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The Development of Central Bank Independence: Empirical Evidence

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Abstract

In the academic literature there are different indices to quantify the independence of Central Banks. The main indices to measure Central Bank Independence (CBI) were published between 1970 and 1990. This paper applies CBI indices to a sample of 15 industrial countries and the European Central Bank (ECB) to the current legal conditions. Hence, we are able to study the development of CBI and how it is related with change of inflation. Overall, we find that CBI has increased over the last decades. However, the original approaches to determine CBI do not consider the unconventional monetary policy (Quantitative Easing (QE)) that has been practised by Central Banks in recent years. Considering QE leads to lower CBI scores which are still higher than the original scores that were determined in the 1970's – 1990's.

Keywords: Central Banking, Central Bank Independence, Measurement of Central Bank Independence

JEL Classification: E52, E58

I. Introduction

The area of responsibility for Central Banks is nowadays multifaceted and not limited to monetary policy. The crisis-triggered increase in responsibility amplifies the relevance of Central Banks to make actions independently in the fields of, e. g., monetary policy, banking supervision, financial stability, and payment systems. The importance of Central Bank Independence (CBI) is highlighted by

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a well-documented negative association between both CBI and inflation (*Jácome/Pienknagura* 2022) and CBI and bank risks (*Andries* et al. 2022). However, there is no exclusive way to measure CBI. Between 1970's – 1990's different CBI indices were developed, and the criteria have consistently been refined.

This paper aims to contribute to the ongoing discussion by examining the main CBI indices. For this, we review existing approaches and apply the main CBI indices developed by *Parkin/Bade* (1978) [PB-Index], *Grilli* et al. (1991) [GMT-Index], *Cukierman* et al. (1992) [CWN-Index], and *Eijffinger/Schaling* (1993) [ES-Index] to a sample of 15 industrial countries (and the European Central Bank (ECB)) to the current legal conditions. The determined scores are then compared with the previous scores in the original papers that were published in the 1970's – 1990's. Hence, we are able to examine the development of CBI. To elaborate the differences between the four measurement methods of CBI, we analyse how strongly they are correlated. Additionally, the relationship between CBI scores and inflation is observed. To further capture the impact of the unconventional monetary policy (Quantitative Easing (QE)) introduced by many Central Banks we analyse how the CBI-related scores change when QE is considered. Hence, the paper provides an in-depth analysis of the progress of CBI by taking the development of inflation and unconventional monetary policy into account.

Overall, we find that the de jure CBI and the correlation between the different indices have increased. The increase in CBI can be traced back to several central bank reforms and a shift away from direct loans to the government (granted by Central Banks). However, considering QE leads to lower CBI scores which are still higher than the scores that were determined in the 1970's – 1990's. Our determined correlation coefficients between the four CBI indices are higher than in *Eijffinger/de Haan*'s (1996) correlation analysis. We observe a negative association between the country-specific average year-on-year change in the Consumer Price Index (CPI) and the CBI scores which supports the evidence in previous studies.

The paper is organized as follows: Section II describes the related literature on central bank independence and its interrelation with inflation. The third section introduces relevant measurement approaches of de jure CBI and compares them with each other. The data used as well as the methods applied in the study are subject of Section IV. The empirical results are analysed and discussed in Section V. Section VI concludes the paper.

II. Related Literature

With the rise of CBI in the first half of the 20th century and its discussion in both the academic literature and the political systems (*Kritz* 1948), the interest

to measure CBI rose likewise. However, there is an ongoing debate in the academic literature that leads to different measurement approaches of CBI. The independence of Central Banks is often associated with goal independence, policy independence, instrument independence, personnel independence, and financial independence (*de Haan/Kooi* 1997). When examining CBI, it is important to note that CBI does not only refer to independence from the influence of the government but also to the ability to maintain monetary stability in general. However, there is a larger scale of variety among the different measurement approaches of CBI (*Eijffinger/de Haan* 1996). Therefore, central banks whose primary mandate is the protection of price stability usually have higher CBI scores than those with multiple mandates. Additionally, stricter lending rules regarding loans to the government are awarded with higher scores of CBI as well (*Cukierman* et al. 1992).

Consequently, CBI is often measured against the average inflation rate, implying that a negative relationship is a sign for an independent central bank (*Kydland/Prescott* 1977; *Barro/Gordon* 1983). However, *Hayo* (1998) argues that CBI per se cannot sufficiently explain low inflation rates. In addition to CBI, a "public consensus on monetary stability" (p. 241) as well as a stability culture lead to a low-inflation environment in developed countries. *Park* (2023) states that central banks' credibility is strongly linked to the efficiency of monetary policy. For developing countries, *Garriga/Rodriguez* (2020) find evidence that higher CBI is related with less inflationary pressure. Most central banks regard price stability as their main mandate, while governments have incentives to prefer higher inflation rates (*Rogoff* 1985) which can lead to the inconsistency problem (*de Haan/Kooi* 1997).

Researchers attempt to quantify the level of CBI. First, one must distinguish between de facto and de jure independence. The former examines the average annual number of turnovers (TOR = turnover rate) of central bank governors or the deviations of common practices from laws, while the latter describes the legal independence of a central bank. It thereby shows how much independence legislators intended to confer upon central banks (*Cukierman* et al. 1992). The de jure independence can be measured via various indices as are described below. In the following section, relevant indices of CBI are described and discussed as well as compared to each other.

