Two Hands on the Wheel:
Independent Central Banks, Politically Responsive Governments, and Inflation

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Abstract: Theories of central bank independence (CBI) offer a more exact set of predictions regarding inflation in different political-economic environments than has generally been understood or empirically examined. The theories suggest that the inflation which prevails in any country-time is a weighted average of that which would obtain if the central bank controlled monetary policy and that which would obtain if instead the government controlled it, with the weight determined by the degree of CBI. Equations embodying these theoretical expectations are estimated by constrained least-squares from a time-series cross-section of annual GDP-deflator inflation-rates in developed democracies since the collapse of Bretton Woods. By supporting these specifications, the evidence indicates that the anti-inflationary benefit of CBI is not constant, as previously estimated, but rather varies with the broader political-economic environment in which the bank operates. Conversely, the inflationary impacts of other political-economic variables depend on the degree of CBI in the country-time in which they incur. More broadly, the study demonstrates that inflation, like other political economic outcomes, is best understood as being determined by the *interaction* of the set of domestic and international, economic and political, and structural and institutional factors operating in some place and time.

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I. Introduction

Political scientists and economists generally agree that central bank independence (CBI) lowers inflation.[1] Both also define CBI as the degree of autonomy of the (conservative) central bank from the political authority in making monetary policy. From the political scientist's view, the central bank is a bureaucratic institution, populated by financial experts who are generally hawkish on inflation, whether socialized to that view or coming from a population with those interests. The government, contrarily, and especially in democracies, is more responsive to various societal pressures which may emerge for inflation. Only the most conservative of governments would be as anti-inflationary as the bank itself, so delegation of monetary-policy authority to the central bank, *i.e.* CBI, reduces inflation. From the (neoclassical) economist's view, monetary policy involves a time-inconsistency problem (described below) which produces an inflationary bias if a government responsive to societal pressures controls it. Credible delegation of monetary-policy authority to an independent and conservative central bank can serve as a commitment device which circumvents this time-inconsistency problem and the resulting inflationary bias; thus CBI lowers inflation.

However, regardless of which view authors hold as to why CBI lowers inflation,[2] the thesis that CBI lowers inflation has been incompletely understood, the empirical testing has reflected this misunderstanding, and thus many important theoretical and empirical implications of the argument have been missed.[3]

The underappreciated point is that the central bank's autonomy in monetary-policy making is always a matter of *degree*. Independence from the political authority is never complete because the bank's authority derives from legal statutes or constitutional provisions, and political authorities could change these if the bank's policies were ever to become sufficiently distasteful to them to justify expenditure of the political capital necessary to effect such a change in the bank's status. Nor is independence ever completely absent because administrating and monitoring monetary policy is always costly, politically and/or economically. The bank enjoys an expertise and/or an informational advantage over the government in conducting monetary policy, and certainly governments require time and other resources even to monitor the bank much less to conduct monetary policy itself. Thus governments cannot costlessly ensure that central banks conduct policy precisely according to their current will. Therefore, CBI must refer to *how far* the bank could stray from the current government's desires before the latter would find the political and economic costs of altering the bank law or of seizing the monetary reins itself worth bearing.[4] This implies that inflation policy is always partially determined by the central bank and partially by the current government.

Four further conclusions follow sequentially. (1) Actual inflation will be a weighted average of that which would occur if the conservative central bank credibly, completely, and autonomously controlled monetary policy and that which would occur if instead the current government controlled monetary policy without any influence from the central bank. The degree of CBI gives the weight on the former. Therefore, (2) the anti-inflationary impact of CBI is not constant, as previously estimated, but rather varies depending on the political-economic environment in which the bank

operates. *E.g.*, the anti-inflationary impact of CBI may be greater under left than under right government, may be less the more trade-open the economy, may vary depending on the labor- and goods-market institutions also present in the system, *etc.* The converses are simultaneously implied: *e.g.*, the difference between inflation under left and right governments and the anti-inflationary impact of trade-openness may be less the greater is CBI, *etc.* This in turn implies that, (3) because their political-economic environments differ, some countries at some times will find CBI more advantageous on anti-inflationary grounds than others would and therefore they will be more or less likely to increase or decrease CBI (*ceteris paribus*). Finally, the argument illustrates a broader point about institutional political economy: (4) the effect of any given institution is contextual, depending upon the configuration of other political, economic, structural, and institutional features of the setting in which the institution in question *inter*acts.

I structure the paper to make these arguments as follows. The next section reviews the model of monetary policy from which the neoclassical view of CBI and inflation derives. I adopt the neoclassical economic exposition for its familiarity, its illustrative clarity, and to demonstrate that even the institutionally sparse model of the neoclassical macroeconomist concludes that the anti-inflationary impact of CBI depends upon the broader political-economic configuration in which the bank *inter*acts. The present argument does not depend upon this expositional choice however.[5] The third section explains how that interactive prediction may be modeled empirically and then estimates such models from annual GDP-deflator inflation-rate data from 18 developed democracies in the post-Bretton-Woods era. The fourth section discusses the results substantively, using them to illustrate the range of further implications emerging from this fuller understanding of the theory of CBI and inflation and better match of the empirical model thereto. The fifth section concludes.

II. Central bank independence and inflation: a theoretical model

The neoclassical argument, condensed to a paragraph, proceeds thus. Given an economy with

nominal and real rigidities,[6] the monetary authority has the incentive to create "surprise" inflation because it will lower real wages (prices) and thus spur employment (output). However, wage and price bargainers know of this incentive and incorporate its inflationary consequences their settlements. In a perfect-information rational-expectations equilibrium, the bargainers cannot be systematically surprised by monetary policy, so real wages and prices and therefore output and employment are unaffected on average and inflation is high. If, contrarily, the monetary authority could credibly commit to refrain from creating such "surprise" inflation, the bargainers may agree to lower wage and price increases without fear of being surprised. With credible commitment, then, inflation will be lower without affecting real wages or prices and thus output or employment on average (but see note 5). Finally, institutionalizing a conservative central bank with greater independence from the political authority can provide just this sort of credibility for the monetary authority, so CBI reduces inflation.

In more detail, the argument[7] begins by specifying the preferences, $V^m(\cdot)$, of the discretionary monetary-policy-maker (*i.e.*, the government):

$$V^m = -[\tfrac{A_g}{2}(N_g^* - N)^2 + \tfrac{1}{2}(\pi_g^* - \pi)^2] \qquad \textbf{(1)}$$

I.e., the government dislikes deviations of employment, N, from the government's target, N_g^*, and deviations of inflation, π, from its target, π_g^*.[8] The weight the government places on employment relative to inflation is given by A_g. The target levels and the relative weight upon them indicate the conservatism of the government; lower N_g^*, π_g^*, and A_g implies greater conservatism.

Next, the nominal and real rigidities imply that unexpected inflation increases employment, N, beyond the natural rate, N_n, yielding the expectations-augmented Phillips Curve:

$$N = N_n + \alpha(\pi - \pi^e) \qquad \textbf{(2)}$$

where π^e is expected inflation and α is the effectiveness of surprise money in increasing employment (*i.e.*, the slope of the Phillips Curve).[9] Finally,[10] substituting **(2)** into **(1)**, maximizing with respect

to π, and then applying rational expectations (equating π^e to π) produces equilibrium inflation in the absence of commitment devices:

$$\pi_d^* = \pi_g^* + A_g \alpha (N_g^* - N_n) \quad \textbf{(3)}$$

π_d^* is the *discretionary inflation* that would obtain if a government with preferences described by **(1)** faced an economy characterized by **(2)** and controlled monetary policy without any influence from the central bank.[11] Notice the *inflationary bias*: discretionary inflation exceeds even the government's own target-rate $\pi_d^* > \pi_g^*$ [*n.b.*: $A_g>0$, $\alpha>0$, and $(N_g^*-N_n)>0$]. Governments cannot achieve *a posteriori* the lower inflation they desire *a priori* because any announced target is inconsistent with what a government caring about employment would seek if the public actually believed that target. That is the *time-inconsistency problem*: if the public expects the government's target, π_g^*, then the government, however benevolent or malevolent its preferences [**(1)**], would create greater inflation, trying to exploit the expectations-augmented Phillips Curve [**(2)**]. Bargainers know this, though, and so would not expect π_g^* in the first place. The only inflation which is rational both for bargainers to expect given the government's preferences and for government to produce given those expectations is π_d^* as given in **(3)**.

Equilibrium inflation could be lower than π_d^* if the government could publicly, truly, and credibly commit to lower inflation. Delegating monetary-policy authority to the central bank could serve as this commitment device to the *degree* that the bank is constructed to have more conservative preferences than the political authority (Rogoff 1985) and that the costs, political and/or economic, of altering the terms of that delegation are constructed to be prohibitive (Lohmann 1992). If the delegation were complete and completely credible, then equilibrium inflation would depend on the central bank's preferences (not the government's):

$$\pi_c^* = \pi_b^* + A_b \alpha (N_b^* - N_n) \quad \textbf{(4)}$$

where π_b^*, N_b^*, and A_b are analogous to π_g^*, N_g^*, and A_g in **(1)**. Thus *commitment inflation*, π_c^*, is lower than *discretionary inflation*, π_d^*, because (a) the bank controls and is publicly known to control monetary policy and (b) the more conservative bank has a lower target employment-rate, $N_b^* \leq N_g^*$, a lower target inflation-rate, $\pi_b^* \leq \pi_g^*$, and a lower weight on employment relative to inflation, $A_b \leq A_g$ (with at least one inequality strict).

To illustrate, suppose that central banks target low, constant inflation ($\pi_b^* = c$) and place no weight on employment ($A_b = 0$) so that equilibrium commitment inflation would be $\pi_c^* = \pi_b^* = c$.[12] To achieve this equilibrium, the bank law would have to be written so as to endow the bank with these preferences and with sufficient autonomy to pursue them. *E.g.*, the bank president could be paid based on achieving a pre-set target inflation ($\pi_b^* = c$) without regard to real outcomes ($A_b = 0$), and some majority in parliament could be required to over-ride the bank or change the bank law.[13] If that majority were effectively impossible to obtain and this were known, then the bank would be perfectly credibly independent, and equilibrium (commitment) inflation would be given by **(4)** as $\pi = \pi_c^* = \pi_b^* = c$. If monitoring the bank and over-riding the bank law were instead politically and economically costless and this were known, then monetary policy would effectively remain entirely in government control, so equilibrium (discretionary) inflation would be given by **(3)** as $\pi = \pi_d^* = \pi_g^* + A_g\alpha(N_g^* - N_n) > c$. In sum, the neoclassical argument equates the autonomy of the central bank from the political authority with the credibility and conservatism of monetary policy and so concludes that CBI lowers inflation.[14]

That CBI lowers inflation has been extensively tested empirically. The typical procedure, illustrated in **Figure 1**, compares postwar-average inflation in some countries to an index measuring their degree of CBI. Occasionally other explanators (controls) are added to this equation and/or the data are temporally disaggregated to some degree, but rarely has the CBI-inflation relationship been

estimated as anything other than linear-additive.[15] Thus the *empirics* have implicitly assumed that each increment in the degree of CBI has a fixed negative impact on inflation *ceteris paribus*; *i.e.* the effect of CBI on inflation, $\frac{\partial \pi}{\partial CBI}$, has been assumed constant and estimated as such by construction. In **Figure 1**, *e.g.*, each 0.1 increase in CBI is estimated to bring a (fixed) 0.5 reduction in inflation. Properly understood, however, the theory of CBI and inflation leads to a considerably different, and considerably more revealing, specification.

