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The Walsh Contracts for Central Bankers Are Optimal After All!

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Abstract

Candel-Sánchez and Campoy-Miñarro (2004) argue that the Walsh linear inflation contract does not prove optimal when the government concerns itself about the cost of the central bank contract. This result relies on the authors. assumption that the participation constraint does not represent an effective constraint on the central banker's decision. Instead, the government can ”impose” or ”force” the contract on the central banker, even though the contract violates the participation constraint. We argue that such a contract does not make sense. The government can impose it, but it does not affect the central banker's incentives. The policy outcomes do not match those of commitment. Then we show that the Walsh linear inflation contract does produce the optimal outcome, even when the government cares about the cost of the contract.

Journal of Economic Literature Classification: E42, E52, E58

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1. Introduction

In the Barro-Gordon (1983) model, discretionary monetary policy generates an inflationary bias because of the time-inconsistency of optimal policies. That is, the central banker may renege on a prior commitment and generate a surprise inflation that increases output and reduces unemployment. Kydland and Prescott (1977) and Barro and Gordon (1983) demonstrate that when the government and the central banker each have an expansionary bias, discretionary monetary policy leads to higher inflation.[1] Those authors assume a single policymaker (i.e., they do not consider the government and the central bank as different entities).

A number of remedies have been proposed for reducing or eliminating suboptimal policy outcome due to the inflation bias. Such approaches include appointing a "conservative" central banker (Rogoff 1985 and Lohmann 1992) and targeting rules, where the government penalizes the central banker for deviating from the targeted variable (Svensson 1997).[2] While these approaches generally reduce the inflationary bias, they do not minimize the social welfare loss because the models incorporate a trade-off between inflation prevention and stabilization policy.

Walsh (1995) and Persson and Tabellini (1993) treat monetary policy delegation as a principal-agent problem and propose a central banker contract whereby the inflationary bias completely disappears. In addition, the trade-off between inflation reduction and stabilization policy also disappears. The contracting literature must assume that the central banker responds to

[1] This idea of an inflationary bias, however, receives criticism. Blinder (1997) and McCallum (1995, 1997) both question why the central bank will choose discretion with an inflationary bias over the optimal policy with no inflationary bias. That is, why should the central banker prove less rational than the private sector when forming its expectations? If the central banker proves rational in this sense, then the no-inflationary-bias outcome dominates the discretionary outcome with the inflationary bias.

[2] While this literature discusses the penalty for deviating from the targeted variable, it does not clearly state how to impose such a penalty, absent a central banker contract.

incentives. Having a contract that imposes a penalty for higher inflation forces the central banker to choose voluntarily actions that eliminate the inflationary bias, while preserving discretion.

Candel-Sánchez and Campoy-Miñarro (2004) recently question whether the Walsh (1995) linear inflation contract can completely eliminate the inflation bias in the standard Barro-Gordon (1983) model. They conclude that the Walsh contract cannot do so, when the model contains two additional assumptions. First, the government cares about the cost of the contract. That is, the contract cost appears in the government's utility (loss) function. Second, the government can unilaterally impose the contract on the central banker and that the central banker will perform as the government expects based on this contract. In other words, the participation constraint does not play any role in the selection or performance of the central banker.

Chortareas and Miller (2003a), in a related paper, demonstrate that an output contract can completely eliminate the inflation bias by addressing the "cause of the disease," the output bias in the social welfare function, rather than the "symptom of the disease," the excess inflation outcome. The inflation bias emerges in the outcome of the model, because of the assumed rational expectations and the natural rate of output. That is, ultimately no deviation of output from the natural rate can occur, even though the social welfare function exhibits an output bias.[3]

This paper considers the optimality of the linear inflation contract for central bankers with explicit recognition of the participation constraint. In this framework, the equivalent to second-best (or commitment) policy outcomes emerges. More specifically, if the government's objective function places some weight on the contract costs, then the inflation contract still

