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BANK OF FINLAND DISCUSSION PAPERS

9/99

Juha Kilponen

Research Department
7.12.1999

Central Bank Independence and Wage Bargaining Structure – Empirical Evidence

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The views expressed are those of the author and do not necessarily correspond to the views of the Bank of Finland.

* I am indebted to David G. Mayes, Mark Salmon, Juha Tarkka, Jouko Vilmunen and Matti Virén for many useful suggestions in the earlier version of the paper.

Central Bank Independence and Wage Bargaining Structure – Empirical Evidence

Bank of Finland Discussion Papers 9/99

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Abstract

This paper studies the relationship between central bank independence, wage bargaining structure and macroeconomic performance in OECD countries. A cross-sectional time-series (TSCS) model for inflation, nominal wage growth and unemployment for the period 1973–1996 is estimated using different and updated measures of central bank independence. The importance of the price stability objective in the central bank statute is used as a proxy for the degree of conservativeness of the central bank. A recently published data set on wage bargaining structure is used, and a distinction is made between coordination of wage bargaining and formal centralization. A new measure of union power is constructed, which combines formal centralization and union density. The implications of the large differences that can be seen between coverage and unionization rates in some countries are briefly discussed. Two important results emerge. First, the central bank's political independence and personnel independence contribute most importantly to a successful inflation policy. Second, a high level of coordination contributes to moderate inflation rates and unemployment, while union monopoly power tends to increase inflation.

Keywords: central bank independence, wage bargaining, monetary policy

Empiirisiä tuloksia keskuspankin riippumattomuudesta ja palkkaneuvottelujärjestelmän rakenteesta

Suomen Pankin keskustelualoitteita 9/99

Juha Kilponen
Tutkimusosasto

Tiivistelmä

Tutkimuksessa analysoidaan keskuspankin itsenäisyyden, työmarkkinarakenteen ja makrotaloudellisen kehityksen välistä riippuvuutta. Tutkimuksessa estimoidaan poikkileikkausmalli inflaatiolle, nimellispalkkojen kasvuvauhdille ja työttömyydelle OECD-maissa ajanjaksona 1973–1996. Aikaisemmista tutkimuksista poiketen keskuspankki-instituutiota tarkastellaan sen poliittisen, päätäntävaltaa käyttävän johdon riippumattomuuden ja keskuspankin taloudellisen riippumattomuuden näkökulmasta. Keskuspankin ”konservatiivisuutta” arvioidaan hintavakauden tärkeydellä keskuspankin mandaatissa. Työmarkkinoiden rakenteen arvioinnissa käytetään uutta aineistoa, jossa erotetaan palkkaneuvottelujen keskittyneisyys ja toisaalta neuvottelujen koordinointi. Lisäksi arvioidaan yleissitovuuden sekä liittojen monopolivoiman vaikutusta palkkaratkaisuihin. Tutkimuksessa käytetty uusi liittojen monopolivoiman mittari yhdistää liittojen keskittyneisyyden asteen ja jäsenmäärän. Empiiriset tulokset osoittavat, että keskuspankin poliittinen riippumattomuus ja sen johdon riippumattomuus ovat merkitseviä onnistuneessa inflaatiopolitiikassa. Samalla onnistunut inflaatiopolitiikka riippuu kuitenkin olennaisesti myös työmarkkinoiden rakenteesta. Palkkaneuvottelujen koordinointi johtaa suhteellisesti alhaisempaan inflaatioon ja työttömyyteen, kun taas huomattava liittojen monopolivoima pyrkii kohottamaan inflaatiota.

Asiasanat: keskuspankin riippumattomuus, työmarkkinat, rahapolitiikka

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Central Bank Independence and Wage Bargaining Structure -Empirical Evidence

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Keywords: Central Bank Independence, Wage Bargaining,
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1 Introduction

Many studies have empirically tested whether higher central bank independence is related to macroeconomic performance in OECD countries with fairly robust observation that inflation is negatively correlated with the measures of legal independence of the central bank. However, the evidence that having independent and conservative central banker is like having a free lunch, that is, an increased central bank independence has actually translated into a better credibility, is inconclusive. Different measures of central bank independence seem not to be correlated with output or employment volatility as predicted by the standard credibility model. Parkin (1987), Grilli et. al. (1991), Alesina and Summers (1993) show that higher central bank independence yields lowered inflation without costs in output. Posen (1994), Debelle and Fischer (1994), in turn, show that higher central bank independence has not translated into lowered costs of disinflation. This has been seen as a evidence against the credibility arguments. Although the inflation targeting approach has gained rapid success in practice, empirical studies of its implications are scarce. McCallum (1996) notes that for some countries the adoption of inflation targeting might have resulted higher unemployment rates.

The debate on monetary policy has somewhat ignored the role of the private sector in successful monetary policy and inflation control, although there exists another line of inquiry where the private sector's behaviour, the management of wage setting in particular, has been seen as a major element in successful economic policy. This literature builds on Bruno and Sachs (1985), Cameron (1984), Calmfors (1982,1985, 1988), Crouch (1985), Freeman(1988), Lindbeck and Snower (1989), Pohjola (1987) and Soskice (1990).¹

Instead of the government "tying its hands" in economic policies, as suggested in the standard credibility literature, this literature suggests that flexible full employment policies (demand management) are crucial in facilitating a co-operation between labour and capital.

Bruno and Sachs (1985) suggests that the relationship between centralisation of wage bargaining, unemployment performance and wage restraint is positive and linear, implying that a more centralised wage setting system would yield a superior macroeconomic performance. In contrast, Calmfors and Driffill (1988) and Freeman (1988) demonstrate that extremes perform the best. In other words, either a highly centralised system with national bargaining or a highly decentralised system with a wage setting at the level of individual firms perform better than with and an industry level bargaining structure. More recent empirical evidence, however, has produced rather mixed results (Traxler (1994), Scarpetta (1996), OECD (1997) and if anything, empirical evidence is inconclusive.

The basic argument in this paper is that a successful inflation policy might be conditional on both monetary and labour market institutions. Indeed, some attempts have already been made to combine the debate on the centralisation

¹Another recently revived branch of the labour literature concentrates on an interaction between specific aspects of labour legislation, such as minimum wages, firing and hiring costs, labour mobility costs and unemployment benefits, and employment (the so-called rigidity vs. flexibility debate). See for instance Bertola and Ichino (1995).

of wage bargaining and central bank independence. (See for instance Akhand (1992), Bleaney (1996), Cubitt (1993), Skott (1995), Cukierman and Lippi (1998), Velasco and Guzzo (1998), Iversen (1998)). Empirical studies, which combine these different aspects are however scarce. Bleaney (1996) argues theoretically that inflation performance should not depend upon the characteristics of wage bargaining, but only on the monetary regime and central bank independence, while unemployment should depend both on the central bank independence and the wage bargaining structure. However, Akhand (1992), Cubitt (1993) and Skott (1995) show that inflation performance should also be conditional on the wage bargaining structure. Skott (1995) also shows that if also the unions are inflation averse, countries may perform well despite a central bank's concern on output. Bleaney (1996) and Iversen (1998) have tested empirically some of the implications of this literature. While Bleaney (1996) confirms his theoretical findings, Iversen (1998) shows that unemployment performance depends upon degree of discretion of monetary policy as well as the degree of centralisation of wage bargaining. Cukierman and Lippi (1998) suggest that when the central bank independence is moderate, there is a clear hump-shaped relationship between unemployment and centralisation of wage bargaining. Their evidence also shows that the inflation-reducing impact of central bank independence is largest when centralization of wage bargaining is at intermediate level.

This paper makes another attempt to assess empirically importance of these issues on the macroeconomic performance of OECD countries. We estimate a cross-sectional time-series (TSCS) model for inflation, nominal wage growth and unemployment for the period of 1973-1996. Sections 2-4 discuss conceptual issues of central bank independence and labour market structure. In particular, the problems that are associated with the measures used in the current literature will be highlighted. Instead of assessing the central bank independence by an overall measure of independence only, as done in the other studies of the kind, we will consider political independence, personnel independence, financial independence and importance of the price stability objective in the statute of the central bank. We also account for inflation targeting. Section 5 discusses the recent dataset on wage bargaining structure, as presented in OECD (1997). In particular, we separate between the co-ordination of wage bargaining and formal centralisation and explain how centralisation/coordination may affect on credence of monetary policy. Moreover, we construct a new measure of union power, which combines formal centralisation and union density and consider the implications of the large differences that can be seen between the coverage and unionisation rates in some countries. Section 6 discusses in some detail the recent reforms in central bank independence and in wage bargaining structure. Section 6 presents a setup of the estimated model. Section 7 interprets the results and section 8 concludes.

2 Central bank independence

2.1 Definition and a measurement of legal independence

According to Friedman (1962), central bank autonomy refers to the relation between the central bank and the government that is comparable with that between the judiciary and the government. The judiciary can rule only on the basis of laws provided by the legislature and it can be forced to rule differently only through a change in the law. Therefore, central bank autonomy can and should be guaranteed by law.

According to Hasse (1990) central bank independence relates to three areas in which the influence of government must be either excluded or cushioned. Those prominent areas are *independence in personnel matters*, *financial independence*, and *independence with respect to policy*. Personnel independence refers to the influence the government has in the appointment procedures of the governing board of the central bank. Financial independence refers to the limitations on lending from the bank to the public. Policy independence refers to the manoeuvring room given to the central bank in the formulation and execution of monetary policy. The policy independence can be further classified according to goal and instrument independence, as suggested by DeBelle and Fischer (1994) (Eijffinger and De Haan (1996)).

