important during disinflation efforts. Ball (1995) shows that, in a model with staggered price adjustment, imperfect credibility (i.e., a positive probability that the central bank may not complete a promised disinflation) worsens the output-inflation trade-off.

Existing theoretical literature on central bank transparency can be interpreted as implying that transparency reduces the costs of disinflation. Cukierman and Meltzer (1986) show that the costs of disinflation are lower when central banks have more precise control over inflation. Tighter inflation control, however, can be interpreted as a higher degree of monetary policy transparency[5]. Faust and Svensson's (2001) model builds on the Cukierman and Meltzer work and implies that disinflation should be less costly when central banks make their forecasts public. The intuition is that when forecasts are published, the public will be able to observe central bank intentions more directly, and as a result inflation expectations should shift more quickly in response to any shift in policy. In each paper transparency has a more positive impact on welfare low-credibility central banks.

In this paper we examine whether the degree of monetary policy transparency can affect disinflation costs. We first develop a simple model that considers how information dissemination by the central bank may help to reduce information asymmetries and how this is related to disinflation efforts. We show that the macroeconomic costs of disinflation are higher when the public is not fully convinced of the central bank's preferences for low inflation. In addition, the more difficult it is for the public to verify the central bank's resolve, the higher is the sacrifice ratio. Finally, we show that trans-

[4]Agenor and Montiel (1999) provide an additional set of arguments relating to the importance of credibility during disinflations mostly pertaining to developing countries, however.

[5]For example, see Cukierman (2000).

parency in the policymaker's knowledge of shocks to the economy enables the public to deduce the policymaker's type more easily. In this context inflation expectations are aligned faster with the central bank's policy intentions, thereby reducing the sacrifice ratio. One might question whether being transparent about the central bank's views on shocks to the economy helps agents to deduce objectives given that central banks generally have statutory objectives of price stability and may also announce explicit numerical targets for inflation. Publishing frequent forecasts and explanations of shocks to the economy, however, enables the public to make a more continuous judgement about preferences.

We provide empirical evidence that show a significant link between the degree of monetary policy transparency and the costs of disinflation. In particular, we use sacrifice ratios based on our estimates of short run Phillips curves in 21 OECD economies. We construct two indices of monetary policy transparency. The first relates to the detail with which central banks publish forecasts and is consistent with our theoretical model. The second measures the extent to which the central bank explains policy decisions -a form of transparency less consistent with our theoretical model. We find that both types of transparency are associated with a lower sacrifice ratio in a sample of 21 OECD economies. The results are robust to the inclusion of a variety of control variables and to alternative estimation techniques. Our findings are particularly interesting given the failure of previous empirical work to detect a negative relationship between the sacrifice ratio and another aspect of the monetary policy framework, namely central bank independence.

The rest of the paper is organised as follows. The second section provides a simple model considering some aspects of the role of monetary policy transparency during disinflations. The third section contains the empirical analysis, results and discussion. Finally, section 4 concludes.

2 The Model

In this section we provide a simple model of disinflation costs under incomplete information and examine the role of information dissemination by the central bank. Consider the standard Phillips curve in the context of a Barro-Gordon model as

$$u_t = \overline{u}_t - \alpha\left(\pi_t - \pi_t^e\right) - \varepsilon_t \tag{1}$$

where $\overline{u}_t$ is the natural rate of unemployment, π_t is inflation, π_t^e is inflation expectations, ε_t a supply side shock, and t is the time subscript. The typical

one-period loss function for the central bank is given by:

$$L^{CB} = \frac{1}{2}(u_t - u^*)^2 + \frac{1}{2}\beta(\pi_t - \pi^*)^2 \tag{2}$$

where $u^* = k\overline{u}_t$, and k $(0 \leq k \leq 1)$ is the inflationary bias. Let also inflation realisations (π_t) be given as the sum of an intended policy outcome $(\widetilde{\pi}_t)$ and a control error or a demand side shock (η_t) as[6]

$$\pi_t = \widetilde{\pi}_t + \eta_t \tag{3}$$

Solving the standard optimisation problem we obtain the central bank's decision rule as

$$\widetilde{\pi}_t = \left(\frac{\alpha}{\alpha^2+\beta}\right)(1-k)\,\overline{u}_t - \eta_t + \left(\frac{\alpha^2}{\alpha^2+\beta}\right)\pi_t^e - \left(\frac{\alpha}{\alpha^2+\beta}\right)\varepsilon_t + \left(\frac{\beta}{\alpha^2+\beta}\right)\pi^* \tag{4}$$