[3] Before considering the output contract, Chortareas and Miller (2003a) consider the Walsh contract in a world where the government cares about the cost of the contract, deriving the same conclusion as Candel-Sánchez and Campoy-Miñarro (2004) with the same optimal penalty rate in the linear inflation contract. That result emerges for

eliminates the entire inflationary bias. Walsh's optimal linear inflation contract remains optimal. In addition, our results do not require making the theoretically unsatisfactory, practically unrealistic feature of "imposing" the contract. Candel-Sánchez and Campoy-Miñarro (2004) generate their conclusion by "imposing" or "forcing" the central banker to accept the contract, irrespective of the central banker's participation constraint. We argue that the imposition of the contract does not make sense, leading to unreasonable results.

The last point proves the crux of our argument. Overlooking the participation constraint renders their results not only theoretical inconsistent, but also irrelevant from an applied policy perspective. What does it mean to ignore the participation constraint? On the one hand, we do not observe the political principal (society or government) offering a menu of contracts to the central banker. We also do not see the central banker rejecting a contract offered by the government. No instances from the recent central banking experience, at least in the industrialized countries, exist, where the central banker "rejects" the assignment offered by the government. Rather, the central banker does not perform, if the imposed contract proves incentive incompatible. That is, central bank performance requires that the participation constraint holds.[4]

In sum, restoring the optimality of linear inflation contracts as a theoretical result is valuable, since such contracts are consistent with best practice in monetary policy as experienced in some of the major industrialized countries. This theoretical framework of contractual monetary policy delegation proves equivalent to the appointment of relatively inflation averse

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the same reason: the authors do not explicitly consider the participation constraint.

[4] Chortareas and Miller (2003b) consider the implications when a central banker breaches his or her contact and acts strategically.

central bankers and the adoption of an implicit or explicit inflation target.[5] To judge the effectiveness of these latter institutional arrangements will take more time. Nevertheless the existing experience seems successful enough so that many major central banks do not hesitate to refer to the recent "period of great stability."[6]

2. Candel-Sánchez and Campoy-Miñarro's Model

We adopt Candel-Sánchez and Campoy-Miñarro's (2004) model and derivation to make the exposition of our conclusions more transparent. The Lucas supply function relates output and unexpected inflation as follows:

$$y = \bar{y} + \alpha(\pi - \pi^e) + \varepsilon \,, \tag{1}$$

where $\bar{y}$ equals the natural level of output, π and π^e equal the actual and expected inflation rates, ε equals a well-behaved random supply shock, and the time subscripts are suppressed. The social welfare (loss) function depends on output and inflation rate deviations from their targeted levels (y^* and $\pi^*=0$, respectively). That is,

$$L^S = (y - y^*)^2 + \beta\pi^2 \,. \tag{2}$$

The government's utility function depends on social loss function as well as the cost of the contract, which equals a transfer payment contingent on inflation performance $t(\pi)$. That is,

$$U^G = -t(\pi) - L^S \,. \tag{3}$$

The central banker's utility function incorporates the social loss function and the optimal incentive scheme ($t(\pi)$) as follows:

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[5] See Walsh (2003)..

[6] Of course it is not clear yet to what extent this stability can attributed to better policy, structural changes, or simply

$$U^{CB} = t(\pi) - L^S. \tag{4}$$

The social loss (L^S) and the incentive scheme ($t(\pi)$) implicitly receive the same weight in the central banker's and the government's utility functions.[7] The targeted output levels of both the government and the central banker incorporate an expansionary bias (k), so that $y^* - \bar{y} = k > 0$.

The sequence of events occurs as follows: (i) The government offers a linear inflation contract [i.e., $t(\pi) = a - b\pi$] that penalizes the central bank for higher inflation; (ii) The agents form a rational expectations value for the inflation rate (i.e., π^e); (iii) The central bank observes the output shock (i.e., ε) before making its inflation-rate decision; (iv) The central bank chooses the inflation rate (i.e., π); and (v) The government accounts for the central banker's response to the linear inflation contract and rewards or punishes the central banker accordingly.