Most of the existing attempts at the systematic characterisation of central bank independence and empirical studies rely on legal aspects of independence, such as Alesina (1993), Grilli, Masciandaro and Tabellini (1991), Cukierman (1992) and Eijffinger-Schaling (1995). The concept of independence used also in our empirical analysis proxies the legal independence that is considered to be an essential component of actual independence. The legal independence inherently suggests what is the degree of independence that legislators meant to confer on central bank. (Cukierman (1992))

The measurement of legal independence of the central bank creates both conceptual and empirical problem, however. Most commonly used summary indices of legal independence of the central banks, such as Cukierman's LVAU index, might not provide an objective measure of actual central bank independence. For instance, when studying a link between the central bank independence and the budget deficits, the most important factor is financial independence. When judging the relationship between inflation and central bank independence, the political independence may play the most important role. Often a lack of, say, goal independence and personnel independence has been supplemented by the instrument independence, as in the case of New Zealand and other inflation targeting countries (Eijffinger and de Haan (1996)). Sometimes, a lack of, say, financial independence may mitigate the political independence as in the case of the Bank of Italy. Therefore, in empirical analysis, one should control for the different forms of legal independence and not to use only the highly aggregated summary measures of legal independence.

Moreover, existing indices of legal independence are often incomplete and noisy indicators of actual independence and subject to subjectivity bias, as noted by Mangano (1998). This subjectivity bias is judged by comparing the values attributed on common legal characteristics of central banks by Grilli et.

al. and Cukierman. In general, Mangano finds that Cukierman and Grilli et. al. disagree nearly 60% of countries when deciding whether the central bank is legally allowed to purchase government debts in the primary markets or not. Virtually a third of the values attributed to their common criteria seem to be subject to conflicting interpretations. In addition, as noted by Eijffinger and de Haan (1996), Cukierman attributes an incorrect value to five out of the 16 characteristics by which he measures the legal independence of the Dutch central bank. However, Cukierman's index contains the largest set of countries and is perhaps the most comprehensive attempt to assess legal independence. For instance, Grilli et. al. index excludes all the Scandinavian countries, that are of substantial interest in our study and separates a form of independence only into two categories; financial and economic independence.

Consequently, although the indices of legal aspects of central bank independence and their coding used in our empirical analysis are based closely on Cukierman's (1992) indices, our measure of financial independence differs from Cukierman (1992). We have reassessed the independence of the Dutch Central bank and corrected the values following Eijffinger and de Haan. We also account for the adoption of inflation targeting, by constructing a dummy for those countries that adopted inflation targeting, as well as for the recent changes in central bank laws. Corresponding changes and their effect on the legal independence are explained in appendix in table A2. Table 1. summarises effects of those changes on an overall legal independence of the central banks and highlights the countries that have adopted explicit inflation targets towards the end of 1996 (**bold face**). This allows us to extend the time period until 1996 and study the effects of these important changes on macroeconomic performance. The legal independence considers 3 different periods, 1972-1979, 1980-1989, and 1990-1996, so that the legal variables of the central bank independence are coded separately for each subperiod.

Table 1 shows some summary indices of the central bank independence that have been used in the recent literature. Comparison between different indices is a fairly difficult task due to the different methods of assessing independence of the central banks. While Alesina, Grilli et.al. and Eijffinger and Schaling use a rather crude measure, Cukierman's and modified index of Cukierman developed in this paper (KICBI), facilitate ranking of the countries in more detail. In order to facilitate graphical comparison, we have standardised different indices in Figure 1 and ranked them according to KICBI index. Moreover, we have calculated Spearman's rank correlation between Cukierman's and our own index as well as between Alesina, Eijffinger and Schaling and Grilli et.al.

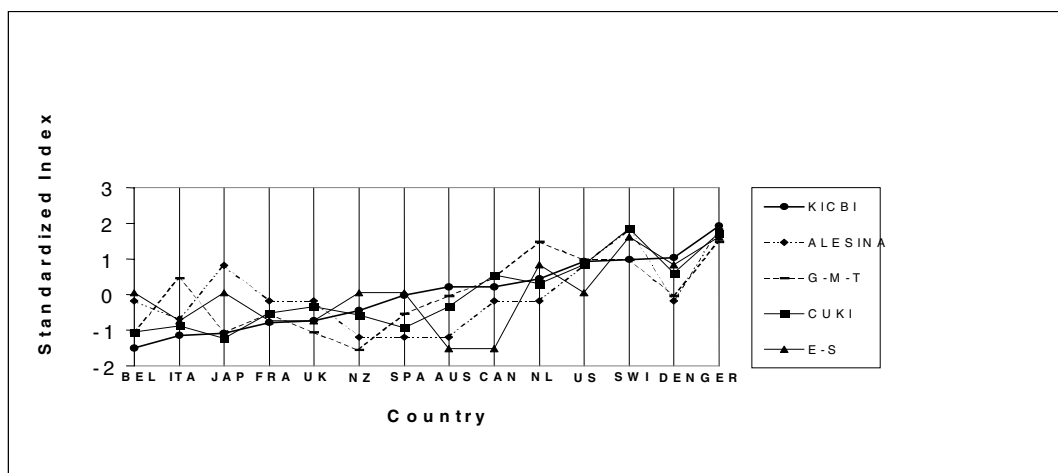
Figure 2 shows fairly substantial differences between the ranking of countries according to different indices. However, rank correlations in table 2. show that indices are highly correlated. Differences are due to the differences in measurement methods as well due to the high subjectivity in the assessment of central bank laws. For instance, Grilli et.al. assess the (political) independence of the Reserve Bank of New Zealand as the least independent, while Cukierman and Kilponen rank the RBNZ as having a medium independence. Different indices seem to agree relatively well between the central banks, that have been ranked the most independent, such as US, Switzerland and Germany.

Table 1. Inflation Targeting and Indices of Central Bank Independence

Country	Alesina	G-M-T	E-S	Cuki	Kicbi
Australia	1	9,3	1	0.31	0.36
Austria	-	9,3	3	0.58	0.59
<i>Belgium</i>	2	7,1	3	0.19	0.07 0.34
Canada	2	11,4	1	0.46	0.36
Denmark	2	8,3	4	0.47	0.50
Finland	2	-	3	0.27	0.28
<i>France</i>	2	7,2	2	0.28	0.19 0.66
Germany	4	13,6	5	0.66	0.65
<i>Greece</i>	-	4,2	-	0.51	0.54 0.62
Ireland	-	7,3	-	0.39	0.60
<i>Italy</i> ^(a)	1.5	5,4	2	0.22	0.13 0.33
Japan	3	6,1	3	0.16	0.14
Netherlands ^(b)	2	10,6	4	0.42	0.40(0.30)
New Zealand	1	3,0	3	0.27	0.25 0.30
Norway	2		2	0.14	0.15
Portugal		3,1	2		
Spain	1	5,2	3	0.21	0.32 0.64
Sweden	2		2	0.27	0.26 0.44
Switzerland	4	12,5	5	0.68	0.49
United Kingdom	2	6,1	2	.31	.20
United States	3	12,5	3	.51	.48

Notes: *Alesina* refers to Alesina (1993). *G-M-T* refers to Grilli, Masciandro, Tabellini (1991). The first figure is their index of economic independence and the second political independence. *E-S* refers to Eijffinger-Schaling (1995), *CUKI* refers to Cukierman (1992) and to an unweighted index of legal independence of the central banks (LVAU). Bold figures indicate an explicit inflation targeting regime as existed as of the end of 1996. The first 4 indices refer to the period of 1980-89. Construction of the *CUKI* and *KICBI* indices has been explained in appendix table A and C. The first figure in the last column refers to 1980s and the last to 1996. a) The first figure in *KICBI* refers to the situation before the divorce between the Treasury and the Bank of Italy in 1981. Otherwise the first figure refers to 1985. If there is one figure only, there has not been a change in the statute of the central bank.

Figure 1. Comparison between Different Indices of Legal Independence of the Central Bank



Notes: *Indices refer to the period of 1980-1989. Austria, Finland, Norway, Sweden, Greece and Portugal were excluded from comparison because of lack of available data. Countries were ranked according to KICBI index from the least independent to the most independent. G-M-T refers to political independence of their index.*

Table 2. Spearman Rank Correlations

Index	KICBI	E-S	ALESINA
CUKI	0.90	-	-
G-M-T	-	0.88	0.89
E-S	-	-	0.96

Notes: *Spearman's rank correlation is calculated between those indices which were closely comparable. KICBI and CUKI ranked the countries with a larger scale, while ALESINA, G-M-T and E-S used the scale that was significantly smaller.*

From table 1 it can be seen also that the legal independence of the central banks in those countries that adopted changes has increased. Table 1 also highlights that inflation targeting countries have traditionally had limited independence. On the contrary, countries that continued with monetary targeting, such as Germany, United States and Switzerland have had the most independent central banks historically. Belgium, France, Greece, Italy, New Zealand, Spain and Sweden have assigned more independence to their central banks recently. When we add the countries which adopted inflation targeting, 10 out of 20 countries have changed their monetary regime since the 1980s.