We assume that there are two types of central bankers; the first corresponds to the period before the disinflation program and has a preference for unemployment rates below the natural rate of unemployment. In other words, this central banker suffers from an inflationary bias implying a low value of k (which we will denote with $\underline{k}$). We will call this the "old" central banker. Note that his preferences are revealed already during the high-inflation period. The second central banker does not suffer from the inflationary bias (i.e., he has a high value of k denoted by $\overline{k}$) and is in office during the disinflation period. Thus, to summarise $k = \underline{k}$ for the old regime so that $u^* < \overline{u}_t$ and $k = \overline{k}$ for the new regime so that $\lim_{\overline{k} \longrightarrow 1} u^* = \overline{u}_t$. Note that the disinflationary bias of the "new" regime versus the "old" regime can be expressed as $d = \overline{k} - \underline{k}$. At the beginning of a disinflation program, however, the public may not be able to assess the new policy regime's commitment to the disinflation program. We consider the implications of monetary policy transparency when the "new" policy regime has not have yet the time to demonstrate its type. Of course other mechanisms may be available to the policymakers for revealing their type over time. Here, however, we focus on a transparency channel that may help policymakers to hasten reputation-building.

2.1 Full Information Policy Outcomes

To keep the analysis as simple as possible, throughout the paper we maintain this assumption that the "new" central banker does not suffer from an

[6] For a more detailed analysis of the concepts of intented versus actual policy outcomes see Faust and Svenson (2001).

inflationary bias ($\overline{k} = 1$). Alternatively, it would be interesting to examine the role of transparency when the central banker is not fully committed to the disinflation programme. We abstract from this possibility, however, to focus more explicitly on the particular information asymmetries that pertain to the problem we identified as more relevant, namely incomplete credibility during disinflations.

In this subsection we obtain the results for an "old" (inflationary) regime and a "new" (disinflation) regime when the public knows the central bank's type with certainty. Consider first the equilibrium policy outcomes under the "old" regime. Inflation is given by

$$\widetilde{\pi}_t^O = \left(\frac{\alpha}{\beta}\right)(1-\underline{k})\,\overline{u}_t - \eta_t - \left(\frac{\alpha}{\alpha^2+\beta}\right)\varepsilon_t + \pi^* \tag{5}$$

and unemployment is given by

$$u_t^O = \overline{u}_t + \alpha\eta_t - \left(\frac{\beta}{\alpha^2+\beta}\right)\varepsilon_t \tag{6}$$

The policy outcomes under the "old" regime are full information outcomes in the sense that the public is aware that the central banker in office has an inflationary bias. This is a realistic assumption that can be justified by a revealed preferences argument. After all, since we are focusing on disinflation endeavours the preferences of the inflationary ("old") monetary policy regime are not in question.

We focus now on the implications of uncertainty about the "new" central banker's preferences. We obtain the policy outcomes when the public can observe the policymaker's type during the disinflation period and verify that the policymaker is indeed "new". Recall the assumption that the "new" policymaker is sincere in his intentions for bringing inflation down, (or equivalently that he is "committed"). To simplify the algebra we also assume that the "new" central bank is completely free from the inflation bias ($\overline{k} = 1$). Solving for the inflation outcome by imposing rational expectations and the typical Nash sequencing of moves we obtain:

$$\widetilde{\pi}_t^{N,FC} = -\eta_t - \left(\frac{\alpha}{\alpha^2+\beta}\right)\varepsilon_t + \pi^* \tag{7}$$

where the superscript "FC" stand for "full credibility" of the central bank. Given the assumption that the "new" policy regime is committed to disinflation, instead of using the terms "full credibility" and "limited credibility" we could use the terms "full information" and "limited information" respectively. When the public has full information about the central bank's type, for example, the "new" policy regime has full credibility.

The corresponding equilibrium level of unemployment is:

$$u_t^{N,FC} = \overline{u}_t + \alpha\eta_t - \left(\frac{\beta}{\alpha^2+\beta}\right)\varepsilon_t \tag{8}$$

2.2 Policy Outcomes with an Unconvinced Public (Limited Central Bank Credibility)

High disinflation costs could emerge in a situation where the public is less than fully convinced about the central bank's intentions even when the central bank's resolve to fight inflation. In this section we examine how incomplete information about the central bank's preferences gives rise to the possibility of an inflation rate higher than the intended one, even when the central banks has no inflation bias.

We follow Cukierman and Liviatan (1991) and Cukierman (1992) in modelling how the public's perceptions about the policymaker's type affect expected inflation. Suppose that the public assigns the prior probability ϕ $(0 \leq \phi \leq 1)$ to the event that the central banker during the disinflation period is a "new" one. Hence a fraction ϕ of the public believes that $k = \overline{k}$. The remaining fraction, however, believes that no change in regime has occurred, so $k = \underline{k}$. Thus, we can write the public's inflation expectations as:

$$E_t\left[\pi_{t+1}|\Omega_t\right] = \phi E_t\left[\pi_{t+1}|\Omega_t, \overline{k}\right] + (1-\phi)\, E_t\left[\pi_{t+1}|\Omega_t, \underline{k}\right] \tag{9}$$

We can view this as the public's expectations formation displaying some degree of persistence across the different policy regimes. This approach is consistent with that of Alesina's (1988) model of rational partizan political business cycles, which describes wage setting behaviour when uncertainty exists about the electoral outcome. Chortareas and Miller (2003) employ a similar scheme when monetary policy is delegated through Walsh-type contracts and uncertainty exists about the policymaker's responsiveness to such schemes.