Walsh (1995) shows that the optimal incentive scheme, when the central banker's reward depends on the inflation rate, produces the following:

$$t(\pi) = a - 2\alpha k\pi, \tag{5}$$

where a equals a fixed payment and the marginal penalization rate equals $2\alpha k$. The parameter a proves most important to our discussion.

The government's problem in Candel-Sánchez and Campoy-Miñarro's (2004) model reduces to the following optimization:

$$\begin{aligned} &\max_{\pi} E[a - b\pi - (y - y^*)^2 - \beta\pi^2] \\ &s.t. \quad y = \bar{y} + \alpha(\pi - \pi^e) + \varepsilon. \end{aligned} \tag{6}$$

The solution to this problem causes the central bank to choose the following inflation rate:

"good luck" (see Bernanke 2004).

$$\pi^{CB} = -\frac{b}{2(\alpha^2+\beta)} + \frac{\alpha k}{(\alpha^2+\beta)} + \frac{\alpha^2}{(\alpha^2+\beta)}\pi^e - \frac{\alpha}{(\alpha^2+\beta)}\varepsilon. \tag{7}$$

The agents incorporate the decision of the central bank into their calculations of the expected inflation rate, leading to the following result:

$$\pi^{e,A} = E(\pi) = -\frac{b-2\alpha k}{2\beta}. \tag{8}$$

The government-designed contract proves optimal when it incorporates the decisions of the central bank and the agents contained in equations (7) and (8). That is, the government's optimization problem reduces to the following:

$$\max_b E[-a + b\pi - (y-y^*)^2 - \beta\pi^2]$$
$$s.t.\begin{cases} y = \bar{y} + \alpha(\pi - \pi^e) + \varepsilon \\ \pi^e = \pi^{e,A} \\ \pi = \pi^{CB} \end{cases}. \tag{9}$$

The first-order condition for this maximization produces the following:

$$E(\pi) + b\frac{\partial E(\pi)}{\partial b} - 2\beta E(\pi)\frac{\partial E(\pi)}{\partial b} = 0, \tag{10}$$

which generates the optimal penalization rate (b^*) as follows:

$$b^* = \frac{4\alpha k}{3}, \tag{11}$$

which falls below the value of Walsh's optimal penalization rate, $2\alpha k$. In addition, the solution for the inflation rate equals the following:

$$\pi^* = \frac{\alpha k}{3\beta} - \frac{\alpha}{(\alpha^2+\beta)}\varepsilon, \tag{12}$$

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[7] Introducing different weights for the two component parts does not alter our conclusion.

which includes a positive inflation bias ($\alpha k/3\beta$), but a bias less than that under discretion ($\alpha k/\beta$). Chortareas and Miller (2003a) earlier derive the same optimal penalization rate. Neither Candel-Sánchez and Campoy-Miñarro (2004) nor Chortareas and Miller (2003a) explicitly consider the participation constraint of the central banker in the optimization problem.

3. The Participation Constraint and the Optimal Linear Inflation Contract

Candel-Sánchez and Campoy-Miñarro (2004) argue that the government can impose or force the linear inflation contract on the central banker, thus allowing a violation of the participation constraint. They use a diagram to facilitate the discussion, which we borrow for our discussion as well. The diagram plots the iso-expected utility (indifference) curves of the government and the central bank in the (*a, b*) parameter space, where *a* and *b* equal the fixed payment and the marginal penalization rate, respectively.

