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

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First Draft: 30 June 1997

This Draft: 21 January 1998

Theory: Theories of central bank independence offer a more exact set of predictions regarding inflation in different political-economic environments than has generally been understood or empirically examined.

Hypotheses: The theories suggest that the inflation rate 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 on the former given by the degree of central bank independence.

Methods: 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.

Results: In supporting these specifications, the evidence indicates that the anti-inflationary benefit of central bank independence 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 central bank independence in the country-time in which they occur.

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I wish to thank Steve Casper, Tom Cusack, Peter Hall, Torben Iversen, and David Soskice for helpful discussions of a related paper; Torsten Persson whose comments on another paper sparked this project; and Bob Barsky, Pradeep Chhibber, John Huber, Vince Hutchings, Paul Huth, Ken Kollman, Ann Lin, Bob Pahre, Michael Ross, and Nick Winter for comments on earlier versions of this paper.

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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, on the other hand 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 which produces an inflationary bias if policy is controlled by a government responsive to societal pressures. Credible delegation of monetary authority to an independent and

conservative central bank can serve as a commitment device which circumvents the time-inconsistency problem and therefore the inflationary bias; thus CBI lowers inflation. For the purposes of the present argument, which view we hold as to why CBI lowers inflation is largely irrelevant.[2] However derived, the thesis that CBI lowers inflation has been incompletely understood, this misunderstanding has been translated into its empirical testing, and thus many important theoretical and empirical implications of the argument have been missed.[3]

This paper makes the simple point that the autonomy of the central bank in making monetary policy is by definition a matter of *degree*. Independence from the political authority could never be complete because the bank's authority invariably derives from legal statute or constitutional provision. Either is subject to change by the political authority if the bank's policies were to become sufficiently distasteful to it so as to justify expenditure of the political capital necessary to effect a change in the bank's status. Independence is never completely absent either because administrating and monitoring monetary policy is costly, politically and/or economically. The bank enjoys an expertise and/or an informational advantage over the government with regard to monetary policy, and in any case at least time if not also other resources are required for the government even to monitor the bank much less to conduct monetary policy itself. All of which implies that the government cannot costlessly ensure that the bank conducts policy precisely according to its current will. CBI therefore measures *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] Thus monetary policy and (thereby) inflation are always partially controlled by the central bank and partially by the government of the day.

From this simple point it follows that observed inflation will be weighted average of what it would be if the conservative central bank credibly, completely, and autonomously controlled

monetary policy and what it would be if instead the government of the day controlled monetary policy without any influence from the central bank, with the degree of CBI measuring the weight on the former. From that it follows further that the anti-inflationary impact of CBI is not constant but rather varies depending on the political-economic environment in which the bank operates. *E.g.*, the anti-inflationary impact of CBI should be greater when the left controls government than when the right does, should be less the more trade-open the economy, should vary depending on the other labor- and goods-market institutions also present in the system, *etc.* As with all interactive propositions, the converses are inescapably implied also: *e.g.*, the difference between inflation under left and right governments and the anti-inflationary impact of trade-openness should be less the greater is CBI, *etc.* This implies still further that, because their political-economic environments differ, some countries at some times will find CBI more advantageous on anti-inflationary grounds than others will. Therefore, *ceteris paribus*, certain country-times will be more likely to see increases or decreases in CBI than others. Finally, this specific argument illustrates a broader point about institutional political economy: the effect of any given institution is contextual–it depends on the configuration of other political, economic, structural, and institutional features of the setting in which the institution in question *inter*acts.

The paper is structured to make these arguments as follows. In the next section, I introduce the model of monetary policy from which the neoclassical view of CBI and inflation derives. Let me state clearly at the outset that this expositional choice indicates *neither* agreement *nor* disagreement with the neoclassical model, and especially I make no claims here regarding that model's real-side predictions–namely that CBI has no effect on employment, unemployment, growth, *etc.* on average.[5] I follow the neoclassical economic exposition (a) because of its familiarity, internal cohesion, and formal illustrative clarity, and (b) because it will presumably be most interesting to show that even

the relatively sparse model of the neoclassical macroeconomist concludes that the impact of CBI on inflation depends upon the broader political-economic configuration in which the bank *inter*acts. The third section explains how that interactive prediction may be modeled empirically and then estimates the models from a time-series-cross-section of annual GDP-deflator inflation-rates in 18 developed democracies in the post-Bretton-Woods era. I discuss the results substantively in the fourth section, using them to illustrate the range of further implications emerging from this fuller understanding of the theory of central bank independence and inflation and better match of the empirical model thereto. The fifth and final section concludes.

II. Central bank independence and inflation: a theoretical model

The neoclassical argument, condensed to a paragraph, proceeds as follows. First, given nominal wage contracts (Lucas and Rapping 1981 [1969]) and/or sticky nominal prices (Mankiw 1985) and/or "near-rationality" or calculation costs in optimization (Akerloff and Yellen 1985), the monetary authority has the incentive to create "surprise" inflation, thereby lowering real wages (or prices), and thus spurring employment (or output). Second, the private sector is, however, aware of this incentive and incorporates its inflationary consequences into their wage and price setting. Accordingly, in the perfect-information rational-expectations equilibrium, the private sector is not systematically surprised by the monetary authority, so real wages and prices and therefore output and employment are unaffected on average while inflation is higher. Third, if, on the other hand, the monetary authority could credibly commit to refrain from creating such "surprise" inflation, the private sector may set lower wage and price increases without fear of being surprised. With credible commitment, then, inflation is lower while real wages and prices and thus output and employment remain unaffected. Finally, institutionalizing a conservative central bank with greater independence from the political authority is held to provide just this sort of credibility for the monetary authority.

Thus CBI reduces inflation without any adverse real effects on average.