3 Different forms of independence

3.1 Measurement

Cukierman's indices are based on a limited number of relatively precise legal characteristics and a code of independence is assigned to each central bank for each characteristic. Different legal variables, altogether 16, are coded using a uniform scale ranging between 0 to 1, from smallest level of independence to highest level of independence respectively. The number of independence levels varies across legal variables depending on the fines of data on alternative legal characteristics. These legal characteristics are then divided into four groups with abbreviations PERI, POLI, OBJE, FINI respectively.²

- Variables concerning the appointment, dismissal and term of office of the chief executive officer of the bank (personnel independence (PERI))
- Variables concerning the resolution of conflicts between the executive branch and the central bank and the degree of participation of the central bank in the formulation of monetary policy and budgetary process. (political independence (POLI))
- Final objectives of the central bank as stated in its charter (importance of price objective in the status of the central bank (OBJE))
- Legal restrictions on the ability of the public sector to borrow from the central bank (financial independence (FINI))

Central banks in which the legal term of office is longer and in which the executive branch has little legal authority in the appointment or dismissal of the governor are classified as more independent. This classification refers to personnel independence of the central bank. Central banks with wider authority to formulate monetary policy and to resist the executive branch in cases of conflict are classified as more independent. This refers to policy independence. Similarly, central banks in which the only or main objective of policy is price stability are classified as being more independent, than central banks with a large number of objectives or banks in whose charter price stability is not

²The coding of these legal characteristics and their aggregation is explained in appendix in tables A1 and A3.

mentioned as an objective at all. Therefore, *the price stability objective could be seen as a measure of "conservative bias" of the central bank in Rogoff's terminology*. Central banks in which the limitation on lending from the bank to the public is limited are considered as having more financial independence. In Cukierman's original index these limitations encompass a number of more detailed variables, but we have chosen to use only one such variable to proxy financial independence. According to this variable, central banks which are not allowed to give advances for the government or when advances are subject to restrictions are considered to have more financial independence.

All in all, restricting the influence of the government in appointment procedures, increasing financial independence, and decreasing policy dependence has a same goal; to improve the credibility of the policy by restricting the discretionary power of the government and to restrict discretionary short-term influence of the government on the conduct of monetary policy. According to Cottarelli and Giannini (1997) the key to success in fighting inflation is to put in place some arrangement so that the private sector believes that the instrument flexibility left to the monetary authorities will not be used to exploit the short-run trade-off between inflation and output. OECD countries have adopted different means to achieve this goal as will be discussed briefly below.

3.2 Examples of different practices

3.2.1 Instrument independence

The Reserve Bank of New Zealand (RBNZ) has an explicit inflation target that is precisely described in a contract with the government. The governor of the central bank can be dismissed for poor performance in delivering the policy target. According to the Reserve Bank Act the appointment of the central bank governor is made by the finance minister and the deputy governor of the central bank is appointed by the board on the recommendation of the governor. Therefore, according to the classification given in the literature, the RBNZ does not have any goal independence, very low personnel independence, but *full instrument independence*, which is supposed to provide full credibility of the price stability objective. Limited legal independence is therefore, substituted by instrument independence. According to Alesina (1988), Grilli, Masciandro, Tabellini (1991) and Cukierman (1992) classification, the RBNZ has very limited legal independence. According to Eijffinger and Schaling (1992) classification, the RBNZ has more than limited independence.

Australia, Canada, Finland, Spain, the U.K., and Sweden have recently introduced inflation targets, such that these countries could be treated as explicit inflation targeting countries with almost full instrument independence. The emphasis in an explicit inflation targeting regime is on accountability and transparency, in the aim of achieving credibility through public monitoring. An explicit inflation targeting regime, therefore, does not constitute solely an announcement, but the announcement of an targeted inflation path extending to few years ahead, coupled with setting up of public monitoring procedures.

Current characterisations of central bank independence, as discussed above, fail to capture this form of instrument independence. Therefore, we proxy the

full instrument independence by constructing a dummy for the countries that adopted inflation targeting. This dummy variable takes value 1 in a case where the country has adopted inflation targeting and is set to zero otherwise.

3.2.2 Policy independence

In Germany, the government can suspend decisions of the Bundesbank for a maximum of two weeks and the Bundesbank can be overruled through a change in the legislature by a simple majority in parliament. The Bundesbank has an obligation to offer general support to the government's economic policy in instances in which this support does not prejudice the primary objectives of price stability. Contrary to the RBNZ the Bundesbank has no obligation to agree, obey, or announce any targets for inflation. The Bundesbank is, therefore, independent of any instruction from the government; according to the Bundesbank law 1957, government representatives have the right to attend meetings of the Central Bank Council, but not to vote. Therefore, the Bundesbank is provided with almost full policy independence, although the central bank policy has to ultimately enjoy confidence of the parliament. According to all indices used in the literature, the Bundesbank has been considered the most independent central bank within industrialised countries.

3.2.3 Financial dependence

Until the beginning of 1980s, the financial independence of the Bank of Italy was drastically limited by a law which explicitly stated that the Bank of Italy had to hold government issued bonds. Financial independence of the Bank of Italy was lacking, since the government had basically direct access to central bank credits implying that the monetary policy was subordinated to fiscal policy. In 1981, the so called divorce between Bank of Italy and the Treasury occurred with new Act. Direct access to central bank credit was limited in order to discipline the fiscal authorities building a large budget deficit. Alesina (1993), Eijffinger and Schaling (1993) and Cukierman (1992) consider the Bank of Italy as having a very limited legal independence, while Grilli et. al. consider the Bank of Italy as having a medium independence.

3.3 Comparison between different forms of central bank independence

Given that OECD countries have adopted different practices in securing the legal independence of their central banks, it is interesting to compare these different forms of independence according to our measures. We have therefore ranked the countries according to each political independence, personnel independence, financial independence and importance of price objective in the status of the central banks and produced a Spearman rank correlation between different forms of independence during 1980-1989 and 1990-1996. Apparently, also these indices capture substantial differences in the ranking of the countries according to different forms of independence. This is evident from figure 2 and table 3 below. Figure 2 reveals that some forms of legal independence

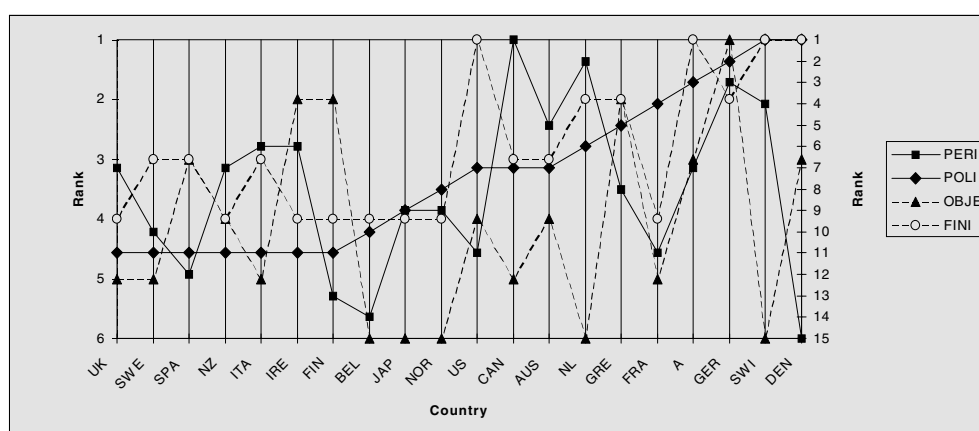
are relatively loosely linked to each others. This loose link is also quantified in table 3 by rank correlations. In general, while the financial independence and the importance of price objective in the status of the central bank seem to be closely related, policy independence and financial independence are very loosely linked. It is also interesting to note that for instance the Danish central bank seems to have very high political and financial independence, while no personnel independence. A similar kind of substantial differences appear also in the case of Canada, the Netherlands and Finland. On the contrary, the Bundesbank is ranked as having a very high independence according to all variables. Consequently, in many countries, there exist a degree of uncertainty with regardl to legal independence of the central banks and it seems that the governments have nevertheless attempted to maintain some channel for discretion on their central banks.

Table 3. Spearman Rank Correlation between Different Forms of Legal Independence

	PERI	POLI	OBJE	FINI
PERI	1			
POLI	0.66 (0.65)	1		
OBJE	0.50 (0.48)	0.64 (0.72)	1	
FINI	0.38 (0.32)	0.05 (0.28)	0.93 (0.89)	1

Notes: Values in brackets refer to year 1996 and values without brackets to the period of 1980-1989.

Figure 2. Comparison between Different Forms of Independence during 1980-1989



Notes: Countries have been ranked according to policy independence (POLI) variable from the least independent to the most independent. Right hand side scale refers to the scale of PERI and POLI and left hand side to the scale of OBJE and FINI. The time period is 1980-1989

4 Wage bargaining

4.1 Some facts

At the beginning of the 1980s, a vast political economy literature concentrated on the macroeconomic consequences of various wage-bargaining systems. It was thought that wage bargaining structure could explain part of the dispersion of macroeconomic performance in advanced industrialised countries. In particular, some wage bargaining systems were seen to have higher wage restraint. Many economists and policymakers were puzzled by the continuously decreasing employment rates in Europe in contrast with the relatively steady and high employment rates in the U.S.

One of the starting points of this literature was in Bruno & Sachs (1985) who argued that

"A real wage moderation is a key to achieving low inflation and low unemployment after a supply shocks. ...In countries with near-universal union coverage and highly centralised negotiations (for example Austria and Sweden) it seems that wages were kept closer to market clearing levels than in more decentralised systems (such as the United Kingdom)"

That is, the relationship between centralisation, unemployment performance and wage restraint seemed to be linear, implying that a more centralised wage setting system would yield a superior macroeconomic performance.

