

## Institutions and Macroeconomic Outcomes – The Empirical Evidence

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### Summary

■ The literature on credibility issues in monetary and fiscal policy predicts that inflation and budget deficits are affected by a set of institutional variables. However, these institutional variables should have no effect on the average rate of unemployment. In this paper I confront these hypotheses with data from the last three decades for 18 OECD countries. The main results are the following: (i) Inflation is negatively related to central bank independence, fixed exchange rate regimes and conservative governments, as predicted by the theory. (ii) Central bank independence has a larger dampening effect on inflation under a floating exchange rate regime, but there is no support for the hypothesis that it also has a stronger negative effect on inflation when the government is less conservative. (iii) Central bank independence tends to reduce the budget deficits, while the impact of the exchange rate regime and government regime is ambiguous. (iv) Finally, neither the level of nor the variance of unemployment are correlated with the institutional variables studied. ■

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# Institutions and Macroeconomic Outcomes – The Empirical Evidence

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There is now a large literature on credibility issues in monetary and fiscal policy.<sup>1</sup> An important insight from this research is that the average rate of inflation is a function of various institutional variables, such as the degree of central bank independence, the exchange rate regime, the degree of flexibility in the labor market, etc. In general, models where a low inflation policy is time inconsistent predict that if the government delegates monetary policy decisions to an agent with more “conservative” preferences, the “inflation bias” is reduced. This has, however, no adverse effect on the average levels of employment and output. Such delegation can be accomplished, for example, by making the central bank more independent or by joining some internationally monitored system of fixed exchange rates. Agell, Calmfors and Jonsson (1994) extend this analysis to include fiscal policy. They show that austere fiscal policy is subject to a similar time inconsistency problem which generates a structural budget deficit. The size of this “deficit bias” is again affected by various institutional variables, but also by the degree of monetary commitment.

The purpose of this paper is to study whether the predictions in this literature are consistent with data on macroeconomic outcomes and rele-

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<sup>1</sup> Some of the most important contributions are collected in Persson and Tabellini (1994). See also Persson and Tabellini (1990) or Cukierman (1992) for overviews of this literature.

vant institutional variables. Earlier empirical studies are somewhat narrow in either scope or method. The focus has been predominantly on simple cross-country correlations between certain institutional features and macroeconomic outcomes. For example, Cukierman (1992) and Alesina and Summers (1993), among others, study the relationship between central bank independence and inflation. Romer (1993) studies the effect of a country's degree of openness on inflation, whereas Alesina and Roubini (1992) focus on how differences in output and inflation outcomes are related to left-wing and right-wing government regimes. However, the results in these studies are in general not conditioned on other factors which, according to the theory, should also affect the macroeconomic outcomes. In this paper I extend the previous empirical research in the following three directions:

(i) I study whether data are consistent with the theory on credibility issues in both monetary policy and fiscal policy.

(ii) When studying (i), I control for ways in which different aspects of the institutional framework differ across countries and evolve over time. Or put differently, I study whether different institutional variables simultaneously affect the macroeconomic outcomes, and how these institutional variables interact.

(iii) I use a panel data set and study the cross-country variations as well as the time-series variations in the data. If the models are true, the predictions should hold in both these dimensions.

It is important to mention, already at this stage, that one should have no illusions about being able to measure any institutional variables – such as central bank independence, government regime or the natural rate of unemployment – with a great deal of precision. The regression results in the following sections must therefore be interpreted even more cautiously than usual. It should also be mentioned that a maintained assumption throughout the paper is that all institutional variables are strictly exogenous and not affected by the macroeconomic development. This has been questioned in some recent papers (e.g. Posen, 1993). However, since most institutions evolve slowly over time, I believe that this assumption is not unjustified. The slow-moving process of changing institutions (such as building up central bank independence) implies further that it is hard to find good instruments for the institutional variables given the relative short time-span of available data. I therefore refrain from any attempts to

test the assumption of exogeneity in this paper. Still, the issue of reverse causality and, in particular, the question of how institutions are formed, are important and interesting topics for further research.

With this in mind, the conclusion drawn from this study is that the empirical results are by and large consistent with the models on credibility issues in monetary policy. Even when controlling for other institutional differences, inflation is negatively related to central bank independence, right-wing oriented governments and fixed exchange rate regimes. It is also found that a higher degree of central bank independence is associated with smaller budget deficits, whereas the effects of government regime and exchange rate regime on the deficits are ambiguous or insignificant. Moreover, there is no systematic relationship between either the level or the variance of unemployment and the institutional variables studied.

The rest of the paper is organized as follows. Section 1 reviews the theoretical framework and discusses earlier empirical studies. In this context I specify the explicit hypotheses to be tested. Section 2 describes the data and explains how some variables are generated. The empirical results regarding the relationship between institutions and inflation, unemployment and budget deficits are given in Sections 3, 4 and 5, respectively. Section 6 concludes.

## **I. Theoretical background and previous empirical results**

### **I.1. A simple model**

A typical model of the credibility issue in monetary policy is laid out as a game between the private sector (consisting, for instance, of monopolistic trade unions) and a policymaker (a government), where the private sector sets nominal wages, and the policymaker controls inflation via money growth. The timing of the game is usually assumed to be that the private sector moves first, then a supply side shock is realized, after which the policymaker determines the inflation rate. The supply side of the economy is then given by

$$x = x^* + \pi - \pi^e + \varepsilon, \quad (1)$$

where  $x$  is employment,  $x^*$  is the natural level of employment (both variables expressed as natural logarithms),  $\pi$  and  $\pi^e$  are realized and expected

inflation, respectively, and  $\varepsilon$  is a supply side shock with mean zero. Hence, the employment level is higher the larger the difference between actual and expected inflation, i.e., employment increases if the policymaker pursues an unexpectedly expansionary policy.<sup>2</sup> (The underlying assumption is that the actual real product wage, which determines employment, is reduced because the nominal wage does not adjust fully in the case of unexpected inflation.) In addition, employment is higher if a good shock hits the economy.

It is further assumed that the policymaker has preferences defined over inflation and unemployment and minimizes the loss function

$$\min_{\pi} L = (\pi - \hat{\pi})^2 + \lambda(x - \hat{x})^2, \quad (2)$$

where  $\hat{\pi}$  and  $\hat{x}$  are the policymaker's inflation and employment targets, respectively. If the employment target is equal to full employment, the unemployment rate is given by  $\hat{x} - x$ . An important assumption is that the policymaker's employment target,  $\hat{x}$ , (full employment) is above the natural level of employment,  $x^*$ . This is usually attributed to some unspecified distortion in the labor market. An implication of this assumption is that the policymaker has an incentive to create a positive inflation surprise in order to reduce the unemployment rate. The parameter  $\lambda$  is the weight the government attaches to unemployment relative to inflation.