The iso-expected utility curves conform to parabolas with the following equations:[8]

$$a = -\frac{1}{4\beta}b^2 + K + E(U^{CB}) \text{, and} \tag{13}$$

$$a = -\frac{3}{4\beta}\left(b - \frac{4\alpha k}{3}\right)^2 - K - E(U^G)\text{,} \tag{14}$$

where $K = \dfrac{\beta^2\sigma_\varepsilon^2 + k^2(\alpha^2+\beta)}{\beta(\alpha^2+\beta)}$ and σ_e^2 equals the variance of *ε*. The lines of symmetry for the two parabolas occur at $b = 0$ and $b = \dfrac{4\alpha k}{3}$ for the iso-expected utility of the central bank and the government, respectively. Figure 1 plots the two sets of parabolas.

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[8] We rewrite the equations slightly from equations (10) and (11) in Candel-Sánchez and Campoy-Miñarro (2004) to

The central banker's participation constraint requires that

$$E(U^{CB}) \geq U_0 , \tag{15}$$

which implies a relationship between the parameters *a* and *b* along the minimum boundary of the binding constraint.

Candel-Sánchez and Campoy-Miñarro (2004) assume that the parameter *a* corresponds to the tangency point (*T*) between the iso-expected utility curves for the government and the central bank. They call this *a** and argue that the government maximizes its utility at *T***, where

$$a = a^*, \quad b = \frac{4\alpha k}{3} . \tag{16}$$

But, why stop there? Since the government imposes the contract on the central banker, lower the parameter *a* below *a**. Doing so lowers the cost of the contract and makes the government better off. See Figure 1. Using Candel-Sánchez and Campoy-Miñarro's (2004) logic, imposing or forcing the contract on the central banker in violation of the participation constraint permits an absurd outcome of increasing the utility of the government without bound.[9]

Given the Candel-Sánchez and Campoy-Miñarro's (2004) model, what happens if we require that the participation constraint holds with an equality? Then the optimization condition in equation (10) gets rewritten as follows:

$$-\left.\frac{\partial a}{\partial b}\right|_{E(U^{CB})=U^0} + E(\pi) + b\frac{\partial E(\pi)}{\partial b} - 2\beta E(\pi)\frac{\partial E(\pi)}{\partial b} = 0, \tag{17}$$

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conform more directly to the equation of a parabola.

[9] Chortareas and Miller (2003a) also generate the penalization rate *b =(4αk/3)* and implicitly assume that the participation constraint holds. If true, then the solution occurs at point *T** in Figure 1. Clearly, the government can do better at point *T* at the Walsh optimal penalization rate. But, why does this happen? We address that issue next.

where the added derivative of *a* with respect to *b* uses the iso-expected utility constraint given in equation (13). Solving equation (17) for the optimal penalization rate gives $b = 2\alpha k$. But this is simply the penalization rate originally derived by Walsh! That is, when the government cares about the cost of the contract and the participation constraint of the central banker holds with an equality, the Walsh penalization rate still holds as the optimal outcome and the inflationary bias gets completely eliminated. In other words, when the participation constraint holds, the optimality of the original Walsh result is restored.

The Walsh (1995) paper does not incorporate the cost of the contract in the government's utility function. In that case, the government's iso-expected utility curve does not exhibit a tradeoff between the parameters *a* and *b*. Nonetheless, the value of the penalty rate affects the central banker's decision on the inflation rate. Thus, indirectly, the government's utility function does respond to changes in the parameter *b*. The first best solution that minimizes the government's loss function, in this case, occurs when $b = 2\alpha k$, the Walsh optimal penalty rate. In sum the iso-expected utility curves for the government when it does not incorporate the cost of the contract appear as vertical lines with a minimum value at $b = 2\alpha k$ as illustrated by the dotted lines in Figure 1. That is, the utility of the government at V^* exceeds the utility at both V^1 and V^2.