III. Measurement Approaches of Central Bank Independence

Table 1 displays relevant de jure CBI indices analysed in the paper. *Parkin/Bade* (1978) lay the groundwork regarding the quantitative measurement of CBI by examining the central banks of twelve industrial countries from 1951 – 1975. They analyse the central banks' primary mandates, the relationship to the re-

Table 1

de jure CBI Indices

Index	Measurement method	Countries & Period	Measured against:			
			Inflation	Economic growth	Unemployment	Further
PB-Index *Parkin/Bade* (1978)	4 political criteria unweighted	12 OECD countries 1951 – 75	Neg. relationship	–	–	No relationship with monetary policies
GMT-Index *Grilli* et al. (1991)	more specified political criteria of PB-Index + economic criteria (14 in total) unweighted	18 OECD countries 1950 – 89	–	No relationship	No significant relationship	–
CWN-Index *Cukierman* et al. (1992)	More specified political criteria of PB-Index (16 in total) Unweighted & Weighted	72 countries 1950 – 89	Neg. relationship in OECD countries, but not in developed countries	–	–	–
Alesina/Summers (1993)	Arithmetic mean of PB-Index (values from Alesina (1988) and GMT-Index	16 OECD countries 1955 – 88	Neg. relationship	No relationship	No significant relationship	No relationship with real interest rates
ES-Index *Eijffinger/Schaling* (1993)	3 political criteria Weighted	12 OECD countries As of 1991	–	–	–	–

Note: The more independent a central bank is, the more points are awarded. Further, if criteria are described as unweighted, it can be assumed that each satisfied criteria is awarded one point.

spective governments in the formulation of monetary policy and the procedures for the appointment of central bank governors (PB-Index). Each positively assessed criterion is then awarded one point and the central banks are ranked accordingly and classified into four categories by aggregating central banks with similar findings (e. g. central banks that have multiple mandates are in the same group as banks without an explicitly legislated mandate). *Parkin/Bade* (1978) then examine the monetary policies of these central banks. Finally, the determined CBI is examined with regard to potential economic effects on, e. g., the inflation rates, of the respective countries. The empirical analysis of *Parkin/Bade* (1978) suggests that the determination of price stability as the sole legislative objective does not necessarily result in lower average inflation rates. Meanwhile, there appears to be strong evidence that a central bank, that is independent in its policy making as well as its appointment of governors, is connected to low inflation rates, although not necessarily to a low variability of monetary policies. The PB-Index, while not giving a very detailed view on CBI, sets the tone for later measurement methods of de jure CBI.

Alesina (1988, 1989) adapts the PB-Index for an empirical study of 17 OECD-countries for the period of 1973 – 1986. He further searches for a link between CBI, political cycles and inflationary expectations and observes that an independent central bank can reduce changes in monetary policy that are caused by an election cycle. Additionally, an independent central bank seems to be more likely to reduce the inflationary bias as well as inflation in general. Nevertheless, *Alesina* (1988, 1989) points out that independent central banks do not necessarily have to cause this observed reduction in inflation. Instead, a society that favours low inflation rates is probably also more likely to prefer independent central banks.[1]

Building upon the work by *Parkin/Bade* (1978), *Grilli* et al. (1991) develop a broader CBI Index, the GMT-Index. They not only apply the previously mentioned political indicators in a more detailed fashion, but also add economic indicators. These economic indicators aim to display how free a central bank is in choosing its monetary policy instruments and to which extent the government can influence the central bank to provide loans to the state. Similar to the PB-Index, the GMT-Index assigns one point for each satisfied criterion. *Grilli* et al. (1991) then apply the GMT-Index to 18 OECD countries and examine the relationship between CBI and various macroeconomic indicators from 1950 – 1989.

[1] The work by *Alesina* (1988, 1989) is often listed as an index of CBI. However, *Alesina* (1988, 1989) merely adopts the PB-Index, applies it to a different time span, and includes more countries. While the determined levels of CBI differ compared to those by *Parkin/Bade* (1978), the index itself is not changed. Therefore, the work by *Alesina* (1988, 1989) will not be referred to as an index in this paper.

They observe no relationship between CBI and a country's macroeconomic performance and no significant relationship between CBI and unemployment.

Cukierman et al. (1992) adapt the PB-Index by using its criteria, adding subcategories and thereby creating the CWN-Index. In contrast to former approaches, the CWN-Index has weighting factors. *Cukierman* et al. (1992) implement the CWN-Index for 72 countries, thereby notably also including developing countries, for the span of 1950 – 1989. The CWN-Index is arguably the most widely employed legal index of central bank independence, with *Crowe/Meade* (2008), *Jácome/Váquez* (2008), and *Garriga* (2016) among others applying it for their studies, sometimes by extending the used criteria. Similar to the GMT-Index, the CWN-Index also includes aspects of economic independence. However, unlike the GMT-Index, the CWN-Index only considers the central bank governor's tenure and appointment procedure and neglects the other board member's independence in policymaking. Since monetary policy is usually determined by the entire board, it is important to extend this criterion to the other board members as well. Further, *Cukierman* et al. (1992) observe that the negative relationship between legal CBI and the average inflation rate, which has been noted by several studies, is only observable when focussing on OECD countries. *Cukierman* et al. (1992) suspect that this is because less developed countries might have laws protecting CBI but their governments do not necessarily abide as strictly by these laws as it is the case in OECD-countries.

