Abstract

Theoretical work on monetary policy has treated independent central banks and fixed exchange rates as separate, substitutable modes to tie the hands of inflation prone governments. As such, the literature cannot tell whether and why policy makers would adopt both institutions to guard against inflation, much less describe the interaction between institutions. In this paper I develop a model that allows the government to act simultaneously in two areas: the exchange rate regime and the independence of the central bank. I find that imperfectly credible fixed rates and central bank can explain why policy makers choose a mix of institutions that fight inflation. I also show that in bad times it is more likely to have an inflation conservative right wing executive choose the institution that guarantees a zero inflation rate even if the zero inflation rule is not totally believed by the public. Finally, when fixed rates are not effective in cutting inflation we see the right, the party with strong inflation credentials, becoming more likely to combine fixed rates with an independent central bank.

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Contents

1 Introduction 1

2 Inflation, Central Banks and Exchange Rates 3

3 Model Setup 8

4 The Game: Exchange Rates Are Not Fixed Forever and Central Bank Independence Is Not Clearly Ascertainable 9

5 The Choice of Imperfectly Credible Institutions 15

6 Conclusion 21

7 References 22
“If the policy maker’s wrists were already bound by exchange target duct tape, what would be the effects of an additional pair of handcuffs from inflation targets and yet another loop of rope from central bank independence? One could argue that the effect would be nil, because the exchange rate commitment already credibly limited the central banker’s discretion. One could instead argue that that the effect would still be greater credibility, albeit with diminishing returns, because inflationary government officials are escape artists and the more restraints the better. … Theory gives no single answer to this empirical question.”


1 Introduction

Independent central banks and fixed exchange rates are institutional arrangements that help maintain price stability by lending anti-inflationary credibility to policy makers. In some countries independent central banks and fixed exchange rates coexist and help lower inflation simultaneously. This has been the case in several transition countries after the communist rule ended in 1989. For example, the Czech Republic in 1993 had a fixed exchange rate regime and the legal independence of its central bank was .69 on a scale from 0 to 1. Bulgaria in 1997 adopted both a currency board regime as well as granted more independence to its central bank. However, institutional arrangements tended to vary: The Republic of Moldova chose only a very independent central bank, while in the beginning of the 1990s Romania had neither fixed rates nor an independent bank. All the countries in Eastern Europe and the former Soviet Union struggled with high inflation during the transition to democratic rule and market economy. Yet, as the examples illustrate, they adopted different mixes of anti-inflationary institutional solutions. What can explain this diversity?

Some of the previous empirical and theoretical work suggests that independent central banks and fixed exchange rates may not be perfect substitutes because each institution has specific disadvantages. Central bank procedures and performance lack transparency and clarity when compared to fixed rates. Visible fixed rates, on the other hand, can be and are devalued and generate political costs for governments when a devaluation occurs (Leiderman and Svensson 1995, Edwards 1996, Canavan and Tommasi 1997, Keefer and Stasavage 2002, Broz 2002, Cooper 1971, Frankel 2005). The formal, game theoretic literature, however, implies a substitution relationship between central banks and exchange rates as models treat the two instruments separately and allow the policy
maker the choice of only one institution (Barro and Gordon 1983, Rogoff 1985, Giavazzi and Pagano 1988, Milesi-Ferretti 1995. Clark 2002 is the exception). Then, given its modeling assumptions, the existing formal literature does not tell us whether and why policy makers would ever adopt both an independent central bank and fixed exchange rates to guard against inflation. Also, the literature cannot describe the interaction between the two alternative institutional solutions that restrain government’s profligate incentives in monetary policy.

In this paper I develop a formal model that describes when and why policy makers would choose independent central banks and fixed exchange rates together, alone, or or not at all, given that the two institutions lack perfect credibility and policy makers are partisan. Improving on the previous literature, in my model the executive has at its disposal a larger set of actions: It can choose fixed or flexible exchange rates and a dependent or independent central bank. Giving the executive the simultaneous choice of commitment institutions is not enough, however. If I follow previous work and solely assume that both fixed rates and independent banks result in zero inflation, I assume directly a substitution relationship between the two institutions. Therefore, I maintain the simplifying assumption that an institutional solution means a zero inflation rule, but, based on the empirical literature, I define more realistic institutions: a fixed exchange rate that the public knows can be devalued and a central bank whose independence is not entirely believed. In describing the lack of perfect credibility of commitment institutions, I model the institutional features that the literature generally agrees upon: Fixed rates can be clearly ascertained by the public while central bank independence is more difficult to observe.

The model has several implications that are consistent with previous work on inflation and time inconsistency. For example, in economies that are expected to face large negative shocks to domestic output, politicians do not limit their discretion to use monetary policy for smoothing production shocks. Further, in the model, policy makers are partisan and assign different weights to achieving high employment. Another finding that is similar to the existing literature is that, in general, the policy maker with the worst inflation fighting credentials will be more likely to limit his options. That is, left wing parties which are known to cater to labor are more prone to tie their hands in monetary policy by adopting commitment institutions.

The model has novel predictions as well. I show that one explanation for the existence of a
mix of institutions guarding against inflation is the fact that institutional solutions lack perfect credibility. I also prove that even imperfectly credible fixed exchange rates and central banks are welfare enhancing: They reduce inflation expectations and inflation. Moreover, the results indicate that when institutions are not trusted, right wing policy makers start behaving the way we would expect the left to behave in normal times. In bad times (when a relatively large part of the public does not believe the independence of the central bank) it will be the right who is more likely to adopt the independent central bank either alone or in combination with a fixed exchange rate. In bad circumstances the right chooses the institution that guarantees a zero inflation rate even if the zero inflation rule is not totally believed. In hyperinflation episodes or in countries democratizing after an authoritarian regime, this model predicts that the right will be more likely to adopt a monetary institution that is conservative but whose independence is not entirely clear to the public.\[1\] The model also speaks to the relationship between the two imperfect institutions: When fixed rates are not effective in cutting inflation we see the right, the party with strong inflation credentials, becoming more likely to combine fixed rates with yet another inflation fighting mechanism - the independent central bank.