Why would the central banker accept an incentive incompatible linear inflation contract and then not perform? First, why accept the contract? The central banker may accept the contract because of the prestige of becoming a central banker. That is, the central bank possesses a monopoly in implementing monetary policy within a country. Thus, getting selected as the central banker provides substantial non-pecuniary benefits. At the same time, the central banker may access large future pecuniary benefits from serving as the central banker. Second, after accepting the contract, why perform? Since the central banker accepts the contract for non-contract motives (i.e., the prestige and potential future pecuniary benefits), no reason exists to expect the central banker to perform (optimize) with respect to the contract.

4. Conclusion

Time inconsistency and political economy problems cause researchers to focus on the institutional design of central banking. This literature tries to reduce and/or eliminate the inflationary bias of discretionary monetary policy, when the government and the central bank each exhibit an expansionary bias. The conservative central banker and the targeting approaches each must confront a trade-off between inflation prevention and stabilization policy. The contracting approach appears to dominate in that the inflation bias completely disappears without affecting stabilization policy.

Candel-Sánchez and Campoy-Miñarro (2004) alter one of the assumptions in the standard contracting model (i.e., the government does not care about contract costs), violate the participation constraint of the central banker, and demonstrate that the contracting approach does not, in general, completely eliminate the inflation bias. Two observations emerge from our analysis. First, the optimal linear inflation contract still completely neutralizes the inflation bias, even when the government places some non-zero value on the contract costs. Second, Candel-Sánchez and Campoy-Miñarro's (2004) finding relies on their assertion that the government can impose or force the contract on the central banker, even though it violates the participation constraint. Imposing or forcing a contract on the central banker that violates his or her participation constraint must, therefore, assume that the central banker delivers the expected inflation outcome, even thought the central bank does not want to participate.

The present analysis restores the optimality of linear inflation contracts, a la Walsh. In addition to producing a theoretical consistent result, our results validate what analysts identify as best practice in central banking for a number of the major industrialized countries.

References:

Barro, Robert J., and Gordon David B. "A Positive Theory of Monetary Policy in a Natural Rate Model." *Journal of Political Economy*, August 1983, 91(4), pp. 589-610.

Bernanke, Ben S. "Remark by Governor Ben S. Bernanke," Eastern Economic Association meetings, 2004.

Blinder, Alan S. "What Central Bankers Could Learn from Academics-and Vice Versa." *Journal of Economic Perspectives*, Spring 1997, 11(2), pp. 3-9.

Candel-Sánchez, Francisco, and Juan Cristóbal Campoy-Miñarro "Is the Walsh Contract Really Optimal?" *Public Choice*, July 2004, 120(1-2), pp. 29-39.

Chortareas, Georgios E., and Stephen M. Miller. "Monetary Policy Delegation, Contract Costs, and Contract Targets." *Bulletin of Economic Research*, January 2003a, 55(1), pp. 101-112.

Chortareas, Georgios E., and Stephen M. Miller. "Central Banker Contracts, Incomplete Information, and Monetary Policy Surprises: In Search of a Selfish Central Banker?" September 2003b, *Public Choice*, 116(3-4), pp. 271-296.

Kydland, Finn E., and Edward C. Prescott. "Rules Rather Than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy*, June 1977, 85(3), pp. 473-493.

Lohmann, Susanne. "Optimal Commitment in Monetary Policy: Credibility Versus Flexibility." *American Economic Review*, March 1992, 82(2), pp. 273-286.

McCallum, Bennett T. "Two Fallacies Concerning Central Bank Independence." *American Economic Review Papers and Proceedings*, May 1995, 85(2), pp. 207-211.

McCallum, Bennett T. “Crucial Issues Concerning Central Bank Independence.” *Journal of Monetary Economics*, June 1997, 39(1), pp. 99-112.

Persson, Torsten, and Guido Tabellini. “Designing Institutions for Monetary Stability.” *Carnegie-Rochester Series on Public Policy*, December 1993, 39, pp. 33-84.

Rogoff, Kenneth. “The Optimal Degree of Commitment to an Intermediate Monetary Target.” *Quarterly Journal of Economics*, November 1985, 100(4), pp. 1169-89.