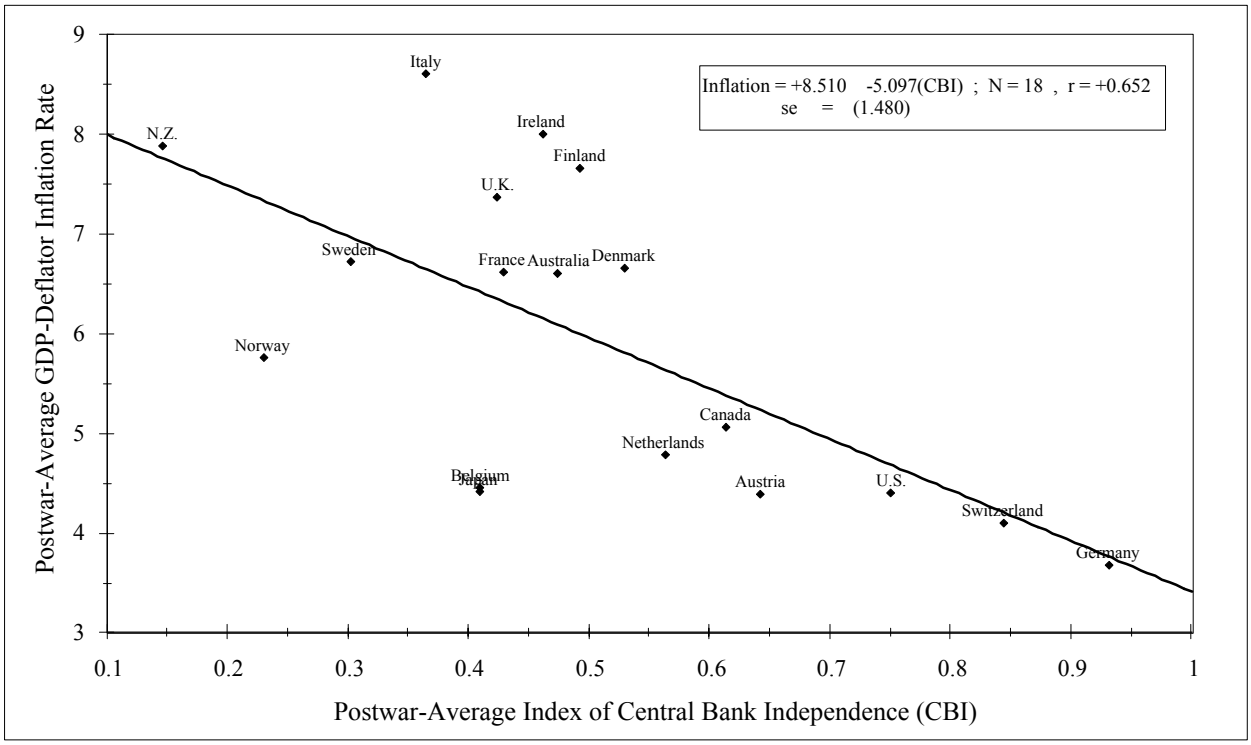

Figure 1: A Typical Bivariate Regression of Inflation on Central Bank Independence

Broadly, the theory states that inflation depends in the first place on who controls monetary policy: the government or an autonomous, conservative central bank. Inflation occurs according to one function if the central bank has autonomy (CBI = 1 ⇒ $\pi = \pi_c^*$) and according to a different function if it does not (CBI = 0 ⇒ $\pi = \pi_d^*$). However, CBI is defined (and measured[16]) as the *degree* to which the conservative central bank is autonomous of the current government in conducting monetary policy. Thus, more generally, the theory of CBI and inflation holds that *to the degree* the central bank is independent, it controls monetary policy and commitment inflation (π_c^*) prevails;

to the (remaining) degree the central bank is dependent, the current government controls monetary policy and discretionary inflation (π_d^*) prevails. The actual inflation in any given country-time, therefore, is some weighted average of (a) what would have obtained under complete independence (π_c^*) and (b) what would have obtained under complete dependence (π_d^*) of the bank from/on the current government, the weight on the former being a function of CBI. For example:

$$\pi = CBI \cdot \pi_c^* + (1 - CBI) \cdot \pi_d^* \qquad \textbf{(5)}$$

Notice that this conclusion does not depend upon the neoclassical model of the macroeconomy examined above; *any* model in which monetary policy affects inflation and which defines CBI as the degree of central-bank autonomy from the current government in conducting monetary policy yields some sort of weighted-average prediction.[17]

The interactive nature of **(5)** implies that—and this is what has been insufficiently recognized in the theory and almost completely absent from the empirics of CBI and inflation—**any *factor which influences the government differently from the central bank alters the anti-inflationary impact of CBI, and,* vice versa*, CBI alters the impact of any such factor on inflation.*** Returning to equation **(3)**, *e.g.*, the neoclassical model implies that anything that increases (i) the weight the government puts on employment (A_g), or (ii) the effectiveness of surprise money in increasing employment, *i.e.* the slope of the Phillip's Curve, (α), or (iii) the government's desired levels of employment and/or inflation (N_g^* and/or π_g^*) increases discretionary inflation while (iv) anything that increases the natural rate of employment (N_n) lowers discretionary inflation. Contrarily, returning to equation **(4)**, inflation with an autonomous central bank is lower ($\pi_c^* < \pi_d^*$) and generally unaffected ($A_b = 0$) by these other considerations. Thus, as indicated in **(5)**, actual inflation, π, decreases proportionately from the discretionary level given in **(3)**, π_d^*, toward the commitment level given in **(4)**, π_c^*, as CBI increases. Therefore, the effect of CBI on inflation, $\frac{\partial \pi}{\partial CBI}$, is *not* constant,

as previously estimated, but rather is more (less) negative the higher (lower) discretionary inflation would have been relative to what commitment inflation would have been:

$$\frac{\partial \pi}{\partial CBI} = -[\pi_d^* - \pi_c^*] \qquad \textbf{(6)}$$

In substantive terms, **(6)** indicates that the anti-inflationary impact of CBI varies depending on the configuration of the other political, economic, structural, and institutional features of the setting in which the bank operates. If the political economy is such that inflationary pressures on the government are low, then π_d^* is little different from π_c^*. Each given free reign, the central bank and the current government would do little differently, so the bank's independence from the government hardly affects inflation in that country-time. If instead the political economy is characterized by great inflationary pressures on the government, then π_d^* is considerably higher than π_c^*, so the central bank would act quite differently from the government, given the chance. Since the bank can act differently only insofar as its independence allows, the degree of CBI matters quite a lot under these conditions. Thus the anti-inflationary effect of any given increment of CBI is greater (less) wherever the government has greater (less) incentive to pursue inflationary policies relative to the conservative central bank.[18]

For completeness, Appendix I formally details the full set of predictions emerging from the theory of CBI and inflation regarding the effect of CBI and the other parameters of the model on inflation $(\frac{\partial \pi}{\partial x_i})$ and how those effects change as each of the other parameters change $(\frac{\partial^2 \pi}{\partial x_i \partial x_j})$. Here I elaborate a subset of the implications more intuitively. *E.g.*, points (i) and (iii) above suggest that CBI reduces inflation more when left parties are in office than when right parties are. Since left governments place greater weight on employment relative to inflation, A_g, (and/or higher targeted employment, N_g^*, and/or inflation, π_g^*) than right governments, the former have higher discretionary inflation, π_d^*, than the latter. CBI, then, lowers inflation from that π_d^* down to π_c^* as it increases from zero to one, which implies greater reductions in inflation for any given increase in CBI under

left than under right governments. Notice the converse also: the same partisan distance between governments produces a lesser difference in inflation the greater is CBI. Points (ii) and (iv), to give another example, suggest that the institutional features of labor and goods markets, being relevant to the effectiveness of monetary expansion (α) and/or the natural rate of employment (N_n), likewise condition the anti-inflationary impact of CBI.

Regarding these labor- and goods-market institutions, Cukierman (1992, 39-42) notes that, in the neoclassical model, the employment motive to create surprise inflation only exists and therefore there is an inflationary bias to discretionary monetary-policy only to the degree that real wages are excessive so that employment is demand determined.[19] He suggests, further, that the monopoly power of unions might account for such excessiveness. The advancement there is to consider the natural rate of employment, N_n, a decreasing function of the excessiveness of real wages, ω, and ω in turn an increasing function of *union power*, U. A union or unions with some monopoly power target(s) a real wage which is higher than market clearing, thus produces a lower natural rate of employment, N_n. The *neocorporatism* or *coordinated wage/price bargaining* (CWB) literature[20] argues contrarily that CWB, as opposed to union power without coordination, produces real-wage restraint rather than real-wage excessiveness.[21] This is because encompassing wage/price bargaining units internalize the costs of excessive wage/price settlements whereas fragmented bargaining units can externalize them to greater extent.[22] Thus, the excessiveness of real wages, ω, is decreasing and so the natural rate of employment, N_n, is increasing in CWB.[23] Combining these two points, we have:

$$N_n = N_n(\omega(U,CWB)) \quad ; \quad \frac{\partial N_n}{\partial \omega} < 0 \ , \ \frac{\partial \omega}{\partial U} > 0 \ , \ \frac{\partial \omega}{\partial CWB} < 0 \qquad \textbf{(7)}$$

Substituting **(7)** back into **(3)** and **(4)** shows that discretionary inflation is increasing in union power, U, and decreasing in the coordination of wage/price bargaining, CWB, and that commitment inflation is less so. Therefore, CBI lowers inflation more the greater is union power and less the

greater is CWB, and *vice versa* that union power increases and CWB decreases inflation less the greater is CBI.

Further implications are not hard to discover. *E.g.*, discretionary inflation should also be decreasing in the trade-openness of the economy, T, since the real effectiveness of (surprise) money, α, is lower in more open economies [$\alpha = \alpha(T)$, $\alpha' < 0$; see Romer (1993)]. Similarly, absent policy to counter the effect, inflation abroad, π^a, tends to be imported; thus discretionary inflation increases with inflation abroad. These arguments now carry the further implications that CBI lowers inflation more the less trade-open the economy and the greater inflation abroad, and, conversely, greater trade-openness and lower inflation abroad lower domestic inflation by a lesser amount the greater is CBI.

Of course, like the broad conclusion that CBI lowers inflation, none of these more specific predictions are unique to the neoclassical theory. The contributions to Kraus and Salant (1977), Hirsch and Goldthorpe (1978), and Lindberg and Maier (1985), *e.g.*, offer a variety of arguments as to why and how trade-openness lowers inflation. The point here is rather more general: however one derives the models of inflation which would prevail if the government completely controlled monetary policy and of that which would prevail if instead the bank completely controlled it, the theory of CBI and inflation predicts that the inflation actually observed will be a weighted average of those two polar-cases. The weighted-average form implies that the effect of CBI on inflation, $\frac{\partial \pi}{\partial CBI}$, is not constant, as was implicit in previous empirical specifications such as illustrated in **Figure 1**, but rather depends on everything which would determine inflation in these two polar cases. I have highlighted partisanship, labor- and goods-market institutions, and international considerations in this regard; others might focus on government stability (Cukierman *et al.* 1992), or incentives for manipulation of the macroeconomy for electoral advantage (Nordhaus 1975).[24] Regardless, the higher is inflation under complete government control relative to inflation under

complete central bank control of monetary policy, the greater is the anti-inflationary impact of CBI [see **(6)**]. Conversely, the inflationary or anti-inflationary effects of other factors are greatest when CBI is low and least when CBI is high.

As an added benefit, the present formulation allows direct consideration of some critics' contention that CBI is epiphenomenal to the determination of inflation. Posen (1995a, 1995b), *e.g.*, argued recently that "effective financial opposition to inflation" (EFOI)—*i.e.*, anti-inflationary interests in society, and institutions and political factors aiding their access to government—are the causal factors behind both low inflation and high CBI.[25] However, while EFOI may, as Posen argues, bolster an independent central bank in its pursuit of low inflation, the argument here suggests that its impact on a politically responsive authority is likely to be even greater. Estimating the weighted-average model suggested by the theory of CBI and inflation, including EFOI among the factors to which bank and government might respond differently, will allow a comparison of the financial sector's anti-inflationary influence when the government controls monetary policy with its influence when the central bank controls monetary policy and will thereby provide a direct test of the epiphenomenality hypothesis.

In sum, previous estimations of the impact of CBI on inflation have missed the simple but very general and important point that observed inflation is a weighted average, and so the regression equations on which they are based have been mis-specified, yielding potentially misleading results.[26] Statistically, the problem could be viewed as "parameter averaging." In assuming the effect of CBI on inflation, $\frac{\partial \pi}{\partial CBI}$, to be constant, previous work may have provided reasonable estimates of the average impact of CBI across the various configurations of the other relevant factors which empirically obtained in the sample country-times. Symmetrically, the effects of other factors on inflation vary with CBI, and so previous estimations also provided only their average effects across the various levels of CBI obtaining in the sample. At best, such parameter averaging leaves

unexplored much of the information in the data and many of the implications of the theory, possibly misleading in so doing.[27] A specification embodying the weighted-average form of **(5)**, contrarily, would not only be more true to the theory; it would also provide more precise and more revealing estimates of the *varying* effects on inflation of an independent, conservative central bank and, conversely, of the other relevant factors included in the model.

III. Central bank independence and inflation: the empirical models

The appropriate empirical model to test the theory of CBI and inflation and to estimate its parameters therefore must embody the weighted-average form of **(5)**. In particular, as suggested above, we expect that discretionary inflation is a function, *inter alia*, of: (a) the partisanship of government, G; (b) union power, U; (c) the coordination of wage/price bargaining, CWB; (d) the trade-openness of the economy, T; (e) the strength of the financial sector in the polity, F; and (f) inflation abroad, π^a. The usual linear-additive model simply adds CBI to this list of (linear) determinants of inflation:

$$E(\pi_{i,t}) = \beta_0 + B_1' C_{i,t} + \beta_g G_{i,t-1} + \beta_f F_{i,t-1} + \beta_t T_{i,t-1} + \beta_u U_{i,t-1} + \beta_{cwb} CWB_i + \beta_{\pi a} \pi^a_{i,t-1} + \beta_{cbi,1} CBI_{i,t-1} \quad \textbf{(8)}$$

where $C_{i,t}$ is a vector of time-series controls and B_1 the vector of associated coefficients thereupon,[28] and the subscripts i and t refer to country[29] and year[30] respectively. If, controlling for these six other factors, CBI reduces inflation, then we expect $b_{cbi,1}<0$; if not—*e.g.*, if CBI were epiphenomenal controlling for these other factors (which, notice, include EFOI)—we would expect $b_{cbi,1} = 0$.