In more detail, the argument[6] begins by specifying the utility function, $V^m(\cdot)$, for the discretionary monetary-policy-maker (*i.e.*, the government):

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

This says that the government gets disutility from deviations of employment, N, from its target level of employment, N_g^*, and deviations of inflation, π, from its target level, π_g^*. The weight the government places on employment relative to inflation is given by $\frac{1}{2}A_g$. The target levels coupled with the relative weight upon them indicates the conservatism of the government: lower N_g^*, π_g^*, and A_g implying greater conservatism.[7]

Next, because there are nominal contracts and market power, unexpected inflation spurs employment beyond the natural rate, N_n. Actual employment, N, is accordingly given by:

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

where π^e is expected inflation.[8] Finally, given rational expectations and no uncertainty, and assuming for simplicity that the policy authority directly controls inflation, we solve for the equilibrium rate of inflation in the absence of any commitment devices by substituting **(2)** into **(1)**, maximizing with respect to π, and then applying rational expectations (equating π^e to π). This yields:

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

π_d^*, then, is the *discretionary-equilibrium inflation-rate*; *i.e.*, it is the rate of inflation that would obtain if the government had utility as in **(1)**, faced an economy described by **(2)**, and controlled monetary policy completely without any influence from the central bank.[9] Note that A_g, α, and $(N_g^* - N_n)$ are all positive, so discretionary inflation exceeds the government's own target-rate: $\pi_d^* > \pi_g^*$; this is the so-called *inflationary bias*. The government cannot achieve a lower inflation rate, even though it desires one *a priori*, unless it can somehow credibly commit to the lower rate. That

is the time-inconsistency problem: if the private sector expected the government's target rate of inflation, π_g^*, the government would actually wish seek higher inflation, trying to exploit the (expectations-augmented) Phillips Curve in **(2)**. The public knows this, though, so it would not have expected π_g^* in the first place. The only inflation rate which is rational both for the public to expect and for the government to produce given those expectations is π_d^* as given in **(3)**.

Inflation could be lower than π_d^* only if the government could somehow credibly commit to a lower inflation rate. Delegation of monetary-policy authority to the central bank could serve as such a 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). A *more conservative* bank would have a lower target rate of employment, $N_b^* \leq N_g^*$, a lower target rate of inflation, $\pi_b^* \leq \pi_g^*$, and a lower weight on employment relative to inflation, $A_b \leq A_g$ (with at least one of these inequalities strict). The *credible-commitment-equilibrium inflation-rate*, π_c^*, prevails when such a bank completely controls monetary policy and is given by:

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

If we assume, as is standard in this literature, that the credible and conservative central bank targets zero inflation ($\pi_b^*=0$) and has zero weight on employment in its utility function ($A_b=0$), then the credible-commitment-equilibrium inflation-rate is zero: $\pi_c^*=\pi_b^*=0$.[10] The bank law would have to be written so as to endow the bank with these preferences and with sufficient autonomy to attain them. For example, the bank president could be paid only on the basis of achieving, say, 2% inflation which would ensure that $\pi_b^*=2$ and $A_b=0$ (this is essentially New Zealand's new law). A super-majority in parliament could be required to over-ride the bank or change the bank law. If the super-majority were effectively impossible to obtain, the bank would be perfectly credibly independent, and

so equilibrium inflation would be given by **(4)**–in this case implying that inflation is simply the bank's target: $\pi=\pi_c^*=\pi_b^*=2$. If monitoring the bank and over-riding the bank law were instead politically and economically costless, then monetary policy would effectively remain entirely in the government's hands and so would be given by **(3)** as $\pi=\pi_d^*$.

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 without real effects, *e.g.* on employment, on average.[11] While the conclusion that CBI has no real effects on average is now contested (see note 5), the nominal-side conclusion that CBI lowers inflation seems rather noncontentious (but see note 2). So long as (a) central banks are generally more conservative on inflation than governments, (b) CBI is defined as the degree of autonomy of the central bank from the government in the conduct of monetary policy, and (c) it is possible for the bank to have some effective autonomy from the government of the day (*i.e.*, institutions matter), CBI lowers inflation.

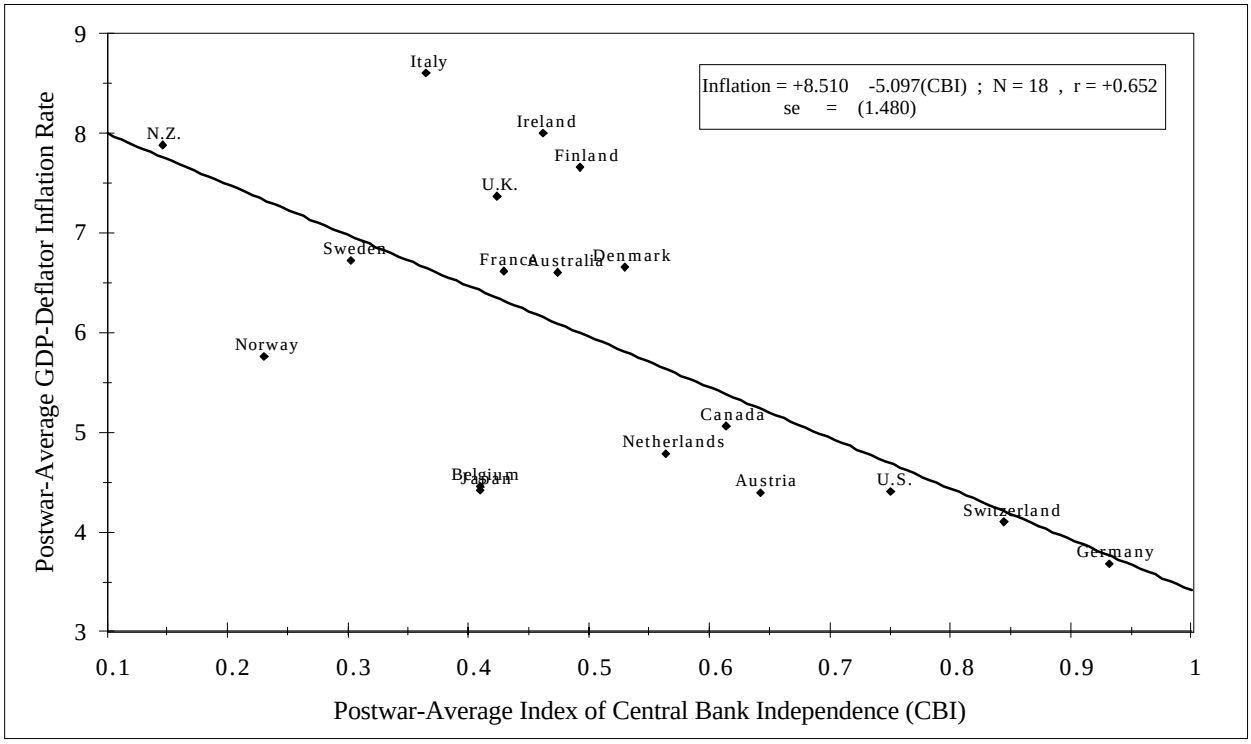

Figure 1: A Typical Bivariate Regression of Inflation on Central Bank Independence