The paper is organized as follows: Section 2 describes the motivation behind policy makers' choice to have fixed exchange rates and independent central banks. Section 3 sets up the model. Sections 4 describes the game. Section 5 describes and discusses the choice of imperfectly credible institutions. Section 6 concludes.

2 Inflation, Central Banks and Exchange Rates

The traditional monetary policy model goes back to Kydland and Prescott 1977 and Barro and Gordon 1983. In this model, executives make inflation-target announcements, private actors make decisions based on their inflationary expectations, and policymakers act again and cheat by introducing surprise inflation after private actors have made decisions about the quantity of money they

\[1\] In this paper, it is imperfect institutions that determine the right to tie its hands relatively more than the left. Canavan and Tommasi 1997 obtain a similar result in a game of incomplete information on the type of policy maker, where executives choose the visibility of a single commitment instrument. In their model the right signals its type by choosing more visible mechanisms. Also, Milesi-Ferretti 1995 has the right preferring to restrict monetary policy in a model with elections and uncertainty about election results.
will hold. The effect of this cheating, if it comes as a surprise, is to increase output and employment. A rational public, however, learns to anticipate government’s moves and makes its decisions accordingly. The result of the game is higher inflation than optimally desired by the government without the long-term benefit of increased employment and output.

Incentives to cheat and rational expectations combine to create a time-inconsistency problem. Policy makers facing such a problem find it difficult to make credible commitments by themselves. In this context, Rogoff 1985, Giavazzi and Pagano 1988, Alesina and Grilli 1992, Milesi-Ferretti 1995 show the advantages of delegating monetary policy by fixing the exchange rate or by allowing the central bank to be independent. The two mechanisms restrain opportunistic politicians and achieve the same goal of low inflation, albeit in different ways. Granting independence to the central bank works because central bankers, generally, come from business, financial or academic circles, tend to take a longer view of the policy process, and are on average more conservative about price stability than elected politicians or the median voter. Fixed exchange rates work by tying domestic economic policy to that of a less inflation-prone country, thus ‘importing’ the lower foreign inflation.

For open economies, the major cost of delegation is common to both fixed rates and independent central banks. The government cannot use freely monetary policy instruments to smooth large negative shocks to the domestic economy. In a recession, for example, policy makers lack flexibility in using monetary policy to increase the quantity of money in the market and thus stimulate output and employment. Lohmann 1992 addresses the loss of flexibility due to delegation and designs an optimal delegation rule that allows flexible policy response to unforeseen large shocks to the economy. Her model allows the policy maker the choice of both the degree of central bank conservatism and the cost at which it could override the central banker in setting inflation. In equilibrium, the policy maker never overrides the central banker, as the central banker accommodates the policy maker when large shocks occur.

The more recent literature addresses additional issues relevant to monetary policy delegation.

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2 The time inconsistency problem: Ex ante policy makers are better off with a low (zero) inflation rate. Ex post, however, if the public believes they will implement zero inflation, policy makers prefer to cheat and inflate the economy to obtain a production boost. Knowing policy maker’s incentives, markets do not believe zero inflation announcements.
Moser 1999 studies the cost of withdrawing the independence granted to the central banker. He analyzes the interaction between a conservative central banker and two legislative bodies with veto power over legislation to amend the independence of the central banker. He shows that a nominally independent bank can choose freely monetary policy only if the two legislative bodies have heterogenous preferences. Keefer and Stasavage 2002 show empirically that the presence of multiple political veto players is crucial to the effectiveness of independent central banks in reducing inflation. They also find that fixed exchange rates have a greater anti-inflationary impact when it is hard for the public to ascertain the sources of the inflationary process. Further, Broz 2002 argues that central bank independence and fixed rates are alternative monetary commitments that vary in terms of transparency and that the transparency of political systems is a substitute for the transparency of monetary commitment devices. He finds evidence that dictatorial regimes are more likely to use fixed exchange rates.

Closer to this paper, Canavan and Tommasi 1997 investigate the incentives created by incomplete information about policy maker’s type in a game where the choice is over the transparency of a single policy instrument. Transparency of commitment institutions is a central concern in my paper, yet, the structure of my model is more similar to that of Clark 2002. Clark explores policy maker’s choice of two commitment institution - the exchange rate regime and the status of the central bank - in a one period game of complete information. The value added in Clark’s model is that he takes seriously the potential for both institutional substitution (fixed rates and independent central banks) as well as policy substitution (fiscal and monetary policy). In doing so, however, he chooses to model a perfectly predictable economy. The problem with assuming no unanticipated shocks to output is that delegation of monetary policy ceases to be costly if we allow players to be strategic and use rational expectations. Clark’s model takes inflation expectations as exogenously determined, while admitting that endogenizing beliefs is desirable (Clark 2002, pp.731). With endogenous rational expectations on the part of markets, the policymaker that does not delegate monetary policy faces the time inconsistency problem and ends up in a situation with high inflation and no output growth. If the economy is considered perfectly predictable the traditional problem of delegation – credibility versus flexibility – disappears as policy makers do not need flexibility to react to future unanticipated downturns in the business cycle. The immediate solution to the
game, then, is that the policy maker always prefers to delegate monetary policy under a contract specifying appropriate action for all contingencies. Such a result is problematic because, in practice, monetary policy delegation is a hotly debated domestic policy choice and delegation is not ubiquitous.

My analysis departs in several ways from that of Clark 2002. My model abstracts from the use of fiscal policy as a substitute for monetary policy, while allowing inflation expectations to be determined endogenously, as well as allowing the economy to suffer shocks unanticipated by either markets or the policy maker. Most importantly, I let both fixed exchange rates and independent central banks be imperfect commitment institutions. To date, the formal literature on time inconsistent monetary policy has overlooked the fact that central banks and fixed rates have specific disadvantages. The two commitment institutions are flawed in different ways. Central bank procedures and performance lack transparency and clarity when compared to fixed rates. Sometimes central banks do not publish their intermediary targets for achieving price stability or it is hard for markets to understand central bank targets or public statements. In a 1986 Bank of England Quarterly Bulletin, the bank governor describes very well the trade-offs between clear rules and mixed messages: “A simple, publicly understood monetary rule has considerable advantages, serving as an external discipline on the authorities and as a guide to both financial markets and the wider economy as to the authorities likely behavior. In these ways it can provide an important underpinning of confidence in the counter-inflationary thrust of policy. But these advantages are lost if in practice the rule proves to be too facile and as a result, needs to be frequently adjusted or overridden. Then it can become counter-productive, serving to undermine confidence.”