An empirical model which instead embodies the weighted-average format of **(5)** and which assumes that none of factors (a) through (f) above affect the inflation that a perfectly autonomous, conservative central bank would seek (*i.e.* which assumes, as standard in the literature, that π_b^* is constant and $A_b = 0$) could be written:

$$E(\pi) = \begin{array}{l} \beta_0 + B_1' C + \beta_{cbi,1} CBI \\ + \beta_g G + \beta_f F + \beta_t T + \beta_u U + \beta_{cwb} CWB + \beta_{\pi a} \pi^a \\ + \beta_{cbi,2} CBI \cdot (\beta_g G + \beta_f F + \beta_t T + \beta_u U + \beta_{cwb} CWB + \beta_{\pi a} \pi^a) \end{array} \quad \textbf{(9)}$$

where the country-year subscripts have been omitted for convenience. Notice that the usual linear-additive model, **(8)**, is nested within **(9)**. If the linear-additive model is correct, we should estimate $b_{cbi,1}<0$ and $b_{cbi,2} = 0$ so that **(9)** reduces exactly to **(8)**. If, on the other hand, the weighted-average model and our assumptions regarding autonomous bank behavior are correct we should estimate $b_{cbi,1} \leq 0$ and $b_{cbi,2} \approx -1$ so that (a) when CBI = 1, inflation is simply commitment inflation as estimated by $E(\pi_c^*) = b_0 + B_1' C + b_{cbi,1}$, (b) when CBI = 0, inflation is discretionary inflation estimated as $E(\pi_c^*) = b_0 + B_1' C + b_g G + b_t T + b_f F + b_{\pi a} \pi^a + b_u U + b_{cwb} CWB$, and (c) when 0<CBI<1 inflation is estimated as a weighted average of (a) and (b) with the weight on (a) given by the degree of CBI. If, controlling for these other factors, CBI is epiphenomenal or otherwise does not affect inflation in either modality, then we would estimate $b_{cbi,1} = b_{cbi,2} = 0$.

Finally, a model which allows all of factors (a) through (f) potentially to affect both the central bank's and the government's desired policy but possibly differently can be written as an interactive linear regression. All other factors interact with CBI thereby allowing each a different effect on inflation depending on the degree of CBI (and *vice versa*):

$$E(\pi) = \begin{array}{l} \beta_0 + B_1' C + \beta_{cbi,1} CBI \\ + \beta_g G + \beta_f F + \beta_t T + \beta_u U + \beta_{cwb} CWB + \beta_{\pi a} \pi^a \\ + \beta_{c,g} CBI \cdot G + \beta_{c,f} CBI \cdot F + \beta_{c,t} CBI \cdot T + \beta_{c,u} CBI \cdot U + \beta_{c,c} CBI \cdot CWB + \beta_{c,\pi a} CBI \cdot \pi^a \end{array} \quad \textbf{(10)}$$

Notice that models **(8)** and **(9)** are both nested within **(10)**. If the linear-additive **(8)** is correct, all the interactive coefficients in the third row of **(10)** should be zero, $b_{c,x} = 0$ *for all x*, and $b_{cbi,1}$ should be negative. Under these conditions, **(10)** reduces to **(8)**. If the restricted weighted-average **(9)** is

correct, *i.e.* if the bank's desired inflation is effectively some low constant, we expect $b_{cbi,1} \leq 0$ and each interactive coefficient, $b_{c,x}$, to be approximately the negative of its non-interacted counter-part, b_x; *i.e.*, $b_{c,x} \approx -b_x$ *for all x*. Under these conditions, **(10)** reduces to **(9)** with $b_{cbi,2} \approx -1$. The generality of **(10)** also allows some factors, *x*, to influence the desired policies of a perfectly autonomous central bank and of the government the same ($b_{c,x} = 0$, $b_x \neq 0$ *for such x*);[31] some *x* to influence both but differently ($b_{c,x} \neq 0$, $b_x \neq 0$, $b_{c,x} \neq -b_x$ *for such x*); some *x* to affect only the policy of a perfectly autonomous bank ($b_{c,x} \neq 0$, $b_x = 0$ *for such x*); and some *x* to influence only the government ($b_{c,x} \approx -b_x$, $b_x \neq 0$ *for such x*). Two further possibilities remain. For any *x* which affect neither the bank's nor the government's desired policy, we would find $b_{c,x} = 0$ *and* $b_x = 0$; and, finally, if CBI is epiphenomenal or has neither linear nor linear-interactive association with inflation, controlling for these *x*, then we expect $b_{cbi,1} = 0$ *and* $b_{c,x} = 0$ *for all x*.

Equation **(9)** is therefore a version of **(10)** constrained in a particular way (namely we force $b_x/b_{c,x} = b_z/b_{c,z}$ *for all x and z* to be true); the standard **(8)** is in turn a constrained version of **(9)** (forcing $b_{cbi,2} = 0$) and so of **(10)** as well (forcing $b_{c,x} = 0$ *for all x*). Alternative constraints on the most general **(10)** might be suggested by the theory and/or empirics—one such will be considered below—but first I reemphasize what is and is not being tested here.

Previously, regarding the theory, I emphasized that the neoclassical model of inflation and employment is not itself at issue here, nor, I now emphasize, is it being empirically tested. As the above discussion of the various empirical models reveals, the alternative hypotheses here are not neoclassical political economy and something else. Rather they are a theory of inflation in which monetary policy is controlled by a conservative central bank to a degree measured by CBI and controlled by the government to the remaining degree [as in **(9)** or **(10)**] against one in which CBI has a fixed negative effect on inflation (or no effect) controlling for other factors [as in **(8)**]. I

belabor the point that most alternative models of the macro-political-economy lead to these same predictions regarding inflation so as to emphasize the generality of the corrective being offered here to the theory and empirics of CBI and inflation. *Any model in which monetary policy affects inflation and in which CBI is defined as the degree of monetary-policy autonomy of a conservative central bank predicts that inflation is a weighted average such as in **(9)** or the more general **(10)**.*

Appendix II gives definitional details, sources, and descriptive statistics for the data, so I only briefly introduce them here. Government partisanship is measured by an index ranging from G = 0 at extreme left to G = 10 at extreme right ($G \in [0..10]$); union power, U, by union density (union membership as a proportion of the labor force: $U \in [0..1]$); coordination of wage/price bargaining, CWB, by a subjective index from 0 = none to 1 = full ($CWB \in [0,.25,.5,.75,1]$); trade-openness, T, by exports plus imports as a fraction of GDP ($T \in [0..2]$); financial-sector strength, F, by employment in that sector as a proportion of total ($F \in [0..1]$); inflation, π, by the GDP deflator ($\pi = x\%$); and inflation abroad, π^a, by average inflation across the *other* countries in the sample that year. The coefficient estimates are reported in Table 1 (standard errors in parentheses). See Appendix III for methodological details.

Equation **(10)** in column B is the most general, encompassing all the others, so I begin with it. One problem with models employing so many interactive factors are the inevitably high correlations among the independent variables, especially in a case like **(10)** where the six interactions all involve a common variable (CBI). The bivariate correlations in the present sample are as high as 0.84 (CBI and CBI·G) and 0.83 (CBI and CBI·F), and the R^2 of CBI regressed on the interactive factors is 0.93! The relatively large standard errors of model **(10)** were to be expected then. However, despite the severe multicollinearity, the results do indicate clearly enough that at least openness and inflation abroad, and possibly also union power, have different impacts on inflation when monetary policy is controlled by independent central banks than when it is controlled

by politically responsive governments. The estimated coefficients on these terms times CBI are individually significantly different from zero at the .02, .04, and .07 levels respectively; jointly they are significantly different from zero at the .03 level.[32]

Table 1: Alternative Models of Inflation in Developed Democracies, 1972-90

Parameter (*name of variable or group of variables*)			(A) Model **(8)**	(B) Model **(10)**	(C) Model **(11)**	(D) Model **(9)**
All Other Factors Besides CBI (X_1)	***Domestic Structural-Political Factors (X_2)***	β_g (G_{t-1})	**-.287** (*.096*)	**-.517** (*.311*)	**-.541** (*.187*)	**-.526** (*.156*)
		β_f (F_{t-1})	**-46.4** (*10.5*)	**-64.0** (*33.1*)	**-85.4** (*28.8*)	**-82.6** (*19.1*)
		β_t (T_{t-1})	**-1.10** (*.575*)	**-8.36** (*3.06*)	**-2.55** (*1.21*)	**-2.45** (*1.04*)
	Labor-Market Structural-Institutional Factors (X_3)	β_u (U_{t-1})	**+4.53** (*1.21*)	**+10.6** (*3.35*)	**+8.23** (*2.41*)	**+8.73** (*2.16*)
		β_{cwb} (*CWB*)	**-3.88** (*.775*)	**-4.84** (*1.97*)	**-6.58** (*1.72*)	**-7.15** (*1.44*)
	Foreign Inflation	$\beta_{\pi a}$ (π^a_{t-1})	**+.266** (*.097*)	**+.650** (*.212*)	**+.600** (*.210*)	**+.564** (*.164*)
CBI (non-interacted)		$\beta_{cbi,1}$ (CBI_{t-1})	**-2.33** (*.907*)	**-2.53** (*8.71*)	**-6.95** (*7.00*)	**-7.39** (*2.46*)
***CBI times effect of all other factors besides CBI* [Model (9)]**		$\beta_{cbi,2}$ ($CBI_{t-1} \cdot X_{1,t-1}$)	—	—	—	**-.838** (*.106*)
***CBI times effect of domestic structural-political factors* [Model (11)]**		$\beta_{cbi,3}$ ($CBI_{t-1} \cdot X_{2,t-1}$)	—	—	**-.875** (*.240*)	—
***CBI times effect of labor-market structural-institutional factors* [Model (11)]**		$\beta_{cbi,4}$ ($CBI_{t-1} \cdot X_{3,t-1}$)	—	—	**-.708** (*.201*)	—
***CBI times effect of foreign inflation* [Model (11)]**		$\beta_{cbi,5}$ ($CBI_{t-1} \cdot \beta_{\pi a} \cdot \pi^a_{t-1}$)	—	—	**-.942** (*.262*)	—
***Simple Interactions* [Model (10)]**		$\beta_{c,g}$ ($CBI_{t-1} \cdot G_{t-1}$)	—	**+.432** (*.671*)	—	—
		$\beta_{c,f}$ ($CBI_{t-1} \cdot F_{t-1}$)	—	**+15.8** (*59.3*)	—	—
		$\beta_{c,t}$ ($CBI_{t-1} \cdot T_{t-1}$)	—	**+14.7** (*6.12*)	—	—
		$\beta_{c,u}$ ($CBI_{t-1} \cdot U_{t-1}$)	—	**-10.4** (*5.74*)	—	—
		$\beta_{c,c}$ ($CBI_{t-1} \cdot CWB$)	—	**+.176** (*3.54*)	—	—
		$\beta_{c,\pi a}$ ($CBI_{t-1} \cdot \pi^a_{t-1}$)	—	**-.698** (*.331*)	—	—
Observations (Degrees of Freedom)			342 (332)	342 (326)	342 (329)	342 (331)
Adjusted R^2 (Standard Error of Regression)			.675 (2.675)	.688 (2.624)	.687 (2.625)	.689 (2.619)

NOTES: Coefficients on the constants and lagged dependent variables suppressed to conserve space. Available upon request. All models estimated in E-Views 2.0 by least squares—**(8)** and **(10)** by OLS and **(9)** and **(11)** by constrained LS—with Newey-West autocorrelation-and-heteroskedasticity-consistent variance-covariance matrices.

Perhaps the other expected interactions occur too, but the estimated standard errors are much too large in model **(10)** for us to distinguish them individually. That is, possibly owing to the high correlation among the interaction terms, only half of them are individually significant at the .10 level even though jointly the six interaction terms are significant at the .001 level. This latter result by itself suffices to reject the linear-additive model overwhelmingly in favor of a linear-interactive model, lending some credence to our weighted-average argument. The joint significance of all the terms involving CBI equally overwhelmingly ($p<.0005$) indicates that, even controlling for the size of the financial sector (our measure of EFOI, see note 25), CBI is *not* epiphenomenal. These two central conclusions will be repeated with equal or better statistical strength and substantive clarity as the specification is refined in columns C-D below. Many empirical researchers have, however, given up on our other central proposition—that the impact of any given institution depends on many other features of its political-economic environment—because of exactly the difficulty we are experiencing here: obtaining precise estimates of so many distinct interactive relationships is extremely difficult in practice since these latter virtually inevitably involve very highly correlated data. In this instance, though, theory can and should inform the empirical analysis in a manner suggesting a number of useful refinements of the model specification.