In contrast, Calmfors and Driffill (1988) and Freeman (1988) demonstrated that extremes perform the best. In other words, either a highly centralised system with a national bargaining or a highly decentralised systems with a wage setting at the level of individual firms perform better than those with an industry level bargaining structure. Calmfors (1988) explained this by the idea of Olson (1965) who stated that an organised interest may be most harmful when they are strong enough to cause major disruptions but not sufficiently encompassing to bear any significant fraction of the costs for society of their actions in their own interest.

The first view emphasises the fact that a high degree of centralisation guarantees that wage setters recognise broader interests. According to this view, institutional arrangements exist to overcome various market failures and may therefore benefit economic performance. This view has been criticised by the insider-outsider view, according to which union officials may not bear enough concern on outsiders mitigating the possibility of union officials "recognise a broader interest" (For instance Lawrence and Summers (1988)). The second view emphasises a role of market forces (competition) in securing the optimal combination of real wage and employment. In contrast to first view, non-market institutions are "rigidities" which only harm economic performance.

4.2 Co-ordination and centralisation -alternative interpretations

The Calmfors-Driffill hypothesis supported the view that the degree of centralisation of union power is the central attribute that determines union behaviour and its impact on the national economy. Calmfors and Driffill (1988) con-

structured an index of centralisation by assessing the co-ordination level within national union confederations and within national employer organisations and the existence of parallel central organisations and their co-operation. Centralisation is then, in fact, defined and measured by the extent of co-operation between different unions and employer organisations in wage bargaining.

However, Golden (1993) emphasises the coercive authority of central confederations over its affiliates (unions). The degree of centralisation and the level at which bargaining predominantly takes place depends on the institutional conditions such as the extent to which national confederations (peak organisations) have coercive authority over its affiliates. The coercive authority appear as the extent to which the peak organisations are able to set wage demands, sanction strikes action and generally disperse union resources. The difference between Golden's definition and Calmfors and Driffill's definition is that she defines centralisation as the formal centralisation of authority between unions and their peak organisations, while Calmfors and Driffill considered centralisation from a broader perspective, combining formal centralisation and co-operation.

The basic insight of Golden's (1993) analysis is that the centralisation of the authority may not be enough to secure sustained wage moderation and better economic performance. This is because the binding/coercive authority that central confederations hold over their affiliates is ultimately voluntary and thus this authority is more likely to rest on bargaining and agreement among the parties. According to the OECD (1997) report, the fact that in highly centralised wage bargaining countries wages tend to drift supports this argument. Because the extent of co-ordination and formal authority are separate independent features of wage bargaining and may evolve in a different direction over time, it may not be appropriate to combine these under the same heading, as in the Calmfors and Driffill index.

Given this conceptual difficulty with defining centralisation, Golden (1993) argues that a lack of co-operation that is potentially harmful for the aggregate economy can be solved even without the formal authority of confederations, provided that institutional conditions facilitate the co-ordination of bargaining strategies among unions. This view, primarily due to the Lange (1984) and Wallerstein (1990), emphasises the collective action problem affecting union behaviour. According to this line of argument co-operation among workers and among unions may be difficult to achieve, because of free riding problems. The idea is that even if workers and unions collectively prefer wage restraint, it is in no individual worker's or union's interest to do so. This idea has been formalised for instance in monopolistic competition models.³

The possibility for co-ordination, in turn, is likely to rest on two factors:

- (i) The number of national-level actors involved in the wage setting process.
- (ii) The degree of competition among them

The first indicates the "unconditional likelihood that labour is able to overcome internal co-ordination problems and the second the likelihood that it resolves internal distributional conflicts. When the number of unions that par-

³Also Soskice (1990) emphasises the role of coordination separately from the formal degree of centralisation.

ticipate in the wage bargaining is small, unions can monitor and assess their own and each other's behaviour in the bargaining process, thus reducing the uncertainties that can be harmful in the wage bargaining process. The second refers to the fact, that not all union problems are simply co-ordination problems that can be eased by reducing the number of actors involved; Inter- and intra union relations are characterised by genuine conflicts of interest as well. The problem of competition, in turn, can be eased by demarcating nonoverlapping union territories and thus, reducing the competition from members. When fewer but larger unions set wages for larger groups of workers the visibility and organisational importance for workers of relative wages can be increased. These together should moderate wage demands, reduce inflationary pressure and help to maintain high employment.

4.3 Credence of monetary policy and wage bargaining structure

More centralised and co-ordinated wage bargaining institutions promote credence of monetary policy due to their better ability to co-ordinate and assess the behaviour of the others. This is because in the centralised and co-ordinated wage setting systems possibly harmful uncertainty on the actions of the others is reduced, when compared with the wage bargaining systems where several competing unions are involved. On the other hand, possibility that sufficiently centralised wage bargaining institutions use their monopoly power, leading to higher wage inflation, may mitigate the effect of this higher credence. In the face of decentralised wage setting institutions, in turn, the monetary policy may suffer a lack of credence, but the ultimate question is, whether a lack of credence outweighs the benefit from reasonably well functioning and flexible market mechanism in wage setting. It is therefore important to note that the degree of centralisation and the degree of co-operation of wage bargaining are conceptually different issues in the context of credence as well. The critical point is that while the higher degree of co-ordination should inevitably promote this credence and improve macroeconomic performance, the higher degree of centralisation may work in the opposite direction. This is due to the fact that a higher degree of centralisation inevitably increases the market power of the unions.

Also Golden (1993) refers to this same phenomenon by "visibility", which inherently decreases uncertainties about the actions of the others in the wage bargaining process. However, Golden (1993) does not notice that an increased centralisation may lead higher wages, due to the exploitation of market power. We turn to this after considering the measurement of co-ordination and centralization of wage bargaining.

4.4 Co-ordination and centralisation -measurement

Unfortunately, there does not exist a simple or even comprehensive combination of measures that would account for all these factors. The best available source for the data is OECD (1997), where the Calmfors-Driffill (1988) index has been extended. OECD (1997) evaluates the degree of formal centralisation

in wage bargaining separately from co-ordination. Table 4 below reproduces these figures.

Table 4. Centralisation and Co-ordination of Wage Bargaining

Country ^c	Centralisation ^c				Co-ordination ^c				Δ	
	70	80	90	94	70	80	90	94	CE	CO
Australia	-	2+	2+	1.5	-	2+	2+	1.5	↓	↓
Austria	-	2+	2+	2+	-	3.0	3.0	3.0	↓	↓
Belgium	-	2+	2+	2+	-	2.0	2.0	2.0	→	→
Canada	-	1.0	1.0	1.0	-	1.0	1.0	1.0	→	→
Denmark	-	2+	2.0	2.0	-	2.5	2+	2+	→	→
Finland	-	2.5	2+	2+	-	2+	2+	2+	↓	→
France	-	2.0	2.0	2.0	-	2-	2.0	2.0	→	↑
Germany	-	2.0	2.0	2.0	-	3.0	3.0	3.0	→	→
Greece	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	-	-	-
Italy	-	2-	2.0	2.0	-	1.5	1.5	2.5	↑	↑
Japan	-	1.0	1.0	1.0	-	3.0	3.0	3.0	→	→
Netherl.	-	2.0	2.0	2.0	-	2.0	2.0	2.0	→	→
New Z.	-	2.0	1.5	1.0	-	1.5	1.0	1.0	↓	↓
Norway	-	2	2+	2+	-	2.5	2.5	2.5	↑	→
Portugal	-	2-	2+	2.0	-	2.0	2-	2.0	↑	↑
Spain	-	2+	2.0	2.0	-	2.0	2.0	2.0	↓	↓
Sweden	-	3	2+	2	-	2.5	2+	2	↓	↓
Switzerl	-	2.0	2.0	2.0	-	2+	2+	2+	→	→
the U.K	-	2.0	2-	1.5	-	1.5	1+	1.0	↓	↓
U.S	-	1.0	1.0	1.0	-	1.0	1.0	1.0	→	→

Source: *OECD (1994,1997)*

Notes: *Centralization and co-operation figures are based on OECD secretariat estimates of prominent bargaining level and the degree of co-ordination. Co-ordination includes both union and employer co-ordination. A value of 1 in each characteristic is assigned to the decentralised/uncoordinated system and a value of 3 for the centralised/ co-ordinated wage bargaining system. The last column then gives direction of change in centralisation and co-ordination of wage bargaining during 1980-1994, (→) indicates no change, (↓) decentralization and (↑) centralization/co-ordination.*

From table 4 we can see that the degree of centralization and co-operation are quite closely related. However, interesting exceptions are those where the degree of centralization has been higher than the degree of coordination. This was the case in Belgium, Finland, France, Italy, New Zealand, Spain, Sweden and the U.K. during the 1980s, while the situation remained similar only in the U.K in 1994. These countries may represent the most unfavourable bargaining systems, since in these countries the market power of the unions has been considerable, while the likelihood for inter- and intra union conflicts of interest perhaps the greatest. In all other countries, the degree of co-operation has been at least as large as the degree of centralization. The difference between centralization and co-operation is particularly large in Austria, Germany and Japan. In those countries industry level or decentralised wage bargaining systems seem to be characterized by genuine co-operation. We should expect this to improve the performance of these systems.

4.5 Union coverage and union density

Ultimately wage bargaining is a process of decision making between the parties representing employer and employee interests. The key element in the decision making process between union and employer is the ability of both sides to halt production. The firm's power depends on the right to lock-out or fire, while the union's power depends on the right to organize and strike. Formally, the external power of the unions and confederations is upheld by a statute and therefore it is more than likely that institutional conditions play a dominant role in the wage setting game between the firms and unions (Layard (1991)).