Solving the policymaker's minimization problem under the assumption that inflation expectations are formed rationally (see Appendix A), we get the following expressions for inflation and unemployment:

$$\pi = \hat{\pi} + \lambda(\hat{x} - x^*) - \frac{\lambda}{(1 + \lambda)}\varepsilon, \quad (3)$$

$$\hat{x} - x = \hat{x} - x^* - \frac{1}{(1 + \lambda)}\varepsilon. \quad (4)$$

Expression (3) captures the notion of an "inflation bias". The average rate of inflation,  $\hat{\pi} + \lambda(\hat{x} - x^*)$ , is above the policymaker's inflation target. The magnitude of this inflation bias is a positive function of  $\lambda$ , the relative weight of unemployment in the policymaker's preference function,

<sup>2</sup> The assumption of a unitary coefficient for the expectational error in (1) is made for analytical convenience but is not important for the qualitative results.

and of  $\hat{x} - x^*$ , which can be defined as the natural rate of unemployment since  $\hat{x}$  and  $x^*$  are the logarithms of the levels of full employment and natural employment, respectively. The major focus of this paper is to study this implication of the model empirically, i.e., to confront the predicted relationship between inflation and the institutional variables captured by  $\lambda$  and  $\hat{x} - x^*$  with data.

Moreover, (4) implies that the average rate of unemployment should be independent of the institutional variables related to  $\lambda$ . However, the policymaker stabilizes the shock's effect on unemployment by varying the inflation rate and creating a temporary (positive or negative) inflation surprise. This is possible given the assumed timing of the game. An implication of this assumption is that the variance in unemployment is a negative function of  $\lambda$ . Hence, a lower  $\lambda$  is associated with lower average rates of inflation, but also with higher unemployment variability. This is the well-known trade-off between credibility and flexibility as discussed in e.g. Rogoff (1985a) or Persson and Tabellini (1990).

The identifying assumptions regarding the disturbance terms are important when setting up the econometric model. Theoretically, the effects of a supply side shock in the above model depend on the timing of the game and on potential information discrepancies between the policymaker and the private sector. The assumed information advantage for the policymaker implies that heteroskedastic disturbance terms should be expected when inflation or unemployment is regressed on the institutional variables. In general, it is not inconceivable that supply or demand side shocks are of different magnitudes in different countries. It is also likely that at least a part of the shock contains an international component, which would make them correlated across countries in a given period. Eichengreen (1991) finds, for example, that various measures of real disturbances are asymmetrical across European countries and considerably more variable than comparable shocks within the United States and Canada. Alesina and Grilli (1991) also argue that there are differences in the magnitude of real shocks across the European countries. In the regressions below I allow for both these possibilities by estimating a consistent covariance matrix where heteroskedasticity and contemporaneous cross correlation across countries are allowed. Moreover, since the models in this literature most often take the form of a repeated game with no state variables, the dynamics of inflation and employment may not be very well captured. It could be argued that supply side shocks are to some extent correlated over time. This would generate a more realistic pattern for

both inflation and employment.<sup>3</sup> In the regressions I therefore also allow the disturbance term to be (first-order) autocorrelated, both within and across countries.

### 1.2. Previous studies

Within the above framework, Rogoff (1985a) shows that a situation with a lower average rate of inflation is achieved if monetary policy is delegated to an independent central banker which is more conservative than the government. A more conservative policymaker is defined as a policymaker with a lower  $\lambda$ . The implication that central bank independence and inflation are negatively related has been tested and confirmed empirically by e.g. Grilli, Masciandaro and Tabellini (1991), Cukierman (1992) and Alesina and Summers (1993).

The same framework has been used to study exchange rate policy incentives for a small open economy. Giavazzi and Pagano (1988) show that a multilateral fixed exchange rate regime may alleviate the time inconsistency problem and reduce inflation. Again, one may think of the mechanism as a situation where the government delegates monetary policy decisions to a foreign central bank with a lower  $\lambda$ .

In the literature on politico-economic cycles it has been noted that elections and government regime affect monetary policy decisions. The rational partisan theory predicts that one should observe left-wing governments to be associated with higher inflation rates than right-wing governments (see e.g. Alesina, 1987, 1988b). The simple explanation is that left-wing and right-wing governments have different preferences regarding either the perceived trade-off between inflation and unemployment or regarding the inflation and/or employment targets, i.e., they differ with respect to  $\lambda$ ,  $\hat{\pi}$  or  $\hat{x}$ . The prediction that economies with left-wing governments on average have a higher inflation rate has been empirically confirmed by Alesina (1988a) and Alesina and Roubini (1992).

Romer (1993) argues and shows empirically that the credibility issue for monetary policy is less severe for more open economies. Cross-country data show a strong negative link between openness and inflation. The argument draws on Rogoff (1985b) who points out that monetary policy cooperation may exacerbate the credibility problem. In a noncooperative

<sup>3</sup> Theoretically, the disturbance term becomes autocorrelated if, for example, the policymaker has a two period ahead information advantage over the private sector regarding an autocorrelated supply side shock.

regime the policymaker (and the private sector) realizes that a unilateral monetary expansion causes a real exchange rate depreciation. This implies that a given employment gain is associated with a higher inflation cost, which is more important the more open the economy. Hence, the incentive to pursue expansionary monetary policy is less severe in a more open economy.

Finally, Agell *et al.* (1994) show that the above framework can be used to study aggregate demand policy more generally. If the government has access to a fiscal policy instrument as well as a monetary policy instrument (the exchange rate), the credibility problem results in both a deficit bias and an inflation bias. Their model predicts that an increase in the natural rate of unemployment should increase both the inflation rate and the budget deficit. Further, in accordance with Rogoff (1985b), they show that more open economies have less incentives to pursue expansionary policies implying less deficit and inflation, and in accordance with Alesina (1987, 1988b) that a policymaker who is more averse against inflation (deficits) creates less inflation (deficits). Finally, they derive the results that inflation is lower under a credible fixed exchange rate regime than under a floating exchange rate regime, but the budget deficit is likely to be larger.

To summarize, different interpretations or slightly different versions of basically the same model have generated a number of testable implications, namely: (i) The average rate of inflation should be higher under a floating exchange rate regime, the less open the economy, the higher the natural rate of unemployment, the more left-wing oriented the government, and the larger the influence of the government on the policy of the central bank. (ii) Unemployment should fluctuate around its natural level, but not be systematically related to any of the other institutional variables. (iii) Larger budget deficits should be observed under a fixed exchange rate regime, the less open the economy, the higher the natural rate of unemployment, and the more concerned the government is about unemployment. Sections 3, 4 and 5 below focus empirically on the above predictions.

## 2. The data

The sample consists of yearly data for 1961–89 for the OECD countries. However, Iceland, Luxembourg, Portugal and Turkey had to be excluded due to lack of data for several variables for a number of years. In addition,

I exclude Greece and Spain whenever government regime (right-wing or left-wing) is used as an independent variable. During the sixties and seventies these two countries cannot be classified as democracies, and it is uncertain how to categorize them on a traditional right-wing left-wing scale. The government regime variable, RIGHT, is coded with 1 for a year with a right-wing government, and 0 for a year with a left-wing government. All together this leaves me with observations for 18 countries over 29 years. Data on GDP, imports, budget deficits and inflation are from the IFS database (IMF), whereas unemployment data are from the OECD. The data on central bank independence, CBI, are taken from Cukierman (1992), and the classification of government regime is taken from Alesina and Roubini (1992) and Banks (1991). A more complete description of the data set is given in Appendix B. All variables are self explanatory, except for the series over the natural rate of unemployment which is discussed below.