Fixed exchange rates, on the other hand - preannounced pegs or bands - are clear and visible rules for the behavior of the currency. Markets can assess easily and clearly whether a commitment has been broken. Yet, fixed rates are not a perfect commitment mechanism either. First, they are prone to being abandoned: “Aside from a few minor tourist economies, oil sheikdoms and heavily dependent principalities, only a very small number of fixed exchange rates have survived

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3Leiderman and Svensson 1995, pp. 54. See also Broz 2002 for a discussion of the relative transparency of fixed rates when compared to independent central banks.

4For example, Eichengreen et al. 1999 compare fixed exchange rates and inflation targets with respect to their visibility: “Even when countries have accomplished a successful transition to a more flexible exchange rate, there is a tendency for the easily monitored exchange rate to become the focal point of private sector expectations, to the detriment of the less visible and more medium term inflation target.”
the past years intact”. Compared to fixed rates, reversals in central bank independence are rare. In general countries have moved towards granting their central banks more legal independence. In Eastern Europe and the former Soviet Union after the fall of communism there are only two cases of countries changing central bank legislation in the direction of less independence: Belarus in June 2001 and the Czech Republic in April 2002. Second, policy makers face important political costs in the event of a currency crisis followed by a devaluation or a collapse of the fixed exchange rate regime. Cooper 1971 shows that in the aftermath of devaluations, nearly 30% of governments fell within 12 months, as opposed to 14% in a contemporaneous control group. Frankel 2005 goes on and expands Cooper’s sample to 103 developing countries over the period 1971-2003. He finds that the chief executive lost office 22.8% of the time in the six months following a currency crash, as opposed to 11.6% of the time otherwise.

In sum, independent central banks and fixed rates have specific disadvantages while bearing the same major cost of a dependent monetary policy. This article, then, assumes fixed rates that can be devalued and central banks whose independence cannot be clearly ascertained and goes on to describe the conditions under which partisan policy makers choose institutions that help them improve monetary policy credibility: The possible institutional outcomes in this game are - flexible exchange rates and a dependent central bank; flexible exchange rates and an independent central bank; fixed rates and a dependent central bank; fixed rates and an independent central bank.

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5Obstfeld and Rogoff 1995. Obstfeld and Rogoff go on: “Governments often feel that if they could pull off a sudden realignment “just once” and thereby put fundamentals right, they would thereafter enjoy the the fruits of a credibly fixed rate, including exchange-rate certainty and domestic price discipline. They are wrong. The factors that led to the last realignment remain and contain the seeds of the next one. No one can say for sure when it will occur, but its likelihood reintroduces both exchange rate uncertainty and inflationary pressures - the very evils a fixed rate was supposed to guard against.”

6Empirically, the legal independence granted to the central bank translates into low inflation more or less efficiently depending on the number of veto players needed to change bank legislation (Keefer and Stasavage 2002) or on whether a country is democratic (Broz 2002).

7This article focusses on solutions to time inconsistent inflation preferences and institutions as commitment devices. There are other potential reasons for countries to adopt fixed exchange rates, most notably for reducing the costs and risks of international trade. For example, the Bretton Woods fixed exchange rate system was set up in order to foster the growth of international trade. Also, Frieden 2002, for example, finds that intra-European trade and investment are important determinant of smaller currency devaluations and less currency volatility in a sample of European countries from 1973 to 1994.
3 Model Setup

I use a standard Barro and Gordon 1983 setup: There are two actors in the model, the executive and the wage setters. The policy maker (the government or the executive) has a quadratic utility function with a trade-off between inflation and output growth. Wage setters are rational and their utility depends only on the real wage. Production takes place according to an expectation augmented Philips curve.

The preferences of the executive are described by the quadratic loss function:

\[ L_i^t(\pi_t, y_t) = (\pi_t)^2 + a_i(y_t - ky^*)^2; \quad k > 1; \quad i \in \{L, R\}. \]  

(1)

The policy maker’s loss function reflects the fact that there are distributional consequences to the choice of inflation rates. Capital owners who see the value of their holdings diminish with inflation prefer low inflation. No one in an economy likes high inflation. However, labor dislikes economic recessions associated with tough anti-inflationary policies and is more willing to tolerate some inflation if that boost employment. Therefore, I assume that there are two types of governments that differ with respect to the trade-off between inflation and output: the right (R), representing capital holders and the left (L), representing labor. By assumption, the right cares relatively less than the left about a drop in production below some target level \( ky^* \), so \( a_R < a_L \). \( \pi_t \) is the contemporaneous inflation, \( y_t \) is the output produced in the economy, and \( y^* \) is the market clearing level of output. \( k \) is greater than one because in the presence of distortions (income and labor taxation, unemployment compensation, minimum wage) \( y^* \) is smaller than the socially optimal level of output \( ky^* \). Because the market clearing level of output is too low and given the production equation (2), the government has incentives to increase inflation above expectations in order to raise output.

The specification of the loss function in equation (1) does not reflect the political costs, \( c \), incurred by policy makers in situations when the fixed exchange rate commitment is abandoned.

\[ ^8 \text{In the model the right cares less about deviations above or below the target.} \]

\[ ^9 \text{Clark 2002 identifies } k > 1 \text{ as an indication of political pressure to push growth above the natural rate. In this model we can interpret minimum wage regulation or income taxation as the result of political pressure on the policy maker.} \]
(Cooper 1971, Frankel 2005). We can omit the political costs of fixed exchange rates because this choice simplifies the computations and does not affect establishing the first results of the paper which show the complementarity between fixed rates and independent central banks. I introduce the political costs of fixed rates once we start discussing the potential substitution relationship between the two institutions.

