Measurement issues in political economy

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Chapter 6

How inflation-averse are central banks?

6.1 Introduction

In the theoretical literature on central bank independence, the degree of inflation aversion plays a central role. However, as already mentioned in chapter 3, in the empirical literature not much attention has been paid to the distinction between the degree of central bank conservativeness and central bank independence proper. In the context of central banks, conservativeness is defined as whether the central bank officially pursues monetary stability among its goals - thus, it reflects the degree of inflation aversion. Central bank independence proper reflects the extent to which the independence of a central bank is formally defined in the legislation of a country. For a thorough discussion of these concepts, see De Haan and Kooi (1997). They show that 'conservativeness as embodied in the central bank law' is not related to the inflation performance of OECD countries. The measurement of central bank independence has been discussed extensively in chapter 3 of this thesis. In this chapter, the focus is on central bank conservativeness, i.e. we examine how inflation-averse central banks are. In particular, we are interested in how conservativeness can be measured.

One of the problems in dealing with the degree of conservativeness of central banks is that it is a variable that cannot be observed. Therefore, a latent variable analysis is applied in order to include conservativeness as a variable in macroeconomic models. In section 6.2, the economic variables that may serve as indicators for conservativeness of central banks are discussed, while in section 6.3 the factor analysis model is presented for the 1980s. Section 6.4 extends the model to include the degree of conservativeness in the 1990s. In section 6.5, the constructed measure of conservativeness is applied empirically. Section 6.6 concludes.

6.2 Possible indicators of conservativeness

The setup of the research is to let macroeconomic theory imply a structure on a model of conservativeness of central banks, in the 15 countries that were a member of the European Union in the late 1990s. This model is consequently tested by the latent variables analysis that is performed, using confirmatory factor analysis. In order to do this, we need variables that may serve as possible indicators of conservativeness, and their relations. One of the most influential papers in the modern theoretical literature on central bank independence and conservativeness is Rogoff (1985). From his work and that of Eijffinger and Hoeberichts (1998), we expect to find that the rate and variability of inflation and the variability of output are related of the degree of conservativeness of a central bank. To a large extent, these variables behave very similarly for all developed countries. In order to obtain a clearer view of their country-specific behaviour, the variables are corrected using their averages vis-à-vis the average of the OECD countries:

$$\pi^* = \pi - \pi_{OECD},$$

where π^* denotes the corrected inflation rate used in this chapter, π is the common inflation rate and π_{OECD} is the average rate of inflation for all OECD countries. The variability of inflation is defined by its standard deviation, denoted as std π^*.

Whereas the inclusion of inflation as a variable expressing policy can be justified, output variability is a variable that clearly reflects economic shocks as well as economic policy. Therefore, we need to take a closer look at how this variable can be defined more precisely, in order to isolate the policy component. First, we specify the standard deviation of real GDP growth as a measure of output variability. To correct for economic shocks, we then subtract the standard deviation of the terms of trade. Terms of trade is defined as the ratio between export and import price indices. The resulting variable, named std Y^*, now mainly reflects the impact of economic policies. Unfortunately, since terms of trade data are largely unavailable for Portugal, we have to exclude this country from our sample. The resulting sample set therefore contains 14 EU countries.

A negative relation is expected between conservativeness and the rate and variability of inflation, whereas a positive relation is expected between conservativeness and output variability. Since we assume that conservativeness adjusts slowly to changes in macro-economic variables, we also include the rate and variability of inflation and the variability of output in the previous time period as possible indicators. Data on inflation, defined as changes in consumer prices, and real GDP have been obtained from the IMF's International Financial Statistics.

A final indicator for conservativeness is obtained from chapter 3. There, we have decomposed the CBI indicators of Cukierman (CUK), Cukierman et al. (CWN) and Grilli, Masciandaro and Tabellini (GMT) into indicators for central bank independence proper and conservativeness. Due to lack of variation in the GMT indicator of conservativeness and its availability for only a limited number of countries, we do not use it here. Since the component of conservativess is the same for CUK and CWN, we end up with one additional indicator for conservativeness, which for the rest of the chapter is referred to as CI. This indicator is available for the periods 1960–1971, 1972–1979, 1980–1989 and 1990–1997. A positive relation is expected between the degree of conservativeness and the CI indicator.

