Checks and Balances, Private Information,

and the Credibility of Monetary Commitments

Philip Keefer
Development Research Group
World Bank
pkeefer@worldbank.org

David Stasavage
London School of Economics
d.stasavage@lse.ac.uk

1.   Introduction

The literature on positive models of monetary policy has focused on the fundamental difficulty that governments can encounter in establishing the credibility of their policy commitments. The problem arises when governments have an incentive to increase the rate of inflation *ex post*, once the public has taken actions such as signing long-term wage contracts. This time consistency problem is further complicated by the presence of two types of private information. First, the public may be unsure of the preferences of government decisions makers with regard to the short-term tradeoffs between inflation and output. Second, the public cannot perfectly observe a government's forecasts for variables such as money demand, and as a result may have difficulty in distinguishing between inflation deliberately generated by government and inflation caused by exogenous shocks. Considerable research has pointed to central bank independence and exchange rate pegs as important instruments which governments can use to establish policy credibility. For example, in a canonical contribution, Rogoff (1985) demonstrates that delegation to an independent central bank might solve the time consistency problem and be welfare-improving.

The puzzle confronting both the central bank and exchange rate peg solutions to credibility problems is the following. In the case of the time consistency problem with complete information, why is it more costly for politicians to revoke central bank independence or fixed exchange rates than to renege on other policy commitments such as a simple pledge to maintain a specific rate of money growth?   The effect of these institutions on the time consistency problem with private information raises a similar puzzle: why are government attempts to revoke central bank independence or fixed exchange rates *more visible* than government failures to pursue low inflation?

In this paper, we use theory and evidence to demonstrate that the effectiveness of central bank independence in solving the complete information time consistency problem depends on the structure of a country's political institutions, and in particular on the number of veto players in government. This argument follows earlier contributions by Lohmann (1998), Moser (1999) and ourselves (Keefer and Stasavage 2000). However, we suggest that the effectiveness of exchange rate pegs in solving the complete information time consistency problem *does not* increase with the number of veto players in government. We also consider whether and how exchange rate pegs and independent central banks have a significant effect on the private information time consistency problem. Here we follow arguments made by Canavan and Tommasi (1997) and by Herrendorf (1998), who suggest that exchange rate pegs have a larger anti-inflationary effect, the more the public is uncertain whether observed inflation is due to deliberate government action. In contrast, central bank independence is not more effective as a commitment device under these same conditions of uncertainty.[1]

Our empirical results support the proposition that central bank independence is more likely to reduce inflation in institutional contexts where there are multiple veto players in government. In contrast, checks and balances have a negative or insignificant effect on the efficacy with which exchange rate pegs reduce inflation expectations. On the other hand, our tests support the view that the anti-inflationary effect of exchange rate pegs increases significantly in contexts where it is difficult for the public to distinguish between inflation that results from deliberate government policy choices and inflation which results from exogenous shocks to the economy. Finally, we demonstrate that our results are robust to alternative specifications emphasizing the effect of democratic institutions more generally on monetary commitments. These results are general: we obtain them using a sample that includes both

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[1] On the idea that exchange rate pegs provide a more transparent form of commitment see also Broz (1999).

developed and developing countries (78 in total) over the period from 1975 to 1994.

Our investigation has direct implications for the question posed by Bernhard, Broz and Clark (2000): if commitment mechanisms such as central bank independence and fixed exchange rate pegs unambiguously improve general welfare, why do all countries not adopt them?[2] One possible answer is that the social welfare function assumed in the literature incompletely reflects the social tradeoffs between inflation and economic growth. Thus institutional reforms such as central bank independence may not unambiguously improve social welfare. The institutional and information hypotheses that we analyze offer a different answer to the question that retains the economic assumptions of existing positive models of monetary policy: some countries do not successfully adopt these mechanisms simply because doing so would have little effect on policy outcomes.

The remainder of the paper is organized as follows. We first consider the conditions under which central banks and exchange rate pegs will prevent governments from reneging on their inflation commitments in a world of complete information. We then consider the conditions under which these two instruments constitute better signals of the preferences of policy makers than do the underlying policies enacted by policy makers. The influence of political institutions is analyzed in both sections. We then present cross-country empirical tests of several propositions. Section 5 then considers robustness issues. Section 6 concludes.

2.   Political institutions and monetary commitments

The basic credibility problem in monetary policy involves the incentive for governments to take advantage of fixed inflation expectations of private actors in order to

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[2] See also Bernhard (1998), Maxfield (1997), (Broz, 1999), Clark and Maxfield (1997), and Bernhard and Leblang (1999)

create a temporary growth spurt through an increase in the money supply. The problem emerges from the simple framework introduced by Barro and Gordon (1983a). Governments minimize a loss function given by

(1) $L_G = \dfrac{1}{2}\pi_t^2 + \dfrac{1}{2}b_G(y_t - y^*)^2$ with respect to π, where

(2) $y_t = \pi_t - \pi_t^e + \varepsilon_t$

Output is a function of π^e, expected inflation, and a supply shock, and y^* is desired output. The term b_G is the relative weight which the government attaches to departures from the desired rate of output relative to departures from the desired rate of inflation. Private actors first build expected inflation into their long term contracts, prior to observing either the supply shock or government policy actions, then the supply shock is realized, and then the government sets actual inflation. Private actors set their inflation expectations understanding that, after the shock is realized, government has an incentive to allow inflation greater than expected inflation, in order to achieve a temporary boost in output. Anticipating this, private actors build an inflation bias into their contracts, which would be zero if governments could credibly commit not to initiate an inflation "surprise". The amount of the bias is $b_G y^*$ and final inflation is given by this bias and an adjustment to the supply shock, or

(3) $\pi = b_G y^* - \dfrac{b_G}{1 + b_G}\varepsilon$.

This is the credibility problem of governments operating under complete information. This section develops several propositions about the conditions under which central banks and exchange rate pegs reduce the inflation bias that emerges from this credibility problem.

Central bank independence and credibility with complete information

Establishing an independent central bank reduces the inflation bias if central bankers

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can act with full autonomy, that is without fear of override, and if their preference parameter b_{CB} is less than b_G. The crucial implicit assumption in contributions such as Rogoff's (1985) is that the central bank acts with irreversible, full autonomy. If, however, central bank decisions are no more difficult for political actors to override than economic policies themselves, independent central banks may do little to prevent *ex post* reneging on inflation commitments. Instead of solving the time consistency problem, central bank independence would merely displace it, as governments would have an incentive to first announce central bank independence and subsequently renege on this commitment.

Central bank independence could be protected from override by constitutional guarantees. The precise effect of constitutional guarantees is clarified by Lohmann (1998): legal central bank independence is likely to make a difference for policy outcomes if a larger number of veto players is required to revise a central bank's statute than would be required to make a change in monetary policy if the government had regained discretionary control over policy.[3] For example, if monetary policy under discretion were set by the executive alone, but revisions of the central bank charter required the agreement of both the executive and the legislature, delegation to an independent central bank could increase the credibility of monetary policy.[4]

However, it is not evident in practice that a greater number of veto players is required to consent to changes in a central bank charter than is required to change monetary policy in the absence of an independent central bank. The central bank charters of most countries are laws voted by legislatures rather than inscribed in constitutions; thus central banks are no less

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[3] More generally, comparative research on political institutions and policy making has demonstrated that it is more difficult to pass laws in countries where decision making is divided between multiple veto players, whether a separate executive and legislature in the case of presidential systems, or multiple parties within a coalition government within parliamentary systems (for a recent comprehensive discussion, see Tsebelis 1999).