Production in the economy takes place according to an expectations enhanced Phillips curve:

\[
y_t = y^* + (\pi_t - \pi_t^e) + \epsilon; \quad E(\epsilon) = 0; \quad Var(\epsilon) = \epsilon^2, \quad (2)
\]

Where \( \pi_t^e \) represents the expected rate of inflation. All variables are expressed in natural logarithms. In this economy, output \( y_t \) grows above \( y^* \) if inflation is above expected inflation, or if the shock to the economy \( \epsilon \) is positive. As \( k \) is greater than one, the policy maker will have incentives to inflate the economy. The shock to domestic country’s output \( \epsilon \) reflects the policy maker’s dilemma in choosing between flexibility and credibility. By choosing to delegate monetary policy, the executive forfeits not only the option to behave opportunistically and inflate the economy after wages have been locked in, but also the liberty to react to negative output shocks.

The workers in this model aim to anticipate inflation and care about maintaining a constant level of the real wage:

\[
w_t = E(p_t) \tag{3}^{10}
\]

\[10\] \( \pi_t - \pi_t^e = p_t - w_t \). Where, \( p_t \) is the price level and \( w_t \) is the wage level.

4 The Game: Exchange Rates Are Not Fixed Forever and Central Bank Independence Is Not Clearly Ascertifiable

The policy maker has a choice of two policy instruments: a fixed exchange rate regime and an independent central bank. With rational expectations and perfect commitment instruments that are used to mitigate dynamic inconsistency, the government’s set of two choices is superfluous. By construction, fixed rates and independent central banks are substitutes. The choice of either represents a commitment to low inflation rates. The substitution relation is disturbed only if the
preferred inflation rate of the domestic central banker differs from the rate induced by fixing the exchange rate - the rate preferred by the foreign central banker. In practice we may observe the divergence of the preferred rates, yet from a modelling point of view this is a trivial problem.\footnote{In the Bretton Woods years Germany had both a relatively independent central bank and a fixed exchange rate. The German case shows a commitment to preserve the value of the Deutsche Mark both by fixing the exchange rate as well as by using an internal commitment device - the independent central bank. This arrangement worked especially well in the late 1960s, when the German central bank avoided importing inflation via fixed rates from the deficit and inflation prone United States.}

In the real world we observe mixes of institutions. Independent central banks and fixed exchange rates need not take turns as inflation fighting mechanisms. In many instances they coexist. This section models the choice that the executive has between a fixed rate that is liable to being adjusted and a central bank whose independence may not be believed by markets. I show formally that a possible reason for coexistence is the fact that both institutions lack perfect credibility. With complete information and perfectly credible institutions, an institutional mix is sometimes a solution to the executive's minimization problem, yet, the mixed solution is indistinguishable from the single institution solution. With the more realistic assumption that institutions lack perfect credibility we are able to describe separate solutions for the adoption of individual institutions, a mix or no institutions.

The assumption that exchange rate commitments are fixed forever is not a realistic one. Countries sometimes are forced to give up fixed rates in the midst of speculative attacks or governments just renounce fixed rates after accomplishing the desired low inflation levels. Suppose that the government announces a fixed rate regime and fixes the exchange rate at the beginning of the period. The public observes the fixed rate yet it does not believe the commitment will last forever. The exchange rates are fixed but adjustable. The game is a one period game, but there is a probability \( q \in (0,1) \) that the announced fixed exchange rate regime collapses at the end of the period after workers set inflation expectations and that inflation will be determined by the government under the flexible rate regime.\footnote{An alternative modeling choice is to let \( q \) be the probability of a devaluation \( d \) that is transmitted to prices in proportion \( \lambda d \).}

Further, I assume that the status of the central bank is not clearly ascertainable. Central banks tend to be less transparent than fixed rates with respect to their goals and the targets that they achieve. Therefore, I assume that when the government chooses and announces an independent
central bank, there is a chance \( p \) that the executive is not believed \( (p \in (0, 1)) \). This is equivalent to saying that part of the public is unaware that the government has made the central bank independent from political pressure. On the other hand, the public takes the executive’s choice to have a dependent central bank at face value: If the government chooses and announces that it will have a dependent bank, it is believed.

The play of the game is shown in figure 1: The government chooses the mix of institutions; Workers set inflation expectations \( \pi^e \). If the executive has made the central bank independent, workers are not entirely sure whether to believe the executive or not; When setting expectations, workers also anticipate that there is a chance that fixed rates do not survive; The executive observes the realization of the output shock; Nature allows the fixed rate to collapse or maintain; The executive sets inflation if the fix has collapsed and if it chose flexible rates or a dependent central bank in the beginning of the period; The central bank sets inflation to zero if it was granted independence; Inflation is zero if the fixed rate has survived.

The model is a sequential game of complete information, and I solve it by backward induction. The government chooses the institutional mix and the rate of inflation that minimizes its expected loss function, given the prevailing expectations about inflation. The public or the workers want to anticipate inflation correctly. In the next four subsections, for each terminal node of the game I solve for the prevailing inflation rate and government ex ante loss function. The executive will choose its most preferred institutional mix by comparing the ex ante loss function for each arrangement. I discuss the executive’s choice over institutional arrangements in Section 5.

**Terminal node 1: Flexible exchange rate and a dependent central bank**

The government is assumed to be unable to commit to a specific inflation rate when the central bank is dependent or the exchange rate is flexible. Wage setters are aware of the government’s problem and would not believe an inflation target announcement. With no commitment, then, the government observes the output shock and simply minimizes its loss function (1) subject to the output equation (2). The game lasts for only one period, so I drop the time subscripts. The optimal inflation rate is:
\[ \pi_i = \frac{a_i}{1 + a_i} (\pi^e - \epsilon + H), \] (4)

Where \( H = (k - 1)y^* \). \( H \) measures the distance between the optimal level of output and the market clearing level. This wedge gives the government incentives to create surprise inflation. Executives have incentives to make commitments in monetary policy in order to circumvent their time inconsistent preferences and avoid a situation of high inflation rates and no output growth. However, commitment is costly: governments lose the flexibility to react to production shocks.