Theory strongly suggests the imposition of some restrictions on the precise type of interactive effects to consider, and these restrictions enable us to obtain more precise and more substantively relevant estimates of the interactive effects in question. In particular, we expect inflation to be determined not by just any set of interactive effects but rather by a *weighted average* formulation in which π_d^* is reduced *proportionately* down to π_c^* as CBI increases from 0 to 1. Moreover, we can group the six other variables being considered here into three sets of political-

economic factors:

> (a) those which should impact inflation primarily by determining the composition of political forces pressuring policy-makers for or against inflation—*i.e.* by altering the parameters of the discretionary authority's utility function—these *domestic structural-political factors* include partisanship, financial-sector strength, and trade openness;
>
> (b) those which should affect inflation primarily by their impact on labor markets and thereby on the economic realities facing policy-makers—these *labor-market structural-institutional factors* include union power and coordinated wage-/price bargaining; and
>
> (c) those which should impact domestic inflation almost automatically *via* the nation's position in the international economy—inflation abroad comprises this last category.

Let us consider, then, whether CBI mitigates the impacts of each factor proportionately, assuming the rate of mitigation to be the same within type of factor, (a)-(c), but allowing it possibly to differ across types since the source of each type's impact on inflation differs.

I examine this possibility first by considering whether, in model **(10)**, we can reject the hypotheses (i) $\beta_{c,g}/\beta_g = \beta_{c,f}/\beta_f = \beta_{c,t}/\beta_t$ and (ii) $\beta_{c,u}/\beta_u = \beta_{c,cwb}/\beta_{cwb}$. These state that central bank independence proportionately reduces the inflationary impact of (i) all three domestic structural-political factors equally and (ii) both labor-market structural-institutional factors equally. The test results are not even close to statistically significant rejection ($p \approx .82$, $p \approx .96$ respectively individually, and $p \approx .90$ jointly). Meanwhile, we can easily reject (iii) $\beta_{c,g}/\beta_g = \beta_{c,f}/\beta_f = \beta_{c,t}/\beta_t \geq 0$, (iv) $\beta_{c,u}/\beta_u = \beta_{c,cwb}/\beta_{cwb} \geq 0$, and (v) $\beta_{c,\pi a}/\beta_{\pi a} \geq 0$ at the $p<.000001$, $p \approx .002$, and $p<.00001$ levels respectively. The lack of empirical evidence against [tests (i)-(ii)], the strong empirical suggestion for [tests (iii)-(v)], and the theoretical argument for this "three-part proportionality" jointly make a strong case that we might benefit from imposing this structure *a priori* on the model to be estimated. In so doing, we begin to moderate the demands estimation of the model puts upon the highly correlated data because we are abandoning the attempt to estimate six distinct interactive effects, the only restriction on which was that they be linear-interactive, and attempting instead to estimate (from the same data) only three distinct interactions, grouped by the substantive source of

their expected impacts, and restricting those to be specifically linear-proportionate interactions. The latter is clearly a less onerous task. The model of column D, which undertakes that task, is:

$$\begin{aligned} E(\pi) \;=\; & \beta_0 + \mathbf{B}_1' C + \beta_{cbi,1} CBI + \beta_g G + \beta_f F + \beta_t T + \beta_u U + \beta_{cwb} CWB + \beta_{\pi a} \pi^a \\ & + \beta_{cbi,3} CBI \cdot (\beta_g G + \beta_f F + \beta_t T) + \beta_{cbi,4} CBI \cdot (\beta_u U + \beta_{cwb} CWB) + \beta_{cbi,5} CBI \cdot (\beta_{\pi a} \pi^a) \end{aligned} \quad \textbf{(11)}$$

How do the empirical results from estimating **(11)** compare to those of the unrestricted linear-interactive model **(10)**? First, hypothesis tests (i)-(ii) just reported demonstrate that model **(11)** cannot be rejected as a restriction on **(10)**. Notice, second, that model **(11)** has three more degrees of freedom than the unconstrained linear-interactive model **(10)** but that, notwithstanding its greater parsimony, model **(11)** has essentially the same standard error of the regression. *I.e.*, adjusting for degrees of freedom, the more parsimonious model fits the data as well as the less parsimonious. Third, as a result of these advantages, the coefficients of model **(11)** are generally more precisely estimated (have smaller standard errors) than their relevant counterparts from **(10)**.[33] In short, by any criteria except generality—and against that are the corresponding gains in parsimony—model **(11)** is superior to model **(10)**.[34]

Model **(11)**, like **(10)** before it, unambiguously supports the weighted-average over the linear-additive specification [model **(8)**, column A]. Even adjusting for its fewer degrees of freedom, the model fits the data better (smaller standard error of the regression). More importantly, the joint-hypothesis test H_0: $\beta_{cbi,3} = \beta_{cbi,4} = \beta_{cbi,5} = 0$, which directly tests the linear-additive model **(8)** against the three-part weighted-average model **(11)**, is overwhelmingly rejected ($p<.000001$). The epiphenominality hypothesis, H_0: $\beta_{cbi,1} = \beta_{cbi,3} = \beta_{cbi,4} = \beta_{cbi,5} = 0$, is equally soundly rejected. Finally, in regard to the degree to which CBI reduces the impact of other political-economic factors on inflation, this model suggests that a fully independent central bank could resist 94.2% of the inflationary effects stemming from inflation abroad ($b_{cbi,5} \approx -.942$) but only about 87.5% and 70.8%

of the inflationary effects stemming from domestic political-structural and labor-market structural-institutional factors ($b_{cbi,3} \approx -.875$ and $b_{cbi,4} \approx -.708$) respectively. However, these differences are neither individually nor jointly significant: $\beta_{cbi,3} = \beta_{cbi,4}$; $\beta_{cbi,3} = \beta_{cbi,5}$; $\beta_{cbi,4} = \beta_{cbi,5}$; $\beta_{cbi,3} = \beta_{cbi,4} = \beta_{cbi,5}$ all fail to be rejected by substantial margins ($p \approx .50$, $p \approx .88$, $p \approx .55$, and $p \approx .67$ respectively).

In sum, model **(11)** enables us to say with some certainty that the effect of CBI on inflation depends on domestic political-structural factors ($\beta_{cbi,3} = 0$ is rejected at $p \approx .0003$), depends also on labor-market structural-institutional factors ($\beta_{cbi,4} = 0$ is rejected at $p \approx .0015$), and also on international conditions as reflected in inflation abroad ($\beta_{cbi,5} = 0$ is rejected at $p \approx .0004$). The converses are likewise implied at the same significance levels; the impact of each type of other political-economic factor depends on the degree of CBI in the country-time where they occur. We cannot say with much confidence yet, however, how large of a mitigating effect CBI has on the inflationary impacts of these other factors. The 95% confidence intervals for the relevant estimates, $\beta_{cbi,3}$, $\beta_{cbi,4}$, $\beta_{cbi,5}$, overlap considerably and stretch from about -.26 (implying a 26% mitigation) to about -1.46 (implying a 146% mitigation[35]).

Since, empirically, we cannot reject that CBI proportionately mitigates the inflationary impacts of all other political-economic factors at equal rates, and since, theoretically, equal mitigation is as plausible as unequal, I next consider model **(9)** which imposes equal, proportionate reduction by CBI of the inflationary impacts of other factors as a constraint on the estimation.

Notice first that this simple weighted-average model fits the data better, adjusting for degrees of freedom, than any of the others (*i.e.*, it has the smallest standard error). Second, the evidence continues to support the weighted-average-interactive model over the linear-additive model. In column D, the relevant statistical test of this is simply the t-test on whether the coefficient $\beta_{cbi,2} = 0$; that is soundly rejected ($p < .0000005$). Third, the epiphenomenality argument is equally soundly rejected (the relevant test is whether $\beta_{cbi,1} = \beta_{cbi,2} = 0$ which has even lower p). Fourth and finally,

we now have reasonably precise estimates of all coefficients. In particular, the 95% confidence interval for the degree to which CBI mitigates the inflationary impacts of other political-economic factors is now reasonably compact, stretching from about 63% to about 104%, with a point-estimate of about 83.8% mitigation ($b_{cbi,2} \approx -.838$). Additionally, we continue to have considerable confidence that each of the other six factors which we have considered here does indeed impact the level of inflation that would prevail if the government completely controlled monetary policy (all but T, which is significant at $p \approx .019$, are significant at better than the $p \approx .001$ level). In short, by any reasonable criteria, model **(9)** is preferred over any of the others, and its estimates strongly support all of our central contentions. I proceed now to consider the substantive and theoretical implications of these findings, using model **(9)** as the basis for discussion.

IV. Substantive and Theoretical Implications

Consider first the epiphenominality argument. The argument would imply that, controlling for other anti-inflationary influences in the polity, especially financial-sector strength, central bank independence has no remaining effect on inflation. We can reject this hypothesis at the .01 level in the linear model, at the .0005 level in the unconstrained interactive model, and at the .000001 level in the fully-constrained (weighted-average) model. There can be no question, therefore, that the degree of CBI affects inflation, even controlling for financial-sector strength. Rather than simple epiphenominality, these results support a subtler understanding of the impact of CBI on inflation. CBI does indeed have little (further) anti-inflationary impact when the structure of the polity and economy would have produced low inflation anyway, but when the political economy is otherwise structured so as to produce higher inflation, the anti-inflationary impact of CBI is great.[36]

Note next that **(9)**, like the unconstrained **(10)** and model **(11)** between them, overwhelmingly supports the weighted-average specification over the simple linear-additive

specification previously estimated in the literature. This is seen most simply in that $b_{cbi,2}$ is overwhelmingly significant (and in fact not far from -1 as we would expect if the bank targeted relatively constant, low inflation);[37] the joint-hypothesis tests that the interaction terms in **(10)** all have coefficients of zero and that $\beta_{cbi,3} = \beta_{cbi,4} = \beta_{cbi,5} = 0$ in model **(11)** establish the same empirical fact at least as strongly if less transparently.

I conclude, therefore, that inflation is indeed a weighted-average of the rates sought by central banks and governments with the weight on the former given by the degree of CBI. Thus, the anti-inflationary impact of CBI depends on a range of other features of the political economy in which it operates. Specifically, CBI has most anti-inflationary bite when (a) the government is most left, (b) union density is highest, (c) the economy is least open, (d) inflation abroad is highest, (e) the financial sector is smallest, and (f) coordination of wage/price bargaining is lowest, and **vice versa.** ***Conversely, the impact of these other factors on inflation, positive or negative, is greatest when CBI is lowest and least when CBI is highest.***

I now examine a small subset of these findings more closely so as to highlight the substantive importance of the weighted-average corrective offered here, beginning with the impact of international conditions on domestic inflation. One interesting question, *e.g.*, concerns the effect of the collapse of the Bretton Woods fixed-exchange-rate regime and the first oil crisis on inflation in developed democracies. Average inflation in the OECD rose about 4.6 points from year-end 1972 to year-end 1974 (around the time of the first oil crisis and just after the fall of Bretton Woods). Taking this 4.6% jump as an admittedly crude estimate of the (assumed exogenous) foreign-inflation shock with which OPEC and the Bretton-Woods collapse hit the OECD, our estimates indicate that the response of domestic inflation thereto will have varied across countries according to the independence of their central banks as depicted in **Figure 2**.

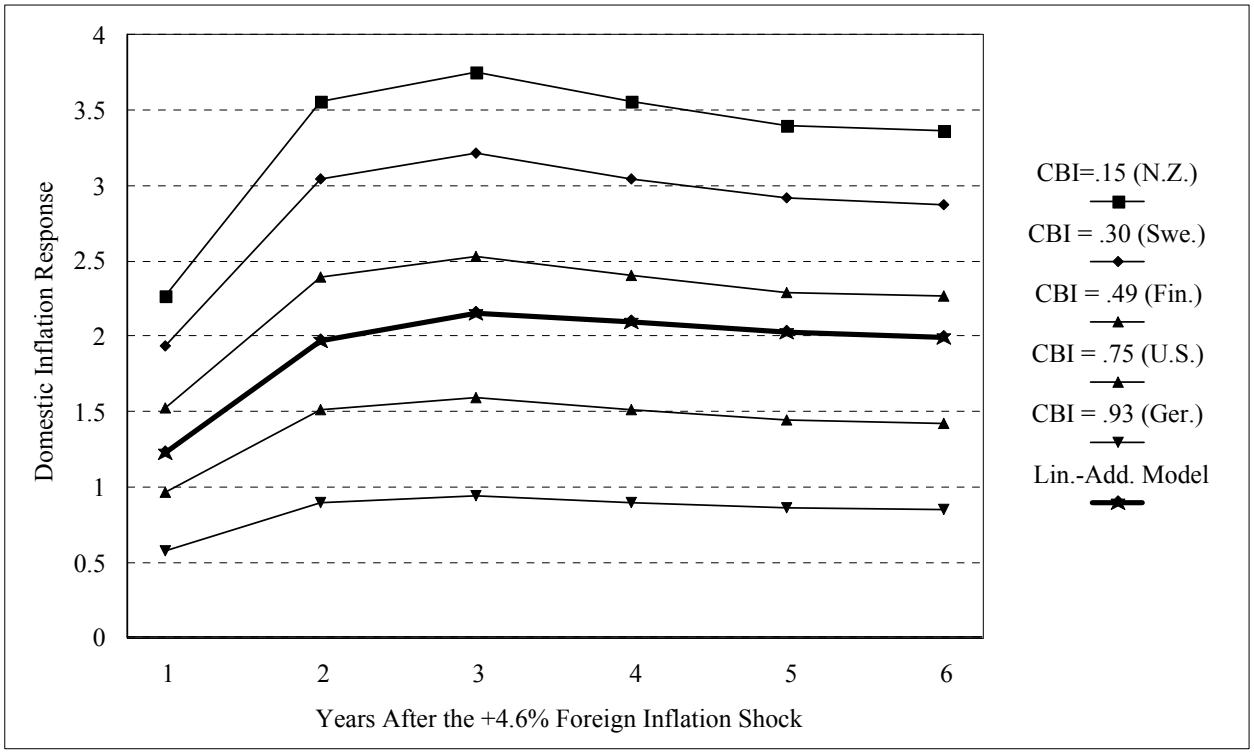

Figure 2: The response of domestic inflation to the Bretton Woods collapse and the first oil crisis (a +4.6% foreign inflation shock by assumption), as a function of the degree of central bank independence characterizing the domestic political economy.