Alesina/Summers (1993) combine the values of CBI according to the PB-Index and the GMT-Index of 16 OECD-countries for the period of 1955 – 1988. These values are then analysed in connection with various macroeconomic indicators. Overall, there does not seem to be a relationship between CBI and the macroeconomic performance of the countries observed.

Eijffinger/Schaling (1993) develop another legal CBI Index (ES-Index) and apply it to 12 OECD countries. They analyse the central bank laws with respect to the following criteria: The final policy authority being either the central bank alone, the central bank in combination with the government or the government alone. Further, the composition of the central bank board (mainly whether there is a government official with or without voting power on the board) and finally the appointment procedures of the board members (whether more than half of the board members are appointed independently from the government). It is further important to note that *Eijffinger/Schaling* (1993) weight the first criterion (policy authority of the central bank) with ½ of the total weight and the other two criteria with ¼ of the total weight. The authors thereby prevent a tradeoff, where the primary mandate might be monetary stability, but the government is the final policy authority. Thus, being the final authority is clearly deemed the most important criterion with regard to CBI.

The de jure CBI indices described in this section all follow the broad categories outlined by *Parkin/Bade* (1978). Further, the indices differ slightly with regard to the addition of new criteria and weighting methods (the inclusion of economic indicators in the GMT- and CWN-indices presents the biggest change to the original set of criteria). The findings by *Eijffinger/de Haan* (1996) however, suggest that the indices vary more than the relatively small differences regarding the included criteria might suggest. They compare the different scores determined by *Parkin/Bade* (1978), *Alesina* (1988), *Grilli* et al. (1991), the unweighted scores of *Cukierman* et al. (1992) and the weighted scores of *Eijffinger/Schaling* (1993) and *Eijffinger/van Keulen* (1995). In general, there seems to be a quite low correlation between the different approaches / measurement methods for CBI. A possible explanation is that while the criteria are rather similar, the interpretation of central bank laws remains subjective. For example, *Eijffinger/de Haan* (1996) observe that researchers tend to weight those countries differently, with whom they are more familiar with.[2] Furthermore, the varying additions of new, equally weighted criteria in each index reduce the weight of the criteria the different indices have in common.

Cukierman (1992) points out that measuring CBI by focussing on legal aspects neglects relevant information such as informal arrangements between central banks and governments, the quality of central banks' research departments as well as the personalities of key figures. Furthermore, laws concerning CBI often do not cover all eventualities and even if they do, the actual practice can deviate from the regulations. *Cukierman* (1992) therefore develops two indices that aim to capture the de facto CBI. The table in the annex summarises both de facto indices.

The first de facto index by *Cukierman* (1992) is composed of a questionnaire, addressed to monetary policy experts in the observed countries. By determining monetary policy instruments and objectives, the responsible authorities, intermediate targets and the legal aspects of CBI as well as the actual practice of these laws, further possible limitations to CBI are considered. *Cukierman* (1992) applies this approach to 24 countries for the period of 1980 – 89.

The second de facto index by *Cukierman* (1992) uses the turnover rate (TOR) of central bank governors as a proxy for de facto CBI arguing that a high TOR implies a low CBI. *Cukierman* (1992) applies this approach by examining the average TOR of governors of 58 countries from 1950 – 89. He observes that TOR's in developing countries spread across a significantly higher range than those in developed countries. There are several reasons why a high TOR does not necessarily signify a lower CBI. In cases of more dependent central banks, a

[2] E. g., *Alesina* (1988) weights the CBI of the Banca d'Italia differently than the other economics.

more compliant central bank governor could stay longer in office than a more assertive governor. Additionally, this approach neglects the independence of the other board members, who usually have voting rights on monetary policy decisions, as well as the reasons for a governor's departure, which do not necessarily have to stem from pressure from the government (*Arnone/Romelli* 2013). Nonetheless, *Cukierman* (1992) argues that above a critical rate, CBI is lower, the higher the TOR is. This threshold would be at around four to five years. The underlying argument is that CBI is probably threatened if the TOR is beneath the term of the executive branch and that most electoral cycles often span at least four years.

IV. Data and Methodology

We analyse the different de jure measurement methods of CBI, the impact of criteria and weighting methods and the level of subjectivity in measuring CBI. To conduct a comparative analysis the included countries are those studied by *Alesina* (1988, 1989) as well as by *Grilli* et al. (1991), *Cukierman* et al. (1992), *Eijffinger/Schaling* (1993) and *Eijffinger/van Keulen* (1995). Additionally, the ECB is examined as well as Portugal, Austria, and New Zealand, which are neglected in the analysis by *Alesina* (1988) but are assessed by the other aforementioned studies. The inclusion of these countries and the ECB enable a closer observation of countries in the Euro Area and their connection to the increased levels of CBI mandated by the Treaty on the Functioning of the European Union (TFEU). This also serves as a robustness test of the CBI indices, since the CBI levels within the Euro Area are expected to be more similar compared to other central banks. Additionally, New Zealand is an important country with respect to CBI since it is a pioneer in inflation targeting after the Reserve Bank Act came into power in 1989 (*Svensson* 1997) and is therefore included as well. We choose this sample of countries to compare the scores as of 2021 (before the inflationary pressure began) as well as the correlation between the different indices.