Since measurement of CBI has been described for the 1980s, we start our analysis of conservativeness in the same period. Later, we extend our model to include the 1990s as well, in order to detect changes in conservativeness. To be able to perform a static factor analysis, the values of π^* and Y^* have been averaged. Summarizing, the indicators that are used in our initial latent variables model are: π^*, std π^*, std Y^*, averaged for the period of interest (1980–1989) and the previous period (1970–1979), and CI in 1980–1989.

6.3 Conservativeness in the 1980s

In this section, we sketch the latent variables approach that is used to evaluate to which extent the indicators that were mentioned in the previous section describe the same unobservable phenomenon. Here, the unobservable phenomenon is the conservativeness of central banks. Since the indicators are intended to measure the same concept, they should be correlated. Table 6.1 gives the correlation matrix of the variables used for the time period under consideration.

It is clear from the table that the correlations between the different indicators are not perfect. Therefore, the different indicators are considered to be imperfect measures of the unobservable concept of conservativeness, generated by the

Table 6.1: Correlations between the indicators * 100%

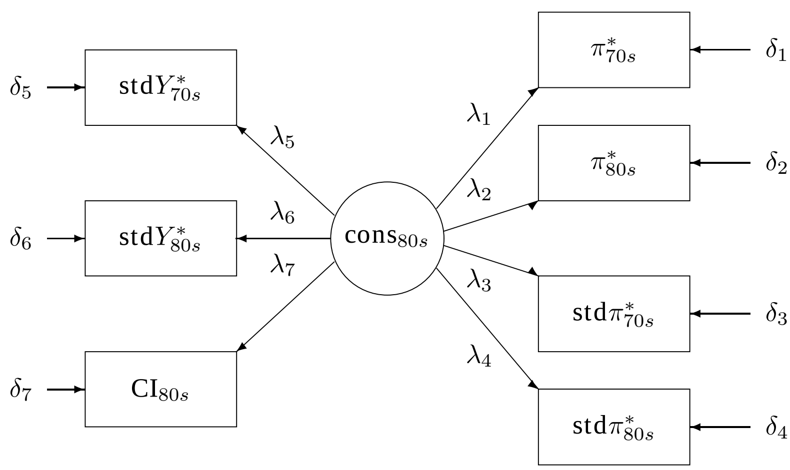
	π^*_{80s}	π^*_{70s}	std π^*_{80s}	std π^*_{70s}	std Y^*_{80s}	std Y^*_{70s}	CI_{80s}
π^*_{80s}	100						
π^*_{70s}	71	100					
std π^*_{80s}	53	48	100				
std π^*_{70s}	64	64	37	100			
std Y^*_{80s}	-9	-3	-6	-11	100		
std Y^*_{70s}	-8	-74	-66	-52	3	100	
CI_{80s}	1	-2	-4	33	25	-6	100

following factor analysis model:

$$x_{ci} = \tau_i + \lambda_i \xi_c + \delta_{ci}, \tag{6.1}$$

where x_{ci} is indicator i for country c and ξ_c is the unobservable concept of conservativeness, denoted as cons80s. Further, τ_i and λ_i are parameters that allow for the differences in mean and scaling between the indicators, and δ_{ci} is a random measurement error. We assume ξ to have mean zero and variance one, and the errors δ_{ci} and δ_{di} to be uncorrelated for $c \neq d$ and independent of ξ_c. A graphical representation of the model is shown in figure 6.1

Figure 6.1: Path diagram of the factor analysis for the 1980s.



As in chapter 3 for the case of central bank independence, we have estimated model (6.1) using maximum likelihood procedures incorporated in the software package AMOS because of the small sample size. The resulting estimates are shown in table 6.2. The values in the second column of the table are the estimates of the coefficients in model (6.1) for the different indicators. Corresponding t-statistics, calculated using the method of White, are given in the second column.