The graphic shows an initial response in New Zealand (the lowest CBI in our sample, 0.15±) of about +2.25%, rising to almost +3.75% after three years, then settling back to about +3.4% in the long run (7 years ± by our estimates). In Finland (CBI≈0.49), the estimated immediate response to the same shock is only about +1.5%, with a peak effect around +2.5%, and a long-run effect around +2.25%. In the country with the most independent central bank, Germany (CBI≈0.93), domestic inflation hardly responds at all to such foreign developments: the analogous estimates being +.57%, +.95%, +.86%. The standard linear-additive model would have concluded, contrarily and quite incorrectly, that all countries incurred an immediate +1.2%, a peak +2.2%, and a long-run +2% impetus to inflation from these events (the response shown in bold in **Figure 2**).[38] More generally and substantively, the linear-additive model simply misses that more independent central banks successfully resisted more of the inflationary impulse originating from the international arena during this time (and others) than more dependent banks could.

Next, consider the effects of government partisanship on inflation. Our results indicate both that CBI has greater anti-inflationary impact under left than under right governments and that the difference between inflation under left and right governments is greater the more dependent is the central bank. **Figure 3** illustrates how this differs from the somewhat misleading conclusions one would draw from the linear-additive model.

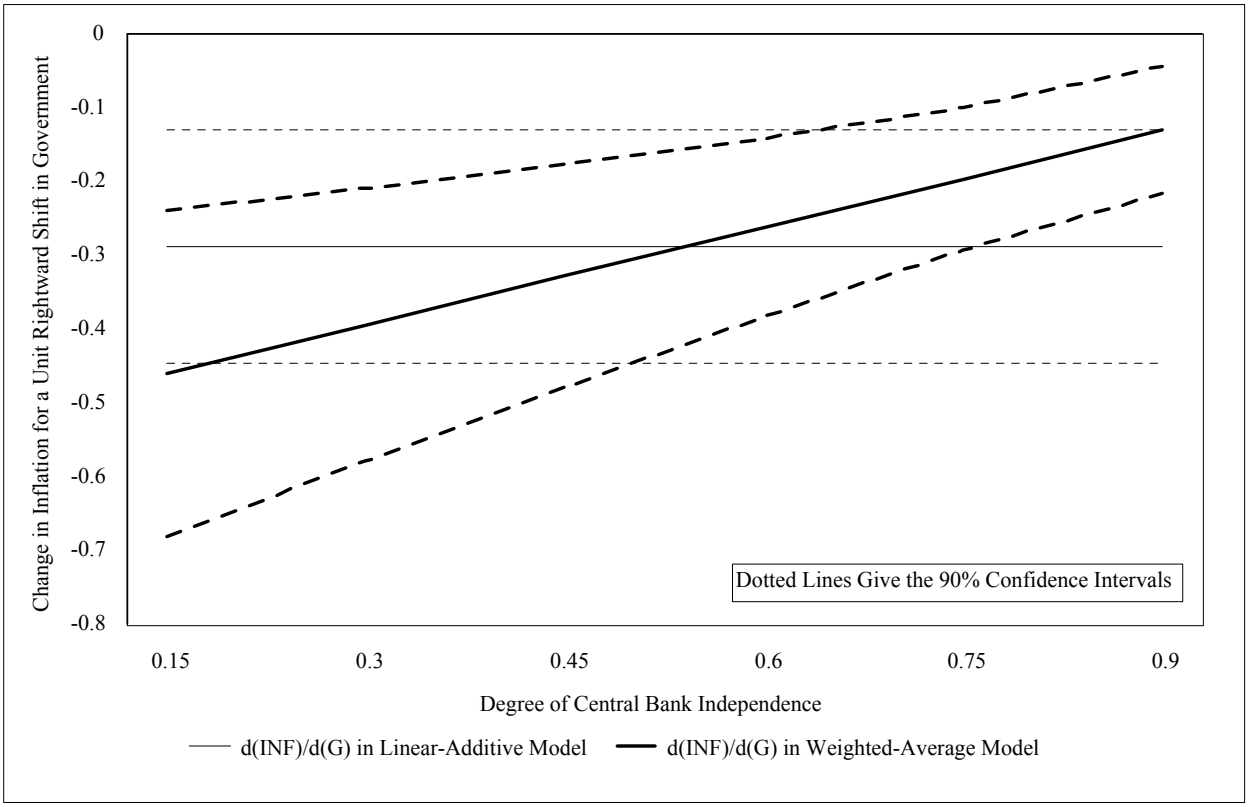

Figure 3: The estimated response of domestic inflation to a one-unit rightward shift in government partisanship, as a function of the degree of central bank independence characterizing the domestic political economy.

The linear-additive model estimates that a one-unit rightward shift in government partisanship—for comparison: about the ideological distance between a typical US government led by a Republican president versus one led by a Democrat—always produces about a .3% decrease in inflation, with a 90% confidence interval on that estimate stretching from -.13% to -.45%. The weighted-average model, however, demonstrates that this estimate is considerably inaccurate in countries with low or high CBI (including the US in fact). Where CBI is extremely low, such as it

was in New Zealand, the same one-unit rightward shift would produce a .46% reduction in inflation (90% c.i. = [-.24..-.68]), while where CBI is extremely high, as in Germany, that same one-unit rightward shift would only produce a .12% decrease in inflation (90% c.i. = [-.03..-.20]). Thus, *ceteris paribus*, identical ideological swings in New Zealand would have produced[39] movements in inflation over 150% as large as those estimated by the linear-additive model, while ideological swings in Germany would produce movements in inflation only about 40% as large.

Also, over most of the sample range of CBI, the confidence interval for the impact of partisanship is smaller in the weighted-average than in the linear-additive model as **Figure 3** illustrates. This demonstrates that the more precise specification of the weighted-average model provides for more precise estimates (*i.e.*, smaller standard errors) of the substantive impact of, *e.g.*, partisanship as well as truer estimates of it (*i.e.*, estimates which vary according to the degree of CBI as, substantively, they should). The same two benefits accrue to the weighted-average model's estimates of the impact of CBI and of all the other variables in the model. Trade openness, e.g., is considerably more significant in the weighted-average model ($p \approx .037$)[40] than in the linear-additive model ($p \approx .056$). This suggests that, had it been a closer call, the linear-additive model could easily have caused the researcher to erroneously conclude that trade openness had no perceivable effect on inflation. This point is worth elaborating.

Because the linear-additive model averages the varying impact of other political-economic factors across the empirically existing range of CBI, it tends to underestimate considerably the substantive magnitude of these effects *per se* (*i.e.*, apart from their mitigation by CBI). *E.g.*, in an environment with a perfectly dependent central bank, the impact of trade openness (T) is more than twice its average impact across all types of banks as estimated by the linear-additive model. The former is also unambiguously significant ($p \approx .019$, see also note 39) while the latter is more marginally so ($p \approx .056$). Additionally, the mis-specification of the linear-additive model also

contributes to statistical inefficiency (*i.e.*, higher standard errors than the lowest possible given the information in the data which further hinders the discovery of effects which actually exist. In sum: by failing to incorporate the manner in which the inflationary impacts of other political, economic, institutional, and structural factors depend upon the degree of independence of the central bank, previous estimates of those impacts have understated or, more precisely, mis-stated them and, in so doing, may well have caused researchers to fail to find them.

Specifically regarding political and partisan business cycles, previous evidence of which is often viewed as weak, the implications of the present analysis are profound. *E.g.*, a US government with a Republican president and one with a Democratic president are typically about 1 point apart on our scale (from 6.5± to 5.5± depending on the partisan composition of Congress). Thus, were the Federal Reserve perfectly dependent (CBI = 0), and were typical Democratic- and Republican-president governments to oscillate in office for one term each, then inflation would tend, *ceteris paribus*, to oscillate with an amplitude of about .9% as illustrated by the dashed line in **Figure 4**. If, on the other hand, the Fed were perfectly independent (CBI = 1), inflation would hardly oscillate at all (amplitude<.1%) in response to these government partisanship changes, as given by the dotted line. And if, as is the case, the Fed has about 0.75 independence, the partisan-induced oscillation would be mitigated by about 63% [*i.e.*, .75·(-.838)], to an amplitude of a little over 0.3%, as given by the heavier solid line. This much smaller amplitude might easily have been missed by a scholar focusing on the US case, not because partisan cycles do not exist, but because the Fed so reduces them in US monetary policy that they are hard to discover.[41] Following the same logic, the comparative political economist should expect larger partisan cycles in inflation, *ceteris paribus*, where central banks are more dependent and smaller partisan cycles where they are more independent.[42,43]

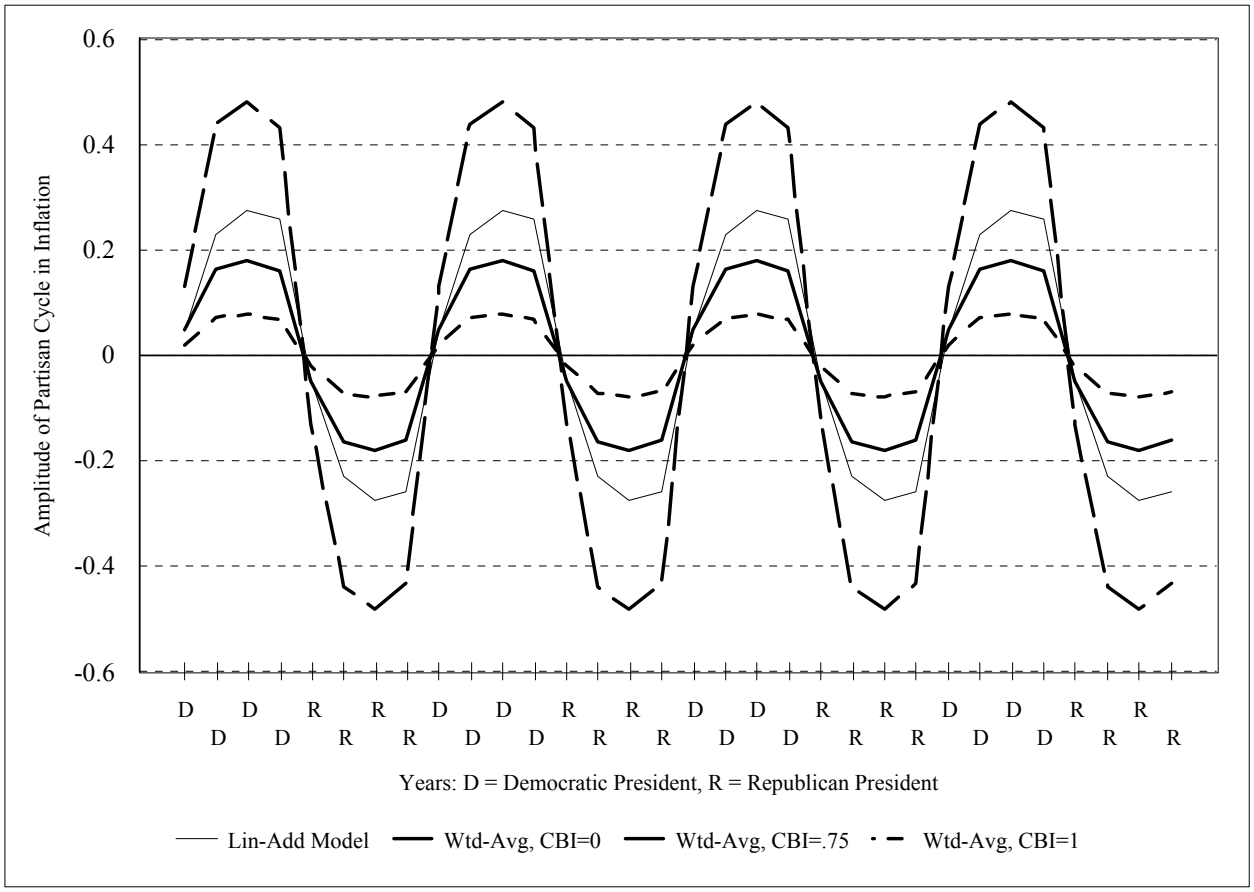

Figure 4: Mitigation of partisan cycles in inflation by the degree of independent of the central bank.