Workers make their decision before the output shock is observed, but have rational expectations, so \( \pi = \pi^e \). Therefore, expected inflation equals:

\[ \pi^e = a_i H. \] (5)

The time consistent inflation rate is obtained by making \( \pi^e \) in equation (4) equal to \( a_i H \):

\[ \pi_i = a_i H - \frac{a_i}{1 + a_i} \epsilon. \] (6)

The expected loss to the government if it decides to choose flexible rates and a dependent central bank is computed by plugging equations (2), (5) and (6) in equation (1):

\[ E(L_{CBI=0}^{Flex}) = a_i (1 + a_i) H^2 + \frac{a_i}{1 + a_i} \sigma^2. \] (7)

Terminal node 2: A flexible exchange rate and an independent central bank

When the policy maker chooses a flexible exchange rate and an independent central bank, if wage setters believe the that the central bank is truly independent, they expect zero inflation. Yet, central bank independence is not perfectly transparent: Wage setters do not believe the government with some positive probability \( p \) and they expect inflation to be same as under a dependent central bank. Ex ante, when it decides to delegate monetary policy to an independent

\[ ^{13} \]Notation: \( CBI=1(p) \) means that the executive chooses an imperfectly credible independent central bank; \( CBI=0 \) designates a dependent bank; \( Flex \) represents flexible rates and \( Fix(q) \) denote a fixed exchange rate that the public knows can be devalued.
central bank, the government knows that the public expects a rate of inflation higher than zero: 
\[ \pi_{gov}^e = (1-p)\pi_{1-p}^e + p\pi_p^e. \]
Where \( \pi_{1-p}^e \) is the public’s expected inflation if it believes that, in fact, the central bank is independent and \( \pi_p^e \) denotes the expectation of non-believers. \( \pi_{1-p}^e = 0 \) and \( \pi_p^e \) equals \( a_i H \) as in the case when the executives chooses a flexible exchange rate and a dependent central bank.

\[ \pi^e = pa_i H. \] 

(8)

Throughout the paper the central bank is a nonstrategic player: The bank’s actions are completely determined by the executive’s choices. Specifically, if the government chooses an independent central bank, the central bank adopts a zero inflation rate (\( \pi = 0 \) if \( CBI = 1(p) \)). The behavior of the central bank is consistent with a situation in which the bank tries to establish its reputation and incurs an initial welfare loss by not matching high inflation expectations. Initially, the bank deflates the economy and the government that chooses an independent bank loses from low output growth. The ex ante loss to the executive from choosing an imperfectly credible central bank is determined by plugging (2), (8) and \( \pi = 0 \) in equation (1) and equals:

\[ E(L_{CB1=1(p)}) = a_i \sigma^2 + a_i H^2 (1 + a_i p)^2. \]

(9)

**Terminal node 3: A fixed exchange rate and a dependent central bank**

When the government chooses a fixed but adjustable exchange rate and a dependent central bank, wage setters expect that, with probability \( q \), the prevailing rate is the inflation rate under no commitment and, with probability \( 1 - q \), the prevailing rate is the inflation rate under the fixed rate regime: 
\[ \pi^e = (1-q)E(\pi^{Fix}) + qE(\pi^{Flex}_{CBI=0}). \]
The government is in good faith when it announces a fixed rate regime. Ex ante, not even the government knows for sure whether its commitment will survive.\(^{14}\) In the case when the fixed exchange rate regime survives, inflation is zero. If fixed

\(^{14}\) Frankel 2005 (pp.9) writes: “I think that a still better way to view the public commitments may be as sincere expressions of a strong desire to maintain the peg. The ministers may realize that events could force the abandonment of the exchange rate policy, if speculative pressures accelerate and it develops that reserves are about to run out, leaving little other option. And they may realize that making an explicit statement beforehand increases the chances that they will have to resign if and when the peg is abandoned. But making the promise is a way of buying a bit of credibility, and buying some time. Specifically it is a device for signaling that their determination to hold the line on
rates collapse, however, and the central bank is dependent, the government gets to choose the time consistent rate of inflation from expression (10). As we would expect, a smaller \( q \) determines a lower inflation rate. Even an imperfectly credible fixed rate reduces the inflation rate in the economy:

\[
\pi_i = \frac{a_i}{1 + a_i(1-q)} H - \frac{a_i}{1 + a_i} \epsilon. \tag{10}
\]

Expected inflation with no domestic commitment and an imperfect exchange rate anchor is also lower than expression (5):

\[
\pi^e = \frac{qa_i}{1 + a_i(1-q)} H. \tag{11}
\]

The loss expected by the government in the beginning of the game is a convex combination of the expected loss when the fix survives and when it collapses: \( E(L_{CB1=0}^{Fix(q)}) = (1 - q)E(L^{Fix}) + qE(L_{CB1=0}^{Flex}) \). Note that when the exchange rate commitment is non credible (\( q = 1 \)) the government expected loss equals equation (7):

\[
E(L_{CB1=0}^{Fix(q)}) = \sigma^2 \frac{a_i}{1 + a_i} (1 + a_i - qa_i) + H^2 \frac{a_i(1 + a_i)}{1 + a_i(1-q)}. \tag{12}
\]

**Terminal node 4: A fixed exchange rate and an independent central bank**

When the executive has selected a fixed rate and an independent central bank, inflation is chosen by the central bank and is zero (\( \pi = 0 \)). If wage setters believe that in fact the central bank has been given independence, expected inflation is also zero (\( \pi^e_{1-p} = 0 \)). However, if wage setters believe the central bank is dependent, the public’s inflation expectation is a linear combination between the expected inflation under a fix and expected inflation under a float: \( \pi^e_p = (1-q)E(\pi^{Fix}) + qE(\pi^{Flex}) = \frac{qa_i}{1 + a_i(1-q)} H. \)

Given \( p \) and \( q \), ex ante the government anticipates a rate of inflation that is a linear combination between the inflation wage setters expect if they believe the government has delegated monetary policy to an independent central banker and, respectively, they do not believe delegation occurred: “the currency is so strong that they are willing to risk sacrificing their jobs.”
\[ \pi_{gov}^e = (1 - p)\pi_{1-p}^e + p\pi_p^e = \frac{pqai}{1 + a_i(1 - q)}H. \] (13)

Government expected loss function is given by the following expression:

\[ E(L_{CB\text{BI}=1(p)}^{\text{Fix}(q)}) = a_i\sigma^2 + H^2a_i\left[1 + \frac{pqai}{1 + a_i(1 - q)}\right]^2. \] (14)