[4] Whether credibility actually increases also depends on the preferences of the different veto players.

vulnerable, in principle, to having their actions or independence overturned by political authorities than are other types of legislation.[5]

One possible response to this argument is to observe that only the executive has full control of monetary policy if there has been no decision to delegate. However, this is not always accurate. For example, in a coalition government, the party controlling the finance ministry may nominally have full control of monetary policy, but in practice other coalition members can threaten to leave the coalition when confronted with finance ministry actions to which they are strongly opposed. Likewise, in a presidential system the legislature also exerts influence on monetary policy making to the extent there are spillovers from fiscal policy to monetary policy. Thus, in practice a similar number of veto players may be required to consent to changes in central bank laws as would be required to consent to changes in monetary policy in the absence of an independent central bank.

The important question that remains, therefore, is how delegation of policy making authority to an independent agency can make a difference for policy when the number of veto players required to overturn delegation and to change monetary policy is the same. Moser (1999) provides one answer to this question. He assumes that under checks and balances, with no delegation, policy outcomes are the result of a simple bargain between the veto players, and he then shows that delegation by multiple political actors can lead to lower inflation expectations than would prevail in the absence of an independent central bank.

Keefer and Stasavage (2000) compare the effects of delegation under a richer variety of institutional arrangements, considering several agenda-setting possibilities that might operate under checks and balances. We find that the effects of delegation are highly sensitive

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[5] Moreover, as the literature on legislative control of bureaucratic institutions (e.g., Weingast and Moran, 1983) emphasizes, failure to observe frequent changes in central bank statutes is an unreliable indicator of independence, since if the threat of a statutory revision is credible, central banks will typically modify their

to the institutional rules. The effect of central bank independence rises with the extent to which veto player preferences diverge; central bank independence has a small effect on inflation expectations when the more inflation-averse veto player is the agenda setter; and its effect is greatest when the less inflation-averse veto player exercises agenda control.

The model developed in Keefer and Stasavage (2000) adds a second government decision maker to the classic Barro-Gordon model, and then compares the outcome under two government decision makers to the outcome when there is delegation to an independent central bank. As in Barro-Gordon, private sector actors establish inflation expectations and embed them in long term contracts. A random supply shock occurs and political decision makers fix inflation. If they cannot agree on a new inflation policy, expected inflation (the price increases written into long terms contracts) becomes actual inflation.

The policy they select depends on whether the more or less inflation-averse political actor has agenda control, or whether neither does. It also depends on whether expected inflation is higher than the preferred inflation outcome of the less inflation-averse political actor, lower than the preferred inflation of the most inflation-averse actor, or between the two, each case resulting in the two actors agreeing to a different inflation outcome.[6]

The introduction of the independent central bank effectively assigns agenda-setting power to the independent central bank.[7] The private actors set expected inflation, the shock is realized, and the central bank fixes inflation. The political actors then decide whether to override the bank (again, both must agree); if an override occurs, monetary policy is set by the two political actors as if there were no central bank.

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policies to avoid revision.

[6] Politicians who place a non-zero weight on stabilizing output will prefer to react to a negative supply shock by increasing the rate of inflation.

[7] The relationship between political actors and central bank therefore reflects the logic of "agency drift" models of legislative control over bureaucratic institutions (McCubbins, Noll and Weingast 1989, 1987). See also

In the presence of checks and balances, the key difference between monetary policy made under discretion (without CBI) and monetary policy made under delegation (CBI) is that the default or reservation outcome changes – the outcome which prevails if veto players are unable to agree on a change in policy is different under discretion than under CBI. Under discretion, the reservation outcome is the rate of inflation which results from the price increases written into wage contracts by the private sector. If the realization of the supply shock is such that one veto player would prefer to inflate, while another would not, as in Figure 1 below, then neither veto player is able to improve on the reservation outcome without making the other worse off. The reservation outcome will be the final rate of inflation.

Under delegation, in contrast, if veto players are unable to agree to override the central bank, the rate of inflation that prevails is that chosen by the central bank. Knowing this, the central bank has an incentive to choose a rate of inflation which is override-proof. Assuming the central bank is more averse than any veto player, then it will choose an inflation outcome which leaves the most inflation-averse political decision maker no worse off than if the two veto players overrode the central bank and agreed on a new rate of inflation.

Figure 1 demonstrates this logic. The "Inflation without CBI" outcome is the outcome that prevails either in the absence of a central bank, or if the political actors override the central banker. The central bank therefore chooses "inflation with CBI", an inflation level that is as no further from Veto Player 1's preferred inflation outcome than is "inflation without CBI", giving veto player 1 no incentive to agree to override the central bank's decision – and generating lower expected inflation than would otherwise have prevailed.

Epstein and O'Halloran (1999)

Figure 1: Reservation outcomes with and without central bank independence
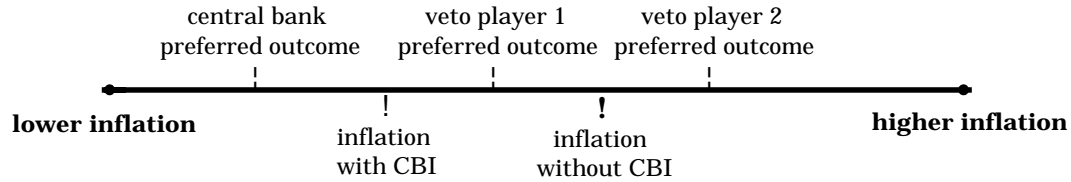
Keefer and Stasavage (2000) show that, as long as the central banker has more "conservative" inflation preferences than any political decision maker, the rate of inflation is unambiguously lower when monetary policy is delegated to a central bank, although, as was earlier made clear, the magnitude of this effect varies greatly with the identity of the agenda setter and the extent of polarization of the political actors.

In the second half of the paper, we present tests of the following proposition that emerges from this discussion.[8]

Proposition 1: Central bank independence is more effective as an anti-inflationary device when there are multiple veto players in government

Checks and balances and exchange rate pegs

Exchange rate pegs are widely believed to serve as a form of credible commitment, because adopting a peg reduces the possibility for a government to conduct an independent monetary policy. As is well-known, if foreign assets are perfectly substitutable for domestic assets, a country's money supply - and hence its inflation rate – are exogenously determined. All a government need do to establish such a peg is to declare that it is willing to sell foreign currency for domestic currency at a fixed rate. If private actors believed that the exchange

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[8] In our empirical tests we assume, as is conventional, that central bankers on average have conservative

rate peg is immutable, their domestic inflation expectations would then simply equal expected world inflation. Given the standard Barro-Gordon loss function, however, government decision makers have an *ex post* incentive to devalue – to abandon the peg – in order to generate a higher rate of inflation.

The literature has suggested that exchange rate pegs may nonetheless increase monetary policy credibility if devaluation imposes additional political costs on governments. These costs are generally modeled with an exogenous parameter C which is added to the Barro-Gordon loss function minimized by government decision makers (as in Obstfeld, 1996).[9]

$$(4) \qquad L_G = \frac{1}{2}\pi_t^2 + \frac{1}{2}b_G(y_t - y^*)^2 + C(\pi)$$

This solution parallels the assumption made by Rogoff (1985) regarding the irrevocability of central bank independence. As with that assumption, it is not clear why governments that renege on exchange rate pegs suffer larger political costs than governments that renege on more simple policy pledges to maintain a specific rate of inflation or to maintain a specific rate of money growth.[10] Little attempt has been made to establish whether these costs, however they are defined, empirically explain differences in the outcomes of pegging across countries.