Finally, it is useful to conclude with a direct comparison of the estimated impact of CBI on inflation in various country times from the weighted-average model and from the linear-additive model which it theoretically and empirically dominates. As **Figure 5** reveals, the linear-additive model estimates a constant anti-inflation benefit for each bank which depends only on its degree of independence; countries with high CBI like the US are estimated to have received some (fixed) inflation benefit while those with lower CBI like Japan received a lesser (but still fixed) benefit. However, both across time and across countries, this estimate can be considerably misleading because, as strikingly demonstrated by the superimposed estimates from the weighted-average model, the anti-inflationary impact of CBI has varied dramatically as the domestic and international political, structural, and institutional features of developed democracies have varied.

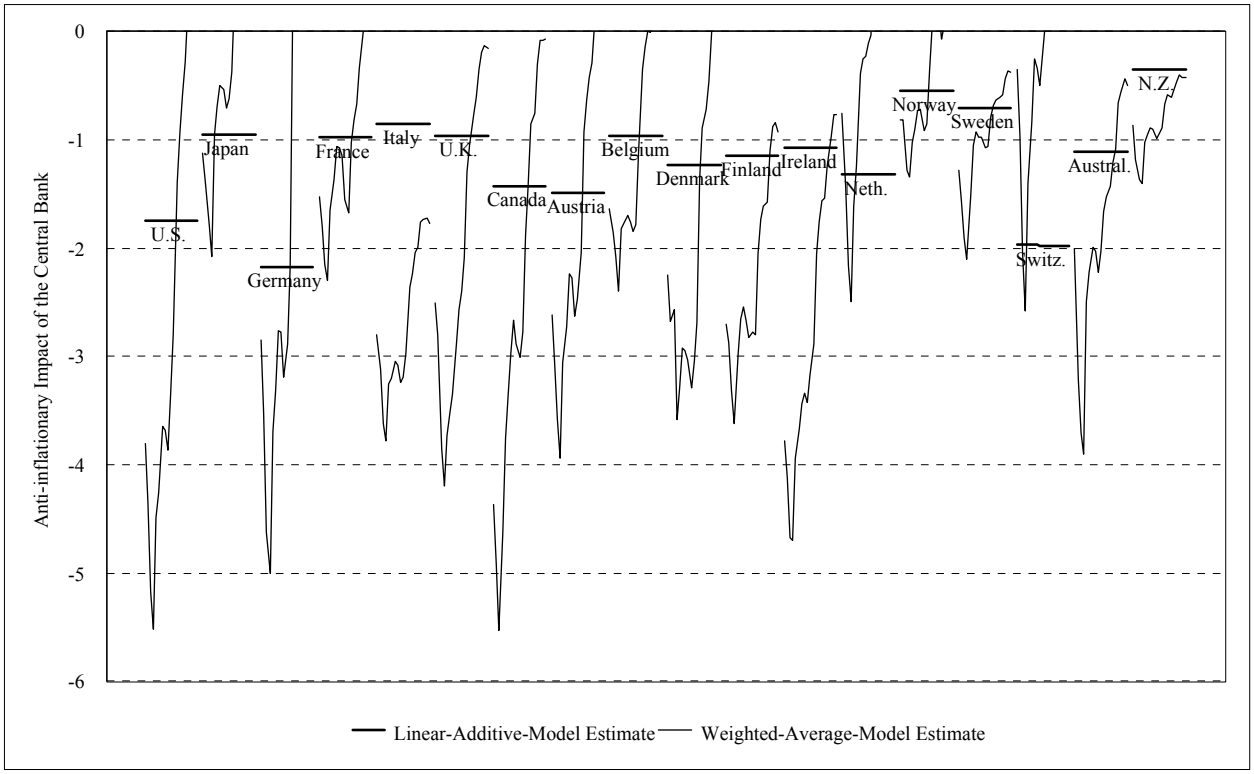

Figure 5 Comparison of the linear-additive and weighted-average estimates of the anti-inflationary impacts of OECD central banks given their degree of independence and the level of other variables in that country-year. The data for each country are from 1972 to 1990, left to right.

One fact highlighted by **Figure 5** is that the anti-inflationary benefit of CBI has been declining in all countries since around the early 1980s, implying that the political economies of developed democracies have been becoming increasingly anti-inflationary with or without highly independent central banks. This is largely due to two structural trends: increasing trade-openness and increasing financial-sector strength (and in some places also increasing right-partisanship). In fact, so strong have these anti-inflationary forces become that in most countries today, the central bank adds nothing further to the anti-inflationary stance of monetary policy however independent it may be.[44] In only 6 of 18 developed democracies (Italy, Finland, Ireland, Sweden, Australia, and New Zealand) is there any further anti-inflationary bite to be gained from increasing CBI, whereas, at least through the early 1980s, CBI provided large anti-inflation benefits everywhere.

Considering that independence of the central bank is now increasingly superfluous as an anti-inflation device, why so many of these countries have moved now and not before to increase CBI

is a puzzle. Certainly part of the tale lies in the new theories of CBI and the regulation of inflation and the real economy, but an inter-temporal perspective on the present theory and evidence may add to our understanding this conjunction of events as well. CBI today has little anti-inflationary impact because the structure of political interests is such that discretionary policy-makers would pursue anti-inflationary policy anyway. That is to say that anti-inflationary forces currently hold the political edge. CBI will be most needed, from the anti-inflationary standpoint, should such forces lose control. Thus, what we are observing now are anti-inflationary forces using their current political strength to establish (*i.e.*, institutionalize) or strengthen the independence of their central banks so that the bank might continue to serve anti-inflationary interests should the structure of the economy and polity turn inflationary in the future. This logic suggests, conversely, that when CBI is most valuable in terms of its anti-inflationary effects is exactly when it is hardest to establish because that is when less anti-inflationary forces hold sway. Assuming political actors understand this dynamic and have some foresight, we should therefore expect pro-CBI forces to be on the offensive when they hold sway even though CBI is least necessary then, and anti-CBI forces to be on the offensive when they hold sway even though CBI would have greatest anti-inflationary impact then.

This suggests, finally, that institutions are endogenous not that they are epiphenomenal. Because institutions (*e.g.* CBI) often adjust discretely (*i.e.*, "lumpily"), with a lag, and with considerable error to the balance of political forces that favor or oppose them, the current institutional structure (including the degree of CBI) will rarely be in line with the current balance of forces in the political economy. Thus, institutions such as CBI may be endogenous, as just suggested, but they are not and CBI is not generally epiphenomenal.

V. Conclusion

The conclusions are both theoretical and empirical, specific and general. Theoretically and

specifically, we have shown that the predictions of the central bank independence literature regarding inflation are more precise (and correctly so) than previous empirical analyses have credited. *I.e.*, the argument is not merely that CBI reduces inflation *ceteris paribus* as the previous linear-additive empirical models have amply demonstrated. Rather, the theory states and the evidence reveals (once the test equations are properly specified) that how much CBI reduces inflation depends on the domestic and international economic, political, institutional, and structural characteristics of the country-year in which the bank operates because these considerations determine the inflation that would prevail in the absence of CBI. Conversely, the impact of other domestic and international economic, political, institutional, and structural characteristics on inflation all depend on the degree of CBI in the country-year in which they occur.

Empirically and specifically, the failure of previous literature to specify test equations which embodied these theoretical expectations resulted in mis-specification which provided estimates of only the average impacts of CBI and other variables across the various configurations of those other variables and CBI occurring in the sample country-times. That mis-specification, by fostering imprecise coefficient estimates, may well have obscured empirical relationships which in fact exist (*e.g.*, political and partisan business cycles). More broadly, the present exercise has demonstrated that the appropriate application of theoretically derived restrictions on empirical estimation can aid researchers seeking evidence for or against the complex, interactive hypotheses which are the hallmark of institutional political economy in particular and political science in general.

The results also suggest that moves toward (away from) CBI are most likely when that institution would have the least (most) anti-inflationary benefits. This is because pro-CBI forces will seek to establish greater CBI when they hold political sway, not because it is currently necessary but because it is currently possible and may become necessary in the future when, if established, it will be harder to remove. Anti-CBI forces should act analogously when they hold political sway, which

will be when CBI would have most anti-inflationary bite. For now, this is merely conjecture, but the notion may suggest avenues for further theoretical development in endogenizing CBI in particular and institutions in general.

Finally, I hold the foregoing exercise to have been illustrative of a broader point regarding institutional political economy. Political economic outcomes are produced by the *interaction* of the set of (a) domestic and international, (b) economic and political, and (c) structural and institutional factors operating in any given point in space and time. Indeed, many researchers have long recognized this to be true not only of political economy but of political science and even of social science more generally. However, the unavoidable limitations of social science and its data have led scholars either to abandon quantitative analysis of such complicated phenomenon or to conduct quantitative analysis of less general, more limited models which explore few if any of the interactions we suspect are present. I hope that this work has demonstrated that an alternative compromise exists and can be fruitfully exploited. We can use our theories to narrow the range and types of possible interactions over which we search, moving beyond linear-additive and linear-interactive models, and we may find it both statistically efficient and theoretically rewarding to do so.

<u>Appendix I:</u> Formal Statement of the Predictions of the Theory of CBI and Inflation

The first-order predictions of the theory of CBI and inflation are that inflation is decreasing in *CBI* and N_n, and increasing in π_b^*, π_g^*, α, A_b, A_g, N_g^*, and N_b^*. Anything which may be argued to affect these parameters will likewise affect inflation, in accordance with the following relationships:

First-Order Predictions of the Theory of CBI and Inflation

The effect of CBI on inflation . . . . . $\frac{\partial \pi}{\partial CBI} = -[\pi_d^* - \pi_c^*] = -[\pi_g^* - \pi_b^* + A_g \alpha (N_g - N_n) - A_b \alpha (N_b - N_n)] < 0$.

The effect of the government's inflation-target on inflation . . . . . $\frac{\partial \pi}{\partial \pi_g^*} = 1 - CBI \geq 0$.

The effect of the bank's inflation-target on inflation . . . . . $\frac{\partial \pi}{\partial \pi_b^*} = CBI \geq 0$.

The effect of the government's weight on employment relative to inflation on inflation . . . . . $\frac{\partial \pi}{\partial A_g} = \alpha(1 - CBI)(N_g^* - N_n) \geq 0$.

The effect of the bank's weight on employment relative to inflation on inflation . . . . . $\frac{\partial \pi}{\partial A_b} = \alpha(CBI)(N_b^* - N_n) \geq 0$.

The effect of the government's employment-target on inflation . . . $\frac{\partial \pi}{\partial N_g^*} = \alpha(1 - CBI)A_g \geq 0$.

The effect of the bank's employment-target on inflation . . . . . $\frac{\partial \pi}{\partial N_b^*} = \alpha(CBI)A_b \geq 0$.

The effect of the natural rate of employment on inflation $\frac{\partial \pi}{\partial N_n} = -\alpha[A_g - CBI(A_g - A_b)] \leq 0$.

The effect of the effectiveness of surprise inflation in increasing employment (*i.e.*, the slope of the Phillips Curve) on inflation . . . . . $\frac{\partial \pi}{\partial \alpha} = (CBI)A_b(N_b^* - N_g) + (1 - CBI)A_g(N_g^* - N_n) \geq 0$.