5 The Choice of Imperfectly Credible Institutions

The ultimate goal of the game theoretic model is to describe the decision process of the policy maker over its two institutional choices. Moving up the decision tree, the executive compares its ex ante expected loss and decides on the optimal mix of commitment institutions, given the parameters \( a_i, p \) and \( q \). The government prefers to adopt a mix of two institutions as opposed to just fixing the exchange rate when the following inequality holds: \( E(L_{CB\text{BI}=1(p)}^{\text{Fix}(q)}) \leq E(L_{CB\text{BI}=0}) \). This is equivalent to:

\[ \sigma^2 \leq H^2\left[\frac{1 + a_i}{a_iq}\frac{(1 + a_i)(1 + a_i - a_iq) - (1 + a_i - a_iq + a_iqp)^2}{(1 + a_i - a_iq)^2}\right]. \] (15)

Let us define \( \beta \) as the expression inside the \([...]\). Further, the executive always prefers two institutions relative to just an imperfectly credible central bank: \( E(L_{CB\text{BI}=1(p)}^{\text{Fix}(q)}) \leq E(L_{CB\text{BI}=1}) \), for all parameter values \(^{15}\) Two institutions are preferred to no commitment at all when \( E(L_{CB\text{BI}=0}^{\text{Flex}(q)}) \leq E(L_{CB\text{BI}=0}^{\text{Flex}(q)}) \), that is when:

\[ \sigma^2 \leq H^2\left[\frac{1 + a_i(1 + a_i)(1 + a_i - a_iq)^2 - (1 + a_i - a_iq + a_iqp)^2}{(1 + a_i - a_iq)^2}\right]. \] (16)

Let the expression in the \([...]\) be \( \alpha \). The policy maker prefers fixed but adjustable rates to no commitment at all (flexible rates and a dependent central bank) when \( E(L_{CB\text{BI}=0}^{\text{Fix}(q)}) \leq E(L_{CB\text{BI}=0}^{\text{Flex}(q)}) \). That is, when the following holds:

\(^{15}\)Later in the paper I show that if abandoning a fixed rate entails an additional political cost \( c \) (Cooper 1971), an institutional mix ceases to be preferred always to an independent central bank.
\[ \sigma^2 \leq H^2 \left( \frac{(1 + a_i)^2}{1 + a_i - qa_i} \right). \]  

(17)

An independent central bank is preferred to no commitment institutions at all if \( E(L_{CBI=1(p)}^{Flex}) \leq E(L_{CBI=0}) \). This is equivalent to:

\[ \sigma^2 \leq \frac{1 + a_i}{a_i} (1 + a_i - (1 + pa_i)^2) H^2. \]  

(18)

Finally, an independent central bank that is not clearly ascertainable is preferred to a fixed but flexible exchange rate when \( E(L_{CBI=1(p)}^{Flex}) \leq E(L_{CBI=0}^{Fix(q)}) \), which is equivalent to:

\[ \sigma^2 \leq H^2 \left[ \frac{1 + a_i}{a_i q} \left( \frac{1 + a_i}{1 + a_i - a_i q} - (1 + a_i p)^2 \right) \right]. \]  

(19)

From expression (17) let \( \eta = \frac{(1 + a_i)^2}{1 + a_i - qa_i} \), from (18) let \( x = \frac{1 + a_i}{a_i} (1 + a_i - (1 + pa_i)^2) \), and from (19) let \( y = \left( \frac{1 + a_i}{a_i q} \left( \frac{1 + a_i}{1 + a_i - a_i q} - (1 + a_i p)^2 \right) \right) \). Propositions 1, 2 and 3 describe the parameter conditions that characterize the single and multiple institution solutions to the monetary policy game.

**Proposition 1**: A mix of two commitment institutions is a possible solution to the policy maker’s time inconsistency problem when the following conditions hold: \( \beta > 0 \) and \( \alpha > 0 \).

Proposition 1 establishes the conditions under which policy makers treat fixed exchange rates and independent central banks as complementary solutions to its credibility problem. For an institutional mix to be a solution to the game, the expected loss from adopting a mix of institutions needs to be smaller than the expected loss from a fix alone (\( \beta > 0 \)), and it should be the case that a mix generates a lower expected loss than no institutions at all (\( \alpha > 0 \)). Also, in the absence of costly devaluation of fixed rates a mix of institutions is always preferred to an independent bank alone. Both conditions in proposition 1 are necessary conditions, however, \( \alpha \geq \beta \) for all \( a_i, p \) and \( q \in (0,1) \), so, in fact, we only need that \( \beta > 0 \). \( \beta \) is larger than zero for \( 0 < p < .48 \) and for all values of \( a_i \) and \( q \). This means that for a low probability that the public does not recognize an independent central bank, a mixture of institutions can be an equilibrium choice to the game.

Figure 2 describes the solution space of the institutional game as a function of \( H^2 \) and \( \sigma^2 \).
The term $H^2$ is relevant as time inconsistency in monetary policy arises because policy makers can use unanticipated inflation to push output in the economy towards its socially optimal level. $H^2$ reflects the wedge between the actual output and its socially optimal level. Countries have a larger or smaller $H^2$ as they differ in their tax policies, unemployment benefits and minimum wage provisions. The variance of the shock to the economy, $\sigma^2$, is relevant because the cost of monetary policy delegation is reflected in the loss of flexibility to address negative shocks to the economy. A large variance of the shocks facing a country implies high costs of delegation of monetary policy. The two lines in figure 2 represent conditions (15) and (17) holding with equality. The two lines separate the solution space of the game. $\beta$ and $\eta$ are the slopes of the lines derived from equation (15) and, respectively, (17). As $\beta$ and $\eta$ are functions of the parameters $a_i$, $p$ and $q$, the two lines can be steeper or flatter, changing the government’s choice of institutions for any given pair $H^2$ and $\sigma^2$.

[Figure 2 about here]

For high levels of the credibility problem (high $H^2$) and low expected shocks to output (low $\sigma^2$) an institutional mix is the preferred solution to time inconsistency. However, as the variance of the shocks to the economy increases, there are fewer incentives for policy makers to doubly tie their hands with both fixed rates and an independent central bank. The behavior of the slope $\beta$ is complex. As expected, for a higher $p$, it becomes less likely that an independent bank would be adopted in addition to having a fixed exchange rate. The effect of government ideology on $\beta$ depends on the level of $p$ and $q$. At low levels of public distrust of central bank independence more leftist executives will prefer to adopt an institutional mix. However, as $p$ approaches .48, the dynamics changes: right wing governments are more likely to adopt a mixed institutional structure as opposed to just fixing the exchange rate. Moreover, as $q$ goes up, the change in dynamics occurs at lower levels of $p$ and $a_i$.