The thesis that CBI lowers inflation has in fact been extensively demonstrated empirically. The typical testing procedure, illustrated in **Figure 1** for reference, regresses postwar averages of inflation across some set of countries on an index of CBI. Occasionally some 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.[12] 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 invariably been assumed constant and estimated as such by construction. *E.g.*, in the example depicted in **Figure 1**, each 0.1 point increase in CBI is estimated to bring a fixed 0.5 point reduction in the inflation rate. Properly understood, however, the *theory* of CBI and inflation leads to a considerably different, and considerably more revealing, specification.

Broadly, the theory is that the inflation rate depends in the first place on who controls

monetary policy: the government or an autonomous, conservative central bank. We expect an inflation rate according to one function if the central bank has autonomy (CBI=1 $\Rightarrow \pi=\pi_c^*$) and according to a different function if it does not (CBI=0 $\Rightarrow \pi=\pi_d^*$). However, CBI is defined (and measured[13]) as the *degree* to which the conservative central bank is autonomous of the government of the day in conducting monetary policy. Thus the theory of CBI and inflation must be interpreted to state: to the degree the central bank is independent, it controls monetary policy and "commitment" inflation (π_c^*) prevails; to the degree the central bank is dependent, the political authority controls monetary policy and "discretionary" inflation (π_d^*) prevails. The actual inflation rate occurring in any given country at any given time, therefore, will be a weighted average of what it would have been had the bank been perfectly independent (π_c^*) and what it would have been had the bank been perfectly dependent upon the discretionary authority (π_d^*), with the weight on the former being given by the degree of CBI:

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

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 autonomy of the conservative central bank from the government of the day in conducting monetary policy produces this sort of weighted-average prediction.

Thus, 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)**, for example, notice that in this model 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.[14] 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 the independence of the central bank increases. This implies that the effect of CBI on inflation, $\frac{\partial \pi}{\partial CBI}$, is *not* a constant; it 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 other words, 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 would operate. If the political economy is such that inflationary pressures on the discretionary authority are low, then π_d^* is little different from π_c^*. Each given free reign, the government of the day would do little differently from the bank, so it hardly matters for inflation in that country-time how independent the bank is from the government. If instead the political economy is characterized by great inflationary pressures on the political authority, then π_d^* is considerably higher than π_c^*, so the bank would have to do quite a lot differently to bring inflation to its desired levels. Since the bank controls monetary policy only to the degree it enjoys autonomy from the government of the day, the degree of CBI matters quite a lot under these conditions. In sum, the anti-inflationary effect of any given degree of central bank independence is greater (less) wherever the government has greater (less) incentive to pursue inflationary policies relative to the conservative central bank.[15]

Appendix I formally details the complete set of predictions which emerge from the theory of CBI and inflation as now understood. These regard the effect of CBI and the other parameters on inflation ($\frac{\partial \pi}{\partial x_i}$) and how those effects themselves change as each of the other parameters of the model

change ($\frac{\partial^2 \pi}{\partial x_i \partial x_j}$). Here I elaborate a subset of these implications more intuitively. Points (i) and (iii) above, for example, suggest that CBI should reduce inflation more when left parties are in office than when right parties are. Since left governments will have 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 would 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 a greater reduction in inflation for any given increase in CBI under left than under right governments. Notice also the converse: the same partisan distance between governments should produce 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) in this model, likewise affect the anti-inflationary impact of CBI.

Regarding these labor- and goods-market institutions, Cukierman (1992, 39-42) notes that, in the neoclassical model, the incentive 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.[16] He suggests, further, that the monopoly power of unions might account for such excessiveness. The advancement here 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, and this produces a lower natural rate of employment, N_n. Alternatively, we could consider the logic of the *neocorporatism* or *coordinated-wage-/price-bargaining* (CWB) literature.[17] CWB, as opposed to union power without coordination, produces real-wage restraint rather than real-wage excessiveness[18] because encompassing wage-/price-

bargaining units internalize the costs of excessive wage-/price-settlements whereas fragmented bargaining units can partially externalize them.[19] Thus, the excessiveness of real wages, ω, is decreasing and so the natural rate of employment, N_n, is increasing in CWB.[20] 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)** leads to the additional predictions that discretionary inflation is increasing in union power, U, and decreasing in the coordination of wage/price bargaining, CWB, which imply that 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. For example, discretionary inflation should also be a negative function of the trade-openness of the economy, T, since the real effectiveness of (surprise) money, α, is lower in more open economies [*i.e.*, $\alpha=\alpha(T)$ with $\alpha'<0$, see, *e.g.*, Romer (1993)]. Similarly, absent policy to counter the effect, inflation abroad, π^a, will tend to be imported so discretionary inflation will generally increase with inflation abroad. These contentions 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), for example, offer quite a variety of arguments as to why and how trade-openness lowers inflation. The point here is rather more general: however one arrives at the models of the inflation rate which would prevail if the government completely controlled monetary policy and of the rate which would prevail if instead the bank

completely controlled it, the theory of CBI and inflation predicts that the inflation rate actually observed will be a weighted average of those two polar-cases. Furthermore, this 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, say, on government stability (Cukierman et al. 1992) or the incentives for manipulation of the macroeconomy for electoral advantage (Nordhaus 1975).[21] Regardless, the higher is inflation under complete government control relative to inflation under complete central bank control of monetary policy, the greater the anti-inflationary effect of CBI [see equation **(6)**]. Conversely, the inflationary or anti-inflationary effects of other factors are greatest when CBI is low and least when CBI is high.