Consider the policy game between the public and the new central banker when the former is uncertain about the preferences/type of the latter and therefore not fully convinced about his resolve to disinflate. The inflation rate that emerges in equilibrium is given by:

$$\widetilde{\pi}_t^{N,LC} = -\eta_t - \left(\frac{\alpha}{\alpha^2+\beta}\right)\varepsilon_t + \pi^* + (1-\phi)\left(\frac{\alpha^2}{\alpha^2+\beta}\right)\left(\frac{\alpha}{\beta}\right)(1-\underline{k})\,\overline{u}_t \tag{10}$$

where the superscript "LC" stand for "limited credibility" of the central

bank. The corresponding unemployment rate is given by

$$u_t^{N,LC} = \overline{u}_t + \alpha\eta_t - \left(\frac{\beta}{\alpha^2+\beta}\right)\varepsilon_t + (1-\phi)\left(\frac{\alpha^2}{\alpha^2+\beta}\right)(1-\underline{k})\,\overline{u}_t \qquad (11)$$

Inflation under the new regime and a less than fully convinced public exceeds inflation under the new regime with a fully convinced public by

$$\widetilde{\pi}_t^{N,LC} - \widetilde{\pi}_t^{N,FC} = (1-\phi)\left(\frac{\alpha^2}{\alpha^2+\beta}\right)\left(\frac{\alpha}{\beta}\right)(1-\underline{k})\,\overline{u}_t \qquad (12)$$

Equation (12) shows that the magnitude of this inflationary bias depends on both the size of private agents' "belief inertia" $(1-\phi)$ and their perception about the magnitude of the bias as inherited from the old regime. The public's sluggish beliefs also have welfare reducing implications regarding unemployment. In particular, unemployment is higher when the public cannot verify the central banker's type as compared to the full credibility benchmark by

$$u_t^{N,FC} - u_t^{N,LC} = (1-\phi)\left(\frac{\alpha^2}{\alpha^2+\beta}\right)(1-\underline{k})\,\overline{u}_t \qquad (13)$$

Note that $\lim_{\phi\longrightarrow 1}\pi_t^{N,LC} = \pi_t^{N,FC}$ and $\lim_{\phi\longrightarrow 1}u_t^{N,LC} = u_t^{N,FC}$. In other words the smaller the fraction of the unconvinced public the more we tend to revert to the full information benchmark.

Now we can construct the sacrifice ratio as

$$SR = \frac{\Delta u}{\Delta\pi} = \frac{u^N - u^O}{\pi^N - \pi^O} = -\frac{\alpha\beta\,(1-\phi)}{(\phi\alpha^2+\beta)} \qquad (14)$$

Proposition 1 *When the public is fully convinced about the "new" policy regime's resolve to carry out the disinflation program the sacrifice ratio is lower as compared to that which would prevail when more than one economic agent doubts the policymaker's commitment.*

Proof. Simply taking the derivative of the absolute value of the sacrifice ratio (14) with respect to the prior probability ϕ that the central banker during the disinflation period is "new" we obtain

$$\frac{\partial\left(\left|\frac{\Delta u}{\Delta\pi}\right|\right)}{\partial\phi} = -\frac{\alpha\beta\,(\alpha^2+\beta)}{(\phi\alpha^2+\beta)^2} < 0$$

That is, the magnitude of the sacrifice ratio decreases in ϕ. ■

2.3 Information Dissemination by the Central Bank

For any discussion of monetary policy transparency to be meaningful some information asymmetry must exist. Moreover, for forecast transparency to be relevant the central banks must possess some degree of private information incorporated (implicitly or explicitly) in its forecasts or forward looking analyses.

Consider now an alternative formulation of the inflation outcomes where the policymaker can forecast part of the stochastic component of inflation. In particular, let the deviations of the equilibrium outcomes (π_t) from the intended ones ($\widetilde{\pi}_t$) in (3) to incorporate two components ϵ_1 and ϵ_2 as

$$\eta_t = \epsilon_{1,t} + \epsilon_{2,t} \tag{15}$$

The term ϵ_1 can be viewed as corresponding to a component of η_t that the central bank can forecast or about which it has private information. This private information may also be interpreted as the central bank's knowledge about its control error as in Jensen (2002). The second component of η_t, ϵ_2, reflects an unidentifiable shock. Thus, (3) can be written as

$$\pi_t = \widetilde{\pi}_t + \epsilon_{1,t} + \epsilon_{2,t} \tag{16}$$

where $\widetilde{\pi}_t$ reflects the intended policy outcome as before. Under the "old" regime intended inflation incorporates a bias ($\widetilde{\pi} = \mathcal{F}(\pi^*, \underline{k})$) while under the "new" regime it does not ($\widetilde{\pi} = \mathcal{F}(\pi^*)$). Moreover, under a non-transparent regime the public cannot distinguish between ϵ_1 and ϵ_2. It instead observes a mixed signal. Under a transparent monetary policy regime, however, the central bank's private information becomes available to the public.