### **2.1. Natural rate of unemployment**

Barro and Gordon (1983) point out explicitly that the magnitude of the credibility problem in monetary policy is a function of the natural rate of unemployment. This is suggested as a potential explanation for why both unemployment and inflation rose significantly in the United States during the seventies. However, in previous empirical studies within this field this variable has been neglected.<sup>4</sup> This is justified only if either the natural rate of employment is constant or if the policymaker's employment target varies in a one-to-one relationship with the natural rate of employment. However, it is not unlikely that the difference between the employment target and the natural rate of employment varies both over time and across countries. In this paper I assume that the employment target always equals full employment. The relevant variable to consider is then the natural rate of unemployment.

Since the natural rate of unemployment is not observable, it has to be estimated somehow. This introduces the usual econometric problems of measurement errors and errors in variables. In this study I have therefore experimented with different definitions of the natural rate of unemploy-

<sup>4</sup> One exception is Alesina (1988a) who finds that growth in money supply in the U.S. between 1949–85 is negatively related to right-wing regimes but positively related to various measures of the natural rate of unemployment.

ment. My prior when constructing the series has been to find a trend in the unemployment series that exhibits a great deal of persistence. In the regressions reported below I treat the natural rate of unemployment as an exogenous variable which is warranted when the trend is deterministic. In general, the results are not qualitatively affected by the choice of definition. The following two approximations for the natural rate of unemployment, UNN1 and UNN2, are used in the empirical sections:<sup>5</sup>

*UNN1*: This series is estimated by filtering the unemployment series between 1960-90 for the different countries using the so-called Whittaker-Henderson filter.<sup>6</sup> This filter decomposes the unemployment series into a cyclical component and a trend component. The trend component of the unemployment series is defined as UNN1. The filter operates by solving an algorithm where the smoothness of the trend component is traded off against its ability to track the actual series. This trade-off is a function of a smoothness parameter which here is set to 1600. In my sample this implies that the trend part is quite smooth.<sup>7</sup>

*UNN2*: This series is constructed by using a common definition of NAIRU. The method consists of regressing the change in inflation on open unemployment, a time trend and a quadratic time trend. The estimated regression equation is then used to extract the series for the natural rate of unemployment by setting the change in inflation to zero.

Simple inspection of the data reveals that the two definitions of UNN generate quite similar series for most countries. However, UNN1 seems to be a more reasonable approximation of the natural rate of unemployment for some countries. Although UNN2 has more intuitive economic appeal, the quadratic form implies that these series tend to exaggerate the difference between the trend and the actual unemployment rate in the beginning and at the end of the sample. UNN1 is plagued by a similar problem. The HP-filter is two-sided in the sense that it uses information

<sup>5</sup> In other studies the natural rate of unemployment has been estimated by using everything from simple deterministic time trends to elaborate regressions of unemployment on variables such as unemployment benefits, the degree of centralization, trade unionization, various taxes, etc. A more elaborate approach gives approximations for the natural rate of unemployment that vary substantially over time, sometimes even more than the actual unemployment series (see e.g. Minford, 1994).

<sup>6</sup> This filter is sometimes called the HP-filter since it was introduced to economists by Hodrick and Prescott (1980).

<sup>7</sup> I also used approximations of the natural rate of unemployment where the unemployment series are filtered with the smoothness parameter equal to 400 or 3200. This does not qualitatively affect the results.

both before and after time  $t$  when estimating the trend component at time  $t$ . Since this is not possible in the beginning and at the end of the sample the estimates here are less reliable.<sup>8</sup>

### 3. Institutions and inflation: empirical results

#### 3.1. Cross-country versus time-series results

In this section I focus on the relationship between inflation and various institutional variables. To start with I study the cross-country and the time-series evidence separately.

The results from cross-country regressions of the average values of inflation on the natural rate of unemployment, UNN, central bank independence, CBI, government regime, RIGHT,<sup>9</sup> import share of GDP, IMPORT, and a fixed exchange rate dummy for the EMS countries, DUM-EMS, are reported in Table 1. Following the classification in Cukierman (1992) the regressions are run for the whole sample period 1961–89 and for the three subperiods 1961–71, 1972–79, 1980–89. They correspond to a period with the Bretton Woods dollar-gold standard, the period of two oil price shocks and floating exchange rates, and the period of disinflation and the EMS arrangement. Since the model predicts the disturbance terms to be heteroskedastic, the regressions are estimated using White's (1980) heteroskedastic consistent covariance matrix.<sup>10</sup>

For the whole sample period the signs of the estimated coefficients are in accordance with the predictions. However, the standard errors are large and only the CBI coefficient is statistically significant. There are also variations in the coefficients over time. In particular, the constant term is much lower during the Bretton Woods period, 1961–71, indicating a lower average level of inflation. It can also be noted that the estimated coefficient for RIGHT is significant for the 1980–89 period, while the central bank independence variable is most important during the high-inflation period (1972–79). Together with the observation that the re-

<sup>8</sup> As an alternative definition of the natural rate of unemployment for period  $t$ , I have used a five-year moving average of unemployment from period  $t-5$  to  $t-1$ . This does not alter the results in any important way. In particular, the estimated coefficients for the other independent variables in the regressions are virtually unaffected when different definitions of the natural rate of unemployment are used.

<sup>9</sup> RIGHT is defined here as percent of total years with a right-wing oriented government.

<sup>10</sup> Following the recommendations by Davidson and MacKinnon (1993) a small-sample adjustment of the covariance matrix is also undertaken.

**Table 1. Cross-country regressions on average values for 18 OECD countries. Dependent variable: Inflation**

| Independent variables | 1961-89          | 1961-71          | 1972-79           | 1980-89          |
|-----------------------|------------------|------------------|-------------------|------------------|
| CONST                 | 8.81<br>[4.86]   | 4.74<br>[3.66]   | 12.43<br>[3.40]   | 11.83<br>[6.06]  |
| UNN                   | 0.22<br>[1.14]   | -0.11<br>[-0.58] | 0.52<br>[1.45]    | 0.18<br>[1.01]   |
| CBI                   | -5.96<br>[-2.40] | -2.00<br>[-1.32] | -10.56<br>[-3.39] | -1.73<br>[-0.42] |
| RIGHT                 | -1.05<br>[-0.72] | 0.13<br>[0.14]   | -0.73<br>[-0.44]  | -6.52<br>[-2.90] |
| IMPORT                | -0.02<br>[-0.41] | 0.01<br>[0.52]   | -0.02<br>[-0.30]  | -0.04<br>[-1.34] |
| DUM-EMS               |                  |                  |                   | -1.36<br>[-1.08] |
| obs                   | 18               | 18               | 18                | 18               |
| $R^2$                 | 0.46             | 0.19             | 0.50              | 0.66             |

*Notes:* Estimation method is OLS. The  $t$ -statistics (in brackets) are based on the heteroskedastic consistent covariance matrix due to White (1980) with a finite sample adjustment proposed by Davidson and MacKinnon (1993).

gression specification performs much worse during the 1961-71 subperiod, these results suggest that the interaction between exchange rate regime, government regime and central bank independence is important. In Section 3.2 below I further study the potential interaction effects.