To assess the CBI levels appropriately, the countries are evaluated using the PB-Index, the GMT-Index, the CWN-Index and the ES-Index. For this, the legal frameworks of the different central banks are examined with regard to the level of independence they provide for the central banks, focussing on the laws and practices that are currently applicable. In some cases, such as in Denmark, the legal basis for the assessment remains the same as for the original assessments. Often however, new laws regarding CBI have been passed in recent decades.

It is important to note beforehand that in cases where there is no clear legal basis for a specific criterion, the assessment of the relating criterion takes the practice more strongly into account. Australia and New Zealand for example, still do not have laws prohibiting a direct financing of the government. This had

a negative influence on the original assessment according to GMT- and CWN-indices in the 1990s. Nonetheless, since the central banks in Australia and New Zealand have not engaged in direct public funding, we choose to reflect this in the scores. *Jácome* et al. (2012) note that these countries have a legislation that "is silent about restrictions on the central bank's provision of credit to the government". This approach presents a slight deviation from the original assessment of these criteria. However, the main focus remains on the legal basis of CBI and this approach merely considers common traditions.

It might be argued that when taking such a stance, the unconventional monetary policy should be represented more appropriately as well. The CWN- and the GMT-indices include criteria questioning loans from the central bank to the government as well as the participation on primary markets. Unconventional monetary policy of central banks led to a series of asset purchase programs. This specific possibility regarded as QE is not included in the original indices used. Consequently, the economic independence in both the GMT- and the CWN-indices is contorted when central banks use these financing methods. To examine the effects of QE, the relevant criteria are therefore interpreted more broadly in a later step.

There are some cases, where the central bank laws are treated differently in our analysis. For example, in the case of the central bank of Japan, the Nippon Ginkō, Art. 34 of the Bank of Japan Act (Act No. 89 of June 18, 1997) refers to Art. 5 of the Fiscal Act (Act No. 34 of 1947) for more information regarding the limits on government spending. This law is not widely available in the English language. Lacking reliable information regarding the specific limits, the mean scores between the two optional scores of the CWN-Index for limited loans to the government were given to the related criteria. The uncertainty regarding the limits is also present in the assessment of economic independence in the GMT-Index, where the points given are subject to the general impression of Japanese laws regarding direct loans to the government.

Additionally, the countries in the Euro Area are only analysed regarding their independence from the respective governments but not from the ECB. This is due to the two following reasons: Firstly, the original indices are created with the intention of representing the relationship to the government. A construct similar to the ECB did not exist at that point in time. In line with the problem of government financing, different interpretations of existing criteria or the addition of newer criteria might be required to reflect the relationship between individual central banks and the ECB in a more appropriate manner. This would not only alter the original indices but also further complicate a comparison to other non-Euro Area countries. Secondly, the ECB itself is largely independent and its decision-making regarding monetary policy is conducted by the individual central bank governors and the ECB Executive Board.

After assessing the central banks according to the different indices previously listed, we examine the correlation between the levels of CBI and the different indices. For this, Kendall's tau and Spearman's rank correlations are employed. Here, we choose Kendall's tau-b since it makes an adjustment for multiple occurring ranks. The resulting values are then analysed and compared the correlation coefficients of *Eijffinger/de Haan* (1996). Unlike them, we chose to consider the unweighted CWN-scores as well.

We then proceed to examine the relationship between the inflation rates according to year-on-year changes in the Consumer Price Index (CPI) between April 2011 and March 2021 and the CBI indices. For every country in the data set we have information about the average change of the CPI and the scores for CBI using the PB-, GMT-, CWN_u-, CWN_w-, and ES-Index. For this, the correlation is calculated applying Pearson Correlation and Kendall's tau-b.

Since the used CBI indices do not capture aspects of QE, they potentially give a contorted view on CBI. The unconventional monetary policy is associated with setting interest rates at the zero lower bound and the large-scale purchase of government bonds on the secondary market. Both policy instruments potentially result in an increase in inflation, which makes it difficult to determine whether they are applied to fight deflationary pressure or to aid the government in its debt management. We therefore adapt the CBI indices for the QE programs conducted by most modern central banks in industrial countries. Thereby, the impact on the shift towards a more unconventional monetary policy on the economic CBI indices can be captured. For this, we reinterpret the criteria concerning loans to the governments for the asset purchase programs. In the cases of the United Kingdom (UK) and Japan, direct funding is also practiced (in the UK) or determined by law (in Japan). If a central bank actively purchases government bonds on the secondary market with the goal of stabilising the overall price levels, criteria 1 – 4 according to the GMT-Index (economic CBI, a) can still be satisfied. Since the central bank board does not automatically order large scale purchases, when the government requires them, but decides on them in dependence on the prevailing interest rates, criteria 1 is still deemed to be fulfilled. Further, the government pays the same bond interest rates to the central bank as it does to other market participants. While new government bonds will be bought when the current government bonds reach their maturity to prevent market disruptions, the QE programmes are meant to last only until the primary mandates are fulfilled to the central bank's satisfaction. Therefore, this criterion is satisfied as well. Since the quantity of purchased bonds depends on reaching the central bank's monetary, and at times macroeconomic, goals and the board decides upon the quantity, the amount is limited. As a result, QE does not have an effect on the CBI scores determined by the GMT-Index.