When the observed value of inflation (π_t) is sufficiently low or sufficiently high then the public can detect whether the central bank is "old" or "new". In a deterministic world, where the inflation outcome consists of the intended component only the public would not have no difficulty verifying whether the central banker in office is "new" or the "old" one.[7] The presence of a stochastic shock, however, makes distinguishing between an old and a new regime more complicated. This is because there may exist a range of of inflation outcomes consistent with either regime for a given distribution of the random error. For example, the public may not be able to distinguish whether a particular inflation rate is the outcome of the intentions of the

[7] The literature focusing on repeated monetary policy games provides solutions relying to the ability of central bankers to signal their type (e.g., Cukierman, 1992). What we suggest in this paper, however, is that under certain conditions monetary policy transparency complements those solutions (and we do not view it as a substitute to them).

"new" regime when a positive supply shock has occurred or the intentions of the "old" regime when a negative supply shock has occurred.

To keep the exposition simple we assume that the random variable η_t follows a uniform distribution.[8] Thus, we let η_i be supported in the range of $(-d_i, d_i)$, with $i = \{old; new\}$. We also assume that ϵ_1 and ϵ_2 are independent. To make our argument more clear assume that the means of π_t^N and π_t^O are sufficiently far apart from each other such that in a deterministic environment separation would always be achieved in the eyes of the public. In a stochastic world, however, the public will often be unable to infer the central banker's type. This would occur when the linear segment to the right of the "new" central banker $(\widetilde{\pi}_t^N + d_N)$ overlaps with the linear segment to the left of the "old" central banker $(\widetilde{\pi}_t^O - d_O)$.

Assume that the public uses a Bayesian updating mechanism to reassess the probability ϕ that the central banker is "new" upon arrival of new information. This rule can be written as

$$\Pr[N|\pi_t] = \frac{\Pr[\pi_t|N]\Pr[N]}{\Pr[\pi_t|N]\Pr[N] + \Pr[\pi_t|O]\Pr[O]} \tag{17}$$

Using subscripts t and $t+1$ to denote the beginning of the disinflation effort (or announcement of new regime) and the end of the first period, the corresponding probabilistic assessments of the private sector become ϕ_t and ϕ_{t+1}respectively. Also note that given the assumption of uniform distribution $\Pr[\pi_t|N] = \frac{1}{2d_N}$, $\Pr[\pi_t|O] = \frac{1}{2d_O}$, and $\Pr[N] = \phi_t = (1 - \Pr[O])$. Consequently ϕ_{t+1}can be computed as

$$\phi_{t+1} = \frac{\phi_t}{\phi_t + (1-\phi_t)\frac{d_N}{d_O}} \tag{18}$$

Proposition 2 *Dissemination of information by the central bank increases the value of the public's Bayesian learning parameter (ϕ).*

Proof. It is enough to demonstrate that the value of the Bayesian learning parameter at the end of the period is higher under transparency (ϕ_{t+1}^T) as compared to no transparency (ϕ_{t+1}^H) (we use the superscript for "hidden" information). Since the standard error of the assumed uniform distribution is $\left(\frac{d_i}{\sqrt{3}}\right)$, we have $\left(\frac{d_N}{d_O} = \frac{se(\eta_t)_N}{se(\eta_t)_O}\right)$, and we can equivalently write (18) as

$$\phi_{t+1} = \frac{\phi_t}{\phi_t + (1-\phi_t)\frac{se(\eta_t)_N}{se(\eta_t)_O}} \tag{19}$$

[8] Cukierman (2000) assumes a uniform distribution in a model with Bayesian learning where the public is uncertain about the policymaker's dependability.