The time-series evidence partly reinforces the cross-country conclusions. Table 2 reports the results from a fixed effect model where 18 country-specific dummy variables are added to the regression specification. The remaining independent variables thus pick up the within-country effects on variations in inflation, or put differently, they pick up the time-series correlations between the independent variables and inflation. Following the discussion in Section 1.1, the disturbance terms are here allowed to be both (groupwise) heteroskedastic and contemporaneously

**Table 2. Pooled regressions using yearly data, 1961–89, 18 OECD countries. Dependent variable: Inflation**

| Independent variables | Fixed effects model |                   | No fixed effects |                  |
|-----------------------|---------------------|-------------------|------------------|------------------|
|                       | (1)                 | (2)               | (3)              | (4)              |
| CONST                 | See notes           |                   | 10.41<br>[10.24] | 10.41<br>[10.74] |
| UNN1                  | -0.66<br>[-1.92]    |                   | 0.08<br>[0.50]   |                  |
| UNN2                  |                     | -0.82<br>[-2.18]  |                  | 0.08<br>[0.52]   |
| CBI                   | -13.26<br>[-2.35]   | -13.99<br>[-2.57] | -5.92<br>[-5.13] | -5.91<br>[-5.18] |
| RIGHT                 | -1.08<br>[-2.76]    | -1.05<br>[-2.65]  | -1.14<br>[-2.82] | -1.14<br>[-2.84] |
| IMPORT                | 0.22<br>[3.02]      | 0.21<br>[3.07]    | 0.01<br>[0.72]   | 0.01<br>[0.72]   |
| DUM-BW                | -4.43<br>[-3.79]    | -4.34<br>[-4.03]  | -3.71<br>[-2.74] | -3.76<br>[-2.79] |
| DUM-EMS               | -1.08<br>[-0.79]    | -0.91<br>[-0.70]  | -2.09<br>[-1.67] | -2.05<br>[-1.66] |
| obs                   | 522                 | 522               | 522              | 522              |
| R <sup>2</sup>        | 0.45                | 0.45              | 0.27             | 0.27             |

*Notes:* Estimation method is OLS. Regressions (1) and (2) include 18 additional country dummy variables (not reported). The *t*-statistics (in brackets) are based on a consistent covariance matrix where heteroskedasticity, contemporaneous cross correlations across countries and MA(1) autocorrelations within and across countries are allowed.

correlated across countries, as well as first-order autocorrelated both within and across countries.<sup>11</sup>

The two different definitions of the natural rate of unemployment, UNN1 and UNN2, are used in regressions 1 and 2, respectively. A dum-

<sup>11</sup> See Greene (1993, Ch.16) for a discussion on how to estimate an asymptotically correct covariance matrix under the given assumptions. Checking the residuals confirms that these assumptions are reasonable. The Lagrange Multiplier tests due to Breusch and Pagan (1980) strongly reject groupwise homoskedasticity as well as diagonality of the covariance matrix in all four regressions reported in Table 2. The *l*-test described in Cumby and Huizinga (1992) rejects the null hypothesis of no first-order serial correlation for on average 16 out of the 18 countries, but it rejects the null hypothesis of no second- to third-order serial correlation for only 2 out of the 18 countries, both at the 5-percent significance level.

my variable for the Bretton Woods exchange rate regime, DUM-BW, is also added. This is basically equivalent to adding a time dummy for the sixties, and the estimated coefficient is strongly negative. The coefficient for the EMS exchange rate regime is also negative though not significant. Moreover, both the estimated coefficients for RIGHT and CBI are significant with the predicted negative sign. We also see that the estimated coefficient for IMPORT is positive and significant, which is opposite to the theoretical prediction and the empirical cross-country results emphasized by Romer (1993). A possible explanation for this result is that both import share and inflation are to some extent determined by how the oil price evolves over time. Finally, the natural rate of unemployment comes in with a negative sign (the *t*-statistics are  $-1.9$  for UNN1 and  $-2.2$  for UNN2), which is also opposite to the theoretical prediction and the cross-country results found in Table 1. This result is to a large extent driven by the developments in the eighties. Unemployment remained at high levels while inflation fell in many countries during this decade. When the fixed effect model is run separately for the three subperiods it is found that the estimated coefficient for UNN is positive during the period 1961–71, but strongly negative during the period 1980–89.

In order to gain degrees of freedom and to estimate the relative importance of the cross-country versus within-country variations, I continue by running pooled regressions where all coefficients are restricted to be the same in all countries. Columns 3 and 4 of Table 2 report the results from these regressions. The fit of this specification is somewhat lower compared to the cross-country model in Table 1 ( $R^2$  falls from 0.46 to 0.27). This is not surprising considering the fact that inflation exhibits a lot of yearly variations, while the natural rate of unemployment, the degree of central bank independence and the dummy variables for exchange rate regime all show "high persistence". However, the use of yearly observations is important in order to better extract the information regarding changes in government regime.<sup>12</sup>

In this restricted model the estimated coefficients for CBI, RIGHT and DUM-BW are all negative, as predicted by the theory, and significant at the 1-percent significance level. The estimated coefficient for the EMS exchange rate regime is also negative but only marginally significant

<sup>12</sup> For example, a country with a right-wing oriented government in power the first five years of a decade would be treated as a country with a right-wing oriented government in power the last five years, if average values over decades are used. Hence, a great deal of useful information is lost if the data are just pooled over decades.

(the  $t$ -statistic is  $-1.7$ ). These results indicate that these three different institutional aspects, captured by the parameter  $\lambda$  in the model, are all important for the inflation outcome, even when controlling for other differences in the institutional environment. The estimated coefficients imply that the inflation rate is on average 2–3 percentage points lower under a fixed exchange rate regime, 1 percentage point lower if a right-wing oriented government is in power and about 3 percentage points lower for a country with a very independent central bank compared to a country with a very dependent one,<sup>13</sup> everything else equal. Finally, the estimated coefficients for the natural rate of unemployment and import share are not significant. Thus, the cross-country effects and the time-series effects, which go in different directions for both these variables, tend to cancel in this pooled restricted regression specification.

### 3.2. Interaction effects

The results in the previous section indicate that central bank independence, government regime and exchange rate regime all are important for the inflation outcome. In this section I exploit the information in the data further by studying the interaction effects among these three variables.

In the theoretical literature there is usually only one policymaker with one policy instrument that controls the inflation outcome. It is then not clear what the inflation outcome would be if the government and the central bank have different preferences regarding inflation and unemployment, and the central bank is only “partly” independent. One possibility is that the inflation outcome (on average) becomes a weighted average of the expected inflation outcomes when the central bank is fully in charge of monetary policy,  $\pi^{central\ bank}$ , and when the government is fully in charge of monetary policy,  $\pi^{government}$ , respectively.<sup>14</sup> This argument implies that on average the inflation outcome is

<sup>13</sup> As shown in the Appendix, the index over “central bank independence” varies between 0.1 and 0.7. Hence, the difference in this index between countries with a highly independent central bank, such as Germany, Switzerland and Austria, and countries with a quite dependent central bank, such as Norway, Belgium and Japan, is about 0.5.