One question to ask, then, is whether checks and balances provide an institutional setting in which the introduction of a pegged exchange rate will have a more negative effect on expected inflation. Three examples make clear that this is unlikely to be the case.

First, it is common in the literature to assume that countries peg their currencies to

the currencies of foreign countries with inflation much lower than their own. This pegging strategy implies that domestic inflation under the exchange rate peg could be to the left of the minimum inflation acceptable to even the most inflation-averse domestic policy maker. That is, if countries are pegged to currencies that exhibit sufficiently low inflation, their inflation outcomes if they retain the peg are less than or equal to the "inflation with CBI" outcome in Figure 1. Following the logic in the model of Keefer and Stasavage (2000), such inflation outcomes would be overturned by domestic political veto players, no matter how many veto players there are. Under these conditions a peg would not change expected domestic inflation, regardless of whether there are checks and balances in government.

A second important point is that pegs are often established by the executive branch alone without legislative approval. If abandoning a peg is also a matter only of executive discretion, we reach a similar conclusion; no matter how many veto players are present in government, the peg will not reduce inflation expectations, because the decision to abandon the peg will be the prerogative of a single veto player.

Third, even if it is the case that foreign inflation outcomes are not extremely low and the introduction of a peg is a decision of both the legislature and the executive branch, checks and balances may still not improve the efficacy of the peg, and may in fact detract from it. The question is similar to the earlier discussion of central bank independence. There, we asked whether, under checks and balances, the introduction of a central bank changes the default inflation outcome that prevails in the absence of government action. We can ask the same question with respect to the peg.

Take a case where economic circumstances are such that government intervention is necessary to avoid *de facto* devaluation and abandonment of the peg. Under these

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[10] See the observation by Persson and Tabellini (1994) p.17.

circumstances, the default outcome under a peg – *de facto* devaluation –converges to that under a flexible exchange rate (where the same circumstances would also lead to devaluation). A peg is under threat whenever economic circumstances trigger an outflow of foreign reserves and those reserves are scarce. Any exogenous shock that increases domestic inflation (such as a positive supply/income shock, $\varepsilon_t > 0$ in equation 2, which increases money demand) would, in particular, trigger such an outflow.

This example demonstrates that if foreign reserves are scarce and a country is exposed to inflationary shocks, a pegged exchange rate leads to nearly the same outcome as a flexible exchange rate in the absence of countervailing government action. If the default outcome is the same under fixed and flexible exchange rates, the presence of checks and balances makes no difference to the comparison. Since private actors have no reason to expect that the options available to multiple policy makers will change under a pegged exchange rate when inflationary shocks occur, they have no reason to lower their inflation expectations. In inflationary environments, therefore, even in the presence of checks and balances, the pegged exchange rate will do little to "tie the hands" of policy makers.

Several institutional variations have been omitted from the foregoing discussion. Their introduction does not fundamentally change the analysis, however. What if the responsibility for defending an exchange rate peg is assigned to an independent central bank or, even more stringently, what if a currency board arrangement is established by law? In this case it is the independence of the bank or the legal status of the currency board, rather than the existence of the peg, that should be the primary focus of analysis.

Similarly, it is sometimes the case that governments attempt to make pegs credible by giving a central bank the right to refuse a request by the government for monetary financing of a fiscal deficit. This makes it difficult for government to entertain fiscal policies that would

trigger a loss of foreign exchange under a peg.   Again, though, it is the presence of central

bank independence which secures policy credibility and not the peg, *per se*.

Among the testable hypotheses that emerge from this analysis is one in particular that

we examine in section 4.

***Proposition 2: Exchange rate pegs are no more effective as anti-inflationary devices
when there are multiple veto players in government.***

3.   The signaling effect of monetary commitments

The literature has identified two further complications to the time-inconsistency

problem analyzed by Barro and Gordon. One is that private actors often have incomplete

information about the inflation-output preferences of political decision makers. A second

complication is that the public may have difficulty determining the extent to which actual

inflation is the deliberate product of the government's planned rate of inflation, or whether it

is instead due to the realization of shocks to money demand that are beyond government

control (Canzoneri 1985). Incomplete information creates incentives for policymakers to

take actions that "signal" their preferences to the public. Imperfect control of inflation

makes these signals difficult for the public to interpret. Central bank independence and

pegged exchange rates have both been identified in the literature as tools with which low-

inflation governments can send more reliable signals about their policy preferences.

The role of signaling in monetary policy was first introduced in models developed

Backus and Driffill (1985), Barro (1986), and Vickers (1986). These authors relax the

assumption from the Barro-Gordon model of monetary policy that the public has complete

information about the inflation/output preferences of policymakers and instead assume that

the public attempts to update its beliefs about policy maker type based on the monetary

policies that government pursues. Vickers shows that inflation-averse policy makers may be

compelled to adopt an even more stringent monetary policy than they prefer, in order to distinguish themselves from less inflation-averse policy makers. [11] However, imperfect control of inflation complicates this signaling as argued above. When different types of policy makers choose different rates of inflation in the first period of a signaling game this is referred to as a separating equilibrium, while when both policy makers choose the same inflation rate (due to attempts by less conservative policy makers to mimic their more conservative counterparts) this is referred to as a pooling equilibrium.[12]

Several authors, such as Maxfield (1997), have argued that establishing central bank independence can send a signal about a government's inflation preferences. Herrendorf (1998) and Canavan and Tommasi (1997) provide formal statements of a similar argument regarding exchange rate pegs: they are easier for private actors to verify than are alternative policy targets such as the money supply. In their more formal argument they use the following two period game. In the first period governments choose whether to adopt an exchange rate peg (or an independent central bank), private actors fix expected inflation, the government chooses the rate of inflation, and finally private actors observe final inflation (the sum of government's unobserved inflation policy and a control error). In the second period, private actors update their beliefs regarding the government's inflation preferences, they revise expected inflation accordingly, and the government chooses whether to devalue and by what rate. The virtue of the exchange rate peg or independent central bank, in these models,

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[11] Barro (1986) models monetary policy with incomplete information using a different set of assumptions. Instead of assuming that the public is unsure of the preferences of decision makers, he models a game where the public is uninformed about whether different decision makers are able to commit to policy announcements. We discuss signaling in monetary policy in the context of the Vickers model, because the assumptions about incomplete information in these papers are more closely in line with the more general game-theoretic literature on signaling.

[12] Note, signaling here allows an inflation-averse policy maker to distinguish herself from other types of policymakers, thus reducing inflation expectations, but as long as the inflation-averse policy maker still places a non-zero weight on using monetary policy to stabilize output she still has an incentive to increase inflation once the public has fixed its expectations – that is, the original time consistency problem persists independent of the

is precisely that the public finds it easier to establish the link between final inflation outcomes and government policy actions, since all those policy decisions that require abandoning the peg or revoking the central bank's charter are easier to distinguish than they otherwise would have been.