Also, we can now consider directly the contention of some that CBI is epiphenomenal in the determination of inflation. Posen (1995a, 1995b), *e.g.*, argues 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.[22] Politically influential financial opposition to inflation may well bolster an independent central bank in its pursuit of low inflation, as Posen argues, but its impact on a politically responsive authority's monetary policy is likely to be even greater. Once we consider that observed inflation will be a weighted average of what it would be under these two polar cases, a direct comparison of the influence of the financial sector on inflation when the government controls monetary policy with its influence when the central bank controls monetary policy becomes possible. 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 thus provide a very direct test of the epiphenomenality hypothesis and

more.

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.[23] Statistically, the problem could be viewed as one of "parameter averaging." In assuming the effect of CBI on inflation, $\frac{\partial \pi}{\partial CBI}$, to be constant, previous work has 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. 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. 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:

$$E(\pi_{i,t}) = \beta_0 + \mathrm{B}_1' C_{i,t} + \beta_g G_{i,t-1} + \beta_f F_{i,t-1} + \beta_t T_{i,t-1} + \beta_u U_{i,t-1} + \beta_{cwb} CWB_i + \beta_{\pi a} \pi^a_{i,t-1} + \beta_{cbi,1} CBI_{i,t-1} \quad \textbf{(8)}$$

where $C_{i,t}$ is a vector of time-series controls and B_1 the vector of associated coefficients thereupon,[24] and the subscripts *i* and *t* refer to country[25] and year[26] respectively. If, controlling for these six other factors, CBI reduces inflation, then we expect $b_{cbi,1}<0$; if not–if, *e.g.*, 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 rate of inflation that a perfectly autonomous, conservative central bank would seek (*i.e.* which assumes, as is standard in the literature, that π_b^* is constant and $A_b=0$) could be written:

$$\begin{aligned} E(\pi) = \; & \beta_0 + \mathrm{B}_1' C + \beta_{cbi,1} CBI \\ & + \beta_g G + \beta_f F + \beta_t T + \beta_u U + \beta_{cwb} CWB + \beta_{\pi a} \pi^a \\ & + \beta_{cbi,2} CBI \cdot (\beta_g G + \beta_f F + \beta_t T + \beta_u U + \beta_{cwb} CWB + \beta_{\pi a} \pi^a) \end{aligned} \quad \textbf{(9)}$$

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 differently can be written as an interactive linear regression. Each of the other factors is interacted with CBI thereby allowing a different effect for each on inflation depending on the degree of CBI (and *vice versa*):

$$\begin{aligned} E(\pi) = {} & \beta_0 + \mathrm{B}_1' C + \beta_{cbi,1} CBI \\ & + \beta_g G + \beta_f F + \beta_t T + \beta_u U + \beta_{cwb} CWB + \beta_{\pi a} \pi^a \\ & + \beta_{c,g} CBI \cdot G + \beta_{c,f} CBI \cdot F + \beta_{c,t} CBI \cdot T + \beta_{c,u} CBI \cdot U + \beta_{c,c} CBI \cdot CWB + \beta_{c,\pi a} CBI \cdot \pi^a \end{aligned} \quad \textbf{(10)}$$

Notice that models **(8)** and **(9)** are both nested within **(10)**. If the linear-additive model **(8)** is correct, all of 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 model **(9)** is correct, *i.e.* if the bank's desired inflation-rate is effectively some low constant, we expect that $b_{cbi,1} \leq 0$ and that each of the interactive coefficients, $b_{c,x}$, is approximately the negative of its non-interacted counter-part, b_x; that is, $b_{c,x} \approx -b_x$ *for all x*. Under these conditions, **(10)** reduces to **(9)** with $b_{cbi,2} \approx -1$. The generality of **(10)** also allows that some factors, *x*, might influence the desired policy of a perfectly autonomous central bank and that of the government the same ($b_{c,x}=0$, $b_x \neq 0$ *for such x*);[27] some *x* might influence both but differently ($b_{c,x} \neq 0$, $b_x \neq 0$, $b_{c,x} \neq -b_x$ *for such x*); some *x* might affect only the policy of a perfectly autonomous bank ($b_{c,x} \neq 0$, $b_x=0$ *for such x*); and/or some *x* might influence only the government ($b_{c,x} \approx -b_x$, $b_x \neq 0$ *for such x*). In this last case **(10)** reduces to **(9)** with $b_{cbi,2}=-1$ as we have already noted. 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* $b_x=0$. Finally, if central bank independence is epiphenomenal or has no effect of either linear or linear-interactive form on 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), and **(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 re-emphasize what is and is not being tested here.

As I have noted repeatedly above regarding the theory, the neoclassical model of inflation and employment is not itself at issue here, nor, I should 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 the alternatives 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 simple (negative) additive effect on inflation [as in **(8)**] or no effect at all controlling for other factors [*i.e.*, model **(8)** and finding $b_{cbi,1}=0$]. I belabor the point that most alternative models of the macro-political-economy will 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 in 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 the total ($F\in[0..1]$); inflation, π, by the GDP deflator ($\pi=x\%$); and inflation abroad, π^a, by the average inflation-rate in the *other* countries in the sample that year. The

coefficient estimates are presented in Table 1 (standard errors in parentheses).[28] (See note 28 for methodological details.)

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.

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.[29]

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 22), 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:

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

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)**.[30] In short, by any criteria except generality–and against that are the corresponding gains in parsimony–model **(11)** is superior to model **(10)**.[31]

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[32]).

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.[33]

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 a relatively constant, low inflation rate);[34] 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. The average inflation rate 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**.