<sup>14</sup> A related argument has been proposed by Flood and Isard (1988). In their model the policymaker follows a simple rule with low inflation in normal times, but acts discretionary when the shocks are large resulting in higher inflation. The probability for breaking the rule is a function of an exogenous cost from switching policy. Lohman (1992) extends the analysis by letting the government explicitly choose the cost which is incurred when the policymaker overrides the central banker’s monetary decision. In both models the cost associated with going from a low-inflation regime to a high-inflation regime may be interpreted as the degree of central bank independence.

$$\pi = cbi \cdot \pi^{central\ bank} + (1 - cbi) \cdot \pi^{government}, \quad (5)$$

where  $0 \leq cbi \leq 1$  can be interpreted as the degree of central bank independence. Since the expected rate of inflation in the model (see Section 1.1) for any policymaker is given by  $\hat{\pi} + \lambda^i (\hat{x} - x^*)$  where  $\lambda^{central\ bank} \leq \lambda^{right\ gov} < \lambda^{left\ gov}$ , we get that a more independent central bank (higher  $cbi$ ) and/or a more right-wing oriented government generates a situation with on average a lower rate of inflation (government regime matters only if  $cbi < 1$ ). In addition, it is also clear that the marginal negative effect of a more independent central bank on inflation is larger for a left-wing government than for a right-wing government, i.e. the derivative

$$\frac{d\pi}{d(cbi)} = (\lambda^{central\ bank} - \lambda^{government}) (\hat{x} - x^*) \quad (6)$$

is more negative the higher  $\lambda^{government}$  is. Put differently, if we run separate regressions of inflation on central bank independence for countries with a left-wing government and a right-wing government, respectively, we would expect both the constant term to be higher (due to the partisan theory effect) and the slope coefficient to be more negative (due to (6)) for the group of countries with left-wing governments.<sup>15</sup>

The most efficient way to estimate this effect is to add the interaction term  $CBI \cdot RIGHT$  to the original regression specification.<sup>16</sup> The above argument implies that the null hypotheses are that the  $RIGHT$  variable remains negative, whereas the interaction term,  $CBI \cdot RIGHT$ , is positive.  $RIGHT$  measures the difference in inflation outcomes between right-wing and left-wing regimes given a dependent central bank, whereas the interaction term measures how the marginal effect of central bank independence on inflation differs between right-wing and left-wing regimes. The results are given in column 1 of Table 3. They are not supportive of the theory. The coefficient for  $RIGHT$  is insignificant, indicating that

<sup>15</sup> Milesi-Ferretti (1991, 1993) also argues that left-wing governments have more to gain than right-wing governments from a reduction of the credibility problem. This is explicitly discussed in the context of fixed versus flexible exchange rates, and the optimal degree of debt indexation, but the argument and predictions also carry over to a situation with different degrees of central bank independence.

<sup>16</sup> The regression specification with an interaction term is valid under the assumption that the two groups have equal disturbance variances. I also performed separate regressions for left-wing and right-wing governments, respectively. The results are very close to the results where an interaction term is used.

**Table 3. Interaction effects among central bank independence, government regime and exchange rate regime. Pooled regressions, 1961–89, 18 OECD countries. Dependent variable: Inflation**

| Independent variables | (1)              | Independent variables | (2)              |
|-----------------------|------------------|-----------------------|------------------|
| CONST                 | 9.63<br>[8.80]   | CONST                 | 10.61<br>[9.04]  |
| UNN1                  | 0.07<br>[0.44]   | UNN1                  | 0.19<br>[1.18]   |
| CBI                   | -3.71<br>[-1.72] | CBI                   | -8.77<br>[-7.76] |
| RIGHT                 | 0.06<br>[0.06]   | RIGHT                 | -1.09<br>[-2.65] |
| IMPORT                | 0.01<br>[0.86]   | IMPORT                | 0.02<br>[1.20]   |
| DUM-BW                | -3.74<br>[-2.80] | DUM-EXCH              | -5.39<br>[-3.54] |
| DUM-EMS               | -1.97<br>[-1.57] | CBI · EXCH            | 5.81<br>[3.77]   |
| CBI · RIGHT           | -3.36<br>[-1.42] |                       |                  |
| obs                   | 522              | obs                   | 522              |
| $R^2$                 | 0.28             | $R^2$                 | 0.29             |

*Notes:* Estimation method is OLS. The  $t$ -statistics (in brackets) are based on a consistent covariance matrix where heteroskedasticity, contemporaneous cross correlations across countries and MA(1) autocorrelations within and across countries are allowed.

the inflation outcome would be fairly similar under left-wing and right-wing regimes given a dependent central bank. The interaction term enters with the wrong sign with a  $t$ -statistic of  $-1.4$ . The other variables remain basically unaffected. The result implies that the difference in the inflation bias between a left-wing and a right-wing government is not lower where (or when) the central bank is more independent. If anything, we see the opposite. One possible explanation for this finding is that inflation is affected by fiscal policy even in economies with a quite independent central bank. This would point to a need for further theoretical research on how the political incentive constraints are affected when the model includes more than one policymaker.

The degree of domestic central bank independence and government regime are not issues in the theoretical papers on how fixed exchange rates may alleviate the credibility problem in monetary policy (see e.g. Giavazzi and Pagano, 1988). This might be reasonable if the exchange rates are fixed once and for all in an irrevocable way. However, if the exchange rates are subject to multilaterally agreed realignments (as was the case both under the Bretton Woods and the EMS regimes), it could be argued that the likelihood for such a realignment is a function of how independent the central bank is in a given country. But precisely because a realignment per definition must be agreed on by the other member countries, it can be hypothesized that the effects of central bank independence on the inflation outcome is smaller under a fixed exchange rate regime (allowing discrete realignments) than under a floating exchange rate regime.

The cross-country results (reported in Table 1) indicate some preliminary support for this argument. The negative effects of central bank independence and government regime on inflation are more important during the seventies and eighties, respectively, than during the sixties. Column 2 of Table 3 reports the results from the regression where the interaction between central bank independence and exchange rate regime is considered. Here, the dummy variable for the fixed exchange rate regime, DUM-EXCH, combines the Bretton Woods and the EMS observations. As predicted, the estimated coefficient for CBI is negative, whereas the interaction term CBI·EXCH is positive. Both coefficients are strongly significant. Hence, the negative effect of central bank independence on inflation is significantly stronger under a floating exchange rate regime than under a fixed exchange rate regime.