Comparative statics suggests that when commitment institutions face large credibility problems, the policy maker more concerned with inflation performance - the right - is more likely to adopt a mix of institutions. In particular, when banks lack credibility right wing governments are more likely to adopt independent central banks in addition to fixed exchange rates. When the fixed rate does not lower inflation expectations enough ($q$ is large), the right starts being more likely to adopt
the independent central bank at ever lower levels of $p$[16].

This result implies that right wing and left wing parties are bound to adopt an independent central bank coupled with a fixed exchange rate at different times. The party more concerned with inflation, the right, will be more likely to choose an independent central bank in bad times for macroeconomic stability. That is when there is a low probability that the public believes announcements made by politicians about monetary institutions. Examples of bad times are periods following swift transitions from authoritarian rule to democracy or a hyperinflation episode. The reverse argument applies to the left: In good times, it is more likely that the left would doubly tie its hands.

Proposition 2: A fixed exchange rate that the public knows can be devalued is a possible solution to the executive’s problem for all parameter values $a_i, p, q \in (0, 1)$. An independent central bank whose independence is not clearly ascertainable is never a single institutional solution to the game if abandoning the fixed exchange rate does not entail any cost $c$ for the politician.

Proposition 2 shows that a fixed but adjustable exchange rate is a more ubiquitous solution to the game than a mix of institutions: The fixed rate solution exists across all the range of parameters, while the mixed institutional solution only exists for particular combination of parameters that guarantee that $\beta > 0$. For any $a_i, p, q \in (0, 1)$, we can find values of $H^2$ and $\sigma^2$ for which a peg is better than a peg coupled with an independent central bank: If $\beta < 0$ a peg is preferred to an institutional mix for all values of $H^2$ and $\sigma^2$. If $\beta > 0$, then, depending on $H^2$ and $\sigma^2$, both a peg and a peg accompanied by an independent central bank can be solutions to the game. Further, as $\eta$ is greater than zero for all parameter values, there are values of $H^2$ and $\sigma^2$ for which a peg is preferred to either an independent central bank alone or to no institutions at all. $\eta$ increases in $a_i$ and decreases in $q$: Left wing governments are more likely to choose a fixed but adjustable exchange rate regime at all levels of $H^2$. Yet, fixed rates lose their appeal when the public believes there is a large probability that they will be devalued (large $q$). Also, the slope $\eta$ is larger than $\beta$ for all $p, q$ and $a_i$. As shown in figure 2, this implies that for a given value variance of the supply shock, policy makers will prefer a mix of commitment institutions the larger the credibility problem.

[16] Note that the right is never more likely than the left to adopt an adjustable fixed rate alone ($\eta$ is monotonically increasing in $a_i$).
of the policy maker (\(H^2\)).

Proposition 2 also shows that an independent central bank is never a single institutional solution to the simple game in which fixed rate devaluations are assumed to be costless for politicians. An imperfectly credible independent central bank is a possible solution to the government’s time inconsistency problem if: \(x > 0\), \(y > 0\) and \(\beta < 0\). However, \(x < 0\) for all parameter values \((a_i, p\) and \(q)\) for which \(\beta < 0\), and if \(\beta > 0\) an institutional mix is always preferred to just having an independent central bank. The explanation for this results is that for the policy maker, adopting an independent central bank that is not completely believed by the public generates a cost that increases with \(p\). In a dynamic setting, the policy maker would pay this cost until the public updates about the status of the central bank. A peg, even if markets know it can be devalued, lowers the cost of an independent bank that sets inflation at zero when the public believes that inflation will be positive.

However, the assumption that politicians face penalties when they abandon or devalue fixed exchange rates is a realistic one and I have worked without it just to simplify the presentation of the results in Proposition (1). As I show below, adding political costs to fixed rate collapses maintains the existence results from proposition (1) but restrains the parameter space for which policy makers choose fixed rates and independent central banks as a complementary mix of institutions. Previous work has documented the fact that politicians are punished for mistakes exchange rate policy. Cooper 1971 finds that devaluation of fixed exchange rates entails significant political costs for governments in developing countries. Building on Cooper 1971, Frankel 2005 discovers that when one month prior to a devaluation government members had given assurances that there would be no devaluation, and a devaluation did subsequently occur, the probability that the chief executive would lose his or her job within 12 months was .67. Where there was no evidence of such assurances, the frequency of job loss was only .39, despite the devaluation. Clarke et al. 2002 also finds that in the aftermath of the 1992 devaluation of the British Pound government approval ratings in Great Britain dropped by 18-19%. Cukierman et al. 2003 suggest that the cost to the policy maker may be due to instability on financial markets, to an overall loss of confidence in monetary policy or to a personal loss of reputation that may undermine the future careers of policy makers in
In my model, the political cost of abandoning a fixed exchange rate is distinct and added to the loss generated endogenously by an imperfectly credible fixed exchange rate (higher inflation). Accounting for the costly devaluation of fixed rates, the loss function from equation (1) becomes:

$$L_i(\pi_t, y_t) = (\pi_t)^2 + a_i(y_t - ky^*)^2 + \varphi c,$$

where $\varphi = 1$ if the peg does not survive and $\varphi = 0$ if the peg maintains. That is, politicians incur the cost $c$ if the fixed exchange rate does not maintain. When fixed rates maintain, there is no additional cost.

**Proposition 3:** With costly devaluation of fixed rates an imperfectly credible central is a possible solution to the policy maker’s decision problem when the cost $c$ is larger than $c^\ast$.