Using (15) and dropping the time subscripts for simplicity we can write

$$\frac{se\left(\eta\right)_N}{se\left(\eta\right)_O} = \frac{se\left(\epsilon_1+\epsilon_2\right)_N}{se\left(\epsilon_1+\epsilon_2\right)_O}$$

and further

$$\frac{se\left(\eta\right)_N}{se\left(\eta\right)_O} = \sqrt{\frac{var\left(\epsilon_1+\epsilon_2\right)_N}{var\left(\epsilon_1+\epsilon_2\right)_O}}$$

Recalling that $\epsilon_1$and ϵ_2 are independent[9] we have

$$\frac{se\left(\eta\right)_N}{se\left(\eta\right)_O} = \sqrt{\frac{var(\epsilon_1)_N+var(\epsilon_2)_N}{var(\epsilon_1)_O+var(\epsilon_2)_O}}$$

Consider now the value of d_N under monetary policy transparency and under "hidden" information (d_N^T and d_N^H receptively). Given that

$$se\left(\eta\right)_N = \frac{d_N}{\sqrt{3}} = \sqrt{var(\epsilon_1)_N+var(\epsilon_2)_N}$$

we have

$$d_N^T = \sqrt{var(\epsilon_2)_N} < \sqrt{var(\epsilon_1)_N+var(\epsilon_2)_N} = d_N^H \tag{20}$$

Therefore $\phi_{t+1}^T \geqslant \phi_{t+1}^H$. ■

The role of transparency in the above model is to enhance credibility during the disinflation period. Of course transparency is not the only way to enhance credibility during disinflation efforts. Many alternative mechanisms could exist and more work is required to weight the relative importance of each.

The implications of our model are in general consistent with existing literature examining the implications of uncertainty about central banks resolve to stick with a disinflation program. Ball (1994) shows that in the presence of staggered wage setting quick disinflations reduce the sacrifice ratio because they result in output booms. In our model, however, the sacrifice ratio is lower not because output increases more during the disinflation but rather because it decreases by less. More importantly, inflation is lower when transparency and credibility is higher. This difference emerges because Ball (1994) assumes full credibility while we consider a case of imperfect credibility. The predictions of our model are more consistent with that of Ball (1995), which combines imperfect credibility and staggered prices in a

[9]The same result holds when $\epsilon_1$and ϵ_2 are positively correlated but not when they are negatively correlated. The independence assumption, however, seems intuitively the most relevant.

model where credibility problems can reduce output. The structure of our model has common elements with Barro (1986) as well, but although Barro's focus is on the central bank's capacity for making a commitment our focus is rather on the central bank's ability to communicate this commitment to the private sector.

3 Central bank transparency and the sacrifice ratio

The model presented above suggests that costs of disinflation will be lower in countries where central banks publish their forecasts. In this section we empirically test this prediction using data on publication of central bank forecasts. We also consider whether costs of disinflation are lower in countries where central banks provide more public explanation of policy changes. Although we are not aware of theoretical work that establishes a direct link between public explanations and costs of disinflation, it is plausible that more public and more detailed efforts by a central bank to provide information about changes in policy may be associated with faster shifts in inflation expectations.

3.1 Measuring transparency

We focus on two specific types of transparency: publication of central bank forecasts and explanation of central bank policy changes. Table 1 reports the transparency data used for the 21 OECD countries in our estimates. The variable forecast transparency is a Guttman scale of transparency of central bank forecasts previously used in Chortareas, Stasavage, and Sterne (2002a). Our measure of transparency takes values between 0 and 4, with higher values being associated with greater detail in published forecasts. A large majority of OECD central banks published some sort of forecast at the time the survey was conducted (1998), but there were significant variations in the extent of information made public. Table 1 also reports scores for a second variable, explanation transparency. This is also a Guttman scale, in this case designed to measure the extent to which information about central bank decisions is made public. See Chortareas, Stasavage, and Sterne (2002b) for a more detailed description.

3.2 Estimating the sacrifice ratio

In two earlier papers (Chortareas, Stasavage, and Sterne, 2002b and Stasavage, 2001) we reported sacrifice ratio estimates based on observation of disinflation periods (following Ball, 1994) and based on time-series estimates of short-run Phillips curves (following Hutchinson and Walsh, 1998). In this paper we estimate sacrifice ratios based on short-run Phillips curves, and we improve on our earlier results in three ways. First, we estimate the individual country Phillips curves as part of a system of seemingly unrelated regressions. This allows for more efficient estimates. Second, we follow a suggestion made by Andersen and Wascher (1999) which helps clarify the measure of the sacrifice ratio. Finally, we attempt to control for supply shocks by using data on changes in import prices.

Hutchinson and Walsh (1998) propose empirically estimating the sacrifice ratio by equation (21) below, where Δx_t represents the percentage change in nominal output, $\left(y_{t-1} - y^*_{t-1}\right)$ represents the lagged deviation of real output from trend, and Δpm represents the change in import prices

$$\pi_t = \alpha + \lambda \Delta x_t + \beta E_{t-1}\pi_t + \phi\left(y_{t-1} - y^*_{t-1}\right) + \eta(\Delta pm_{t-1} - \pi_{t-1}) + u_t \quad (21)$$

