Nexus Between Financial Innovation And Central Bank Independence: Evidence From Some Selected Oecd Countries

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Abstract

This study utilized the static panel estimators (fixed effects and random effects) and the panel quantile regression approach to examine the relationship between central bank independence and its determinants for a sample of 14 OECD countries over the period of 2006 to 2019. Generally, the study suggests that the relationship between central bank independence and financial innovation, as well as the two control variables (commitment towards inflation targeting rule and the rule of law score), is sensitive to the choice of estimators and measures of central bank independence, as was also found out by Agoba et al. (2017). Notwithstanding that the study employed alternative panel estimators, in line with the existing literature, the significant determinants of central bank independence include: financial innovation, inflation gap and observance of the rule of law. Based on the findings, this study recommends, amongst others, that central bankers in the selected OECD should not underestimate the possible influence on their statutory and operational autonomy by way of tracking the developments in financial sector innovation and resolving the areas of conflict with their monetary policy business.

Keywords: Financial Innovation, Central Bank Independence, Fixed-effect, Random-effect, Quantile regression

1. Introduction

The function of a central bank is statutorily limited to achieving price and financial stability. However, the realization of this objective requires some level of independence. The central bank should not be rendered so weak that its budgetary position predisposes it to political manipulations, nor should it be oversized such that the Bank becomes ungovernable (ECB,

2016). The central bank's independence is commonly defined in terms of personnel, policy objectives, policy instruments, and financial independence, reflecting the institutional and legal frameworks that allow central banks to operate in a technocratic and accountable manner (Eijffinger et al., 1996; Momani and Amand, 2014). The notion of central bank independence (CBI) became a globally accepted truth about 30 years ago, as it stresses that monetary policy is

conducted in a way that is consistent with the appropriate central bank objectives and is free of political influences (Wachtel and Blejer, 2020). Statistics a couple of decades ago supported the argument that independent central bankers have largely been able to keep inflation under reasonable control even in the era of macroeconomic instability. Moreover, as the countries with independent central banks grew to nearly 70 in recent years, the average global inflation rate fell sharply to 4% from over 25% recorded three decades ago (Marcel, 2021). One key reason for a solidly established independence is that central bankers prioritised credibility in their policies. Unlike many other policy units, independent central bankers rarely renege on previous promises and emphasise the predictability of monetary policy rules (Pastén and Reis, 2021).

On the flip side, financial innovation is generally conceived as creating new financial instruments, technologies, institutions, and markets. It includes institutional (for instance, new types of financial firms), product (say, new types of derivatives or securitized assets, among others) and process (for instance, online banking, phone banking, and other forms of information and communications technology) innovations (Dabrowski, 2017). In the perspective of Aayale (2017), financial innovation refers to any plausible improvement of a financial system. Financial innovation and digitalization in the financial sector involve the provision of payments, clearing, settlement services and credit. Incumbent financial institutions cooperate with or acquire FinTech firms, produce in-house technological solutions, and develop new business models - setting up bank affiliates with no physical branches or promoting mobile banking - to defend their market shares (Dabrowski, 2017; IFC, 2020; Thakor, 2020). Drawing on the classical theory of banking and the literature on digital transformation, Broby (2021) concluded that the relevance of trust in banking would remain as the world becomes more digital, while the nature of banking and financial services will change dramatically. The emergence of financial innovations as a substitute for traditional banks has been described as the Schumpeterian "creative destruction" - where

certain levels of risk and disruption must be allowed to ensure progress and innovation (see Dabrowski, 2017; Khraisha and Arthur, 2018).

These innovations can benefit final users by reducing the cost of financial services or easing financial access. One of the main advantages is greater competition, as FinTech lowers the barriers to entry and hence could expand the variety of services and reduce prices to end-users. Also, FinTech could boost financial inclusion in emerging and developing countries, as it may help unbanked people gain access to financial services through mobile devices. In advanced countries, financial innovation helps to provide a wider range of financial services to the underserved, usually low-income households. Lending and equity-based crowdfunding are other positive innovations in emerging and advanced economies (IFC, 2020). Central bank innovation via financial technology has potently engendered improved financial inclusion (Carstens, 2019). Moreover, advances in technology have introduced bank credit and debit cards, electronic banking, commercial paper, and securitization. Needful to know is that the financial products emerge to avoid or bypass existing regulations, such as reserve requirements and restrictions on interest paid on deposits, which brings to bear the creation of money market mutual funds that are not influenced by reserve requirements and interest rate ceiling (Mishkin, 2004).