The second-order predictions are that each of these parameters affects inflation in a way which depends on at least one of the other factors. Therefore, the impact on inflation of *any* political, economic, institutional, or structural characteristic which determines *CBI*, N_n, π_b^*, π_g^*, α, A_b, A_g, N_g^*, and/or N_b^* depends on other political, economic, institutional, and/or structural characteristics operating in that environment which also determine *CBI*, N_n, π_b^*, π_g^*, α, A_b, A_g, N_g^*, and/or N_b^*. Formally, these second-order predictions can be listed as cross-derivatives:

Second-Order (Interactive) Predictions of the Theory of CBI and Inflation

Statement	Converse	Formally
The effect of CBI on inflation depends on the government's target inflation.	The effect of the government's target inflation on inflation depends on CBI.	$\frac{\partial^2\pi}{\partial CBI\partial\pi_g^*}\equiv\frac{\partial^2\pi}{\partial\pi_g^*\partial CBI}=-1$
The effect of CBI on inflation depends on the bank's target inflation.	The effect of the bank's target inflation on inflation depends on CBI.	$\frac{\partial^2\pi}{\partial CBI\partial\pi_b^*}\equiv\frac{\partial^2\pi}{\partial\pi_b^*\partial CBI}=1$
The effect of CBI on inflation depends on the government's weight on employment.	The effect of the government's weight on employment on inflation depends on CBI.	$\frac{\partial^2\pi}{\partial CBI\partial A_g}\equiv\frac{\partial^2\pi}{\partial A_g\partial CBI}=-\alpha(N_g^*-N_n)<0$
The effect of CBI on inflation depends on the bank's weight on employment.	The effect of the bank's weight on employment on inflation depends on CBI.	$\frac{\partial^2\pi}{\partial CBI\partial A_b}\equiv\frac{\partial^2\pi}{\partial A_b\partial CBI}=\alpha(N_b^*-N_n)\geq 0$
The effect of CBI on inflation depends on the government's target employment.	The effect of the government's target employment on inflation depends on CBI.	$\frac{\partial^2\pi}{\partial CBI\partial N_g^*}\equiv\frac{\partial^2\pi}{\partial N_g^*\partial CBI}=-A_g\alpha<0$
The effect of CBI on inflation depends on the bank's target employment.	The effect of the bank's target employment on inflation depends on CBI.	$\frac{\partial^2\pi}{\partial CBI\partial N_b^*}\equiv\frac{\partial^2\pi}{\partial N_b^*\partial CBI}=A_b\alpha\geq 0$
The effect of CBI on inflation depends on the natural rate of employment.	The effect of the natural rate of employment on inflation depends on CBI.	$\frac{\partial^2\pi}{\partial CBI\partial N_n}\equiv\frac{\partial^2\pi}{\partial N_n\partial CBI}=\alpha(A_g-A_b)>0$
The effect of CBI on inflation depends on the slope of the Phillips Curve.	The effect of the slope of the Phillips Curve on inflation depends on CBI.	$\frac{\partial^2\pi}{\partial CBI\partial\alpha}\equiv\frac{\partial^2\pi}{\partial\alpha\partial CBI}=$ $-[A_g(N_g-N_n)-A_b(N_b-N_n)]<0$

Appendix II: Data Definitions, Sources, and Descriptive Statistics

This appendix describes all of the data used in the text. Unless otherwise noted, all data are annual from 1972 to 1990 in 18 OECD countries: the US, Japan, (West) Germany, France, Italy, the UK, Canada, Austria, Belgium, Denmark, Finland, Ireland, the Netherlands, Norway, Sweden, Switzerland, Australia, and New Zealand.

π: GDP-deflator Inflation (x%). Taken from Layard, *et al.* (1991).

CBI: Central Bank Independence (0-1). The average of the 5 most commonly used indicators of CBI in the literature: LVAU and QVAU from Cukierman (1992), EC and POL from Grilli, *et al.* (1991), and the original index from Bade and Parkin (1982). [*N.b.* Alesina's commonly-cited index is based on this last source (personal communications).] Since Cukierman's LVAU (potentially) varies by "decade": 1950-9, 1960-72, 1973-9, 1980-9, so too does the average. In fact, though, fully 96.6% of the variance in LVAU is cross-national since CBI rarely changes over time in the sample. The 5 source indices are linearly rescaled 0-1, and then the available rescaled measures are averaged.

G: Government Partisanship (0-10). Data use "expert" codings of the left-right positioning of parties available in the literature (see, *e.g.*, Appendix B to Laver and Schofield 1990) to measure the partisan position of the average government member. A left-right code for each party is obtained by the rescaling several source indices from 0≡extreme-left to 10≡extreme-right and then averaging available indices for each party. The farthest left of government participants in the sample is the French Communist Party at about 1.3755; the farthest right is the Japanese Liberal Democratic Party at 8.9. The U.S. Democrats are at 4.8213 and Republicans at 7.61 for comparison. These party scores are then used to calculate the government's partisan position as the average of the party positions of the government's members. In straight parliamentary democracies *government members* means

cabinet members; mixed systems are more complicated. Opting for simplicity, I code the US government's position as 1/3 the President's, 1/3 the average Senator's, and 1/3 the average Representative's. The French Vth Republic and the Finnish governments' positions are considered to be ½ the President's position and ½ the Cabinet's average position. Country-years in which more the one government held office are coded as the weighted average of those governments' partisan position, each government's position being weighted by the proportion of the year it holds office.

T: Trade Openness (0-2). Exports plus imports over GDP; from the IMF IFS CD-ROM, June 1996.

F: Financial-Sector Employment (x%). Finance, insurance, real estate, and banking employment as a percent of total employment; from OECD National Accounts Volume II, Detailed Tables.

π^a: Inflation Abroad (x%). Created from π. Each country-year's observation on π^a is the average inflation in the *other* 17 countries in that year.

U: Union Density (0-1). Union membership as a fraction of the labor force; from Golden and Wallerstein (1995).

CWB: Coordination of Wage/Price Bargaining (0-1). A subjective index of CWB from Hall and Franzese (1997). The index varies only by country: US = 0, Japan = .75, Germany = .75, France = .25, Italy = .25, UK = 0, Canada = 0, Austria = 1, Belgium = .5, Denmark = .75, Finland = .75, Ireland = 0, Netherlands = .5, Norway = 1, Spain = 0, Sweden = 1, Switzerland = .75, Australia = .25, New Zealand = .25.

Data Descriptive Statistics (Sample = 18 OECD Countries, 1972-90)

	π	CBI_{t-1}	G_{t-1}	T_{t-1}	F_{t-1}	π^a_{t-1}	U_{t-1}	CWB
Mean	7.63	.501	5.49	.514	.068	8.04	.450	.486
Median	6.85	0.468	5.51	.470	0.068	8.56	.450	.500
Maximum	27.2	.931	8.90	1.40	.113	13.7	.846	1.00
Minimum	-1.40	.150	2.78	.084	.021	3.73	.102	.000
Std. Dev.	4.69	.196	1.56	.260	.021	2.69	.172	.359
# Obs.	342	342	342	342	342	342	342	342

Appendix III: Methodological Notes

To mitigate endogeneity concerns, all independent variables in all models are lagged one year (except CWB which is time-invariant).

Columns D-E estimated by constrained least-squares (CLS), A-C by ordinary least-squares (OLS). CLS resembles OLS except that parameters must be estimated numerically and the variance-covariance matrix of the estimated coefficients estimated accordingly; see Greene (1997, 453-8).

Controlling for two lags of the dependent variable, Ljung-Box Q residual-correlation tests fail by large margins to reject nulls of no serial correlation in the residuals (at any lag length). Lagrange-multiplier tests were less sanguine, but models with autoregressive processes in residuals instead of lagged dependent-variables perform as poorly or worse, nor does complicating the lag structure produce more favorable Lagrange tests. Therefore I proceed cautiously, reporting standard errors and hypothesis tests employing Newey-West autoregressive-and-heteroskedasticity-consistent covariance-matrices (truncation at 5 lags).

Beck and Katz (1996) demonstrate that estimating (by FGLS) more complicated error-covariance structures allowing for contemporaneous correlation is not advisable in data sets of these proportions. They demonstrate the superiority of estimating a version of White's heteroskedasticity-consistent variance-covariance matrix which allows for contemporaneous correlation (called *panel-corrected standard-errors*: *PCSE's*). Implementing PCSE's in the CLS setting awaits future work, so I rely on inclusion of π^a to bring any contemporaneous correlation into the systematic component in both OLS and CLS settings for comparability. Especially given that π^a is among the independent variables, the Newey-West covariance matrix employed should be some further help with regard to whatever contemporaneous correlation in the stochastic component may remain.

Finally, all models estimated indicated clearly that the dynamic properties of inflation do not depend on the degree of CBI. *I.e.*, interactions of CBI with the lagged dependent variables have

estimated coefficients substantively near zero and statistically insignificant individually or jointly.

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Notes

1. The modern (neoclassical) economics of CBI and monetary policy developed from Kydland and Prescott (1977); Bade and Parkin (1982); Barro and Gordon (1983a, 1983b); Rogoff (1985, 1989); Alesina (1988); Grilli *et al.* (1991); Lohmann (1992); Cukierman (1992); Alesina and Summers (1993); Persson and Tabellini (1994), Cukierman (1996), Eijffinger and De Haan (1996). Cukierman (1992) represents a recent and the most complete compilation of theory and evidence; Eijffinger and De Haan (1996) is an excellent, briefer survey of theory and evidence; Cukierman (1996) is a brief theoretical introduction. The political science literature is more variegated, but Hirsch and Goldthorpe (1978), Beck (1984), Woolley (1984, 1985), Lindberg and Maier (1985), Goodman (1989, 1991, 1992), Mayer (1990), and Kennedy (1991) would provide a good introduction to the politics of inflation among central banks, governments, and society.

2. That CBI lowers inflation is not quite universally agreed. A common claim, Posen (1995a, 1995b) *e.g.*, is that CBI is epiphenomenal, itself produced by other anti-inflationary forces which also produce the low inflation. The view offered here and either of the standard views underlying it require to the contrary that institutions, specifically CBI, matter. The present approach will allow an empirical evaluation of the epiphenominality claim against appropriate alternatives.

3.To my knowledge, Jonsson (1995) is the only exception, (independently) having noted the weighted-average formulation in his theoretical exposition. Even his empirics do not fully reflect the theoretical insight though.

4. See Lohmann (1992) for a formal development of this argument.

5. Note especially that I take no stand here on the model's real-side prediction that CBI has no real effects (*e.g.*, on employment, income, or output) on average; considerable theoretical and empirical question has recently emerged regarding that claim. See Hall (1994), Cukierman (1997), Franzese (1997), Hall and Franzese (1997), Iversen (1997), and Iversen and Soskice (1997).

6. See Ball and Romer (1990) on the necessity of nominal and real rigidities for real monetary-policy effectiveness. Wage or price contracts (Lucas and Rapping 1981 [1969]; Mankiw 1985) plus wage/price bargaining would suffice as would "near-rationality" or calculation costs in optimization (Akerloff and Yellen 1985).

7. This review follows Cukierman (1992) chapter 3: "The Employment Motive for Monetary Expansion." There are other "motives" (*e.g.*, chapters 4-5, 7), and any or any combination would suffice here. The employment motive's familiarity recommends it for these expositional purposes.

8. This utility function has the government deriving *disutility* from employment (inflation) which is *too high* (*too low*): highly unrealistic. Theorists usually assume arbitrarily high (low), say 100% (0%), targets to avoid this absurdity. Partisan differences are then modeled solely as variations in A_g.

9. Unexpected inflation increases employment here because it lowers real wages, which increases labor demanded, which, if employment is demand constrained, increases employment. Expected inflation does not affect any real variables in a pure neoclassical model (but see note 5).

10. *I.e.*, assuming no uncertainty and that the policy authority directly controls inflation: these are merely simplifying assumptions in the standard neoclassical framework.

11. π_d^* involves only parameters known with certainty by the public ($\pi_g^*, A_g, \alpha, N_g^*, N_n$), so expected inflation (π^e) is actual inflation (π_d^*) and employment (N) does not deviate from its natural rate (N_n) in equilibrium. This is the real side of the neoclassical argument (about which see note 5).

12. This is a common assumption in the literature, another is that the bank's utility function is what a benevolent social planner *capable of credible commitment* would have it be (see Walsh XXXX). The present analysis does not hinge on this assumption.

13. The current New Zealand bank law provides the closest empirical approximation to the pedagogical example in the text.

14. The theoretical and empirical research has been compiled in and advanced by Cukierman (1992). Summarizing drastically: credible commitment lowers inflation and, adding uncertainty and/or incomplete information to the standard framework just reviewed, sacrifices the use of monetary policy for macroeconomic stabilization but entails no other real costs on average. While the latter conclusion is now contested (see note 5), the former is more nearly noncontentious (but see note 2).

15. Alesina and Summers (1993) could serve as a statistical and graphical summary of the standard empirical approach. Eijffinger and De Haan (1996) Appendix B provides a tabular summary of previous empirical specifications and findings. Some work moving beyond the simplest linear-additive model does exist, *e.g.* Jonsson (1995), Clark *et al.* (1997), Hall and Franzese (1997), Franzese (1997), but all lack the generality of the present offering.

16. Some scholars measure the degree of CBI based upon bank-law characteristics thought to enhance or detract from the central bank's autonomy and conservatism—*e.g.* the length of the bank president's term, who appoints her, the terms under which the bank may or must purchase government securities, *etc.*—[*e.g.*, Cukierman (1992, chpt. 19)]. Others focus upon the central bank's reputation, among some set of "experts", for autonomy and conservatism in policy-making [*e.g.*, Bade and Parkin (1982)]. I employ the average of the 5 most-commonly-used indices of both types. A third method employs estimated parameters of monetary-policy reaction-functions. In relating CBI to inflation, though, that method introduces circularity, so I omit such measures from my averaged index. Regardless, all CBI indices measure the *degree* to which the central bank as opposed to the current government controls monetary policy.