Hutchinson and Walsh suggest that if the term $\lambda \Delta x_t$ reflects the degree of rigidity of inflation, then the sacrifice ratio can be calculated as $(1-\lambda)/\lambda$. Andersen and Wascher (1999) argue that this is not the only definition of the sacrifice ratio that one can derive from this equation. If in an empirical estimation one uses π_{t-1} as a proxy for $E_{t-1}\pi_t$ (as is frequently the case in cross-country work), then this introduces the possibility that inflation is persistent over time, and as a result, the coefficient on lagged inflation might also be used to calculate the sacrifice ratio. Andersen and Wascher propose dealing with this ambiguity by imposing a homogeneity restriction on the equation, so that $\beta = (1-\lambda)$.[10] Equation 22 can then be estimated in order to obtain the sacrifice ratio: $(1-\lambda)/\lambda$.

$$\pi_t = \alpha + \lambda \Delta x_t + (1-\lambda) E_{t-1}\pi_t + \phi\left(y_{t-1} - y^*_{t-1}\right) + \eta(pm_{t-1} - \pi_{t-1}) + u_t \quad (22)$$

We estimated equation 22 for OECD countries using quarterly data for the period 1990-2000. In the estimates we used lagged inflation as a proxy

[10] They also suggest imposing the restriction that the coefficients on the lagged output gap term and on the change in nominal output are identical. Our results when using this method were similar.

for expected inflation, and trend GDP was calculated by using a Hodrick-Prescott filter.[11] Given the likely correlation between the error terms for individual countries we estimated equation 22 as a system of seemingly unrelated regressions. This allowed for more efficient estimates, and standard tests confirmed that error terms for individual countries were significantly correlated. Table 1 column 3 reports our estimates of individual country sacrifice ratios, together with estimated standard errors. As can be seen, for most countries the sacrifice ratio is estimated quite precisely, though in several cases, and in particular those countries where the estimated sacrifice ratio is very high, t-ratios are very low. In our regressions that model determinants of the sacrifice ratio we take into account that some sacrifice ratios are estimated more precisely than others. In all but two country cases we could accept the restriction proposed by Andersen and Wascher that $\beta = (1 - \lambda)$.[12]

3.3 Determinants of the sacrifice ratio

The next step in our inquiry is to consider whether countries with more transparent central banks tend to have lower sacrifice ratios, and whether this correlation is robust to controls for other determinants. To do this we performed several cross-section regressions of the estimated sacrifice ratio on individual country characteristics. These include our index of forecast transparency as well as the index of explanation transparency. We also examined a number of potential control variables, though in the final regressions reported in this paper, we have only retained the controls that proved to be statistically significant.

For one, we considered using a measure of legal central bank independence, drawn from Fry et al (2000), based on the argument that if it results in greater credibility, then central bank independence should be associated with lower costs of disinflation. Previous studies have actually found that central bank independence is either uncorrelated or positively correlated with the sacrifice ratio. We found this index was not significant in any of the regressions we performed.

Several additional controls were considered that did not prove to be statistically significant. These included Exchange Rate Mechanism (ERM) membership and inflation targeting. We also considered variables to proxy for structural features of the economy that may be associated with nominal rigidities. An OECD index of employment protection, designed to measure costs of dismissing employees, was not significant in any of our regressions.

[11] With the lambda coefficient set at 1600.

[12] We rejected the restriction for Germany and Norway. Inclusion of unconstrained sacrifice ratios for these two countries did not change any of our subsequent results

It would have also been useful to add institutional features that would be more directly associated with nominal rigidities, such as the average duration of contracts, but these are not yet available for the 1990s on a cross-country basis.

Two further controls did prove significant and were retained for our final regressions. The first of these was the level of wage bargaining coordination, based on an index developed by Nickell et al (2001). As surveyed by Calmfors (2001), when wage bargaining is coordinated across firms and across sectors of the economy, then nominal rigidities may be weaker. The main reason is that coordinated wage bargaining institutions may increase the speed with which wage-setters respond to a policy change.[13] Second we included the initial rate of inflation for each country, based on the common conjecture that the slope of the Phillips Curve may be steeper in high inflation environments.

$$\frac{1-\widehat{\lambda}_i}{\widehat{\lambda}_i} = \alpha + \beta_1 \text{Transparency } + \beta_2 X_i + \varepsilon_i$$

Table 2 reports weighted least squares estimates of the above equation where$\frac{1-\widehat{\lambda}_i}{\widehat{\lambda}_i}$ is our estimate of the sacrifice ratio for country "i" (based on the SUR estimates of equation 2), and X is a vector of our control variables. This equation is linear in parameters, so we can estimate it using a standard linear regression. However, given the fact that the sacrifice ratio $\frac{1-\widehat{\lambda}_i}{\widehat{\lambda}_i}$ is itself an estimate that is more precise for some countries than others, we take account of this by weighting each observation by the inverse of the estimated standard error for the sacrifice ratio. As a consequence, countries in which the sacrifice ratio is estimated more precisely are given greater weight in the regression.[14] As can be seen, the coefficients on both indices of transparency are negative and statistically significant. The coefficient on initial inflation is also negative, suggesting that costs of disinflation may be lower at higher levels of inflation. Finally, the coefficients on the variable that captures the level of coordination in wage bargaining are also negative and significant, suggesting the costs of disinflation are actually lower in countries with centralised wage bargaining systems.