Table 6.2: Estimation results for the factor analysis of the period 1980-1989

	Estimate	t-stat
Intercept (τ_i)		
π^*_{80s}	-0.0198	-1.8279
π^*_{70s}	-0.0127	-1.7169
std π^*_{80s}	-0.0198^{**}	-8.1979
std π^*_{70s}	-0.0281^{**}	-8.7711
std Y^*_{80s}	0.0483^{**}	4.1190
std Y^*_{70s}	0.0315^{**}	4.2146
CI_{80s}	-0.4714^{**}	-5.1403
Loading (λ_i)		
π^*_{80s}	-0.0388	-1.5544
π^*_{70s}	-0.0245^{**}	-3.4208
std π^*_{80s}	-0.0057	-1.5119
std π^*_{70s}	-0.0086	-1.6751
std Y^*_{80s}	0.0030	0.1611
std Y^*_{70s}	0.0228^{**}	2.7103
CI_{80s}	-0.0199	-0.1100
Error variance (ψ_{ii})		
π^*_{80s}	0.0006	1.8145
π^*_{70s}	0.0002^{*}	2.3724
std π^*_{80s}	0.0001^{**}	3.2499
std π^*_{70s}	0.0001^{**}	2.9372
std Y^*_{80s}	0.0019	1.8615
std Y^*_{70s}	0.0003^{**}	2.6792
CI_{80s}	0.1174^{**}	5.2559

The χ^2-statistic, which compares the proposed model to the saturated model, has a value of 4.83 with 14 degrees of freedom, lying way below the 5% critical value of 23.7. The comparative fit index CFI has value 1. According to these measures, the model fits very well. The estimated reliability of the indicators is 0.90.

From table 6.2 it follows that the estimated coefficients all have the expected sign. It is also clear that the results are dominated by the 'lagged' variables: the loadings of π^*_{70s} and std Y^*_{70s} are the only ones that are significant.[1] The Cukierman indicator is not significant.

[1] Other measures of output, such as the variability of real GDP and the output gap have been experimented with. However, they all turn out to be insignificant in a factor analysis.

Our model contains observations on three variables in the current as well as previous time period, which are expected to be correlated *a priori*. As seen in table 6.1, especially the correlations among the rates and variabilities of inflation are high. This casts some doubt on the assumed independence of the corresponding measurement errors. Therefore, we have also performed a factor analysis on an augmented model. In this augmented model, a parameter is added that reflects the correlation between the measurement errors of the variables that have been included for two different time periods. In figure 6.1, this comes down to adding two-sided arrows between the error terms δ_1 and δ_2, δ_3 and δ_4 and between δ_5 and δ_6. Consequently, the results of the factor analysis include an estimate for these correlations. Since these estimated correlations all turn out to be small and insignificant, however, we stick to our original model specification.

Using the results of the factor analysis, the concept of conservativeness can be quantified. Using the estimated parameters, we can calculate the predicted factor scores, which are shown in table 6.3 in descending order of inflation aversion.

Table 6.3: Predicted factor scores

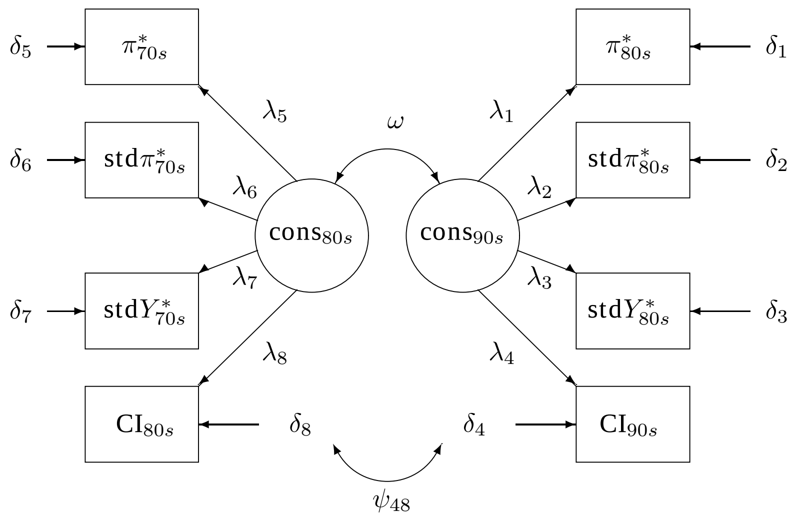
Country	Score
Austria	1.1328
Germany	1.0585
Belgium	0.9370
Netherlands	0.9098
Sweden	0.4951
France	0.4875
Denmark	0.4840
Finland	0.2974
Norway	0.2064
UK	−0.7247
Ireland	−1.1252
Italy	−1.2353
Spain	−1.2968
Greece	−1.6265

The table shows that for the period 1980–1989, Austria can be classified as the most inflation-averse country in the EU, closely followed by Germany, Belgium and the Netherlands. The southern European countries are the ones that are most inflation-prone. Since we are also interested in inflation-aversion in the EU for the period 1990–1999, we would like to extend the model (6.1). This is done in the next section.