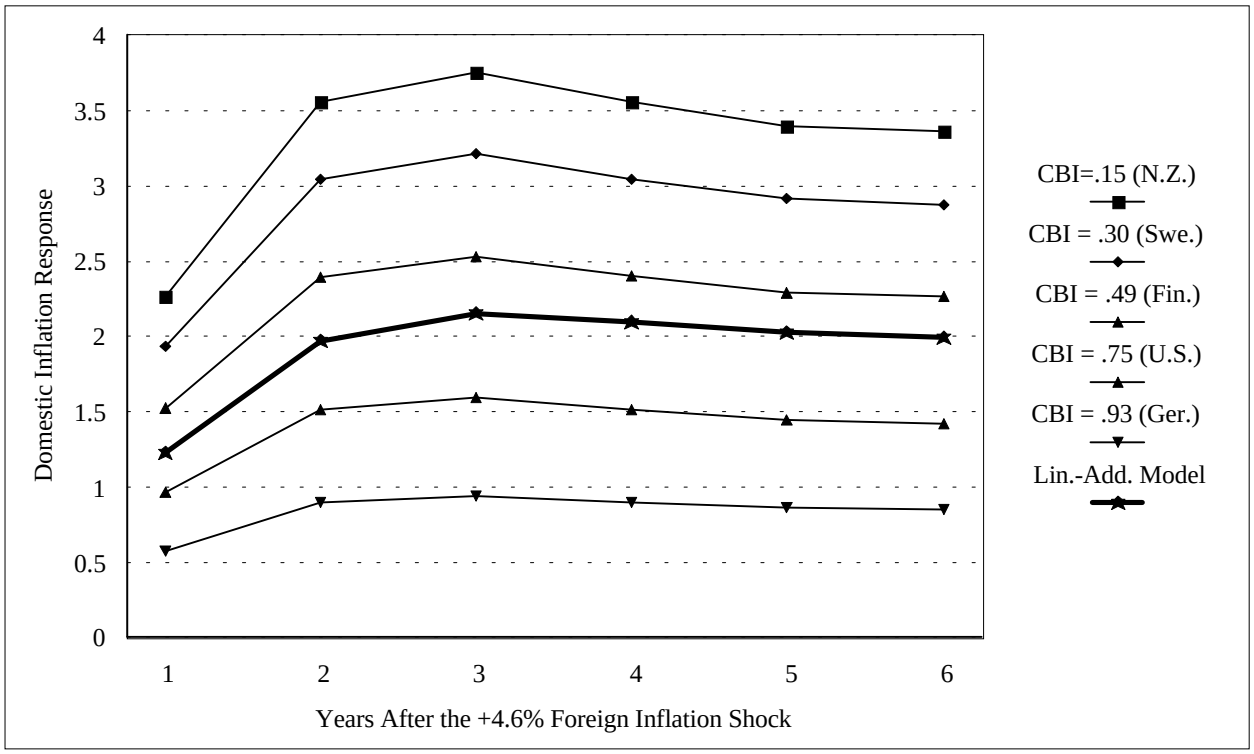

Figure 2: The response of domestic inflation to the Bretton Woods collapse and the first oil crisis (a +4.6% foreign inflation shock by assumption), as a function of the degree of central bank independence characterizing the domestic political economy.

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**).[35] 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.

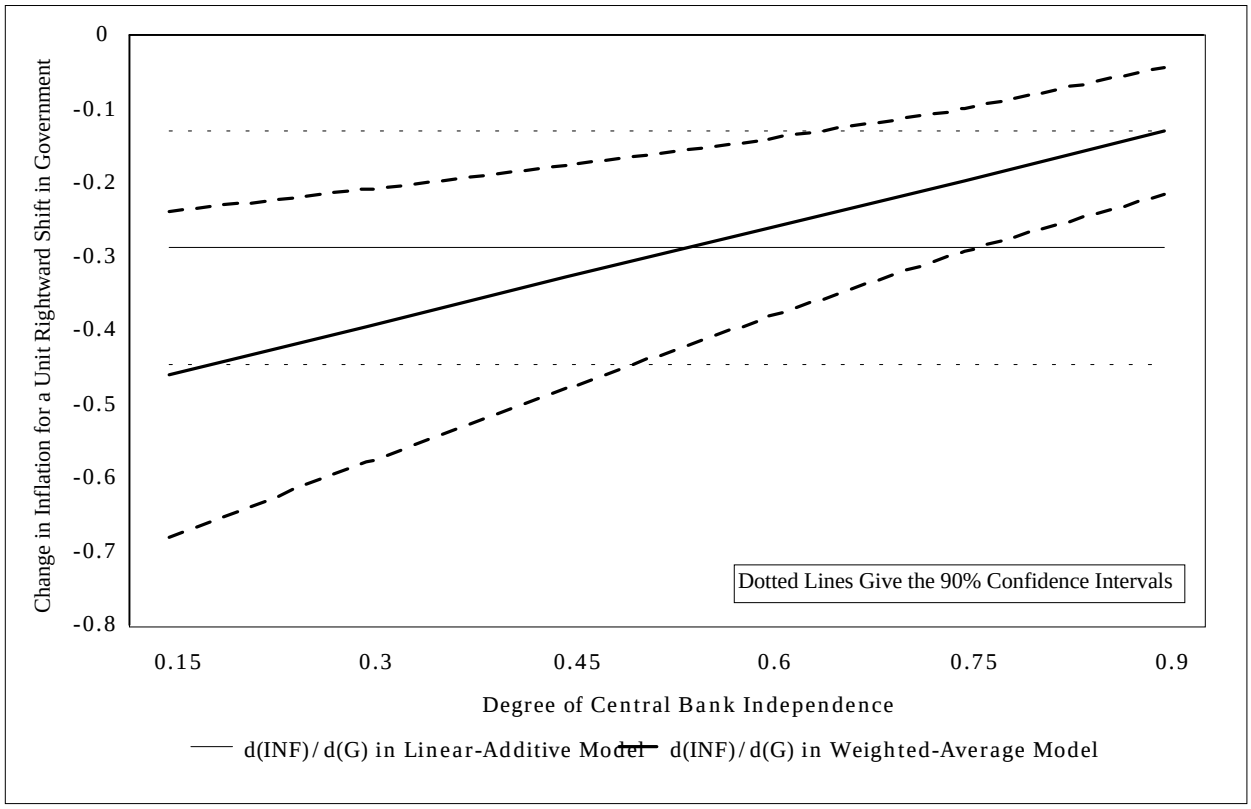

Figure 3: The estimated response of domestic inflation to a one-unit rightward shift in government partisanship, as a function of the degree of central bank independence characterizing the domestic political economy.