Jackman et. al. (1991) have analyzed the issue in a simple model of bargaining between unions and firms. Under reasonable assumptions, the rise in union power leads to relative wage increases and a fall in aggregate employment. An increase in union coverage increases union employment and total employment rises. However, if the supply in the competitive sector is elastic enough, a rise in union coverage depresses the competitive sector wages and leads to fall in employment. This result is increasingly likely the nearer one is to complete unionization. *In general, over most relevant ranges an increase in coverage reduces total employment.*

Conceptually, external union power is a complex matter and thus difficult to assess. Often, union density, which is the proportion of eligible employees who become union members, has been considered as an initial but fundamental measure of union power. Union coverage, instead, is often in effect larger than the union density because statutory and other requirements extend the collectively-bargained wage to non-union employees. Union coverage is perhaps a more accurate measure of the extent to which unions affect wage levels than union density and for this reason maybe also more accurate measure of union power. In the empirical analysis, however, it turns out that neither the density nor the coverage rates alone can explain inflation, wage growth or unemployment. The reason is that union density nor union coverage as such does not tell anything about the actual monopoly power of the individual unions. The density and coverage can be high even in reasonable decentralised and non-cooperative wage bargaining systems as can be seen by comparing

table 4 and table 5, where a good example is France.

We therefore propose an alternative measure of union power by multiplying the degree of centralization and union density (MOPO). This measure of monopoly power of the unions takes into account the fact that in more centralized wage bargaining systems, a high density promotes monopoly power, while in highly decentralized systems high density does not secure monopoly power of the individual union.

From table 5 we can see that the rates of union coverage and union density differ across countries by wide margins. This is evident from only a modest positive correlation ($r = 0.32$)⁴ between the two rates. Several groups of countries can be identified. First, there is a group - Canada, Japan and United States - with below average coverage and unionization with little difference between them. Another group -Finland, Norway and Sweden, features very high unionization and coverage rates with a relatively modest difference between. The most interesting are perhaps the countries with considerable differences between the two. The gap is especially wide in France, but also significant in countries such as Austria, Germany, the Netherlands, Spain and Italy. The likelihood of the free rider problem is perhaps highest in those countries with large difference between these rates. In order to assess importance of large differences between these two rates, we constructed a new variable by subtracting union density from the union coverage(DICODE). The higher the value, higher the likelihood of free rider problems. In the empirical analysis, this variable partially explains the dispersion in wage growth and unemployment rates in OECD countries.

⁴This correlation refers to year 1994

Table 5. Density and Coverage rates in OECD Countries

Country	Union Density ^a				Bargaining Coverage ^b			
	70	80	90	94	70	80	90	94
Australia	.47	.48	.41	.35	-	.88	.80	.80
Austria	.57	.56	.46	.42	-	.98	.98	.98
Belgium	.52	.56	.51	.54	-	.90	.90	.90
Canada	.32	.36	.36	.38	-	.37	.38	.38
Denmark ^b	.68	.76	.71	.76	-	.69	.69	.69
Finland	.66	.70	.72	.81	-	.95	.95	.95
France	.22	.18	.10	.09	-	.85	.92	.95
Germany	.34	.36	.33	.29	-	.91	.90	.92
Greece	.36	.38	-	-	-	-	-	-
Ireland	.53	.57	-	-	-	-	-	-
Italy	.44	.49	.39	.39	-	.85	.83	.82
Japan	.34	.31	.25	.24	-	.28	.23	.21
Netherl.	.36	.35	.26	.26	-	.76	.71	.81
New Z.	-	.56	.45	.30	-	.67	.67	.31
Norway	.52	.57	.56	.58	-	.75	.75	.74
Portugal	.61	.61	.32	.32	-	.70	.79	.71
Spain ^c	.27	.09	.13	.19	-	.76	.76	.78
Sweden	.73	.80	.83	.91	-	.86	.86	.89
Switzerl.	.32	.31	.27	.27	-	.53	.53	.50
the U.K.	.48	.50	.39	.34	-	.70	.47	.47
U.S.	.26	.22	.16	.16	-	.26	.18	.18

Source: *OECD (1997, Table 3.3, p. 71)*

Notes:.. a) *The latest figures refer to 1994 except in the case of collective bargaining coverage in Canada (1993), Finland (1995) France (1995), Italy (1993), Japan (1995), Norway (1993), Portugal (1993) and in the case of union density in Denmark (1993), Finland (1995), Germany (1993), Italy (1992), the Netherlands (1993), Portugal (1990), Sweden (1993) and Switzerland (1992).*

5 Recent reforms

5.1 Central banks

The two most visible institutional developments during the 1980s and 1990s have been associated with central banking and wage bargaining. As already hinted upon, many OECD countries have significantly altered the legal framework within which their central bank operates, while at the same time many OECD countries have significantly altered the methods of wage bargaining. The revision of the legal framework of central banks has basically implied a more precise definition of the central bank's mission, a considerable widening of the degree of independence of the central banks and a greater emphasis on the means and forms of accountability and transparency. The revision in wage bargaining structures, in turn, has implied either a greater emphasis on market forces and a move to firm level bargaining or a greater emphasis on co-ordinated and centralised wage bargaining, the former being perhaps more common. In many countries labour law has also been changed considerably, with emphasis on increased flexibility.

During the 1990s a number of countries adopted a monetary policy framework centred on explicit inflation targets. Such a framework was first adopted in New Zealand in 1990, under the Policy Targets Agreement. This followed the Reserve Bank of New Zealand Act in 1989, which established a statutory commitment to price stability. Canada followed in February 1991 by introducing inflation-reduction targets, in a joint declaration by the Bank of Canada and the Canadian government. The United Kingdom turned to inflation targeting in October 1992 after the collapse of ERM exchange rate band in September 1992. Similarly, the Riksbank of Sweden announced explicit inflation targets in January 1993 following the dramatic breakdown of the currency target zone in November 1992. Finland followed shortly after in February 1993, again after the breakdown of the currency peg in September 1992. Australia introduced an inflation target in April 1993, Mexico in September 1994 and Spain in summer 1994. Typically, those countries that adopted inflation targeting regimes have been characterised by a lack of legislative independence of the central bank prior to the monetary reforms.⁵

A number of countries have also recently made substantial changes to their Central Bank Laws. From table A2 in appendix, we can see that Belgium, France, Greece, Italy, New Zealand, Spain and Sweden have increased the legal independence of their central banks in various ways. In Greece, Belgium, France, Italy and Spain, the central banks were freed from obligation to finance either the government or government-controlled bodies. In France, Italy, New Zealand and Spain, the central bank objectives were clarified and maintenance of price stability or monetary stability was set as the main goal of these central banks. A number of these recent changes were clearly related to satisfying the requirements of the Maastrich Treaty.⁶

⁵For more detailed description and discussion see for instance McCallum (1996).

⁶During the 1997 also Finland and the U.K modified their central bank laws according to the Maastrich treaty. Indices here do not capture these effects since the new law was only passed through the parliament during 1998.

5.2 Wage bargaining

Many OECD countries have witnessed dramatic changes in the wage bargaining structure during late 1980s and early 1990s. From Table 4 we notice that the revision of the wage bargaining structure has implied either a greater emphasis on market forces and firm level bargaining or a greater emphasis on co-ordinated and centralised wage bargaining. Australia, Finland, New Zealand, Sweden and United Kingdom decentralised wage bargaining during the 1980s and 1990s. In New Zealand and in the United Kingdom extension procedures were rescinded in the early 1980s and New Zealand's Employment Contracts Act 1991 resulted in an extensive deregulation of labour law. As a result of this act, the system of collective bargaining that was conducted at multi-employer level basically collapsed. In the United Kingdom major individual company and plant agreements have taken over the pace-setting role of annual wage rounds. In both countries, coverage and unionization rates have decreased considerably, as well as difference between them. In New Zealand, the number of workers covered by collective bargaining decreased by one half while the share of workers covered by multi-employer contracts fell even more, from 90% to 14% (Harbridge and Honeybone (1996)).

The Swedish bargaining system went through considerable decentralization at the beginning of 1990s. Sweden's highly centralised bargaining structure fell into crisis as it became less able to take into account the needs of the export sector and external competitiveness. This movement in Sweden was echoed in Finland. The central incomes policy agreements for 1992 and 1993 were an important step in promoting wage bargaining at the company level. Aimed at restricting inflation and enhancing Finland's competitiveness, the agreement emphasized the necessity to develop a bargaining system that enabled parties to pay closer attention to the needs of companies and their employees at the workplace. Contrary to the U.K. and New Zealand, there have not been decline in unionization nor coverage rates, both of which have remained very high in Sweden and Finland. However, it is notable that a difference between coverage and unionization rate has been in decline since 1970s in both countries, reaching 2% in Sweden and 15% in Finland in 1994.

In Spain, as the government switched to tighter macroeconomic policies at the end of the 1980s, attempts that were made during the early phase of democracy to develop an economy-wide bargaining temporarily ceased. In 1992 a degree of economy-wide concentration was again temporarily restored, together with the new left-wing government's interest in macroeconomic restructuring. In 1994 the unions, however, became increasingly hostile to government proposals on labour market reform, leading to a general strike on January 1994. Although the unionization rate has been modest in Spain, the coverage rates reached almost 80% level in 1994. The difference between these two rates reached almost 60% level in 1994.