In case of the CWN-Index, taking QE into account affects the criteria 4a-g (limitations on government lending). As there are no legal limits regarding the

quantity of purchased bonds, criteria 4a and b are not deemed to be satisfied when a central bank practices QE. Meanwhile, criterion 4c is met since the central bank board decides upon the purchase programs. For 4d, it depends on whether a central bank extends its purchase program to corporate bonds. If this is the case, the criterion is not satisfied, if the bank focuses on government bonds by the central government, it is. The limits on the quantity of purchased bonds depends on reaching a central bank's primary target. If a bank's sole objective is price stability, the criterion is satisfied. If other goals are pursued as well or instead, criterion 4e is not fulfilled. Since none of the purchased bonds have maturities of less than one year and are often repurchased upon maturity to prevent market disturbances, criterion 4f is not fulfilled either, if QE is practiced. Lastly, the government pays the market interest rates on the bonds, and thus, criterion 4g is usually satisfied when QE is conducted.

V. Results and Discussion

Table 2 displays the CBI scores according to our assessment (as of 2021) as well as the scores according to the original assessments a few decades ago (in brackets). The CBI scores of this analysis are higher than in the original assessments[3]. There are several possible explanations: The most crucial factor is probably that legal CBI increased substantially. The scores differ depending on whether economic independence is considered, as is the case for the GMT- and CWN-Index, or whether they are disregarded, as it is the case for the PB- and ES-Index. Consequently, when focussing on the GMT- and the CWN-Index, those central banks that can provide direct loans to the government (UK and Japan) have by far the lowest levels of CBI. Additionally, countries whose central banks are in some ways subordinate to the Treasury are ranked lower than those whose central banks are not subjugated to any form of additional control in the determination of monetary policy. This can be observed for all central bank indices. The personal independence of the central bank governor is assessed in every index as well.

[3] *Alesina* (1988); *Grilli* et al. (1991); *Cukierman* et al. (1992); *Eijffinger/Schaling* (1993).

Table 2

Assessment of CBI (Current Conditions vs. Scores of Original Papers)

Country / Area	**PB-Index** (*Alesina* 1988)	**GMT-Index** (*Grilli* et al. 1991)	**CWN-Index unweighted** (*Cukierman* et al. 1992)	**CWN-Index weighted** (*Cukierman* et al. 1992)	**ES-Index** (*Eijffinger/ Schaling* 1993)
Australia	1 (1)	12 (9)	0.72 (0.31)	0.64 (0.36)	3 (1)
Austria	4	13 (9)	0.9 (0.58)	0.84 (0.61)	4 (3)*
Belgium	4 (2)	13 (7)	0.83 (0.19)	0.79 (0.17)	4 (3)
Canada	2 (2)	10 (11)	0.84 (0.46)	0.75 (0.45)	3 (1)
Denmark	5 (2)	15 (8)	0.91 (0.47)	0.82 (0.5)	5 (4)*
Euro Area	4	13	0.86	0.82	4
France	4 (2)	12 (7)	0.86 (0.28)	0.8 (0.24)	4 (2)
Germany	4 (4)	13 (13)	0.86 (0.66)	0.82 (0.69)	4 (5)
Italy	4 (1/2)	14 (5)	0.83 (0.22)	0.79 (0.25)	4 (2)
Japan	3 (3)	9 (6)	0.64 (0.16)	0.56 (0.18)	3 (3)
Netherlands	4 (2)	13 (10)	0.85 (0.42)	0.81 (0.42)	4 (4)
New Zealand	2	11 (3)	0.78 (0.27)	0.69 (0.24)	3 (3)*
Portugal	4	13 (3)	0.85 (0.4)	0.8 (0.41)	4 (2)*
Switzerland	4 (4)	14 (12)	0.9 (0.68)	0.84 (0.64)	4 (5)*
UK	2 (2)	8 (6)	0.25 (0.31)	0.26 (0.27)	3 (2)
U.S.	3 (3)	12 (12)	0.75 (0.51)	0.66 (0.48)	4 (3)

Note: CBI scores according to the PB-, the GMT-, the CWN- and the ES-indices. The numbers without brackets are the scores determined by the authors of this paper for the CBI levels in 2021. The numbers in brackets are the original values given by *Alesina* 1988, *Grilli* et al. 1991, *Cukierman* et al. 1992 and *Eijffinger/Schaling* 1993. The bracketed numbers followed by an asterisk in the column to the right are values assessed by *Eijffinger/van Keulen* (1995).