Figure 3 and figure 4 show the solution space of the monetary policy game when assuming costly fixed rate devaluation. The cost $c^\ast$ makes the policy maker just indifferent between choosing an independent bank alone or together with a fixed rate: $E(L_{CBI=1}^{fix(q)}) = E(L_{CBI=1}^{flex})$. $c^\ast$ is derived from the indifference condition and equals $c^\ast = \frac{a_i}{q}H^2[(1 + pa_i)^2 - (1 + a_i pq(1 + a_i - a_i q)^2)]$. When the cost of fixed rates devaluation is low, $c < c^\ast$ (figure 3), policy makers still prefer a mix of two institutions to an independent central bank alone. The executive chooses to supplement an institution that pays an up-front and certain cost (the independent central bank) with an institution which entails delayed and probabilistic costs (the fixed rate). However, politically costly fixed rate devaluations further restrict the domain of existence of the mixed institutional solution: Comparing figures 2 and 3, it is apparent that when policy makers have a small structural credibility problem (small $H^2$) fixed rates that are costly to relinquish are not appealing to the policy maker. When the cost $c$ is greater than 0 it becomes less likely that the policy maker chooses fixed exchange rates either alone or in combination with an independent central bank.

[Figure 3 and Figure 4 about here]

Figure 4 shows the solution space of the game when the cost of a fixed rate devaluation is large: $c > c^\ast$. When the cost $c$ is large, a peg that can be devalued stops being an institutional arrangement that makes an imperfectly credible independent bank more attractive. In fact, as figure 4 shows, when the cost $c$ is larger than $c^\ast$, for a range of small values of $H^2$ and $\sigma^2$, an independent central bank becomes the only institutional solution to the game. For an independent

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17 Edwards 1996 and Bloomberg et al. 2001 also talk about the political costs generated by the devaluation of fixed rates.

18 $\eta \geq \alpha \geq \beta$ and $\eta \geq x \geq y$ for all parameter values $a_i$, $p$, and $q$. 

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central bank to be an institutional solution $x$ needs to be greater than zero. Similar to the behavior of the parameter $\beta$, $x$ is larger than zero for small values of the probability $p$. If $p$ is large ($p > .5$), bank independence will never be preferred and the likely institutional solution will be a fixed exchange rate. The comparative statics of $x$ with respect to the ideology of the policy maker $a_i$ is also similar to the comparative statics of the parameter $\beta$: In an environment where delegation of monetary policy to an independent central banker has large chances of being believed by the public ($p \leq 0.36$), left wing policy makers will be more likely to adopt an independent central bank. However, circumstances marked by deep distrust in institutions and policy makers ($0.37 \leq p \leq 0.5$) induce a reversed dynamic. That is, right wing, conservative politicians will be more prone than the left to delegate monetary policy.

6 Conclusion

Institutions along with policy maker and voter preferences shape outcomes in a very wide set of circumstances from economic policy to elections. Therefore, if we care about outcomes we need to improve our understanding of the factors that influence the choice of particular institutional structures. This article started out with a puzzle: “If the policy maker’s wrists were already bound by exchange target duct tape, what would be the effects of an additional pair of handcuffs from inflation targets and yet another loop of rope from central bank independence?” (Kuttner and Posen 2001). My model brings forth an explanation for why governments would ever choose a mixture of institutions to reign in inflation. I show that when exchange rates are fixed but adjustable and central bank independence is not readily ascertainable, policy makers may choose both of these institutions.

In addition, I find that in a situation where declarations about central bank independence are not entirely believed by the public, it is the right wing policy maker that is more likely to choose a central bank that is conservative but not credible. The right wing is also more likely to choose an independent central bank in addition to a fixed exchange rate that markets do not trust, as such a fixed rate does not reduce inflation sufficiently. Hyperinflation episodes and periods of deep distrust of public institutions can be examined to get support for the hypotheses developed in
the model. For example, the most recent Bulgarian hyperinflation was brought to a halt by the adoption of a currency board arrangement in July 1997. The policy was carried out by the right wing government of Ivan Kostov, which came to power in elections held in April 1997. In Bulgaria, the currency board and a more independent central bank were adopted despite initial opposition from the right wing Sofiyanski government which was arguing that the currency board imposes too much constraint on the policy maker.

The recent literature in political science has begun to examine interrelated processes and the implications of potential policy and institutional substitutability. For example: Kaiser 2005 looks at endogenous elections and politically motivated economic intervention; Clark 2002 examines central banks, exchange rates, and monetary and fiscal policies; Ting 2003 models bureaucratic redundancy in a principal-agent model with multiple potential bureaucratic agents. In this paper, the focus is on institutions that overlap with respect to the goals that they need to achieve but which can only achieve these goals imperfectly. Policy makers operating in such a monetary policy institutional environment can end up with a mix of institutions that keep inflation in check. Beyond the choice of monetary commitment institutions, the more general implication of this paper is that if institutions do not suffer from similar weaknesses and are able to only partly fulfill their role. then we should observe some degree of institutional proliferation.

7 References


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Figures 1 - 4

Figure 1. Play of the game

Fixed rates can be devalued and central bank independence is not entirely believed.

- Workers set wages, i.e. inflation expectations.
- The output shock is realized.
- The government observes whether the fixed rate is maintained.
- Government sets inflation rate if the rate is flexible and / or the central bank is dependent.
  Inflation is zero if the fixed rate maintains or the central bank is independent.

Note: Fix(q) means that the government chooses a fixed exchange rate that the public knows can be devalued. Flex means that the government chooses a flexible rate. CBI is central bank independence. CBI=1(p) means that the independence of the central bank is not completely clear to the public.
Figure 2. Imperfect institutions: The choice of an institutional mix

\[ \sigma^2 = \eta H^2 \]

Flex, CBI=0

\[ \sigma^2 = \beta H^2 \]

Fix (q), CBI=0

Fix (q), CBI=1(p)

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Figure 3. Imperfect institutions and costly devaluation: \( c < c^* \)
The choice of an institutional mix

\[ \sigma^2 = \eta H^2 \]

Flex, CBI=0

\[ \sigma^2 = \alpha H^2 \]

Fix (q), CBI=0

\[ \sigma^2 = \beta H^2 \]

Fix (q), CBI=1(p)

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\[ cq \frac{a_i + 1}{a_i^2} \]

\[ cq \frac{a_i + 1}{a_i^2 (1-q)} \]
Figure 4. Imperfect institutions and costly devaluation: $c > c^*$

The choice of an independent central bank

\[ \sigma^2 = \eta H^2 \]

\[ \sigma^2 = x H^2 \]

\[ \sigma^2 = y H^2 \]