#### **4. Institutions and unemployment: empirical results**

Much of the literature on credibility issues rests on the assumption that only policy surprises have real effects. The assumed surprise supply function implies that employment fluctuates around its natural level in the short run. However, since the expected value of both the shocks and the policy surprises is zero, employment should not be affected by any institutional variable in the long run. On the other hand, if the policymaker has an information advantage over the private sector regarding the

shocks, the policymaker will stabilize the shock's effect on unemployment. The extent of this stabilization depends on the same institutional variables as studied previously. In this section I study whether these two predictions are consistent with the data.<sup>17</sup>

Table 4 reports the results from cross-country regressions of average values of unemployment on the institutional variables CBI, RIGHT and IMPORT. Since the average rate of unemployment in the long run per definition is equal to the natural rate of unemployment in this study, the regression can be interpreted as an examination of whether the natural rate of unemployment is related to the other institutional variables. The regression is run for the whole sample period and for the three different subperiods. For the period 1980–89 DUM-EMS is added as an independent variable. Finally, a pooled regression using the average values from the three subperiods is also performed, in which case DUM-BW is also used as an independent variable. The results support the prediction that there is no systematic correlation between unemployment and the institutional variables central bank independence, government regime and degree of openness. As expected, the fit of this regression is consequently worse than when inflation (or budget deficits, see below) is used as a dependent variable. The estimated coefficients for CBI and IMPORT are always close to zero. RIGHT comes in with a negative sign, indicating that more conservative countries on average tend to be associated with less unemployment, but the estimated coefficient is only marginally significant with a *t*-statistic around  $-1.6$ . The only significant variables are DUM-EMS and DUM-BW. However, these variables, both capturing a fixed exchange rate regime, enter with different signs. The EMS countries had significantly higher unemployment during the eighties compared to the non-EMS countries and earlier subperiods, while the estimated negative coefficient on DUM-BW simply says that unemployment was lower during the sixties compared to the seventies and eighties.

If the policymaker has an information advantage over the private sector, in the sense that the supply side shock is realized after nominal wages have been determined but before the policymaker acts, then the policymaker is going to stabilize the shocks. The extent of this stabilization is a

<sup>17</sup> In an extended version of this paper, I also study the short-run fluctuations in unemployment (Jonsson, 1995). Although the fit of these regressions is very poor and the identifying restrictions are quite strong, the results support the prediction that there is a negative relationship between unemployment fluctuations and inflation surprises.

**Table 4. Cross-country regressions on average values for 18 OECD countries. Dependent variable: Unemployment**

| Independent variables | 1961-89          | 1961-71          | 1972-79          | 1980-89          | Pooled           |
|-----------------------|------------------|------------------|------------------|------------------|------------------|
| CONST                 | 5.70<br>[2.33]   | 3.90<br>[2.39]   | 5.31<br>[2.10]   | 6.75<br>[3.31]   | 5.73<br>[5.39]   |
| CBI                   | 1.04<br>[0.33]   | -0.40<br>[-0.22] | 0.08<br>[0.02]   | -0.54<br>[-0.10] | -0.53<br>[-0.29] |
| RIGHT                 | -3.67<br>[-1.65] | -1.76<br>[-1.44] | -2.01<br>[-1.06] | -2.30<br>[-0.70] | -1.64<br>[-1.55] |
| IMPORT                | 0.01<br>[0.16]   | -0.02<br>[-0.55] | -0.02<br>[-0.39] | -0.00<br>[-0.09] | -0.02<br>[-0.70] |
| DUM-BW                |                  |                  |                  |                  | -1.93<br>[-3.04] |
| DUM-EMS               |                  |                  |                  | 4.70<br>[3.43]   | 5.92<br>[6.17]   |
| obs                   | 18               | 18               | 18               | 18               | 54               |
| $R^2$                 | 0.16             | 0.18             | 0.09             | 0.50             | 0.57             |

Notes: See Table 1.

function of the policymaker's concern about unemployment relative to inflation. Thus, the variance in the cyclical component of unemployment should be positively related to the institutional variables captured by the parameter  $\lambda$  in the model, i.e., central bank independence, government regime and exchange rate regime. Table 5 reports the results from regressions of the variance in unemployment,  $\text{Var}(\text{UN})$ , or in the cyclical part of unemployment  $\text{Var}(\text{UN}-\text{UNN})$ , on CBI, RIGHT and a dummy variable for fixed exchange rates, DUM-EXCH, again combining the Bretton Woods and the EMS observations. All variables are measured and pooled over the three subperiods. None of the estimated coefficients are significant in any regression, and the fit of the regression is very poor.<sup>18</sup>

Hence, I find no empirical support for the theoretical prediction of a trade-off between credibility and flexibility. The countries and the time periods where the institutions are such that a low-inflation policy is credi-

<sup>18</sup> The results in this section are consistent with Alesina and Summers (1993) who show that cross-country plots over CBI and the average unemployment rate or the variance in unemployment do not reveal any relationship between these variables.

**Table 5. Variance in unemployment and institutional variables.**  
**Pooled regressions over the periods 1961–71, 1972–79 and 1980–89**  
**for 18 OECD countries**

| Independent variables | Dependent variable |                  |                  |
|-----------------------|--------------------|------------------|------------------|
|                       | Var(UN)            | Var(UN-UNN1)     | Var(UN-UNN2)     |
| CONST                 | 2.09<br>[3.00]     | 1.00<br>[2.34]   | 1.18<br>[2.32]   |
| CBI                   | 0.70<br>[0.51]     | 0.49<br>[0.52]   | 0.41<br>[0.37]   |
| RIGHT                 | -1.44<br>[-1.36]   | -0.34<br>[-0.54] | -0.37<br>[-0.48] |
| DUM-EXCH              | -0.15<br>[-0.25]   | 0.11<br>[0.30]   | 0.02<br>[0.04]   |
| obs                   | 54                 | 54               | 54               |
| $R^2$                 | 0.05               | 0.01             | 0.01             |

*Notes:* See Table 1.

ble are not at the same time associated with higher unemployment variability. One possible interpretation is that the private sector anticipates the policymaker's stabilization efforts. Put differently, the policymaker may have very little information advantage that can be used for stabilization. This casts some doubts on the basic structure of the model commonly used for analyzing the credibility versus flexibility trade-off.

## **5. Institutions and budget deficits: empirical results**

If it is aggregate demand policy that affects the price level in the economy, then the literature on credibility problems can be generalized to also include fiscal policy, as discussed in Agell *et al.* (1994). They show that the incentive to reduce unemployment with expansionary fiscal and monetary policy generates a deficit bias as well as an inflation bias. This structural deficit is larger the higher the natural rate of unemployment, the less open the economy, and the more left-wing oriented the government (assuming that a left-wing government is more concerned about

unemployment relative to budget deficits than a right-wing government). Further, a general idea in their model is that restrictions on the monetary instrument might strengthen the incentives to use the fiscal policy instrument. Under certain circumstances the deficit therefore ends up being larger in a fixed exchange rate regime than in a floating exchange rate regime. Although not explicitly modeled, a conjecture would then also be that a relatively more independent central bank leads to larger budget deficits.<sup>19</sup> In this section I confront these implications with data.

Again I start by looking at the cross-country and the time-series evidence separately. The results from the cross-country regressions are reported in Table 6.<sup>20</sup> For the whole sample period we find that only UNN is significant. The estimated coefficient has the predicted sign and implies that countries with an on average 5 percentage points higher unemployment rate have on average about 3 percentage points higher annual budget deficits. It can further be noted that the effect of a higher degree of central bank independence on the deficits is negative and significant in two of the three subperiods, which is opposite to the above conjecture.