6.4 Conservativeness in the 1990s

In order to get a measure for the level of conservativeness in the 1990s, we add a second latent variable to our model, which is denoted as cons90s. Since table 6.2 shows the 'lagged' variables to have the largest weight in constructing the measure of conservativeness in the 1980s, we use the variables averaged for the 1970s as indicators for cons80s, together with the CI indicator for the 1980s. The variables averaged for the 1980s, as well as the CI indicator for the 1990s, are taken as indicators for cons90s.[2] The correlation between CI_{80s} and CI_{90s}, which is not shown in table 6.1, is 0.95. Therefore, we include the assumption that these indicators are correlated in the factor model. The correlations between CI_{90s} and the rest of the model variables are below 0.30 and insignificant. We also assume that the latent variables cons80s and cons90s are correlated. The resulting two-factor model is shown graphically in figure 6.2. The assumed correlations are depicted using arrows with arrowheads on both sides.

Figure 6.2: Path diagram of the factor analysis for the 1980s and 1990s.



We have again estimated the model using maximum likelihood procedures incorporated in AMOS. The estimated results are shown in table 6.4. The χ^2-

[2] We have also experimented with specifications that include the economic variables averaged for the 1990s. However, due to the small number of observations, these models turn out to be too complex to be estimated correctly.

statistic has a value of 13.5 with 18 degrees of freedom, lying well below the 5% critical value of 28.9. The comparative fit index CFI has value 1. According to these measures, the model fits very well.

Table 6.4: Estimation results of the two-factor model

	Estimate	t-stat
Intercept (τ_i)		
π^*_{80s}	-0.020	-1.76
π^*_{70s}	-0.013	-1.66
std π^*_{80s}	-0.020^{**}	-7.90
std π^*_{70s}	-0.028^{**}	-8.46
std Y^*_{80s}	0.048^{**}	3.97
std Y^*_{70s}	0.032^{**}	4.06
CI_{90s}	-0.500^{**}	-5.62
CI_{80s}	-0.471^{**}	-4.91
Loading (λ_i)		
π^*_{80s}	-0.035^{**}	-3.31
π^*_{70s}	-0.025^{**}	-3.92
std π^*_{80s}	-0.006^{*}	-2.41
std π^*_{70s}	-0.009^{**}	-2.89
std Y^*_{80s}	0.003	0.26
std Y^*_{70s}	0.023^{**}	3.35
CI_{90s}	-0.031	-0.36
CI_{80s}	-0.047	-0.52
Error variance (ψ_{ii})		
π^*_{80s}	0.0006	1.13
π^*_{70s}	0.0002	1.35
std π^*_{80s}	0.0001^{*}	2.21
std π^*_{70s}	0.0001	2.09
std Y^*_{80s}	0.002^{*}	2.55
std Y^*_{70s}	0.0003	1.90
CI_{90s}	0.102^{*}	2.54
CI_{80s}	0.118^{*}	2.53
Error covariance (CI_{90s}, CI_{80s})	0.105^{*}	2.48
Covariance between factors	0.924^{**}	6.35

Again, we have also performed a factor analysis on an augmented model, in which a parameter is added that reflects the correlation between the measurement errors of the variables that have been included for two different time periods. Since the estimated correlations all turn out to be small and insignificant, we stick to the model specification in figure 6.2. Using the estimates in table 6.4, we can calculate the predicted factor scores for both the 1980s and the 1990s. These are shown in table 6.5.