The observed increase in CBI scores can be partially explained by the large amount of Euro Area countries in the sample. The establishment of the Euro Area required an enhancement of CBI in the participating countries. This led to numerous central bank laws being passed in the early 1990s prohibiting the government from influencing the monetary policy course, the dismissals of central bank governors, unless for serious misgivings, and direct central bank loans to the government. Further, the goal of price stability was defined as the primary mandate of the concerned central banks. Since more than half of the countries examined are either part of the Euro Area or of the EU, which also requires improved levels of CBI, albeit not as high, this influences the increase in legal CBI.

In a further step, the correlation coefficients between the different CBI indices give information on the relationships between the indices and the development of CBI in the recent decades. When focussing on the levels of correlation according to Kendall's tau-b (Table 3), a positive correlation between the different indices is evident. Further, one can observe a stronger correlation between those indices that include economic indicators (CWN- and GMT-Index) and between those that concentrate on purely political aspects (PB-and ES-Index). Furthermore, the CWN-Index is the least correlated with the other indices, excluding its correlation with the GMT-Index. When comparing the correlation coefficients of this analysis with those of *Eijffinger/de Haan* (1996), one can see that *Eijffinger/de Haan*'s (1996) correlation coefficients are slightly lower. Moreover, while our correlation analysis shows mostly values between 0.61 and 0.89 (excluding the correlation between the weighted and unweighted CWN-scores), *Eijffinger/de Haan*'s (1996) analysis presents a far larger spread of 0.2 – 0.71. Meanwhile, Spearman's rank correlation shows higher values of a positive correlation between the CBI indices with a spread of 0.72 – 0.93. The correlation between the CWN-Index and the other measurement methods of CBI is lower than the other correlation values. Overall, the levels of this analysis exceed the values determined by *Eijffinger/de Haan* (1996), who observe values between 0.35 and 0.78. When applying Kendall's tau-b, the unweighted CWN-scores show a slightly higher correlation with the other CBI indices than the weighted CWN-scores. In case of Spearman's rank correlation, the opposite holds true. Overall, the weighting of the criteria does not seem to have a considerable impact on either the scores or the correlation with other CBI indices. Further, in support of this statement, the correlation between the unweighted and weighted CWN-scores is comparatively high. In *Eijffinger/de Haan*'s (1996) analysis, the GMT-Index is characterised as the least correlated index. Meanwhile, in our correlation calculation, the CWN-Index stands out as the index with the lowest correlation towards the other measures.

Table 3

Correlation Coefficients Between CBI Indices

	Kendall's tau-b					Spearman's rank correlation				
	PB	**GMT**	**ES**	**CWN_U**	**CWN_W**	**PB**	**GMT**	**ES**	**CWN_U**	**CWN_W**
PB	1	0.7232 (0.58)	0.8875 (0.71)	0.6408 (0.38)	0.6202	1	0.8457 (0.69)	0.9301 (0.78)	0.7733 (0.44)	0.7836
GMT	–	1	0.7775 (0.36)	0.6163 (0.52)	0.6163	–	1	0.8528 (0.48)	0.7307 (0.63)	0.7718
ES	–	–	1	0.6307 (0.20)	0.6078	–	–	1	0.7255 (0.35)	0.7273
CWN_U	–	–	–	1	0.8119	–	–	–	1	0.926
CWN_U	–	–	–	–	1	–	–	–	–	1

Note: Correlation of CBI indices. The numbers in brackets represent the numbers estimated by *Eijffinger/de Haan* 1996, whereas the numbers without brackets are the correlation values of the CBI scores as of 2021 (calculated by the authors). CWN_U is the unweighted CWN-Index, whereas CWN_W is the weighted CWN-Index. Further, the correlation coefficients of the CBI scores (2021) are significant at the 10% level.

The overall patterns show that the analysis conducted with the newly determined scores is characterised by a higher correlation between the CBI indices than *Eijffinger/de Haan*'s (1996) correlation analysis with the original scores. There are several possible explanations for this increase in correlation. Firstly, the scores determined in the paper were not calculated by multiple different authors. In this regard, *Eijffinger/de Haan* (1996) mention a potential bias towards countries with whom the researcher is more familiar with. Secondly, the period observed is the same for all indices, whereas the examined periods of the original assessments differ. Thirdly, the development of CBI can also be responsible for the observed higher correlation. In recent decades, new central bank legislation mainly led to an increase of legal CBI. This partially stems from the regulations required by the TFEU. Several of the observed central banks in Europe already had medium to high levels of political CBI. The new laws however, had a more considerable impact on economic CBI (forbidding loans to the government and the purchase of government debt on the primary market) while also increasing the political CBI, albeit by not as much. This translates into an overall increased economic CBI according to the indices. Consequently, the correlation between indices that take economic CBI into account (the GMT- and the CWN-Index) and purely political CBI indices (the BP- and the ES-Index) increased. Nonetheless, CBI increased overall and not only between these two particular groups of CBI indices.