As a further step in the inquiry, we also considered to what extent different sub-components of our forecast transparency and explanation transparency indices are significantly correlated with the sacrifice ratio. In terms of forecast transparency, the main variation within the OECD occurs between those

[13] These arguments are distinct from other evidence that coordinated wage bargaining may be may be in.... from a microeconomic perspective.

[14] Our results with regard to transparency also remain robust if we instead weight each observation equally.

central banks that discuss risks to forecast and past forecast errors in their publications and those which do not. Regressions (1) and (2) in Table 3 demonstrate that sacrifice ratios are unambiguously lower in countries where central banks satisfy these transparency criteria. In terms of explanation transparency, the principal variation within the OECD is between those central banks that publish minutes of meetings and/or voting records and those that do not. Regressions (3) and (4) show that the coefficient on both of these transparency criteria are negative and the coefficient on the variable measuring whether voting records are published is statistically significant. While the magnitude of several of the coefficients in Table 3 is quite large (and perhaps implausibly so), the results nonetheless indicate that these individual components of transparency are associated with lower costs of disinflation.

We also considered whether our finding that costs of disinflation are lower when monetary policy is more transparent is robust to variations in the time period considered and in the estimation technique used. We re-estimated equation 22 as a system of seemingly unrelated regressions but after dropping the constraint that $\beta = (1 - \lambda)$. We also estimated the equation using OLS, both with and without the constraint. We then re-estimated regressions 1 and 2 from Table 2 using the sacrifice ratios generated by the alternative estimates of equation 22. Table 4 reports the coefficients on the forecast transparency and explanation transparency variables. While some of our individual country sacrifice ratios vary considerably depending on the estimation method, our basic finding that the sacrifice ratio is negatively correlated with transparency appears very robust. Table 5 shows that in most cases we also continue to observe a negative correlation between transparency and the sacrifice ratio when using alternative time periods for our estimates. Finally, our results are also robust to the exclusion of outliers.

3.4 Discussion

Our results suggest that more transparent monetary regimes are associated with lower disinflation costs. This is consistent with the channel identified in our model, suggesting that when the central bank attempts to reduce inflation greater transparency can help to improve the output-inflation trade-off to the extent it facilitates faster adjustment of inflation expectations and acquisition of credibility. Our results are striking insofar as we are the first to show that a greater degree of transparency in monetary policy is associated with an improved output-inflation trade-off. Previous empirical work did not detect a negative relationship between the sacrifice ratio and other aspects of the monetary policy framework, namely central bank independence (e.g., Walsh 1994, Fisher 1996, and Posen 1996).

One set of explanations for the negative empirical association of the sacrifice ratio with transparency and positive association with central bank independence may relate to measurement issues. First, a number of authors (e.g., Forder, 1996) have objected to the use of legal indicators of central bank independence, pointing out that although the theory of central bank independence relates to actual behaviour, empirical studies generally rely on a reading of statutes. Our measure of transparency, however, focuses entirely on the practice of central banks in forecasting, and includes a qualitative assessment of forecast detail. Indeed, those components within our index that measure the detail, rather than the mere practice of forecasts, have significant explanatory power.

A second measurement issue relates to the relative importance of transparency and independence in this particular sample and in the particular circumstances of the 1990s. Even if legal statutes are key aspects of independence, it is plausible that by the mid-1990s, all of the 21 OECD central banks in our sample had attained a relatively high degree of independence. Responses of central banks to the Fry et al. (2000) survey suggested of the 21 OECD central banks in this sample, none perceived there to be any significant qualification in the extent to which they were instrument independent.[15]. For these countries, it is plausible that the obstacle to improved credibility was an unconvinced public rather than a lack of independence. As such, the 1990s was a period in which transparency had a particularly important role to play in improving the output-inflation trade-off insofar as explanations of policy actions could help to hasten credibility-building.

Further reasons may exist, however, that explain why transparency may be more significantly related than independence to the output-inflation trade-off. For example, it could be that the measured significance of transparency may be related to difficulties in controlling for other potentially important variables, such as the characteristics of labour markets. Fully controlling for the possible effect of such factors is not feasible due to lack of appropriate data. To the extent that labour market flexibility influences the output-inflation trade-off and is correlated with transparency, the effect of transparency on the costs of disinflation could be overstated. The task of identifying better ways to control for the effect of economic structure, including nominal rigidities, warrants further research.

[15]Some details are not reported in Fry et. al. (2000) but are available upon request from the authors.