Signaling and central bank independence

Maxfield (1997) has argued that many recent efforts to increase central bank independence can be explained as attempts by governments to signal policy preferences. When the public observes high inflation, it cannot distinguish whether this is the result of a money demand shock or high planned inflation. The government announces the creation of an independent central bank and claims that it is staffed by inflation-averse individuals. If the public subsequently observes high inflation, it understands that this can only be consistent with the planned inflation of a conservative central bank if there were an extraordinarily high money demand shock, an event that occurs with low probability. The public is therefore likely to believe that high inflation is due to meddling by the government, either in the form of appointing a liberal central banker when the government claimed the banker was conservative, or through pressuring the central banker to adopt policies closer to the government's preferred outcome. This would make the adoption of an independent central bank a potentially valuable signal for an inflation-averse government.

The difficulty with this logic is that it does not clearly demonstrate why central bank independence has a greater signaling value than do other types of policy announcements. The government could just as easily have announced a particular inflation or monetary growth target at the beginning of the period, and the public could have drawn the same conclusions after observing final inflation: high inflation is more likely to be the result of

resolution of the imperfect information problem.

reneging on the target than of the low-probability event of a large money demand shock.

One reply to this argument might be that, as Canavan and Tommasi observe, it is difficult for the public to track money growth. If it is easier to assess the preferences of the central bank or the extent of government interference in central bank decisions than to verify government claims about money growth, the announcement of central bank independence could indeed provide a better signal than a simple policy announcement. However, it seems implausible that government meddling in central bank decisions should always be easy to observe. Governments do not need to revoke the charter of a central bank or replace a central bank governor to pressure central banks to pursue a more generous monetary policy. They can instead exercise more subtle and less visible forms of pressure, ranging from reducing the resources of the central bank to social ostracism of the central bank leadership. Nor is it the case that central bankers are usually willing to resign when pressured to undertake policies with which they disagree (despite occasional heroic examples of the contrary).

This discussion suggests that central bank independence is likely to be a weak response to the problem of incomplete information in monetary policy. As in the earlier discussion, though, we can ask what effect the institutional environment has on the efficacy of central bank independence in treating this problem.[13] We know from the earlier argument that government meddling is more difficult in the presence of checks and balances. However, the key issue in a signaling context is whether, under checks and balances, meddling with central bank decisions is more *visible* than government management of monetary growth. There are a number of reasons to suspect that this might be the case. For example, override of a central bank may require a legislative act that is more public than the

bureaucratic issuance of monetary growth figures, and less demanding of special expertise to interpret. Competing political actors inside government may have a greater incentive to register public complaints about the treatment of the central bank than about the massaging of money growth data. We leave to further work the more rigorous exploration of this issue, however.

Signaling and exchange rate pegs

Deviation from exchange rate pegs is transparent and for that reason pegging is potentially more effective than central bank independence as a signal of policy maker inflation preferences (Broz, 1999). In particular, abandonment of a peg is a more transparent indicator of inflationary government practices than is either a high rate of growth of the money supply (which may be generated by an unanticipated change in the money multiplier) or a high rate of inflation (which may result from a shock to money demand). This avoids the uncertainties surrounding the connection between unobserved government policy and observed final inflation, allowing the public to better infer the preferences of government actors after observing first period inflation and before signing contracts governing each subsequent period. [14]

Canavan and Tommasi (1997) and Herrendorf (1999) have formalized this argument using somewhat different models.[15] Both models provide a rigorous explanation of previous empirical findings showing that countries that have adopted fixed exchange rate pegs have lower inflation than others. However, the specific predictions of these models have not yet

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[13] Clark and Maxfield (1997) also emphasize the importance of examining the institutional context.

[14] An alternative proposed solution to the private information problem is for a central bank to commit to publishing its inflation forecast, as discussed by Faust and Svensson (2000).

[15] The conclusions of Herrendorff's model are very similar to those of Canavan and Tommasi, except he follows Barro (1986) in assuming that there is incomplete information about the ability of policymakers to commit rather than about the preferences of policy makers.

been empirically tested. In particular, the basic premise is that pegging should be more effective in environments in which it is difficult for the public to distinguish the government contribution to inflation. Canavan and Tomassi show that inflation should be lower the greater is the precision with which the public can observe the contribution of the government's policy action to final inflation. Since in their model the point of pegging the exchange rate is to increase this precision, if precision is high to begin with (in the absence of a peg), we would expect the peg to have little impact on inflation.[16]

As with central banks, we can ask whether the signaling effect of pegs changes in the presence of checks and balances. It is evident that abandoning a peg that was previously established is as visible to the public when there are multiple veto players as when there is only one. The signaling value of the peg does not, therefore, change. The question of whether pegs are more or less likely to be adopted under checks and balances is the more important and complex one, exceeding the bounds of this paper.[17] For example, executives might be more likely to adopt a peg in the presence of an effective legislature in order to signal their private information about their ability to gain legislative cooperation in the conduct of macroeconomic policy. On the other hand, if all veto players are required to acquiesce to a peg (as in the case of a currency board) and they had distinct preferences over inflation, a peg may be less likely to emerge under checks and balances.

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[16] In their model, the inflation choices of the two types of decision makers are given by equation 2.11

$\frac{A^i}{2}\left\{1+\sqrt{1-4\beta\frac{p_\varepsilon}{p_\varepsilon+p_A}}\right\}$, where the parameter A^i indicates the inflation tolerance of the two types, *1* and *2*;

β is the discount rate; the precision with which the public can distinguish the two types is captured by p_A, and the precision with which the public can infer the policy choices of the decision makers from the observed inflation outcome is p_ε. Differentiating the expression with respect to p_ε, one can see that inflation rises with the dispersion of the control error (the noise in the system). Other predictions also emerge from the model. For example, by differentiating again with respect to p_A or the discount rate β, we can also see that the impact on inflation of a reduction in the standard deviation of the control error is greatest when p_A and β are smaller – that is, when it is more difficult for the public to distinguish the high and low inflation types, and when officials have longer horizons.

The above discussion of central banks and pegged exchange rates suggests that if these are indeed to be useful as signals, then they should have the greatest impact on inflation when the public has the greatest difficulty discerning government policy contributions to inflation outcomes, due for example to volatility of money demand. Propositions 3 and 4 reflect this logic, negatively in the case of central banks, which we argue are unlikely to provide a useful signal, and positively in the case of fixed exchange rates. We test these propositions in Section 4.

Proposition 3: The effectiveness of central bank independence in reducing inflation does not vary with the public's difficulty in inferring government policy choices from inflation outcomes.

Proposition 4. Exchange rate pegs will be more effective in reducing inflation when the public has greater difficulty inferring government policy choices from inflation outcomes.

4. Empirical tests

In order to test our propositions, we examine economic and political determinants of inflation in a sample of 78 countries covering the period 1975-1994. This choice of time period is determined by the end of the Bretton Woods era and by data availability. Our empirical tests follow the specifications used in recent papers investigating the effect of monetary institutions on inflation outcomes including Franzese (1999), Hall and Franzese (1998), Campillo and Miron (1996) and Cukierman, Webb, and Neyapti (1992). Because the institutional variables with which we are concerned change with relatively low frequency, we follow the majority of recent papers in the literature by investigating period averages. We report results both from cross-section regressions (averaging values for each country over the entire period) and from cross-section time-series regressions where variables are averaged

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[17] See Bernhard and Leblang (1999)

across five-year time periods.