Svensson, Lars E. O. “Optimal Inflation Targets, “Conservative” Central Banks, and Linear Inflation Contracts.” *American Economic Review*, March 1997, 87(1), pp. 98-114.

Walsh, Carl E. “Optimal Contracts for Central Bankers.” *American Economic Review*, March 1995, 85(1), pp. 150-167.

Walsh, Carl E. *Monetary Theory and Policy*, 2003, MIT Press.

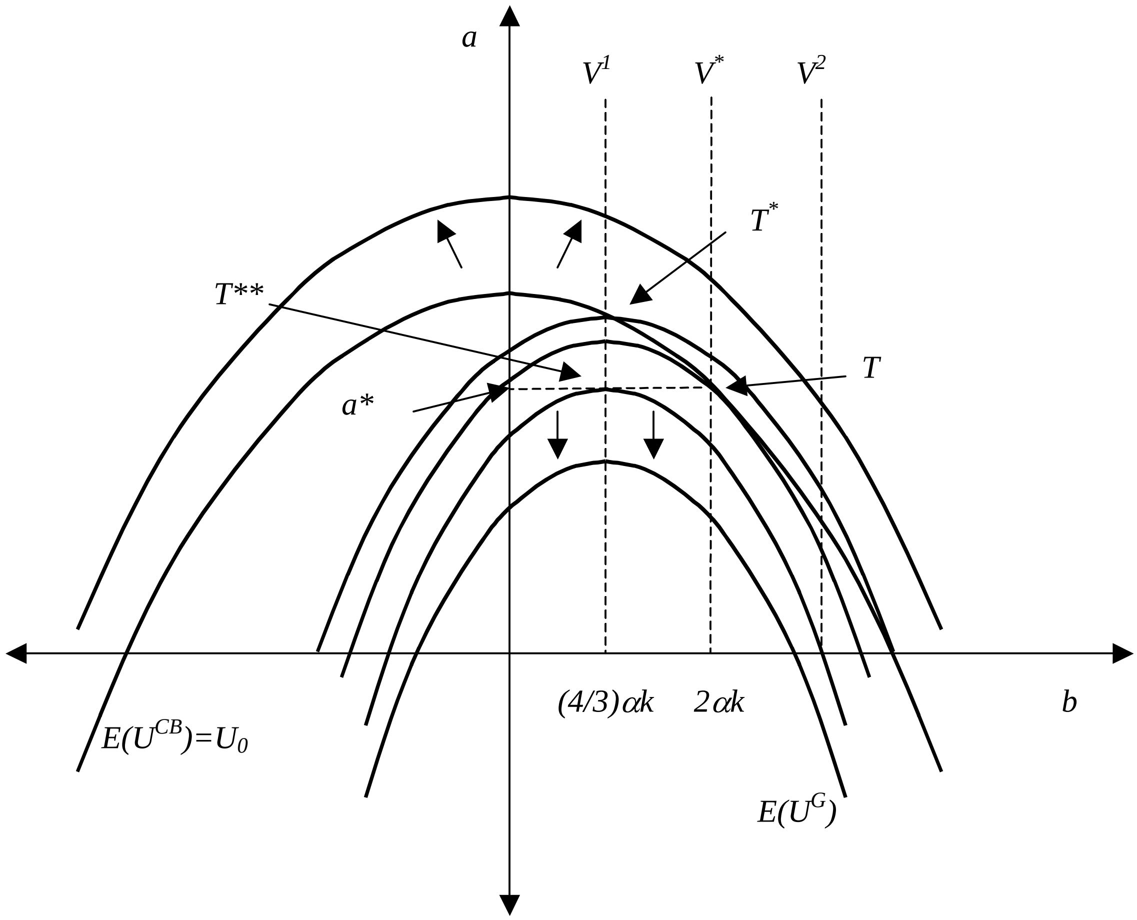

Figure 1