In Australia, the Accord struck in 1983 by the government and the Australian Council of Trade Unions centralised and co-ordinated the wage determination process. However, under the influence of the Accord, Australia's industrial tribunals subsequently initiated the process of decentralization, coupling wage settlements with increased enterprise-level bargaining. The unionization

rate has been in steady decline since the 1970s reaching 32% in 1994, while the coverage rates has stayed at high level. (OECD (1997))

From table 4 we notice that these developments are captured by the indices of centralization and co-operation aswell. Together with Australia, New Zealand, Sweden, and the U.K, also Denmark have both decentralised and moved towards more non-coordinated system. Italy, in turn, has centralised and moved towards more co-ordinated system, while Norway has moved towards more centralised wage bargaining system only. At mid 1990s, purely decentralised wage bargaining systems can be found from U.S., Canada, New Zealand and the U.K. Somewhat paradoxically, the typical industry level bargaining systems are numerous and can be found from Belgium, Denmark, Finland, France, the Netherlands, Portugal, Spain, Sweden and Switzerland. Austria, Germany and Norway represent the most centralised/co-ordinated systems, while Japan is an interesting exception with highly decentralized but co-ordinated system.

Table 6.A and 6.B provide a fairly rough description of these changes. We have grouped countries according to the degree of legal independence and centralization of wage bargaining using the overall measure of legal independence of the central banks and a measure of the degree of centralization/coordination. Polar cases are those of Austria and Germany, representing a combination of centralised/co-ordinated wage bargaining structure and an independent central bank. According to all theories, these countries should have had superior inflation and unemploment performance. Another, say, favorable institutional arrangement is that of USA with independent central bank combined with decentralised wage bargaining. If we believed in Calmfors-Driffill hypothesis and credibility arguments the USA should have low inflation at the given level of unemployment. At the other edge is Japan, which represents a decentralised, but co-ordinated wage bargaining system and a dependent central bank and Norway, which represents the centralised and fairly co-ordinated wage bargaining and a dependent central bank.

Table 6.B assess the same situation after important changes in the labour markets and in the central bank laws in the late 1980s and 1990s. In particular, the U.K. and New Zealand have moved to an extreme of an independent central bank and decentralised wage bargaining. Also Finland, Spain and Sweden have changed the monetary policy framework centred with an explicit inflation target, while at the same time also the decentralisation of wage bargaining has been visible. From the point of view of the history of corporatist institutions and economic policy making, based on economy-wide income policy, Sweden and Finland provide interesting examples of countries of substantial changes in the institutional framework of policy making. Canada, which adopted explicit inflation targeting in 1993 serves as an interesting comparison to Scandinavian countries due to the historically decentralised wage bargaining structure. In contrast, Germany, Austria, USA, Switzerland, Norway, Japan, Denmark and Netherlands have not changed their institutions considerably according to our measures. France, Canada, Italy and Belgium only changed monetary regime significantly. One country that significantly altered only the wage bargaining structure was Australia during 1980s and 1990s.

Table 6.A Wage Bargaining and Central Bank Independence in 1971-1989

	CENTRAL BANK INDEPENDENCE			
		<i>Substantial</i>	<i>Medium</i>	<i>Moderate</i>
WAGE BARG- AINING	<i>Central.</i>	A, GER	-	FIN, SWE NOR
	<i>Medium</i>	-	U.K, AUS, DEN NL, SPA, SWI	BEL, FRA ITA, NZ
	<i>Decent.</i>	USA	CANADA	JAPAN

Table 6.A Wage Bargaining and Central Bank Independence in 1996

	CENTRAL BANK INDEPENDENCE			
		<i>Substantial</i>	<i>Medium</i>	<i>Moderate</i>
WAGE BARG- AINING	<i>Central.</i>	A, GER	-	NOR
	<i>Medium</i>	FIN, FRA SPA, SWE	SWI, ITA, NL DEN,, BEL	-
	<i>Decent.</i>	USA, CAN NEW Z, U.K.	AUS	JAP

Notes: The central bank is considered independent if $KICBI > 5$, Medium, if $0.5 < KICBI < 3$, moderately independent if $KICBI < .3$. If the country has chosen an explicit inflation targeting regime, it is considered as a substitute for the lack of legal independence. Bold face figures correspond to inflation targeting countries, while italics those which have changed the status of the central bank only. The degree of centralisation/co-ordination of wage bargaining has been assessed as in table 4.

6 A cross-section-time-series model

6.1 Setup of the model

In order to assess the statistical significance of these institutional structures and reforms, we estimated a cross-section-time-series model for inflation, nominal wage growth and unemployment rates. In contrast with other studies of this kind, we estimate a fully specified econometric model, extended with institutional variables for each price inflation, unemployment and wage inflation. We also account for endogeneity of the regressors and use specification tests to compare between different models. The endogeneity problem arises from the fact that inflation, wage growth and unemployment are jointly determined.

Primarily, our interest is to test whether, and how, inclusion of wage bargaining variables together with different measures of central bank independence discussed above helps to explain variation in macroeconomic performance in OECD countries during the period of 1973-1996. We are also interested in whether the Calmfors-Driffil hypothesis of hump-shaped relationship between wage growth and the degree of centralisation on the one hand and unemployment and the degree of centralisation on the other hand, gets support from the data. This section presents results from these estimations and discusses the results.

In brief, we estimated the following equation for each price inflation, wage inflation and unemployment⁷.

$$\begin{aligned} y_{it} &= \delta y_{it-1} + x'_{it}\beta + Z'_{i(t)}\lambda + u_{it}, \quad i = 1, \dots, N, t = 1, \dots, T \\ u_{it} &= \mu_i + \gamma_t + v_{it} \\ v_{it} &= \rho v_{it-1} + \epsilon_{it}, \quad \epsilon_{it} \sim iid \end{aligned} \quad (1)$$

where

$Z_{i(t)}$ = institutional features of each country	i denotes country
u_{it} = error term	T denotes time period (1973-1996)
μ_i = random component (individual effects)	ρ = common autocorrelation coefficient
γ_t = time effects common to all units	y_{it} = inflation(π), unemployment(U) or nominal wage growth(W)
v_{it} = possibly serially correlated component of errors	y_{it-1} = one period lagged dependent variable
	x_{it} = time varying variables

6.2 Estimation methodology and summary of results

We first estimated the model for price inflation, nominal wage growth and unemployment without accounting for possible endogeneity of the regressors. Results from this basic model are presented in table 7, panel A. The endogeneity problem was then accounted by instrumental variable estimation. The

⁷Portugal, Greece and Ireland were excluded from the estimated models due to the lack of data.

lagged dependent variable was included into the model in order to remove serial correlation from the errors. Lagged dependent variable also captures the dynamic adjustment, since dependent variables inhibit a substantial degree of persistence in each equation. Serial correlation of the errors was then tested by a Lagrange Multiplier test (LM_ρ)⁸. In the models for price inflation and wage growth lagged dependent variable and other explanatory economic variables were able to remove serial correlation from the errors. In the case of unemployment it was necessary to include also the lagged change in unemployment and other economic variables.

Inclusion of the lagged dependent variable among the regressors results in some collinearity problem between lagged dependent variable and institutional variables. In order to assess seriousness of this problem we also estimated the basic model without lagged dependent variable but with an autocorrelation correction for the errors, as suggested by Park (1967). In this case we assumed that autocorrelation coefficient (ρ) for each country was the same. In the model where the lagged dependent variable was included into the model, autocorrelation coefficient (ρ) was restricted to be zero. In general, the model specification remained the same, but significance of the institutional effects was increased.

Time effects (γ_t) were also included into the model, when appropriate. These time effects are country-invariant and account for any time-specific effects that is not included in the regression, such as oil shocks. Time effects can also mimic the general trend in the dependent variables, such as declining world inflation. Time effects in the errors was then tested by a Lagrange Multiplier test (LM_γ), as given in Baltagi (1995), equation (4.42). The model misspecification was tested by testing whether individual effects should be included into errors. Again Lagrange Multiplier test (LM_μ), as given in Baltagi (1995), equation (4.38), was used. Finally it was assumed that errors were correlated and heteroskedastic across countries. The appropriateness of this assumption was tested by a Likelihood Ratio test, comparing the restricted and unrestricted model. The model specification was accepted when the model passed all these specification tests. Normality of the errors was also assessed using the test statistic. None of the models passed this test, however. This is not surprising, given the data at hand, since outliers are highly likely. Finally, although OLS estimation was used to estimate parameters of interest, robust standard errors were calculated following a method of Beck and Katz (1995).

In panel B of table 7 we relaxed an exogeneity assumption and estimated each model with the instrumental variables technique. Lagged values of explanatory economic variables were used as instruments. Institutional variables were not included into the instrument equation, in order to avoid orthogonality between instrumented regressors and institutional variables. Finally, we used growth rates of each country as an additional instrument.

After these two estimation rounds, we run instrumental variable regressions for each price inflation, wage growth and unemployment without the labour market variables. Our idea was to test whether exclusion of the labour market variables lead into misspecified model. Lagrange Multiplier test, which tested

⁸This test refers to Baltagi (1995), p. 92, equation (5.38).

jointly whether errors contained significant individual effects and whether the errors were serially correlated, tested this misspecification from the partial model $(LM_{\rho,\mu})^9$. In addition, we used WALD test to test for joint significance of the labour market variables in the fully specified model. Finally, also the Calmfors-Driffill hypothesis was tested by WALD test from fully specified model. Results from these estimations and hypothesis tests are summarised in tables 8 and 9 respectively.

⁹This test refers to Baltagi (1995), equation (5.36).