When the time-series evidence is explored (by using the fixed effect model), the results regarding the natural rate of unemployment are again reversed. The results from this model are reported in Table 7.<sup>21</sup> The estimated coefficients on UNN1 and UNN2 are  $-0.39$  and  $-0.57$ , respectively, which can be compared with the value of  $0.63$  from the cross-country regression. This result is again to a large extent driven by the observa-

<sup>19</sup> However, both Tabellini (1986) and Alesina (1988a) argue tentatively that, at least in the long run, one would expect the opposite (a negative) relation between central bank independence and budget deficits. A more independent central bank can be seen as a commitment device not to provide monetary financing of a fiscal deficit, which would strengthen the fiscal authority's (the government's) incentive to balance the budget.

<sup>20</sup> Although the model in Agell *et al.* (1994) is deterministic, the disturbance term can also in these regressions be thought of as a supply or demand side shock. If the policymaker uses both monetary and fiscal policy to stabilize these shocks, we would therefore expect the disturbance terms to be heteroskedastic. Hence, all regressions are estimated using White's (1980) heteroskedastic consistent covariance matrix with a small sample adjustment proposed by Davidson and MacKinnon (1993).

<sup>21</sup> All regressions in Table 7 are estimated under the same assumptions about the disturbance terms as when inflation was used as a dependent variable. These assumptions also seem to be reasonable here. The LM-test (Breusch and Pagan, 1980) rejects groupwise homoskedasticity as well as diagonality of the covariance matrix in all four regressions. The *l*-test (Cumby and Huizinga, 1992) rejects the null hypothesis of no first-order serial correlation for on average 16 out of the 18 countries, whereas the null hypothesis of no second- to third-order serial correlation is rejected for on average 4 out of the 18 countries, both at the 5-percent significance level.

**Table 6. Cross-country regressions on average values for 18 OECD countries. Dependent variable: Budget deficit in percent of GDP**

| Independent variables | 1961-89          | 1961-71          | 1972-79          | 1980-89          |
|-----------------------|------------------|------------------|------------------|------------------|
| CONST                 | 0.31<br>[0.12]   | -1.74<br>[-2.02] | 1.61<br>[0.38]   | 3.04<br>[0.68]   |
| UNN                   | 0.63<br>[2.59]   | 0.72<br>[4.71]   | 0.53<br>[1.33]   | 0.36<br>[1.59]   |
| CBI                   | -4.86<br>[-1.55] | -2.63<br>[-1.99] | -7.09<br>[-1.93] | -1.87<br>[-0.27] |
| RIGHT                 | 0.83<br>[0.34]   | 2.48<br>[3.90]   | 0.81<br>[0.31]   | -3.15<br>[-0.79] |
| IMPORT                | 0.04<br>[1.20]   | 0.04<br>[2.59]   | 0.07<br>[1.01]   | 0.02<br>[0.33]   |
| DUM-EMS               |                  |                  |                  | 0.91<br>[0.39]   |
| obs                   | 18               | 18               | 18               | 18               |
| R <sup>2</sup>        | 0.50             | 0.75             | 0.36             | 0.46             |

Notes: See Table 1.

tions from the eighties. A number of countries ran smaller deficits during this decade compared to the late seventies, whereas the natural rate of unemployment remained high or even increased. If the fixed effect model is applied separately to the three subperiods, the coefficient on UNN is positive during the period 1972-79 but negative during the period 1980-89. It can also be noted that, although the budget deficits were significantly lower during the Bretton Woods regime, the countries which fixed their exchange rates within the EMS experienced significantly higher deficits during the period with this arrangement. Otherwise the signs of the estimated coefficients go in the same direction when the time-series evidence is studied as in the cross-country analysis. In particular we see that IMPORT comes in significantly with a positive sign, which is opposite to the null hypothesis, whereas the estimated coefficient for CBI is still negative.

Columns 3 and 4 of Table 7 report the results from the pooled regressions where all coefficients are restricted to be the same in all countries. We now find that UNN comes in strongly significant with a positive sign. This implies that the cross-country variations in the natural rate of

**Table 7. Pooled regressions using yearly data, 1961–89, 18 OECD countries. Dependent variable: Budget deficit in percent of GDP**

| Independent variables | Fixed effects model |                  | No fixed effects |                  |
|-----------------------|---------------------|------------------|------------------|------------------|
|                       | (1)                 | (2)              | (3)              | (4)              |
| CONST                 | See notes           |                  | 1.37<br>[2.02]   | 1.50<br>[2.37]   |
| UNN1                  | -0.39<br>[-2.33]    |                  | 0.39<br>[4.55]   |                  |
| UNN2                  |                     | -0.57<br>[-3.32] |                  | 0.38<br>[4.60]   |
| CBI                   | -3.82<br>[-1.34]    | -4.86<br>[-1.78] | -4.56<br>[-5.57] | -4.57<br>[-5.64] |
| RIGHT                 | 0.34<br>[1.25]      | 0.35<br>[1.29]   | 0.30<br>[0.85]   | 0.28<br>[0.81]   |
| IMPORT                | 0.24<br>[5.62]      | 0.24<br>[5.78]   | 0.05<br>[4.42]   | 0.05<br>[4.28]   |
| DUM-BW                | -1.57<br>[-2.58]    | -1.65<br>[-2.86] | -0.65<br>[-0.88] | -0.93<br>[-1.26] |
| DUM-EMS               | 2.50<br>[3.77]      | 2.90<br>[4.85]   | 0.57<br>[0.95]   | 0.87<br>[1.46]   |
| obs                   | 522                 | 522              | 522              | 522              |
| R <sup>2</sup>        | 0.70                | 0.69             | 0.34             | 0.34             |

Notes: See Table 2.

unemployment explain more of the total variation in the deficits than the within-country variations. Otherwise the previous findings are confirmed. The estimated coefficient for IMPORT is positive and significant, which is opposite to the theoretical prediction, while RIGHT is insignificant. These results are fairly similar under fixed and floating exchange rate regimes, respectively (not reported). How restrictions on monetary policy affect the deficit outcome is ambiguous. The EMS countries ran larger deficits both relative to previous periods and relative to the non-EMS countries. However, the deficits were in general lower during the Bretton Woods regime. None of these coefficients are significant though.

More interesting is perhaps that the estimated coefficient on CBI is negative and significant at the 1-percent level. A more independent central bank is thus associated with both lower inflation rates and lower bud-

get deficits, once we control for the other institutional variables. The point estimate implies that the annual budget deficit is on average about 2 percentage points lower for a country with a high CBI-index compared to a country with a low CBI-index. This result might not be regarded as too surprising, since the CBI-index includes a measure of the legal restrictions on the ability of the public sector to borrow from the central bank. However, the results are qualitatively unaffected if this category is excluded when constructing the CBI-index.<sup>22</sup> And the result is contrary to the empirical findings in Grilli *et al.* (1991), who emphasize that there is no link between monetary and fiscal discipline. In their regression of fiscal deficits on central bank independence, they control for various measures of political instability and government weakness. They find that, in particular, a higher degree of government durability is associated with stronger fiscal discipline, whereas the coefficient on central bank independence is insignificant although negative. A possible explanation for these different results could be that a more independent central bank is a consequence of, or generated in, a more stable political environment. However, when Grilli *et al.* (1991) instead use inflation as the dependent variable, they find the opposite results: central bank independence remains significantly negative, whereas variables measuring government weakness and political instability are usually insignificant.