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[36] 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 ($p \approx .037$)[37] 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 37) 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.[38] 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.[39,40]

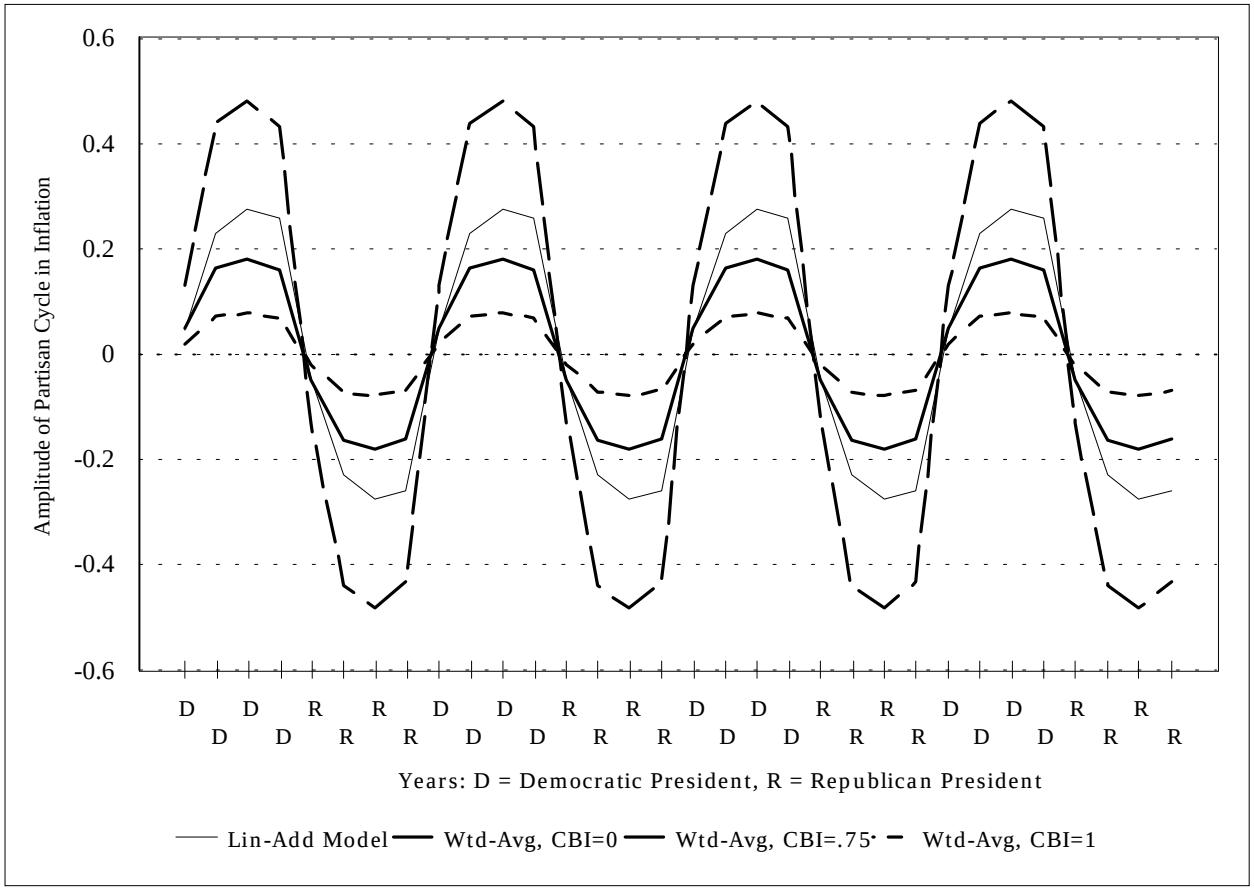

Figure 4: Mitigation of partisan cycles in inflation by the degree of independent of the central bank.

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.