Presentation of data

We use inflation as our dependent variable, following the logic that where the inflation bias due to time-consistency problems is higher, so also is inflation. In order to control for the effect of countries with extremely high levels of inflation, we use the log of the inflation rate.[18]

To measure central bank independence we use the index developed by Cukierman, Webb, and Neyapti (1992), since this is the one indicator which covers a sample of both OECD and non-OECD countries. It is based on sixteen different characteristics of central bank statutes, such as provisions for monetary policy decisions, resolution of conflicts between central bank and government, and provisions for replacing the central bank governor. While Cukierman, Webb, and Neyapti's original dataset runs only up to 1989, more recent studies have compiled updated information on central bank independence and in some cases data on new countries (see in particular Cukierman, Miller and Neyapti (1998).[19]

The IMF's Annual Report on Exchange Arrangements and Exchange Restrictions presents information on exchange rate pegs, as reported by Ghosh et al. (1995).[20] We have classified countries according to those which adopt some form of a nominal exchange rate peg (peg = 1) and those which do not. This covers countries which peg their currency to a single other currency and those which peg to a basket of currencies. Countries that allow a very limited amount of nominal exchange rate flexibility (as in the European Monetary System) are also classified as having pegged regimes. We opt for this binary classification

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[18] Based on CPI data from the IMF, *International Financial Statistics*

[19] Note that the *de facto* indicator that they have developed of central bank independence, rates of central bank governor turnover, are not appropriate for our tests, since we are precisely interested in the extent to which legal prescriptions prevent this sort of intervention.

(peg vs. no peg), because economic theory does not offer firm predictions about the extent to which some types of pegs might be more effective than others.

This study also uses newly developed cross-country data on political institutions. Keefer (1998) has developed a measure of checks and balances in government, based on objective indicators assembled by Beck et al. (1999). The index counts the number of veto players present in a political system, including both what Tsebelis (1995) has called "constitutional" veto players as well as "partisan" veto players. For presidential systems checks counts the number of veto players, counting the executive and legislative chamber(s) separately only if they are controlled by different parties. For parliamentary systems, checks counts the number of parties in the government coalition, based on the assumption that individual coalition members will enjoy veto power over policy. The index is modified to take into account the fact that certain electoral rules (closed list vs. open list) affect the cohesiveness of governing coalitions.[21] Since the probability that at least one actor prefers the status quo is likely to increase at a decreasing rate with the number of veto players counted by checks, we use a log version of check, *log check*, in our regressions.

Testing of the informational propositions 3 and 4 requires variables that capture the public's difficulty in distinguishing between inflation generated by government policy and inflation generated by exogenous shocks. We use several different proxy measures for the public's uncertainty, achieving significant results with all of them.

The first measure we use to proxy for the degree of uncertainty about inflation policy

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[20] We have updated this dataset to cover the period 1990-94.

[21] For presidential systems, *checks* is the sum of 1 for the president and 1 for each legislative chamber. The value is increased by 1 if an electoral competition index developed by Bates, Ferree, and Singh is greater than 4 (out of a possible 7). Also, in closed list systems where the president's party is the 1st government party, the legislature is not counted. For parliamentary systems, *checks* is the sum of 1 for the prime minister and 1 for each party in the governing coalition. If elections are based on a closed list system and the prime minister's party is the 1st government party, then this sum is reduced by one. As for presidential systems, the value of *checks* is

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is instability in a country's money multiplier, suggested by both Canavan and Tommasi and by Herrendorf as a source of error in the public's inference of government policy from inflation outcomes. We use the variable *volatility M2/M0*, the standard deviation of the ratio of broad money (M2) to base money (M0), as our second measure of uncertainty about inflation policy. The idea is that the government or central bank controls base money directly, but inflation outcomes also depend upon unobserved influences on broad money. Where the money multiplier is volatile, the public faces a larger challenge in inferring monetary policy from inflation outcomes.[22]

The second measure of the noise that interferes with the public's ability to infer government policy is the volatility of the terms of trade. The variable *volatility tot* measures the standard deviation of the annual change in a country's capacity to import as a share of national income.[23] The capacity of a country to purchase imports out of its exports can increase either because the world prices of a country's imported goods have fallen relative to those of its exports, or because a country has experienced a positive supply or income shock so that it can afford more imports (for example, if its costs of production have exogenously declined). Under a flexible exchange rate, both shocks have implications for domestic prices. Consequently, the larger the *volatility tot* measure, the larger are the shocks that are obscuring government inflation policy, and the larger the impact that we would expect the introduction of a peg to have on inflation.[24]

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modified upwards by 1 if the value of the index for electoral competition is greater than 4.

[22] In our section considering the robustness of our results we also ask whether including volatility in the money multiplier as an explanatory variable creates a simultaneity bias in our regressions.

[23] *World Development Indicators CD-ROM.* The terms of trade adjustment variable that we use equals capacity to import less exports of goods and services. Data are in constant local currency. We preferred this to a another standard terms of trade measure, (price of exports / price of imports), because the extent to which terms of trade shocks affect domestic inflation depends not only on the size of the shocks, but also on the degree of openness of an economy.

[24] It is interesting to note here that governments with volatile terms of trade will face an acute dilemma, because

The third proxy we use to gauge the public's difficulty in observing planned inflation is the quality of a country's economic data. As Herrendorf (1998) argues, when a country's consumer price statistics are known to include frequent errors, it is more difficult for the public to assess the true rate of inflation and therefore more difficult to extract from actual inflation the underlying and unobserved inflation policies followed by the government. The introduction of a peg has a larger impact on the precision with which the public can assess government policy when CPI data is of poor quality, and therefore should have a larger downward impact on inflation. The quality of a country's consumer price index data cannot be measured directly, but there are indicators available which are designed to measure the overall quality of a country's economic statistics. The Penn World Tables data set constructed by Summers and Heston (19xx) includes a measure of data quality, grade, which is based on results of United Nations surveys. A higher value for grade indicates more reliable data.

In addition to the institutional and informational variables, the regressions include three further variables to control for determinants of inflation that are unrelated to the theoretical arguments in the paper. First, there are both strong theoretical and empirical reasons to believe that political instability is causally linked with inflation. In order to measure political instability with improved precision, we have developed a new variable *political instability,* based on information in the database reported in Beck, et al., which for each country and each period measures the fraction of all veto players who were replaced from the period earlier. In authoritarian systems with only one veto player this amounts to measuring

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if exchange rate pegs have a greater anti-inflationary impact in countries with more volatile terms of trade, governments which peg will also find it more difficult to achieve real exchange rate adjustments, and this cost will be greater the more volatile are terms of trade. Thus, traditional theories of exchange rate regime choice and predictions derived from Canavan and Tommasi and Herrendorf suggest opposite policy prescriptions for governments with volatile terms of trade.

the rate of government turnover. In systems with more than one veto player, however, this variable captures the possibility that governments might frequently change, but some coalition partners might be present in several successive governments.

Following Romer (1993) we also include a measure of openness based on the argument that incentives for policy makers to generate surprise inflation should be weaker in countries which are more open to trade. The variable *openness* is measured in the standard manner as the sum of exports plus imports, divided by a country's GDP.

We also include the log of real GDP per capita as a control variable. One rationale for including *log GDP* is that poorer countries tend to have less well developed tax systems, and under these conditions governments have an increased incentive to rely on seignorage for revenue. A further rationale is that some of our institutional variables are highly correlated with levels of income. Including *log GDP* in the specification addresses concerns that our political and informational variables are merely proxying for overall levels of development between countries.