## 6. Discussion

This paper takes the literature on credibility issues in monetary and fiscal policies seriously as an empirical description of actual economies. Different versions of the same basic model predict that both inflation and budget deficits are affected by a set of institutional variables. However, although the driving force behind the theoretical results is the policymaker's desire to reduce unemployment, the models predict no correlation between these institutional variables and unemployment in the long run. In this paper I confront these hypotheses with a panel data set for 18 OECD countries over the last three decades. The main results can be summarized as follows:

<sup>22</sup> The estimated coefficient for CBI changes from  $-4.6$  to  $-3.4$ , which still is significant at the 1-percent level.

(i) Inflation is negatively related to central bank independence, fixed exchange rate regimes and conservative governments, as predicted by the theory. This holds even when controlling for other variations in the institutional environment.

(ii) Central bank independence has the largest dampening effect on inflation under a floating exchange rate regime, but there is no support for the hypothesis that it also has a stronger negative effect on inflation when the government is more left-wing oriented.

(iii) Budget deficits are negatively associated with central bank independence, whereas the exchange rate regime and the government regime have ambiguous or insignificant effects. Moreover, the deficits are higher in countries with a higher natural rate of unemployment.

(iv) Neither the level of unemployment nor the variance of unemployment are correlated in a systematic way with the institutional variables studied.

In the introduction it was mentioned that a maintained assumption throughout this study is that all independent variables are strictly exogenous. This has been questioned by some authors. Posen (1993) argues that both central bank independence and inflation are functions of society's attitude towards price stability. In particular it is showed that the political power of the financial sector is crucial in determining cross-country inflation differences. Cukierman (1992) also discusses the possibility of a simultaneity problem when regressing inflation on various measures of central bank independence. He therefore reestimates his regressions using the instrumental variables method and also performs a Granger causality test. He then finds that central bank independence indeed has a contemporaneous effect on inflation. However, the Granger causality test is inconclusive, and the conclusion drawn is that low central bank independence and high inflation reinforce each other.<sup>23</sup>

Another potential problem is that the theoretical models in this literature are too rudimentary to be used as empirical descriptions of time-series variations in macroeconomic outcomes. The econometric models might therefore suffer from an omitted variable problem. This might in

<sup>23</sup> The measure of central bank independence here is the actual turnover rate of the central banker since the sample includes a number of less-developed countries. The time-spans considered are decades.

turn yield disturbance terms that are correlated both over time and across countries. An example of such a variable would be the change in the world price of oil. However, this problem is at least partly handled by using asymptotically correct standard errors. When estimating the covariance matrix, I allow for both heteroskedasticity and contemporaneous cross correlations across the countries as well as autocorrelations within and across countries. Moreover, all qualitative results from the inflation and the deficit regressions are the same if the variables are pooled over decades instead of years (the results are available on request).

All together these qualifications imply that the results in this study should be interpreted with caution. However, the general conclusion that can be drawn is that the broad empirical picture seems to be consistent with the literature on credibility issues in monetary policy. But there is no empirical support for the theoretical prediction that different institutional environments are associated with trade-offs between low inflation and high variability in unemployment. Finally, there exists indications of a link between monetary and fiscal discipline. The government affects inflation even when the central bank is quite independent, but central bank independence is in turn related to fiscal deficits. This suggests that it would be of interest to develop more elaborate models of the interaction between monetary and fiscal policy under different institutional setups in order to better understand the political incentive constraints when there are several policymakers who control different policy instruments.

In this context it should be noted that there exist other models on the relationship between fiscal deficits and various institutions. Hagen (1992) studies how the budgeting procedures differ between the EC countries, and Molander (1992) extends his sample to also include Sweden. These studies show empirically that a budgeting process with a strategic dominance of the finance minister over the spending ministers and limits on the parliamentary power significantly reduces the deficits. In contrast, long term legal constraints on fiscal policy have no effect on the budget outcome. Upcoming elections might also affect the incentives for the policymaker to run fiscal deficits. This has been studied theoretically by e.g. Persson and Svensson (1989) and Alesina and Tabellini (1990). These models predict that a political system with more political instability and a larger degree of political polarization generate larger public debts. In this context it has also been emphasized that conflicts or disagreements between different political actors might in themselves introduce myopic behavior by the government, resulting in larger budget deficits, (e.g. Alesina

and Drazen, 1991). The propositions in this literature have been studied empirically and partly confirmed by Roubini and Sachs (1989) and Grilli *et al.* (1991).

Although it would be interesting to examine the relative importance of such institutional variables as compared to those used in this paper, this issue is beyond the scope of the current paper. However, the general conclusion drawn from this study is that institutions matter for the macroeconomic outcomes, and they matter in a way that is broadly consistent with the theory. An interesting topic for future research is then, of course, to explain the driving forces behind the institutional developments that have been found important.

### Appendix A. The model in Section 1.1

If the private sector forms inflation expectations rationally we have that  $\pi^e = E[\pi]$  where  $E$  is the expectations operator. The explicit expression for inflation expectations is found by using the policymaker's first-order condition:

$$E\left[\frac{dL}{d\pi}\right] = E[2(\pi - \hat{\pi}) + 2\lambda(x^* + \pi - \pi^e + \varepsilon - \hat{x})] = 0. \quad (\text{A.1})$$

Thus

$$\pi^e = E[\pi] = \hat{\pi} + \lambda(\hat{x} - x^*). \quad (\text{A.2})$$

Minimizing (2) subject to (1) and (A.2) yields expressions (3) and (4) in the text.

### Appendix B. Definitions and data sources

**BUDGET DEFICIT:** The ratio between overall deficit for the consolidated central government and GDP.

Source: International Financial Statistics 6, 1993, IMF.

CBI: Central Bank Independence, a measure of “legal central bank independence” which is constructed by aggregating numerical codings of four broad aspects of the legal relationship between the central bank and the government. These four categories are:

- (1) variables concerning the appointment, dismissal, and term of office of the chief executive officer of the bank;
- (2) variables concerning the resolution of conflicts between the executive branch and the central bank;
- (3) final objectives of the central bank as stated in its charter;
- (4) legal restrictions on the ability of the public sector to borrow from the central bank.

The final overall index over  $CBI \in [0,1]$ , and it is calculated for each country for the three subperiods 1961–71, 1972–79 and 1980–1989. Summary statistics are: *mean* = 0.37, *standard deviation* = 0.16, *min* = 0.12 (Norway 1961–71), *max* = 0.68 (Switzerland 1980–89).

Source: Cukierman (1992)

IMPORT: Import share of GDP.

Source: International Financial Statistics 6, 1993, IMF.

INFLATION: Percentage change in consumer price index.

Source: International Financial Statistics 6, 1993, IMF.

RIGHT: A dummy variable for a year with a right-wing oriented government. This variable is coded with 1 if a right wing government has been in power for at least three quarters or the first two quarters in a given year.

Source: Alesina & Roubini (1992) and Banks (1991)

UNEMPLOYMENT: The ratio between open unemployment and the labor force.

Source: OECD Economic Outlook 54, December, 1993.

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