Table 7. Estimation Results from Complete Model

(A) OLS, PCSE				(B) IV, PCSE			
	π_{it}	W_{it}	U_{it}		π_{it}	W_{it}	U_{it}
π_{it}		0.61 (0.070)		π_{it}		0.52 (0.151)	
W_{it}	0.36 (0.025)			W_{it}	0.30 (0.045)		
ΔU_{it}	-0.15 (0.083)	-0.37 (0.124)	0.29 ^(a) (0.057)	ΔU_{it}	-0.03 (0.199)	-0.83 (0.221)	.29 ^(a) (0.056)
π_{it-1}	0.45 (0.036)			π_{it-1}	0.44 (0.059)		
W_{it-1}		0.43 (0.057)		W_{it-1}		0.42 (0.107)	
U_{it-1}			0.91 (0.019)	U_{it-1}			0.92 (0.19)
RW_{it}			-0.11 (0.004)	RW_{it}			-0.01 (0.007)
$POLI$	-1.28 (0.778)		-0.23 (0.112)	$POLI$	-2.05 (1.000)		-0.24 (0.106)
$PERI$		-1.59 (0.577)		$PERI$		-1.78 (0.647)	-0.08 (0.033)
$OBJE$		-0.69 (0.304)	0.06 (0.028)	$OBJE$		-0.69 (0.363)	0.03 (0.025)
$EITAR$	-.70 (0.475)	1.29 ^(b) (0.611)		$EITAR$	-0.99 (0.505)	1.73 ^(b) (0.642)	0.016 (0.046)
$COOP$	-0.64 (0.149)	0.46 (0.194)	-0.03 (0.014)	$COOP$	-0.76 (0.190)	-0.24 (0.250)	-0.04 (0.016)
$CODE$		1.86 (0.657)	0.03 (0.040)	$CODE$		1.95 (0.762)	0.05 (0.047)
$MOPO$	0.36 (0.136)			$MOPO$	0.48 (0.163)	0.29 (0.307)	
$C - D$		-0.16 (0.370)	-0.08 (0.029)	$C - D$		-0.07 (0.418)	-0.05 (0.028)
$N = 17$ (1972 – 1996)				$N = 17$ (1973 – 1996)			

Notes: *OBJE* measures an importance of price stability in the status of the central bank. *POLI* measures political independence of the central bank. *PERI* measures personnel independence of the central bank. *COOP* measures a degree of co-operation of wage bargaining (See Table 2). Higher the index, higher the degree of co-operation. *MOPO* is constructed as $MOPO = CENTRA \times DENSITY$ and captures a monopoly power of unions and effect of unions to aggregate wages. (See Tables 2, 3). *EITAR* is dummy for countries that adopted inflation targeting (See Table 2.1). $C-D = (2 - CENTRA)^2$ and captures the Calmfors-Driffill hypothesis of hump-shaped relationship between macroeconomic performance and a degree of centralisation of wage bargaining. $CODE = COVERAGE - DENSITY$. *RW* is real wage growth. Values in brackets are panel-corrected standard errors (PCSE). See appendix for details.

Table 8. Estimation Results from Partial Model

IV, PCSE				
	π_{it}	W_{it}	U_{it}	
π_{it}		0.49 (0.143)		
W_{it}	0.26 (0.045)			
ΔU_{it}	0.19 (.183)	-0.80 (.222)	.32 (0.059)	
π_{it-1}	0.50 (0.061)			
W_{it-1}		0.45 (0.103)		
U_{it-1}			0.92 (0.19)	
RW_{it}			-0.01 (0.007)	
$POLI$	-3.61 (1.080)		-0.07 (0.133)	
$PERI$		-1.62 (0.588)	-0.07 (0.029)	
$OBJE$		-0.38 (0.322)	0.05 (0.025)	
$EITAR$	-.531 (.531)	1.59 (0.635)	0.02 (0.046)	
$N = 17$ (1973 – 1996)				

Notes: See table 7 above

Table 9. Hypothesis Testing

	π_{it}	W_{it}	U_{it}
Misspecification test ($LM_{\mu,\rho}$)	2.62 (0.004)	1.09 (0.580)	0.06 (0.473)
WALD test for the significance of the labour market variables	$\chi^2(2) = 16.28$ (0.000)	$\chi^2(3) = 6.94$ (0.078)	$\chi^2(4) = 14.14$ (0.006)
WALD test for C-D -hypothesis	-	$\chi^2(1) = 0.04$ (0.833) $\chi^2(1) = 2.67^{(a)}$ (0.102)	$\chi^2(1) = 2.80$ (0.094)

Notes: a) This refers to the case where the variable *DICODE*, the difference between coverage and density rates, was excluded from the model. $LM_{\mu,\rho}$ refers to joint test for serial correlation and individual effects in the errors. See appendix for details.

7 Interpretations

7.1 Inflation

Our basic model for inflation suggests that the importance of price stability objective in the status of the central bank (*OBJE*), which proxies the conservativeness bias of the central bank was not related to inflation significantly. The political independence of the central bank, however, appeared significant and

negatively related to inflation. This seems to imply that conservativeness of the central bank per se does not secure moderate inflation. Granting political independence for the central bank seems to be decisive for moderate inflation rate. Inflation seemed to be negatively related to the degree of co-operation and positively to the power of the unions. A higher degree of co-operation seems to moderate inflation, as expected, while a larger power of unions leads higher inflation.

After relaxing the exogeneity assumption the results changed somewhat. Most importantly, the inflation targeting dummy appeared negatively related to inflation at 5.2% significance level. This seems to imply that countries that adopted inflation targeting were able achieve moderate inflation level faster than those following traditional approaches. Most likely this implies that an idea to substitute a lack of legal independence by the full instrument independence was successful. Moreover, power of the unions remained positive and significant together with the co-operation variable, which remained negatively and significantly related to inflation. All these results are, again, in line with theory, but they emphasise that moderate inflation rates are conditional not only on the legal independence of the central bank, but also on wage bargaining structure. The bottom line is, then, that it may not be sufficient to secure credibility of the central bank by granting legal independence for the central bank. Structural reforms in the wage bargaining practice may be necessary. Our results hint a need either to increase the co-operation in wage bargaining or decrease the power of the unions.

Indeed, formal Lagrange Multiplier test statistic shows that omitting labour market variables from the regression leads into a misspecified model. Moreover, WALD test statistic for omitting the labour market variables rejects the hypothesis that labour market variables are insignificant. This can be seen from table 9.

7.2 Wage Growth

On the contrary to inflation model, and somewhat surprisingly, importance of the price objective in the status of the central bank had significant negative effect on nominal wage growth in the basic model. In addition, also the personnel independence of the central bank has contributed to moderate wage growth, while the political independence variable was not significant. However, in contrast to the results on inflation, inflation targeting dummy, when lagged one period, had a significant *positive effect on nominal wage growth*, while inflation targeting dummy without the lag was not significant.

The difference between coverage and density rates and power of the unions had marginally significant positive effect on wages, while the co-operation in wage bargaining had significant *positive effect on nominal wage growth*. This was somewhat unexpected since we found that inflation was negatively and significantly related to co-operation.

After relaxing the exogeneity assumption results changed somewhat. In general, significance of the institutional variables was reduced. In particular, the puzzling co-operation variable was no more significant while the personnel independence and importance of price objective status remained significant

and negative. It is important to note that nominal wage growth seemed to be very closely related to the central bank independence variables. The fact that the OBJE variable, which proxies the conservativeness of the central bank, was significant and negative strongly supports the argument that wage bargaining institutions and their beliefs on policymakers preferences play an important role in successful economic policy. The fact that personnel independence of the central bank was significant and negative, gives support for the credibility arguments, that granting legal independence of the central banks increases the credibility of the policymakers and therefore, leads into moderate inflation expectations.

Formal Lagrange Multiplier test statistic shows that even if the labour market variables were omitted from the regression the model specification was accepted. However, WALD test statistic for omitting the labour market variables rejects the hypothesis that labour market variables are insignificant. This can be seen from table 9.. In addition, we tested formally the Calmfors-Driffill hypothesis according to which the relationship between centralisation of wage bargaining and wage growth should be hump-shaped. This was tested again by WALD test. Omitting the variable (C-D), which captured this hump-shaped relationship, was not rejected. However, when the wage growth model was estimated without the variables DICODE (the difference between coverage and density rates), omitting C-D was rejected at 10% significance level.

7.3 Unemployment

We first experimented with the standardised unemployment rate, but experienced difficulties with the model specification. We decided to use the log of the standardised unemployment rates instead. Interestingly, we found that policy independence had significant negative effect on unemployment, while more emphasis on the objective of price stability in the central bank status had positive effect on unemployment. The latter result seems to be consistent with the finding that also the wage growth is negatively related to personnel independence, while the former results seem to be inconsistent with the result that the price stability objective had a negative effect on the wage growth. Nevertheless, the result that importance of price stability objective was positively related to unemployment gives some support for the argument that establishing weight conservative central banker is not like a free lunch.

The degree of co-operation in wage bargaining was negatively related to unemployment. The difference between coverage and density rates had significant positive effect on unemployment, when the model was estimated without the quadratic term C-D, capturing the Calmfors-Driffill hypothesis. When the model was estimated with both variables, only the quadratic term C-D remained significant. This is due to the fact that these two variables are highly correlated.

After relaxing exogeneity assumption, results again changed somewhat. In general, the significance of institutional variables was reduced. The importance of price objective in the status of the central bank did not remain significant. This is better in line with the result from wage growth equation, which showed that the price stability objective plays a role in moderating wage growth. Co-

operation and personnel independence variables, however, remained significant. The result that policy independence of the central bank leads moderate inflation and personnel independence leads into both moderate wage growth and unemployment rate gives a strong support for the arguments of Cottarelli and Giannini (1997). Namely, it seems that establishing arrangements which decreases the discretionary power of the government on central bank, but leaves necessary flexibility for the monetary policy is desirable. Moreover, because co-ordination variable both contributes moderate inflation rates and unemployment rates, it seems likely that in the co-ordinated wage bargaining systems, this co-ordination has improved the credence of the monetary policy as argued above.