4 Conclusion

We consider the role of monetary policy transparency during disinflations. Although a substantial body of literature examines how other institutional characteristics of central banks, such as the degree of independence, affect disinflation costs, little work exists that focuses on the implications of central bank transparency. We first provide a simple model showing that when economic agents are less than fully convinced about the central bank's resolve to the disinflation program, the unemployment costs of reducing inflation increase. An informational asymmetry emerges when the public is not fully convinced about the new policy central bank's resolve to disinflate. Provided that the central bank has some private information or early knowledge about a shock or a control error, sharing this information with the public helps to remove the inefficiency associated with inertia in the public's beliefs about the policymaker's type. In this context transparency is not a substitute for other means of achieving credibility but is rather a channel through which policymakers with preferences for low inflation can hasten credibility-building. This channel is relevant, given that one of the problems often countered by policymakers during disinflation efforts relates to the scepticism with which the public views the central banker's commitment to the disinflation programme. In this context, successful disinflations depend, among other things, on the speed with which such expectations are adjusted and credibility is acquired.

We test the implications of the model by estimating the extent to which transparency in publishing forecasts is associated with disinflation costs in a cross-section of 21 OECD economies. We measure the costs of disinflation using sacrifice ratios based upon estimation of the short-run Phillips curve for each economy. The results are consistent with the view that greater transparency is associated with lower costs of disinflation, even after we control for the initial rate of inflation and the extent to which wage-bargaining is centralised. The results are robust to a number of alternative specifications. Furthermore, they support the view that lower costs of disinflation may be secured by publishing detailed forecasts, including a discussion of risks and forecast errors. We also find that efforts made to explain policy decisions though published minutes of meetings and voting records may help to reduce disinflation costs.

The association between greater transparency and lower sacrifice ratios is of particular interest given the failure of earlier empirical literature to find evidence associating other desirable aspects of central bank design with lower sacrifice ratios.

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Table 1: Central Bank Transparency and Estimated Sacrifice Ratios

	Forecast	**Explanation**	**Sacrifice Ratio**
Austria	0	0	10.8 (6.33)
Greece	0	1	0.03 (0.02)
Denmark	0	1	11.7 (11.1)
France	0	2	9.48 (12.8)
Spain	2	1	2.32 (0.58)
Germany	2	2	2.63 (1.76)
Belgium	2	2	2.89 (1.36)
Finland	2	2	9.74 (5.83)
Australia	3	2	2.19 (0.79)
Japan	3	4	1.42 (0.62)
Switzerland	4	2	0.51 (0.13)
Portugal	4	2	1.76 (0.85)
Netherlands	4	2	2.27 (1.04)
Italy	4	2	3.08 (1.43)
Norway	4	2	3.43 (0.67)
Ireland	4	2	3.87 (2.12)
New Zealand	4	3	1.65 (0.39)
Canada	4	3	10.9 (24.2)
Sweden	4	4	0.08 (0.02)
UK	4	4	0.81 (0.22)
USA	4	4	2.25 (0.76)

Table 2: Determinants of the Sacrifice Ratio in 21 OECD Countries

	(1)	**(2)**
Forecast transparency	-.794 (.311)	
Explanation transparency		-.674 (.266)
Wage coordinaton	-1.09 (0.38)	-.780 (.232)
Initial inflation	-.457 (.148)	-.286 (.103)
Constant	8.79 (2.61)	6.38 (1.74
R^2	.42	.46
N=	21	21

Table 3: Sacrifice Ratio Determinants: Individual Components of Transparency

	(1)	**(2)**	**(3)**	**(4)**
Risks to forecast	-1.73 (0.47)			
Past forecast errors		-2.47 (0.48)		
Voting			-1.43 (0.60)	
Minutes				-1.79 (1.06)
Initial inflation	-.262 (.062)	-.357 (.056)	-.357 (.056)	-.196 (.071)
Wage coordination	-.894 (.323)	-.791 (.302)	-.791 (.302)	-1.22 (0.74)
Constant	5.58 (1.08)	6.73 (0.99)	6.73 (0.99)	5.23 (2.18)
R^2	.39	.49	.44	.29
N=	21	21	21	21

Table 4: Effect of transparency using alternative sacrifice ratio estimates

Method	**Forecast Transp**	**Explanation Transp**
SURE - with constraints	-.794 (.310)	-.673 (.266)
SURE - without constraints	-.330 (.573)	-.610 (.299)
OLS - with constraints	-.734 (.225)	-.627 (.214)
OLS - without constraints	-.570 (.483)	-.730 (.243)

Table 5: Effect of transparency using alternative time periods

Period	**Forecast Transp**	**ExplanationTransp**
1990-2000	-.794 (.310)	-.673 (.266)
1991-2000	-.682 (.294)	-.920 (.204)
1992-2000	-.602 (.248)	-.676 (.182)
1993-2000	-.868 (.156)	-.879 (.131)
1990-1999	-.715 (.316)	-.635 (.207)