Table 4

Correlation (CBI and Inflation)

	Pearson Correlation	**Kendall's tau-b**
PB	–0.4734 (0.0640)	–0.3690 (0.0786)
CWN_U	–0.3594 (0.1716)	–0.3220 (0.0944)
CWN_W	–0.3476 (0.1871)	–0.2373 (0.2223)
ES	–0.2865 (0.2820)	–0.2615 (0.2404)
GMT	–0.3134 (0.2373)	–0.3101 (0.1237)

Note: Pearson Correlation and Kendall's tau-b of the CBI-indices (scores as of 2021 without QE) and the inflation rates (country-specific average year-on-year change in the Consumer Price Index (CPI) between April 2011 and March 2021). Probabilities (t=0) are displayed in brackets. CWN_U is the unweighted CWN-Index, whereas CWN_W is the weighted CWN-Index.

We observe negative correlation coefficients between the country-specific average year-on-year change in the Consumer Price Index (CPI) between April 2011 and March 2021 and the CBI scores (Table 4). This confirms previous studies noting a negative relationship between CBI and inflation rates.[4] The correlation coefficients range from –0.2373 for the CWN-Index (weighted; Kendall's tau-b) to –0.4734 for the PB-Index (Pearson Correlation) and support the findings of previous studies. For instance, *Jácome* (2001) studies legal CBI and inflation in Latin America and documents correlation coefficients ranging from –0.26 to –0.46. *Eijffinger/de Haan* (1996) focus on developed countries and they document correlation coefficients ranging from –0.19 (GMT-Index) to –0.77 (ES-Index).

To also account for the effects of QE on CBI, the CWN- and the GTM-Indices are adapted. While the GMT-Index scores do not change, the CWN-scores are affected. In Table 5, QE is considered (the bold numbers).

As was to be expected, the CWN scores are lower than when QE is taken into account. Nonetheless, the scores often remain above the CBI levels of the 1970's – 1990's. Table 6 summarises the scores under current legal conditions, the scores of the original papers, and the scores that take QE into account. To a certain extent, the increase in political de jure independence was able to set off the effect of QE. Additionally, the decline in direct funding is a contributing factor to the increase in CBI levels. Most importantly, QE can only be represented to a certain extent without further altering the CBI indices. The GMT-Index, for example, does not reflect QE at all, even when reinterpreting the criteria on government lending towards QE. At the same time, the underlying reason for granting loans/purchasing government bonds shifted from outright support of the government's debt management to curbing inflation. For Germany, Switzerland, the UK and the U.S., the partial representation of QE leads to a downgrade in CBI compared to the levels of 1989.

Most of the CBI indices developed so far differ considerably from each other. Be it due to the interpretation of the central bank laws, the different weighting of similar criteria or the variations in criteria included in the first place, the outcome varies substantially. The PB-Index is very easy to adapt. However, it thereby lacks the level of detail that characterises later published measurement methods. Meanwhile, the GMT-Index not only examines the main categories outlined by *Parkin/Bade* (1978) in more detail, but also adds important criteria describing the economic independence of central banks. The CWN-Index neglects some important aspects of the GMT-Index, such as the independence of all the board members. Nonetheless, *Cukierman* et al. (1992) weight the criteria and also take economic independence into account. This is crucial because cer-

[4] *Parkin/Bade* (1978); *Alesina* (1988); *Cukierman* (1992); *Cukierman* et al. (1992).

Table 5

CBI scores (using CWN-Index) and QE

Country/Area	CWN-Index unweighted (*Cukierman* et al. 1992)	CWN-Index weighted (*Cukierman* et al. 1992)
Australia	0.72 (0.31) **0.42**	0.64 (0.36) **0.33**
Austria	0.9 (0.58) **0.63**	0.84 (0.61) **0.53**
Belgium	0.83 (0.19) **0.57**	0.79 (0.17) **0.48**
Canada	0.84 (0.46) **0.54**	0.75 (0.45) **0.44**
Denmark	0.91 (0.47) **0.68**	0.82 (0.5) **0.55**
Euro Area	0.86 **0.6**	0.82 **0.51**
France	0.86 (0.28) **0.57**	0.8 (0.24) **0.48**
Germany	0.86 (0.66) **0.6**	0.82 (0.69) **0.51**
Italy	0.83 (0.22) **0.54**	0.79 (0.25) **0.43**
Japan	0.64 (0.16) **0.54**	0.56 (0.18) **0.46**
Netherlands	0.85 (0.42) **0.59**	0.81 (0.42) **0.5**
New Zealand	0.78 (0.27) **0.55**	0.69 (0.24) **0.43**
Portugal	0.85 (0.4) **0.58**	0.8 (0.41) **0.5**
Switzerland	0.9 (0.68) **0.69**	0.84 (0.64) **0.58**
UK	0.25 (0.31) **0.28**	0.26 (0.27) **0.27**
U.S.	0.75 (0.51) **0.45**	0.66 (0.48) **0.35**

Note: CBI scores according to the CWN-Index. The numbers without brackets are the scores determined by the authors for the CBI levels in 2021. The numbers in brackets are the original values given by *Cukierman* et al. 1992. The bold numbers are the scores that take QE into account (as of 2021).