Similarly with the wage growth equation, a formal Lagrange Multiplier test statistic shows that the model specification was accepted even without wage bargaining variables. WALD test statistic for omitting the labour market variables, in turn, rejects the hypothesis that labour market variables are insignificant. This can be seen again from table 9. The formal WALD test for Calmfors-Driffill hypothesis was marginally supportive. Omitting the variable (C-D), which captured this hump-shaped relationship, was rejected at 9% significance level.

8 Concluding comments

First, it seems to matter which form of independence is emphasised when considering the status of the central banks. While higher political independence of the central bank seems to effect negatively on inflation, personnel independence contributes both lower unemployment rate and wage inflation. Increased emphasis of the price stability goal in the legal status of the central bank seemed generate some negative effects on unemployment, but this relationship was not robust in different specifications of the models. Inflation targeting has proved fairly successful, generating moderate inflation rates, without costs in term of unemployment. With regard to labour markets, it seems to be that facilitating co-operation in wage bargaining is crucial and *ceteris paribus* yields moderate inflation and unemployment rates. On the contrary, a large difference between coverage and density rates leads to both higher nominal wage growth and higher unemployment rate. Calmfors-Driffill hypothesis gained some support from the data. However, due to the high collinearity between the variable which captured this hump-shaped relationship and the variables which measures the difference between bargaining coverage and union density (DICODE), it is difficult to say, whether this effect was due to the quadratic term *per se*. Nevertheless, these results give evidence of the free-rider type of problems and strongly support a need either to reduce statutory arrangements that extends wage contracts to non-union members or a need to move away from the industry level bargaining systems, where the difference between coverage and density rates tend to be largest.

Surprising result was that adoption of inflation targeting had lagged positive effect on wage growth, but simultaneous negative effect on inflation. This may be due to the slow adjustment of inflation expectations at the beginning

of new monetary regime. However, we did not find out that unemployment performance in the countries that adopted inflation targeting would have been significantly worse.

Our results suggest that the wage bargaining structure and the central bank independence are related to dispersion of macroeconomic performance in OECD countries in rather complicated fashion. It seems evident that empirical studies, which have studied these two issues separately have neglected an important interaction of wage bargaining parties and monetary authorities. This is evident from the fact that we find much more significant results with respect to wage bargaining structure than for instance OECD (1997), which abstain from the central bank independence discussion. Our formal tests for this significance most strongly suggested that estimated inflation model without labour market variables is misspecified.

A better understanding of this interaction requires to reconsider theoretical models. In particular, our results doubt the theoretical findings of Bleaney (1996) that inflation is not dependent upon wage bargaining structure, while gives a clear support for the arguments and findings of Cubit (1992), Iversen (1998) and Skott (1995).

This paper has addressed the issues related to the average levels of inflation, nominal wage growth and unemployment only. It would be interesting to analyse, whether, for instance, unemployment variability is related to these institutional variables. However, it seems that complexity of the relationship between monetary policy and wage bargaining needs a more careful theoretical analysis and direct hypothesis testing should, then, be based on fully articulated economic model.

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APPENDIX

Table A1. Coding of the Central Bank Independence Index

adb: Budgetary policy formulation 1.00: if active role for central bank 0.00: if no active role for central bank too: Terms of office 1.00: if ≥ 8 years 0.75: if $\geq 6, \leq 8$ years 0.50: if if equal to 5 years 0.25: if equal to 4 years 0.00: if smaller than 4 years	lint: Limit of interest rates when lending to government 1.00: if must at market rate 0.75: if cannot be lower than certain floor 0.50: if cannot higher than certain ceiling 0.25: if not restricted 0.00: if no interest payment requirement
lla: Limit on advances 1.00: lending prohibited 0.67: if lending subject to strict limits 0.33: if lending subject to acc. limits 0.00: if lending unlimited	lls: Limit on securitized lending 1.00: if prohibited 0.67: if subject to strict limit 0.33: if subject to accommodative limits 0.00: if unlimited
ldec: Who decides lending term 1.00: if controlled by the central bank 0.67: if control attributed by law to CB 0.33: if control left by law negotiations between CB and the government 0.00: If control left to the government	ltype: Type of limit in government lending 1.00: if absolute cash amount 0.67: if percentage of CB's capital 0.33: if percentage of government's reven 0.00: if percentage of government expenditures
app: Appointment of Central Bank Gov. 1.00: if appointed by CB Board 0.75: if appointed by legislative and executive branchers 0.50: if appointed by legislative branch 0.25: if appointed executive branch 0.00: if appointed by 1 or 2 members of executive branch	obj: Price stability as statutory objective 1.00: if only objective and CB has final authority 0.80: if only objective 0.60: if other non-conflicting objectives 0.40: if other conflicting objectives 0.20: if no objectives in CB charter 0.00: if only other objectives in CB charter

Table A1 (continued)

off: Other office held 1.00: if prohibited 0.50: if subject to approval by executive branch 0.00: if not prohibited	lwid: Width of circle of borrowers 1.00 if only central government 0.67: if central and state governments 0.33: if all of above plus private firms 0.00: if all of above plus private sector
lmat: Maturity of loans to government 1.00: if limited to 6 months 0.67: if limited to 12 months 0.33: if limited to more than 12 months 0.00: if unlimited	mpo: Monetary policy formulation 1.00: granted to CB alone 0.67: if granted to both CB and Gov. 0.33: if CB's capacity only advisory 0.00: if granted to government alone
diss: Governor dismissal 1.00: if not possible 0.83: if possible only for nonpolicy reasons 0.67: if unconditionally possible by central bank Board 0.50: if conditionally possible by legislative branch 0.17: if conditionally possible by executive branch 0.00: if unconditionally possible by executive branch	conf: Conflict resolution 1.00: if attributed to central bank 0.80: if attributed to government only for non-objectives 0.60: if attributed to CB board, legislative and executive branches of the government 0.40: if unconditionally attributed to legislative branch 0.20: if conditionally attributed to executive branch 0.00: if unconditionally attributed to executive branch
lpr: Lending in primary market 1.00: if central bank forbidden to participate 0.00: if central bank allowed to participate	

Table A2 Recent Changes in Central Bank Laws

Country	Act	Main Changes	Code	Change
Belgium	93	The government cannot oppose the decision taken by CB relating to its key tasks	mpo	$0.0 \rightarrow 1$
		Extension of credit by the CB for the government forbidden	lla	$0.0 \rightarrow 1$
France	93	The CB shall formulate and implement monetary policy with the aim of ensuring price stability	obj	$0.20 \rightarrow 1$
		The CB shall neither seek nor accept instructions from the government or any person	mpo	$0.67 \rightarrow 1$
		Credit for the government forbidden	lla	$0.67 \rightarrow 1$
Greece	92	Credit for the government forbidden	lla	$0.25 \rightarrow 1$
New Zealand	89	Primary objectives defined as economic objectives of achieving and maintaining stability in the general price level	obj	$0.40 \rightarrow 0.8$
		The Bank has sole authority to implement monetary policy, but override provision of the government exists Governor can be missed from policy reasons	diss	$0.83 \rightarrow 0.17$

Table A2 (Continued)

Country	Act	Main Changes	Code	Change
Italy	92	Governor sets the official discount rate	int	0.25 \rightarrow 1
	93	Credit for the government forbidden	lla	0.33 \rightarrow 1
Spain	94	Primari objective price stability but supports the general policy of the government if that does not conflict with price stability	obj	0.6 \rightarrow 0.6
		Term of office of the governor extended to 6 years	too	0.25 \rightarrow 0.75
		No instructions from the government in implementation of monetary policy	mpo	0.33 \rightarrow 1
		Dismissal of governor restricted to non-policy reasons only	diss	0.0 \rightarrow 0.83
		Credit to the public sector prohibited	lla	0.33 \rightarrow 1
Sweden	88	Term of office of the Governor extended to 5 years	too	0.0 \rightarrow 0.25
		Credit for the government forbidden	lla	0.0 \rightarrow 1

Sources: Cukierman (1992), Cottarelli and Giannini (1997, Table 7, p. 18) and various central bank laws.

Notes: Change of coding is based on own judgement of the central bank laws according to the main changes introduced. Changes are then translated into numerical values following the coding in table A1..

Table A3. Construction of Central Bank Independence Indices

Based on Table A.1 above, Cukierman (1992) constructs composite indices for personal independence, policy independence, importance of price stability, financial independence and overall independence in the following way.

- *PERI (personal independence) = unweighted average of too, app, diss, off.*
- *POLI (Policy independence) = weighted average of mpo, conf, adb, where weights are .25,.5,.25 respectively.*
- *OBJE (Central bank objectives) = obj.*
- *FINI (financial independence) = weighted average of variable lla, lls, ldec, lwid, ltype, lint, lpr.*
- *CUKI (overall independence) = unweighted average of PERI, POLI, OBJE, FINI.*

KICBI differs from CUKI, because in KICBI, FINI = variable lls. We have chosen this, because of high degree of subjectivity with respect to codings of other financial variables as explained in the main text. Moreover, KICBI, as well as indeces above were updated with the recent changes in the central bank laws. See Table A2. Otherwise

- *KICBI= unweighted average of PERI, POLI, OBJE, FINI.*