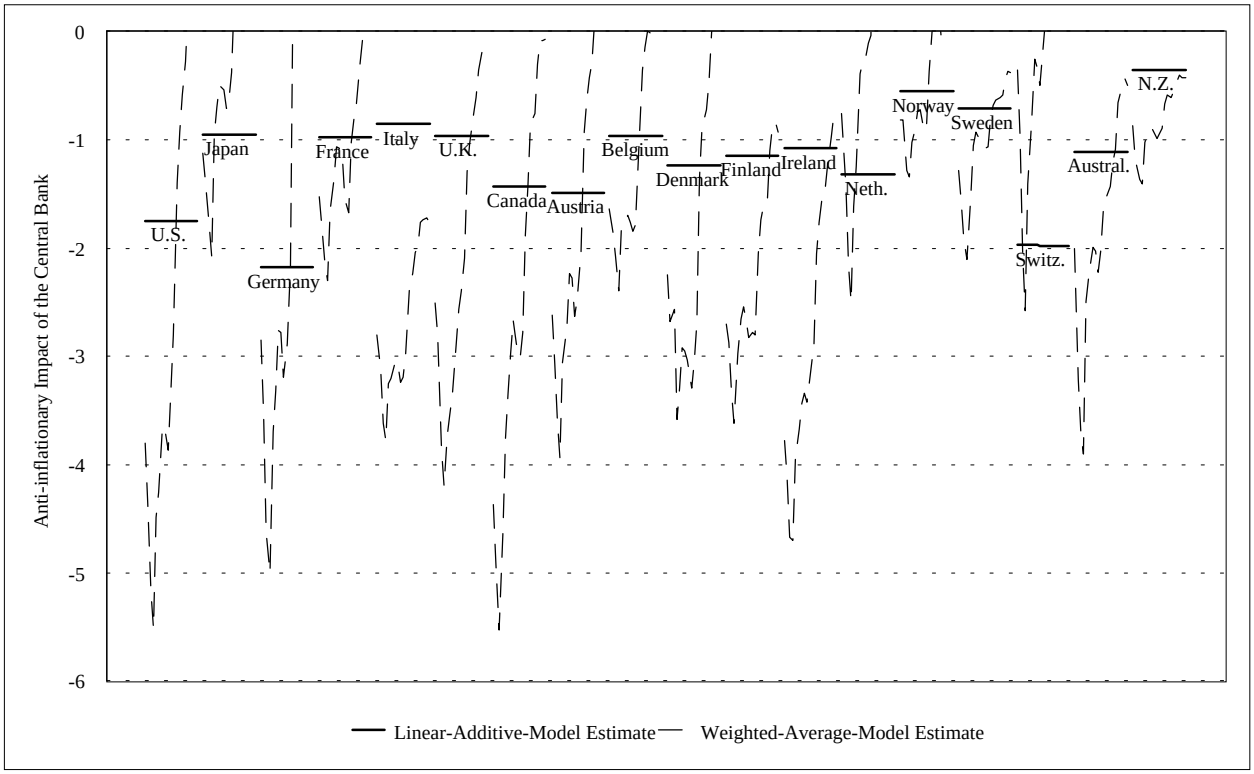

Figure 5 Comparison of the linear-additive and weighted-average estimates of the anti-inflationary impacts of OECD central banks given their degree of independence and the level of other variables in that country-year. The data for each country are from 1972 to 1990, left to right.

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.[41] 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. That is, 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 rate 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. Many 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 do not explore many or sometimes even any 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.

Appendix I: 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-rate target on inflation

$$\frac{\partial \pi}{\partial \pi_g^*} = 1 - CBI \geq 0.$$

The effect of the bank's inflation-rate 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-rate target on inflation

$$\frac{\partial \pi}{\partial N_g^*} = \alpha (1 - CBI) A_g \geq 0.$$

The effect of the bank's employment-rate 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 rate.	The effect of the government's target inflation rate 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 rate.	The effect of the bank's target inflation rate 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 rate.	The effect of the government's target employment rate 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 rate.	The effect of the bank's target employment rate 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 Rate (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

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Notes

1. The modern (neoclassical) economics of central bank independence and monetary policy has developed through 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 between central banks, governments, and society.

2. That CBI lowers inflation is not quite universally agreed however. Posen (1995a, 1995b), *e.g.*, argues essentially that CBI is epiphenomenal, being produced by other anti-inflationary forces which also produce the low inflation. The view to be offered here and both standard views just introduced do require to the contrary that institutions, specifically CBI, matter. The present approach allows an empirical evaluation of the epiphenominality claim against appropriate alternatives.

3.To my knowledge, Jonsson (1995), which (independently) noted the correct weighted-average formulation in its theoretical exposition, is the only exception. Even there, however, the empirics do not fully reflect the theoretical insight.

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

5.The conclusion that CBI has no real effects on average has recently come under considerable theoretical and empirical fire; see Hall (1994), Franzese (1997), Iversen (1997), Hall and Franzese (1997), Cukierman (1997), and Iversen and Soskice (1997). As just noted in the text, however, the real side of the theory is not at issue here.

6. Specifically, the exposition here follows Cukierman (1992) chapter 3: "The Employment Motive for Monetary Expansion." There are other "motives" (see subsequent chapters in that volume); any or any combination would suffice for the present purposes. The employment motive is presented here since it is most familiar.

7. The utility function actually implies that the government derives *disutility* from employment (inflation) which is *too high* (*too low*) which seems highly unrealistic. We assume, as is standard, that the target rate is arbitrarily high (low), say 100% (0%), to avoid the problem. Partisan differences in preferences are then captured entirely by variations in A_g.

8. Unexpected inflation increases employment here because it lowers real wages which increases the quantity of labor demanded. If employment is demand rather than supply constrained, this increases employment. In the neoclassical model, expected inflation does not affect real wages and therefore does not affect employment.

9. Since π_d^* involves only parameters known with certainty by the private sector (π_g^*, A_g, α, N_g^*, and N_n), expected inflation (π^e) will be actual inflation (π_d^*) and employment (N) will not deviate from its

natural rate (N_n) in equilibrium in this model. This is the real side of the neoclassical argument which, as I have said, is irrelevant to the present argument and about which, as I have also said, I do not here express any opinion. See also note 5.

10. For the most part in what follows I will be assuming that $\pi_b^* \leq \pi_g^*$ is a constant and that $A_b=0 \leq A_g$. This is stronger than necessary and probably than strictly true empirically. The necessary elements are that $\pi_b^* \leq \pi_g^*$, $N_b^* \leq N_g^*$, and $A_b \leq A_g$ with at least one of these inequalities strict, and that much is certainly empirically true. Another common assumption in the literature is that the parameters of the bank's utility function are what a benevolent social planner *capable of credible commitment* would have them be. Staying in a neoclassical world, such an assumption would generally imply that $A_b=0$ (or t least that $A_b<A_g$) though π_b^* might now be a function of optimal-seignorage considerations and the like and thus of some other parameters such as the efficiency of the tax system and the size of the money stock. π_b^* would still be less than π_g^* since the latter would surely include the same factors as the former (both government and bank being interested in rasing public revenue by seignorage) plus some other pro-inflationary considerations since the government is likely to rely on seignorage more than optimally (see, *e.g.*, Cukierman 1992, ch. 4).

11. The state of the art in this research, both theoretically and empirically, has been compiled in and considerably advanced by Cukierman (1992). Most of the theoretical advances detailed therein involve allowing for uncertainty and/or incomplete information of certain sorts in the model. For the most part, one gets similar conclusions: inflation is lower with credible commitment (CBI) and real variables are not affected *on average*. Some costs do now arise in the form of more variant real quantities. *I.e.*, in this framework, a credible commitment to refrain from surprise bursts of inflation is a sacrifice of some ability to use monetary policy for macroeconomic stabilization.