Table I: Summary statistics

Variable	No. obs.	mean	std. dev.	min.	max.
log inflation	277	-2.02	1.43	-5.39	3.90
CBI	297	0.35	0.13	0.10	0.82
log check	293	0.95	0.48	0	2.08
peg	297	0.53	0.41	0	1
grade	266	2.43	1.04	1	4
volatility M2/M0	226	1.07	2.45	.02	27
volatility tot	258	0.02	0.03	0	0.16
political instability	289	0.15	0.14	0	0.68
openness	279	68.4	52.4	10	394
log GDP	275	8.06	1.62	4.57	10.7

Testing propositions 1 & 2

We evaluate our first and second propositions by using a model with interaction terms, which allows the marginal effect of central bank independence and exchange rate pegs on inflation to vary with the extent of checks and balances. The general form of our regressions is as follows.

$$log\ inflation = \alpha + \beta_1 CBI + \beta_2\ peg + \beta_3\ CBI \times log\ check + \beta_4\ peg \times log\ check + \beta_5\ openness + \beta_6$$

$$instability + \beta_7\ lngdp + \beta_8\ log\ check$$

Proposition 1 predicts that the interaction term *CBI x log check* has a negative coefficient while the interaction term *Peg x log check* is predicted in Proposition 2 to be insignificant. The net effect of central bank independence, given by $\beta_1 + \beta_3 * log\ check$ should

be negative at high levels of checks and balances. In contrast, proposition 2 does not deliver a firm prediction about whether the net effect of pegging $\beta_2 + \beta_4 * log\ check$ should be positive or negative at high levels of checks and balances.

Regressions 1 and 2 in Table II report results of baseline regressions that do not include interaction terms. In both regressions the estimated anti-inflationary effect of adopting an exchange rate peg is both statistically and economically significant. In contrast, in both samples the coefficient on CBI is actually positive and significant, suggesting that higher central bank independence is actually associated with higher rates of inflation when one controls for other determinants. This is a strong indication that legal central bank independence on its own is, on average, unlikely to deliver anti-inflationary credibility.

Regressions 3 and 4 test our propositions about the effect of political institutions on the credibility of monetary commitments. In both regressions the coefficient on the interaction term *CBI x checks* is negative and statistically significant at the 5 percent level. The substantive results of the regressions are also consistent with Proposition 1. Based on the estimates in regression 3 in a parliamentary system with a three party coalition (*log check*=1.6) an increase of 0.2 in *CBI* (equivalent to moving from the 25th percentile to the 75th percentile in the sample) would be associated with a 37 percent decrease in the annual rate of inflation. The effect of the same increase in central bank independence in a parliamentary system with a single party majority (*log check*=1.1) would actually be an *increase* in inflation of 39 percent.

To provide a better visual impression of our findings, Figure I shows the estimated effect on log inflation of a 0.2 increase in CBI at different levels of *log check* (based on regression 3). The solid line represents the estimated effect, the two dotted lines represent the boundaries of the 90% confidence interval, and the horizontal line represents 0 change in

inflation.[25] The evidence here suggests that increased central bank independence has a

negative effect on inflation only in the set of countries with relatively high levels of checks

and balances (within the highest quartile of our sample).

Table II: CBI, exchange rate pegs, and political institutions

depvar: log inflation	(1)	(2)	(3)	(4)
Constant	1.15	0.33	-0.33	-0.56
	(0.91)	(0.62)	(1.61)	(0.66)
openness	0.001	-0.002	0.001	-0.003
	(0.003)	(0.002)	(0.00)	(0.002)
log GDP	-0.36	-0.27	-0.37	-0.26
	(0.11)	(0.12)	(0.10)	(0.11)
political instability	1.52	1.34	0.43	1.21
	(1.52)	(0.40)	(1.46)	(0.41)
CBI	2.14	1.84	10.3	5.15
	(1.03)	(0.48)	(4.15)	(1.75)
peg	-2.07	-0.84	-4.50	-1.33
	(0.61)	(0.20)	(1.11)	(0.56)
log check	-0.04	-0.36	1.73	0.54
	(0.54)	(0.19)	(1.62)	(0.51)
CBI x log check			**-7.58**	**-3.20**
			(3.91)	**(1.50)**
peg x log check			**2.05**	**0.44**
			(0.95)	**(0.38)**
R²	0.40	0.29	0.46	0.30
N	78	258	78	258
p-value for Chi-sq.	p<0.01	p<0.01	P<0.01	p<0.01

OLS with White's heteroskedastic consistent standard errors for regressions 1 and 3 reported in
parentheses. Regressions 2 and 4 are estimated using panel corrected standard errors.

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[25] Since the effect of a change in CBI here depends on both B_1 and B_3, we calculated the standard error of the
effect using a formula which takes into account both the variance of each individual coefficient and their

covariance.

Figure I: estimated effect of 0.2 increase in CBI (at different levels of log check)
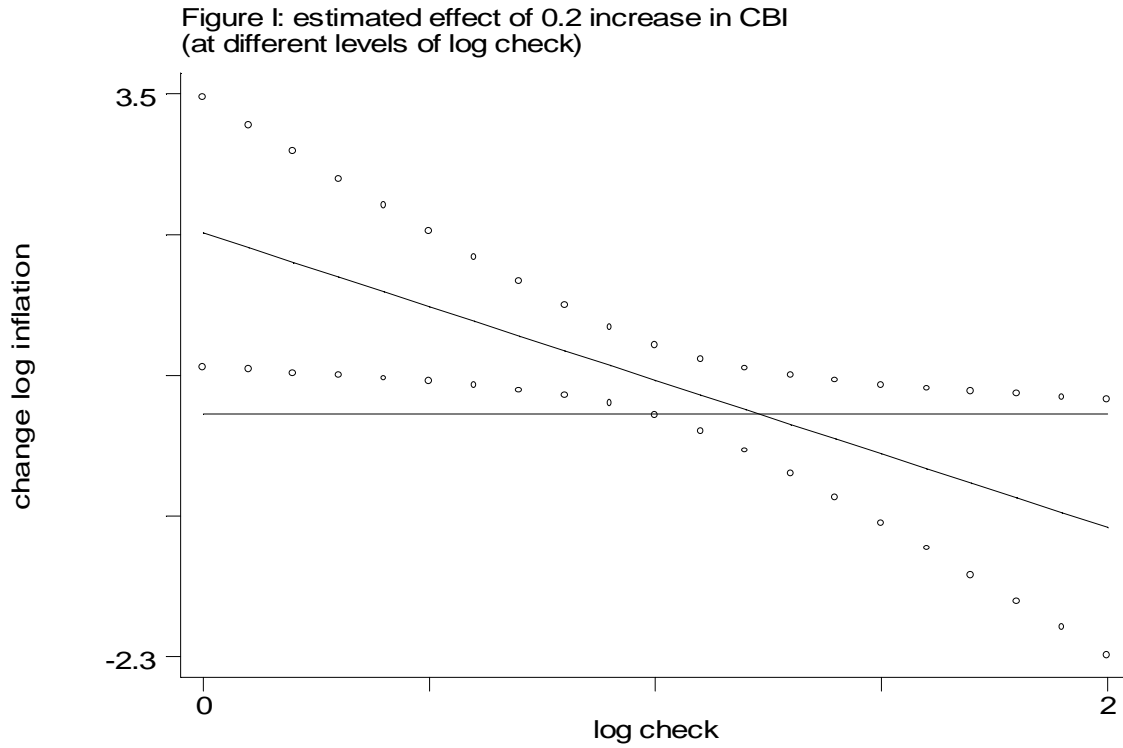
Regressions 3 and 4 in Table II suggest that exchange rate pegs may actually be less effective as anti-inflationary commitments when there are multiple veto players in government. This result is consistent with proposition 2. The interaction term *peg x checks* is positive in both regressions, significantly in the cross-sectional estimation but not otherwise. In both regressions the estimated effect on inflation of adopting an exchange rate peg is negative for nearly all sample values of checks and balances (the maximum value of *log check* is 2.07). However, the magnitude of this effect is much smaller in countries characterized by checks and balances in government.