tain aspects of CBI surpass other indicators in importance. This thought is also present in the ES-Index, which however lacks the level of detail of the CWN- and the GMT-Index. Further, *Cukierman* et al. (1992) point out that the indices focussing on legal CBI are less applicable in developing countries. To measure the CBI in developing countries alternative indices such as a questionnaire for monetary policy experts and members of the examined central banks or the TOR are more appropriate. Especially the TOR however, seems to be inconclusive when applied to developed countries. It is therefore difficult to measure CBI worldwide with a single index. In case of a differentiation between developed

Table 6

CBI scores of 2021, as well as original scores (1970's – 1990's) and scores taking QE into account

Country/ Area	PB-Index (*Alesina* 1988)	GMT-Index (*Grilli* et al. 1991)	CWN-Index unweighted (*Cukierman* et al. 1992)	CWN-Index weighted (*Cukierman* et al. 1992)	ES-Index (*Eijffinger/Schaling* 1993)
Australia	1 (1)	12 (9)	0.72 (0.31) **0.42**	0.64 (0.36) **0.33**	3 (1)
Austria	4	13 (9)	0.9 (0.58) **0.63**	0.84 (0.61) **0.53**	4 (3)*
Belgium	4 (2)	13 (7)	0.83 (0.19) **0.57**	0.79 (0.17) **0.48**	4 (3)
Canada	2 (2)	10 (11)	0.84 (0.46) **0.54**	0.75 (0.45) **0.44**	3 (1)
Denmark	5 (2)	15 (8)	0.91 (0.47) **0.68**	0.82 (0.5) **0.55**	5 (4)*
Euro Area	4	13	0.86 **0.6**	0.82 **0.51**	4
France	4 (2)	12 (7)	0.86 (0.28) **0.57**	0.8 (0.24) **0.48**	4 (2)
Germany	4 (4)	13 (13)	0.86 (0.66) **0.6**	0.82 (0.69) **0.51**	4 (5)
Italy	4 (1/2)	14 (5)	0.83 (0.22) **0.54**	0.79 (0.25) **0.43**	4 (2)
Japan	3 (3)	9 (6)	0.64 (0.16) **0.54**	0.56 (0.18) **0.46**	3 (3)
Netherlands	4 (2)	13 (10)	0.85 (0.42) **0.59**	0.81 (0.42) **0.5**	4 (4)
New Zealand	2	11 (3)	0.78 (0.27) **0.55**	0.69 (0.24) **0.43**	3 (3)*
Portugal	4	13 (3)	0.85 (0.4) **0.58**	0.8 (0.41) **0.5**	4 (2)*
Switzerland	4 (4)	14 (12)	0.9 (0.68) **0.69**	0.84 (0.64) **0.58**	4 (5)*
UK	2 (2)	8 (6)	0.25 (0.31) **0.28**	0.26 (0.27) **0.27**	3 (2)
U.S.	3 (3)	12 (12)	0.75 (0.51) **0.45**	0.66 (0.48) **0.35**	4 (3)

Note: CBI scores according to the PB-, GMT-, CWN- and ES-Index. The numbers without brackets are the scores determined by us for the CBI levels in 2021. The numbers in brackets are the original values given by *Alesina* 1988, *Grilli* et al. 1991, *Cukierman* et al. 1992 and *Eijffinger/Schaling* 1993. The bracketed numbers followed by an asterisk in the column to the right are values assessed by *Eijffinger/van Keulen* 1995. The bold numbers are the scores that take QE into account (as of 2021).

and developing countries, it cannot be clearly stated which index is the best measurement approach for a group of countries. Lastly, it is important to note, that while these measurement methods attempt to quantify CBI, they still leave room for subjective interpretation.

VI. Conclusion

This paper attempts to capture the different causes for the varying de jure CBI scores and to examine the main legal CBI indices. By applying the measurement approaches developed by *Parkin/Bade* (1978), *Grilli* et al. (1991), *Cukierman* et al. (1992), and *Eijffinger/Schaling* (1993) to a sample of 15 countries (and the European Central Bank (ECB)), we evaluate the level of Central Bank Independence (CBI) under current legal conditions. Then, the scores and the indices' correlation are compared to those determined by the original papers a few decades ago. Our analysis of CBI indices observes that – as of 2021 (before the inflationary pressure began) – de jure CBI and the correlation between the different indices have increased. The increase in CBI can be traced back to several central bank reforms and a shift away from direct loans to the government.

In a further step, we take effects of the unconventional monetary policy into account (Quantitative Easing (QE)). QE leads to lower CBI scores for the CWN-Index. However, aspects of unconventional monetary policy are not adequately reflected in most of the original CBI indices. A more serious alteration of the existing CBI indices would be necessary to reflect QE more appropriately. The development of a new index taking measures of unconventional monetary policy into account might proof advantageous.

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Annex
de facto CBI Indices

Index	Measurement method	Countries & Period	Measured against:			
			Inflation	Economic growth	Unemployment	Further
Questionnaire *Cukierman* 1992	Questionnaire addressed to monetary policy experts	24 countries 1980 – 89	Neg. relationship			
TOR *Cukierman* 1992	Average TOR of governors	58 countries 1950 – 89	Neg. relationship			

Note: The more independent a central bank is, the more points are awarded. Further, if criteria are described as unweighted, it can be assumed that each satisfied criterion is awarded one point.