17. The weighting need not be linear—exponential weighting, *e.g.* $\pi = CBI^{\alpha} \cdot \pi_c^* + (1\text{-}CBI^{\alpha}) \cdot \pi_d^*$, is also possible—depending on the substance and the arbitrary scaling of the CBI index.

18. Notice how this addresses the issue raised by Posen [(1995a, 1995b), see note 2], but without making the claim that institutions are epiphenomenal. Where other anti-inflationary forces would have produced low inflation anyway, CBI *per se* does little; where such other forces are not present and yet CBI persists, as *institutions* will tend to do, CBI has great impact. I elaborate upon and present evidence regarding this below.

19. More precisely, "employment [must be] a decreasing function of the real wage" implying that "own effects [must] dominate cross-effects in labor demands or...the supply of labor in the

competitive segment of the labor market [must be] relatively irresponsive [*sic*] to the real wage... or... both conditions [must] hold" (Cukierman 1992, 41). Notice that, if at least some unemployment is involuntary, then the supply of labor is effectively in excess so the supply of labor is effectively wage inelastic. Thus Cukierman's conditions generally hold.

20. Despite former term's greater familiarity, I prefer the latter since *neocorporatism* often means considerably more than CWB which latter fits rather more directly into the present theoretical model. I derive the CWB argument as applied here from Headey (1970), Lange (1984), Cameron (1984), Bruno and Sachs (1987), Alogoskoufis and Manning (1988), Calmfors and Driffill (1988), Carlin and Soskice (1990), Soskice (1990), Layard *et al.* (1991), and Calmfors (1990, 1993).

21. Calmfors and Driffill (1988) argue that the relationship between wage-/price-bargaining *concentration* and wage restraint is curvilinear with greatest restraint at zero and full concentration and less restraint at intermediate concentration. Seeking simplicity, I separate that curvilinear relationship into two opposite linear relationships, one between labor-/goods-market structure and market power and one between labor-/goods-market institutions and internalization of wage/price externalities. Union power, as defined by Cukierman (1992), and measured here by union density, is monotonically negatively related to wage restraint. Coordination, as defined by Soskice (1990), and measured here by the subjective index in Hall and Franzese (1997), is monotonically positively related to restraint. Calmfors and Driffill's *concentration* conflates these two effects. See Carlin and Soskice (1990), Soskice (1990), and Layard *et al.* (1991) for approaches which similarly disaggregate the Calmfors-Driffill "hump" (and do so empirically successfully).

22. The externality in question is that each actor's nominal wage/price gains lowers the real value of others'. Fragmented bargainers ignore these effects, but, given sufficient market power, may settle upon excessive nominal and perhaps real gains (see references in note 20, esp. Franzese 1997).

23. See references in note 20, esp. Alogoskoufis and Manning (1988) and Layard *et al.* (1991) for empirical support of this contention.

24. A preliminary effort to consider these two factors revealed little empirical support for either in the present sample. For now I conclude only that more thorough consideration is warranted and that any such consideration should incorporate the weighted-average formulation.

25. Posen's EFOI index of the political potency of anti-inflationary interests combines two indicators of banking system structure—whether there is universal banking and whether banking supervision is directed by the central bank—with two indicators of political-system openness to interest-group influence—whether the state is federal and party fractionalization of the legislature. The first two are also indications of CBI and therefore do not distinguish Posen's from CBI theory. Regarding the latter two, Posen claims that federal systems provide more access for anti-inflation groups and fractionalization reduces access for such groups (1995b, 258-62). Unclear, however, are why 'openness' (or 'closedness') created by these structures should (dis-)advantage more anti-inflationary groups over less anti-inflationary groups who face the same structures, and why 'openness' created by federalism should favor the anti-inflationary forces while 'openness' created by fractionalization hinders them. Furthermore, fractionalization may contribute to inflation for reasons unrelated to financial-sector strength [see, *e.g.*, Cukierman *et al.* (1992)], and, while federalism *is* empirically correlated with CBI and thereby with inflation, the former relation may

have little to do with financial-sector opposition to inflation. CBI and federalism may correlate because separation of power by region (federalism) has intellectual affinity with separation of power by function (CBI) so that constitution-writers have tended to enshrine either both or neither. In two cases, the correlation is certainly spurious; the German and Austrian banks and their federal constitutions resemble the US's Federal Reserve and its federal constitution because the US had great influence in establishing them. Accordingly, measuring EFOI more directly, as I do below using the weight of the financial sector in employment, will enable a less ambiguous evaluation of Posen's arguments than could any direct application of his own EFOI index.

26. Hall and Franzese (1997) and Jonsson (1995) are among the few partial exceptions. The former allow the anti-inflationary effect of CBI to be a function of CWB and *vice versa* while the latter allows the effect of CBI to be a function of government partisanship and *vice versa*. Others have explored the possibility that partisan and/or electoral cycles in inflation are mitigated by CBI [most recently: Clark *et al.* (1997)], though without incorporating the specific manner in which the theory indicates the mitigation should occur (*i.e.*, the proportionate reduction implied by the weighted-average form). Morever, the generality of this mitigating role of CBI has been missed; generally the influences of all other factors should be so mitigated, not merely the impacts of government partisanship or of wage/price bargaining institutions.

27. The situation may have been worse. Omitting relevant interactions produces "average-parameter" estimates only if the missed variation in effects is uncorrelated with all included independent variables (see, *e.g.*, Parks XXXX); otherwise the estimates are biased even as estimates of the average effects. In this case, our estimates across the various models do indicate that there has been some bias in the linear-additive models XXXX.

28. Two lags of inflation sufficed to capture the dynamics of inflation in all models. Conveniently, none of the interactive models indicated any difference in dynamics by the degree of CBI. See also note 30.

29. The 18 larger, continuously democratic OECD countries comprise the sample: US, Japan, Germany, France, Italy, UK, Canada, Austria, Belgium, Denmark, Finland, Ireland, Netherlands, Norway, Sweden, Switzerland, Australia, and New Zealand.

30. Annual, 1972-1990, data are the sample; prior to that national monetary-policy autonomy was considerably limited by the Bretton-Woods fixed-exchange-rate regime.

31. Notice this implies the case where all six other factors affected governments and banks the same would have been empirically indistinguishable from the simple linear-additive model. Indeed, one way to view the assumption of the linear-additive model is that all other factors impact governments and central banks the same. Empirically, this is not the case.

32. All joint-hypothesis tests reported are Wald F-tests of parameter restrictions, these being more appropriate than the (perhaps more familiar) change-in-R^2 F-tests when consistent variance-covariance matrices are employed.

33. These comparisons are not transparent from Table 1. The quantity in model **(11)** which corresponds to $b_{c,t}$ in model **(10)** is $b_{cbi,3} \cdot b_t$. One avenue to deriving the standard error of the latter is to generate the F-statistic for the Wald test that $b_{cbi,3} \cdot b_t = 0$. That $F_{1,n-k}$ statistic is equal to the square

of the corresponding t_{n-k} statistic. That t-statistic is also equal to $b_{cbi,3} \cdot b_t$ divided by the standard error of $b_{cbi,3} \cdot b_t$ which is all the information necessary.

34. The attentive reader may still be disturbed that, in model **(11)**, the variables CWB and F-and-G, whose interactions with CBI were quite insignificant in model **(10)**, are grouped with U and T whose interactions with CBI were contrarily quite significant. However, this is not the major source of model **(11)**'s and **(9)**'s strength in estimating the effect of CBI·CWB, CBI·G, and CBI·F. Rather, I discovered that once *any* restriction is placed on model **(10)** which constrains the coefficient on CBI·T from being greater in magnitude than that on T—the former is nearly twice the latter in model **(10)**, which is substantively nonsensical—then the coefficients on (i) CBI·CWB and CBI·F become more nearly the negative of the coefficients on CWB and F, and (ii) CBI·G, CBI·F, and CBI·CWB all become more significant. This too makes theoretical sense: see Franzese (1997) for a thorough exposition of how the structural composition of the labor force (here reflected in F), particularly its exposure to international trade (here reflected in T), affects the impact of the interaction of CBI and CWB on inflation and unemployment.

35. Mitigation over 100% has numerous implausible implications. Therefore, respecifying these models in some way so that the degree of mitigation cannot exceed 100% would be appropriate. Given that I do not estimate mitigation degrees noticeably over 100% in any of the specifications presented, I do not bother to do so here, but it must be noted—in keeping with the spirit of the present exercise—that imposing such greater structure on the model could lead to still more precise coefficient estimates.

36. Moreover, central banks can indeed be independent when these other factors are not conducive to low inflation and *vice versa* dependent when these other factors are conducive to low inflation: regressing CBI on G, U, T, F, and CWB indicates that less than 50% of the variance in the former is explained by variance in that latter. (The decade-frequency of the CBI index is used for this regression. Decade-frequency CBI is regressed on decade-averages of the other variables.) Interestingly, the strongest explanatory factor for CBI by this quick analysis seems to be union density (a strong negative relationship) not financial-sector strength, though the latter does register.

37. $b_{cbi,2}$ is not quite significantly different from -1 ($p \approx .13$) but perhaps is rather farther from -1 than we might like. $0 > \beta_{cbi,2} > -1$ would mean that even a (hypothetical) perfectly independent bank is a little responsive to external conditions. However, other reasonable specifications yield $b_{cbi,2}$ ranging approximately from -.85 to -1.2, so I resist putting any great substantive weight on $b_{cbi,2}$ equaling exactly -1. What is critical here is that, whatever minor changes made in the set of other variables to include, the estimate of $\beta_{cbi,2}$ always clearly indicated approximately a weighted-average of the sort expected and overwhelmingly supported that specification over the linear-additive model **(8)**.

38. Statistically, the weighted-average estimates for the responses of countries near the top and the bottom of the CBI scale tend to be more than a standard error different from the linear-additive model's estimates. In **Figure 2**, that applies to New Zealand, Sweden, and Germany.

39. Past tense because New Zealand has recently substantially increased its degree of CBI.

40. The relevant joint hypothesis test which is least favorable to this comparison is that $\beta_t = \beta_t \cdot \beta_{c,t} = 0$ which is the one reported. One could argue that the test that $\beta_t = 0$, which produces

p≈.019, is sufficient in model **(9)**.

41. The thinner solid line represents the partisan cycles estimated by the linear-additive model wherein the amplitude would be the same regardless of the degree of CBI in the political economy in question, which we now know is misleading.

42. See Clark *et al.* (1997) for more direct exploration of this and related hypotheses. There are many other issues to be considered—such as endogenous election timing, the clarity of responsibility for policy of alternating governments, *etc.*—so the issue is more raised than resolved here. But note also that we had no trouble finding partisan effects even in the linear-additive model. I attribute this to our exclusive focus on the post-Bretton-Woods era (see Clark et al. again) and to the more precise measurement of G here than is common. Regarding political and partisan cycles, then, perhaps the 'rumors of its demise have been greatly exaggerated'?

43.**Figure 4** amply demonstrates that CBI mitigates partisan cycles in inflation, but this is only one example of a more general phenomenon. The weighted-average/proportionate-reduction form of the interaction between CBI and the rest of the political economy in determining inflation implies that CBI mitigates fluctuations in inflation arising from any of these other sources not just government partisanship. This implies further that whether or not the bank is explicitly seeking to reduce the variance of inflation (as opposed to its level), it is almost inherent in the facts that (a) it targets lower inflation and (b) responds to other factors, if at all, considerably less than the discretionary authority, that it will in fact reduce the variance of inflation. We can see this best by considering the implications of equation **(5)** for the variance of inflation:

$$V(\pi) = CBI^2 \cdot V(\pi_c^*) + 2 * Cov(\pi_c^*, \pi_d^*) \cdot CBI \cdot (1 - CBI) + (1 - CBI)^2 \cdot V(\pi_d^*) \qquad \textbf{(12)}$$

Given a relatively fixed target for the bank, $V(\pi_c^*)$ and $Cov(\pi_c^*, \pi_d^*)$ are both near zero, and so the first two terms on the right vanish, and thus $V(\pi)$ is manifestly decreasing in CBI. More generally, so long as $V(\pi_c^*) < V(\pi_d^*)$ and the covariance is not too large, CBI will reduce the volatility of inflation. Since, in any model, discretionary inflation depends on a whole host of factors which the commitment inflation does not, there is good reason to suppose that $V(\pi_d^*)$ is greater than $V(\pi_c^*)$ and that the covariance is not too large even if π_c^* itself is not "relatively fixed". Thus, the empirical finding that CBI reduces the variance of inflation, much celebrated in the previous literature, is not really separate from the finding that it lowers the level of inflation, once we understand the weighted-average manner in which the theory implies the level of inflation will be lowered.

44.In some countries the current estimate is even that independent central banks *increase* inflation somewhat relative to what the (apparently extremely conservative) social and political structure would have produced itself. I take such estimates, which are substantively hard to interpret but thankfully rare in the sample, as indication that the anti-inflationary stance of monetary policy is over-determined in these country-times. Such estimates have been suppressed from **Figure 5**.