Taken together, the above results provide support for the idea that the structure of

political institutions plays an important role with regard to monetary commitments and that this effect varies dramatically depending upon the type of monetary commitment under consideration. While central bank independence is likely to have a bigger increase on credibility in political systems with multiple veto players, the opposite may well occur with exchange rate pegs.

Testing propositions 3 & 4

If central banks or exchange rate pegs help governments credibly commit because they are transparent, then their anti-inflationary effects should be greatest in countries where it is particularly difficult for the public to distinguish between inflation attributable to deliberate government decisions and inflation attributable to exogenous shocks. We have argued that exchange rate pegs should exhibit this characteristic, but that central bank independence is unlikely to be an informative signal. As with propositions 1 and 2, these propositions can best be tested in a model with interaction terms, which follows the specification below. We use three different proxies for the ability of the public to distinguish the contribution of government policy to final inflation outcomes: the Summers and Heston grade for data quality (*grade*), instability of the money multiplier (*volatility M2/M0*), and a variable capturing instability in terms of trade (*volatility tot*). Based on proposition 3, we predict that the interaction term *peg x grade* should have a positive sign (since data quality is higher in countries where the value of *grade* is high), while the interaction terms *peg x volatility tot* and *peg x volatility M2/M0* should be negative. We again report results from both cross-section regressions and from regressions based on 5-year period averages.

$$log\ inflation = \alpha + \beta_1 CBI + \beta_2\ peg + \beta_3\ CBI\ x\ log\ check + \beta_4\ information\ variable + \beta_5\ peg\ x$$

$$information\ variable + \beta_6\ openness\ + \beta_7\ instability + \beta_8\ lngdp + \beta_9\ log\ check$$

The results in Table III suggest that exchange rate pegs are more effective as anti-inflationary commitments under conditions where data quality is poor and there is significant economic volatility which makes it more difficult for the public to observe government policy choices.

In regressions 1 and 2 the interaction term *peg x grade* is positive and highly significant, as predicted. The economic significance of the peg effect is also quite large. Based on regression 2, for a country with a Summers and Heston grade for data quality equivalent to the 25th percentile of the sample (1.7), adopting an exchange rate peg is estimated to result in a 62 percent reduction in the annual rate of inflation. A country with a grade for data quality equivalent to the 75th percentile would, in contrast, be predicted to experience only a 45 percent increase in annual inflation.[26]

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[26] Elasticities calculated using the formula for dummy variables in a semi-log equation proposed by Halvorsen and Palmquist (1980).

## Table III: CBI, exchange rate pegs, and information

depvar: log inflation	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-3.09	-2.17	-3.03	-1.68	-1.50	-1.52
	(1.16)	(0.47)	(1.36)	(0.70)	(1.75)	(1.01)
openness	-0.01	-0.01	-0.002	-0.004	0.002	-0.001
	(0.002)	(0.001)	(0.002)	(0.002)	(0.004)	(0.002)
log GDP	0.26	0.18	-0.22	-0.19	-0.37	-0.29
	(0.14)	(0.03)	(0.11)	(0.09)	(0.15)	(0.12)
political instability	-0.43	0.82	0.87	1.16	0.43	1.14
	(1.07)	(0.44)	(1.44)	(0.33)	(1.72)	(0.44)
CBI	10.2	6.56	10.2	5.12	10.2	6.15
	(2.96)	(1.45)	(4.26)	(2.13)	(4.80)	(1.46)
peg	-3.37	-2.14	-1.43	-0.47	-2.04	-0.24
	(0.93)	(0.52)	(0.63)	(0.28)	(1.16)	(0.24)
log check	2.96	0.76	2.82	0.94	2.59	0.80
	(1.15)	(0.61)	(1.39)	(0.60)	(1.82)	(0.43)
CBI x log check	-7.37	-2.40	-8.20	-3.58	-7.73	-3.65
	(3.20)	(1.63)	(4.01)	(1.65)	(4.64)	(1.43)
grade	-1.20	-0.73				
	(0.49)	(0.21)				
peg x grade	**0.90**	**0.68**				
	(0.27)	**(0.12)**				
CBI x grade	**-0.79**	**-1.26**				
	(1.00)	**(0.48)**				
volatility tot			27.1	22.2		
			(22.0)	(22.9)		
peg x volatility tot			**-39.2**	**-24.0**		
			(15.9)	**(10.9)**		
*CBI * volatility tot*			**14.1**	**-0.33**		
			(78.5)	**(45.3)**		
volatility M2/M0					0.15	0.72
					(0.29)	(0.23)
peg x volatility M2/M0					**-0.05**	**-0.55**
					(0.30)	**(0.18)**
CBI x volatility M2/M0					**-0.15**	**-0.42**
					(0.48)	**(0.47)**
R^2	0.65	0.45	0.56	0.34	0.32	0.34
N	67	247	74	246	62	202
p-value for Chi-sq.	p<0.01	p<0.01	p<0.01	p<0.01	p<0.01	p<0.01

OLS with White's heteroskedastic consistent standard errors for regressions 1 and 3 reported in parentheses. Regressions 2, 4, and 6 are estimated using panel corrected standard errors.

In regressions 3-6 coefficients on the interaction terms for peg x volatility tot and peg x volatility M2/M0 are negative as predicted and generally highly significant. Once again, these results are also substantively significant. For example, based on the estimates in regression 6 the effect of adopting an exchange rate peg would be a 32 percent drop in inflation for a country with relatively low volatility in its money multiplier (0.27, the value for the 25th percentile), while the effect for a country with high volatility (1.01, the value for the 75th percentile) would be a 55 percent drop in annual average inflation. We provide a visual display of the estimated of effect of adopting an exchange rate peg in Figure II, below, which shows that effect of a peg, (together with the estimated 90% confidence interval) at different levels of money multiplier volatility (based on regression 6 in Table III). The horizontal line represents 0 change in log inflation.