12. See, *e.g.*, Alesina and Summers (1993) which could serve in this context as a statistical and graphical summary of the standard empirical set-up and findings. Eijffinger and De Haan (1996) Appendix B provides a very helpful tabular summary of the empirical specifications and findings in the literature. Some work moving beyond the simplest linear-additive model–such as Jonsson (1995), Clark et al. (1997), Hall and Franzese (1997)–does exist, but these allow only one other variable to interact with CBI whereas the theory indicates that most or all factors should so interact.

13. The degree of CBI is sometimes measured based upon characteristics of the bank law thought to enhance or detract from the autonomy and conservatism of the central bank–such as the length of the bank president's term, the terms under which the bank may or must purchase government securities, *etc.* Sometimes it is measured based upon the reputation of the central bank; *i.e.* some 'expert' judgements are made as to how autonomous and conservative the bank is in policy-making. The index I employ is the average of five commonly used indices of both types, all scaled to 0-1. CBI has also been measured based on the estimated parameters of monetary-policy reaction-functions. For the present purpose of relating CBI to inflation, though, that would amount to assuming the conclusion, so I do not incorporate such measures into the index used here. However one measures CBI, though, no bank is ever completely autonomous from the discretionary authority ($CBI \neq 1$) nor is any bank ever completely dependent ($CBI \neq 0$) as I have pointed out above; rather, CBI measures the *degree* to which the central bank as opposed to the government of the day controls monetary policy.

14. For simplicity the rest of the discussion assumes $A_b=0$ and π_b^* is a constant less than π_g^*.

15. 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.

16. More precisely, "employment [must be] a decreasing function of the real wage rate" which in turn implies 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 rate, or...both conditions [must] hold" (Cukierman 1992, 41). To which I would add that, if at least some unemployment is involuntary, then the supply of labor is effectively in excess. Accordingly, the supply of labor is not effectively wage elastic in this vicinity, and Cukierman's conditions hold.

17. Despite the greater familiarity of the former term, I prefer the latter since *neocorporatism* often means considerably more than CWB which latter fits rather more directly into the present theoretical model. The historical development of the coordinated-wage/price-bargaining argument as it applies here can be traced 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).

18. One version of the argument (Calmfors and Driffill 1988) argues that the relationship between coordination and wage restraint should be curvilinear with greatest restraint at zero and full coordination and less restraint at intermediate levels of coordination. Here, 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 to be measured by union density, is monotonically negatively related to wage restraint. Coordination, as defined by Soskice (1990), and to be measured by the subjective index in Hall and Franzese (1997) which builds thereupon in this regard, is monotonically positively related to restraint. 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).

19. The externality in question arises from the fact that one person's nominal wage/price gain is another's real wage/price loss (see the references in note 17). Fragmented bargainers with sufficient market power can externalize these costs.

20. See the references in note 17, and Alogoskoufis and Manning (1988) and Layard *et al.* (1991) in particular, for empirical support of this contention.

21. In fact, I made some preliminary effort to consider these factors but found little empirical support for either contention in the present sample. I leave more thorough consideration of these factors for the future, simply noting for now that any such work would do best to incorporate the weighted-average formulation suggested here.

22. Posen measures the potency of anti-inflationary interests in society by an index of EFOI which combines two indicators of banking system structure–whether or not there is universal banking and whether banking supervision is directed by the central bank–with two indicators of the openness of the political system to interest group influence–whether the state is federal and how fractionalized is

the party system in the legislature. The first two are also taken to be indicators of CBI and therefore do not represent any departure from CBI theory. Posen's claims regarding the latter two are that federal systems provide more access for anti-inflation groups and fractionalization reduces access for such groups (1995b, 258-62). Unclear, however, are (a) 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 (b) 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 entirely 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 fact, in two cases, we know that the correlation is 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 provide a much less problematic test of Posen's arguments than could any direct application of his own EFOI index.

23. 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 [Clark *et al.* (1997) is an excellent recent example], though without noticing the specific manner in which the theory indicates this should be so (*i.e.*, proportionate-reduction by weighted-average). Morever, the generality of this mitigating role of CBI has universally been missed; the influences of most if not all other factors should be so mitigated, not merely the impacts of government partisanship or of wage-/price-bargaining institutions.

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

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

26. The data are annual from 1972-1990. The post-Bretton-Woods era of flexible exchange rates is chosen since fixed exchange rates and perfect capital mobility would remove national monetary-policy autonomy from all but the N^{th} country.

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

28. Methodological Notes:

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

Columns D and E must be estimated by constrained least-squares (CLS); the rest can be estimated by ordinary least squares (OLS). CLS estimation differs from OLS in that the parameter values which minimize the sum of squared residuals are found by numerical methods since analytic solutions may not exist. The calculation of the variance-covariance matrix of the estimated coefficients also differs accordingly; see Greene (1997, 453-8).

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

As Beck and Katz (1996) have demonstrated, attempting to estimate by feasible generalized least-squares a more complicated error-covariance structure allowing for contemporaneous correlation is not advisable in data sets of these proportions. They suggest (and 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*). Implementation of PCSE's in the CLS setting is not straight-forward, however, so I have relied on the inclusion of π^a to bring any contemporaneous correlation into the systematic component (in both OLS and CLS settings for comparability). Furthermore, especially given that π^a is among the independent variables, the Newey-West covariance matrix employed should be some help with regard to whatever contemporaneous correlation in the stochastic component may remain. Writing computer code to combine Newey-West with PCSE in the constrained or non-linear LS setting remains a project for future research.

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.

29. 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.

30. 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.

31. 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.

32. 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.

33. 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.

34. $b_{cbi,2}$ 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)**.

35. 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.

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

37. 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 $p\approx.019$, is sufficient in model **(9)**.

38. 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.

39. 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'?

40.**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 a lower inflation rate 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 rate 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.

41.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**.