Table 6.5: Predicted factor scores and corresponding country rankings

Country	1980–1989		1990–1999	
	Score	Rank	Score	Rank
Austria	1.0252	1	0.8909	4
Germany	0.9403	2	0.9433	2
Belgium	0.8436	3	0.5496	6
Netherlands	0.7999	4	0.9543	1
Denmark	0.7585	5	0.9042	3
France	0.7381	6	0.4922	7
Sweden	0.6201	7	0.7201	5
Finland	0.2933	8	0.4902	8
Norway	0.1728	9	0.0283	9
UK	−0.7851	10	−0.4103	10
Ireland	−1.1538	11	−1.4177	13
Italy	−1.1778	12	−1.2476	12
Spain	−1.4154	13	−1.0295	11
Greece	−1.6598	14	−1.8681	14

First of all, the scores for the 1980s do not differ much from the scores in table 6.3, as should be the case. The values are slightly different, due to the fact that the model includes additional parameters and restrictions, and the factor is constructed such that it has expectation zero and variance one. The main difference is that the rank order of Sweden, France and Denmark, the scores of which are very close in both analyses, is reversed in table 6.5. Due to the restrictions on the mean and variance of the factors, a comparison of absolute values between both decades is not very informative. When we look at their relative positions, however, we see that Austria is no longer the country in the EU with the highest degree of inflation aversion. The Netherlands, Germany and Denmark have overtaken Austria in the 1990s. The southern European countries still rank among the most inflation-prone, although Ireland has moved to thirteenth place in the 1990s.

6.5 Conservativeness in an empirical model

Now that we have quantified the concept of conservativeness, we would like to use the resulting construct in an empirical model. In the literature, the impact of conservativeness on inflation is often the topic of research. Examining this relation here would lead to circular reasoning, however, since the rate and variation of inflation are used to construct our measure of conservativeness. Consequently, regressing conservativeness on inflation would almost certainly lead to a significant result. Instead, we examine the impact of conservativeness on unemployment in the period 1980–1989. For this purpose, we use the factor scores of table 6.3. Using the factor scores given in table 6.5 for the 1980s does not qualitatively change the results. We follow the approach used in the empirical model for CBI in section 5 of chapter 3, first using a bivariate model and then adding control variables one-by-one. As control variables, we include CBI and trade openness. As in chapter 3, we also include the log of GDP (value for 1985) in the model containing openness. The estimates, along with their t-values, are shown in table 6.6. The superindex * denotes significance of the coefficient at a 5% level.

Table 6.6: The impact of conservativeness on unemployment

Control	coeff	t-stat	cons-coeff	t-stat	R^2
–	–	–	-1.9750	-1.8456	0.129
CBI	-0.5045	-0.3066	-1.7224	-1.2778	0.056
Trade openness	19.1842^*	2.5665	-3.0218^*	-3.1339	0.301
log GDP (1985)	1.7098	1.8815			

From the table, it follows that the effect of conservativeness on unemployment has a negative sign, and is only significant if trade openness is included in the model. To correct for the underestimation of the coefficient of conservativeness, we have also estimated the models using the CALS estimator. The resulting coefficients of the conservativeness variable are shown in table 6.7.

Table 6.7: CALS estimates of the indicator of conservativeness

Control	cons-coeff	t-stat	CALS coeff	CALS t
–	-1.9750	-1.8456	-2.2532	-1.8367
CBI	-1.7224	-1.2778	-2.1453	-1.2690
Trade openness[a]	-3.0218^*	-3.1339	-3.5551^*	-3.0675

[a] Model specification includes log GDP in 1985.

It is clear from table 6.7 that, using the CALS estimator, there is a reasonable increase in the absolute value of the coefficients. The t-values decrease, as they should, but this effect is small. The significance in the model that includes trade openness is not affected.

6.6 Conclusions

This chapter is an attempt to measure the degree of conservativeness of central banks using a latent variables approach. For a sample of 14 European countries it is shown that, unsurprisingly, the rate of inflation is the most important indicator of conservativeness. The indicator of Cukierman, which has been designed specifically to measure conservativeness, does not seem to be of much use. Also, when results for the 1980s and 1990s are compared, the analysis shows that there have not been major changes in the degree of conservativeness. Finally, the impact of conservativeness on unemployment is examined. Only when trade openness is also included in the model, the relation is significant.