Fig II: estimated effect of an exchange rate peg
(at different levels of volatility)
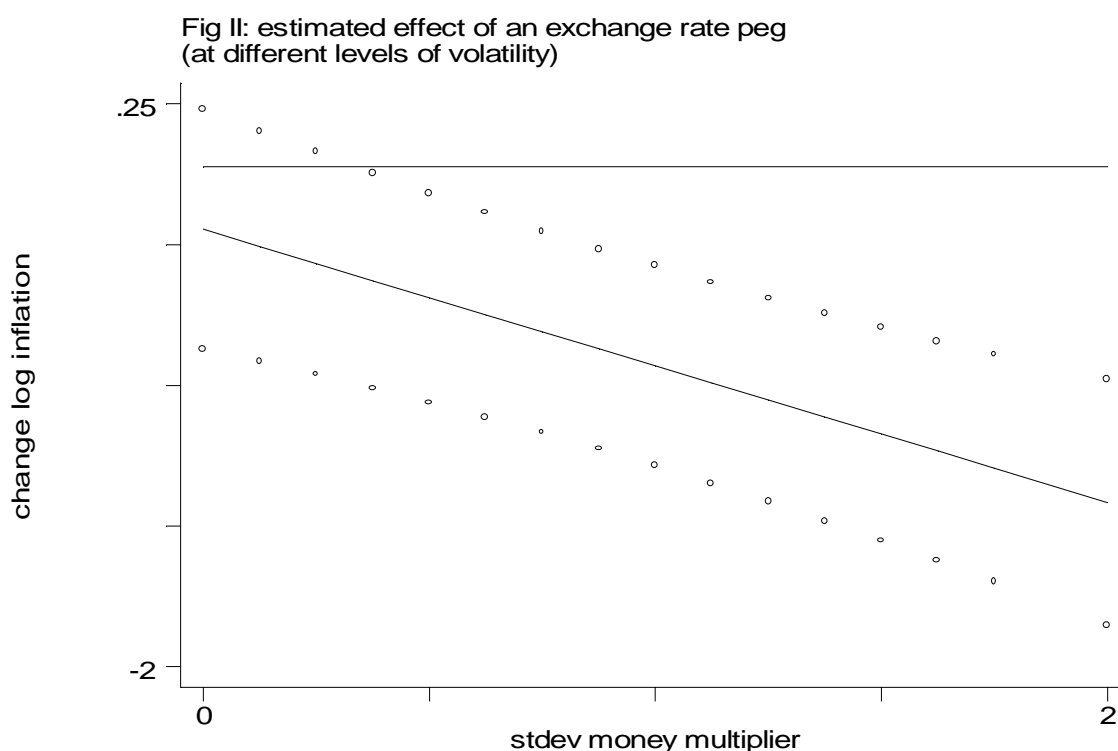
In stark contrast with our results with regard to exchange rate pegs, the effect of central bank independence does not seem to vary significantly with the extent of either terms of trade volatility or volatility in a country's money multiplier. The coefficients *CBI x volatility M2/M0* and *CBI x volatility tot* are not statistically significant in regression 3-6. The results with regard to data quality are more mixed. While as our theory predicts, the interaction term *CBI x grade* is not significant in regression 1, it is significant in regression 2.

5. Robustness of the results

We consider here several issues that might affect the robustness of our results, including whether our institutional variables are proxying for more general features of political systems, whether the results are biased by autocorrelation, and whether they may be biased by endogeneity of central bank independence to inflation.

While the estimation results are consistent with all three of our propositions, there may be potential concerns whether several of our explanatory variables are measuring the phenomena we claim, or whether they might in fact be capturing more general features of political systems, such as levels of democracy or levels of income. The simple correlation between the variable *democracy* from the Polity III dataset and our variable *checks* is fairly high (0.52), and the simple correlation between our measure of data quality (*grade*) and *democracy* is even higher (0.74). Similar conclusions might be drawn from the high correlation of *grade* and *checks* with per capita income.[27]

Given that models where the effect of central bank independence or of exchange rate pegs vary with levels of democracy or income would be alternative specifications, the best

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[27] The simple correlations of our two other information variables *volatility tot* and *volatility M2/M0* with either *log GDP* or *democracy* did not exceed 0.35, and so we do not consider the possibility that these specifications are

way to test these alternative hypotheses against the specifications in Tables II and III is to use the *J*-test methodology developed by Davidson and Mackinnon (1981). This test involves estimating the two specifications to be compared and then re-estimating each specification while including the fitted values from the alternative model as an explanatory variable in each regression.[28] The *t*-statistic on the fitted values can be interpreted as a test of the null that the alternative specification *would not* add explanatory power to the existing model. Table IV below reports results of *J*-tests where we tested regression 4 from Table II and regression 2 from Table III against two alternative specifications. The first alternative involved replacing the relevant institutional or informational variable with the Polity III measure *democracy*. The second alternative specification involved replacing the relevant institutional or informational variable with log GDP.

What should we conclude from the above results? The test statistics are significant in most cases at the 1 percent level and in all but one case at the 10 percent level of confidence. In three out of four cases, specifications using only *democracy* or *log GDP* add explanatory power to our existing specifications from Tables II and III. The exception here is regression 2 from Table III where we clearly reject the *democracy* specification in favor of the *grade* specification. Likewise, using the 10 percent level as a cutoff, all of the specifications using our institutional and informational variables add explanatory power to regressions using only *democracy* and *log GDP*. In sum, we can reject the hypothesis that our institutional and informational variables are simply proxying for more general phenomena. At the same time, however, more general features of democracy or levels of income may also have an influence on the effectiveness of central bank independence or exchange rate pegs as commitment

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picking up effects due to levels of GDP or democracy.

[28] For an application of J-test methodology to compare alternative political economy hypotheses see Franzese (1999).

mechanisms.

Table IV: J-tests against alternative specifications

regression	null hypothesis	alternative hypothesis	p-value
Table II 4	log check	democracy	p=0.00
	democracy	log check	p=0.08
Table III 2	grade	democracy	p=0.54
	democracy	grade	p=0.00
Table II 4	log check	log GDP	p=0.00
	log GDP	log check	p=0.09
Table III 2	grade	log GDP	p=0.00
	log GDP	grade	p=0.00

We also considered whether the results of our statistical tests might be biased by serial correlation of error terms. With regard to autocorrelation, our cross-section results are by definition immune from this problem, and therefore should assuage concern about the importance of autocorrelation for our findings. Nevertheless, standard Lagrange multiplier tests did detect autocorrelation in our five-year period regressions. Using a Prais-Winsten regression, rather than OLS estimates, would be one way to deal with this problem. However, using this technique depends upon accepting the restriction that the autoregressive process influencing each of the variables in our regression is identical. Standard testing procedures strongly reject this restriction. As a result, we have chosen to retain our OLS estimates.

As a final robustness test, we also considered the possibility that there might be biases in our results due to the endogeneity of certain explanatory variables. This could involve the endogeneity of legal central bank independence to past levels of inflation. It could also involve the possibilities for simultaneity bias, if variables shocks have an effect on both *CBI*

and *log inflation* within the same time period. Volatility in the money multiplier (*volatility M2/M0*) might also be subject to this problem. In the case of central bank independence, Granger causality tests failed to establish that current levels of *CBI* were "Granger-caused" by lagged levels of log inflation. With regard to simultaneity bias, a Hausman specification test did not reject OLS estimates from Table II when compared with estimates which instrumented for current values of central bank independence with past values. In the case of volatility in the multiplier *volatility M2/M0*, a Hausman specification test also failed to reject the consistency of the OLS estimates.

Conclusion

In this paper we have attempted develop and test several new hypotheses about the anti-inflationary effect of central bank independence and exchange rate pegs across different institutional and informational contexts. Theory provides a strong reason for believing that while central bank independence will prove more effective as a commitment mechanism in countries with multiple veto players in government, the credibility of exchange rate pegs will not be increased by these multiple veto players. We reach an opposite conclusion with regard to the effect of central bank independence and exchange rate pegs in different informational contexts. In economically volatile conditions, where it is more difficult for the public to distinguish inflation deliberately generated by government from inflation created by unanticipated economic shocks, the anti-inflationary effect of central bank independence will be unchanged while the effectiveness of exchange rate pegs will be significantly enhanced. Cross-country tests using newly developed data provide strong support for both our institutional and our informational propositions.

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