In light of the aforementioned, the opportunities and risks associated with financial innovation have sparked wide-ranging debates among academia and policymakers alike on whether the emergence of financial innovation has any far-reaching implication on the independence or autonomy of the central bank in its conduct of monetary policy or not. Fintech presents unique opportunities for central banks in terms of the rapid changes in technology that are transforming the financial system so that they can perform their core functions, such as currency issuance and payment systems, more efficiently. Conversely, the national and international payment infrastructure could become dominated by private firms and networks considering the growing momentum of FinTech (see Bechara et

al., 2021). It has, however, been argued in some quarters that financial innovation disruptions would not interfere with the monetary policymaking and would not undermine the ability of central banks to achieve their price stability objective (Dabrowski, 2017). While this provides some relief, central banks must closely monitor the developments in financial innovation as they may surpass expectations and have significant implications for their statutory responsibilities (Mbazima-Lando and Manuel, 2020).

The critical ways central banks could place financial innovation developments under their surveillance are four-pronged. Firstly, developments in the financial sector may alter the reactions of the economy to monetary policy changes. Secondly, financial innovation could affect the content of information that central banks regularly monitor, thereby shaping their policy decisions (Solans, 2003). Thirdly, the introduction of financial innovation could necessitate new regulations, which might, in turn, compromise the effectiveness of the monetary policy. For example, central banks might need to change their operating procedures in response to the demands of financial innovation to guarantee the financial system's sustainability (Misati et al., 2010). Lastly, central banks might be prompted to amend their monetary policy frameworks, like the European Central Bank (ECB). The monetary policy strategy of the ECB, for instance, encapsulates an analysis of various monetary and non-monetary indicators and allows it to cross-check information from different sources using different approaches. Finally, this strategy monitors the financial innovation influence to better understand the risks to price stability in the Euro Area and the impact on the overall economic activities (see Mbazima-Lando and Manuel, 2020).

In addition, CBI separates the authority that prints money (the central banks) from the authority that spends it (the treasury). It is expected that, with this separation of authorities, central banks can focus on achieving price stability. CBI gives credibility to monetary policy in this way. For central banks that have adopted inflation targeting, the independence to choose a policy goal and/or instrument with which this goal can be achieved is embedded in its independence from the government (Agoba et al., 2017). To this end, this paper focuses on OECD countries that do not belong to a monetary union, that is, non-Euro Area member-states. The reason for this is not far-fetched as the selected countries have clear-cut monetary policy autonomy, which is one of the CBI components (see Balls et al., 2018). Besides, these countries have demonstrated unreserved commitment towards their set inflation targeting rules. Furthermore, these OECD member-states are high-income and advanced countries, with the expectation that central bank independence - hinged on the observance of the rule of law - would take its full course in their respective domains, as observed in the literature (see Cukierman, 1994; Agoba et al., 2017). The rest of this study is structured as follows: Section two contains a brief empirical literature review. Section 3 entails the methodological approach and data utilized in this study. Section 4 contains empirical analysis and discussion of results, while the last section concludes the paper.

2. A Review of the Empirical Literature

A large quantum of the literature has investigated the relationship between central bank independence and the macro-economy, albeit with mixed results across different measures of central bank independence, indicators of economic performance and samples (Cukierman, 2008). A strand of the literature examined the nexus between central bank independence and inflation. A strong correlation between central bank independence and low and stable inflation has been established in the literature (see Marcel, 2021). Instances include the Central Bank of Chile, which provides an excellent example of the merits of institutional independence. The independence of the Bank ended the 40 years of double-digit inflation, coinciding with a successful transition to democratic rule in 1990. The country's inflation dipped to 3% from 30% through the 1990s, while the economy expanded by 6% on average in the decade (Marcel, 2021).

Using a sample of 118 developing countries between 1980 and 2013, Garriga and

Rodriguez (2019) established that higher central bank independence is associated with lower inflation rates. This effect on inflation is stronger the more democratic a country is, but it is also present in non-democratic countries. Meanwhile, some studies have proved that there are some institutional prerequisites for central bank independence to be effective in taming inflationary pressures. For instance, focusing on 48 African countries over the period of 1970 to 2012, Agoba et al. (2017) found that the nexus between central bank independence and inflation depends on the model, sample and estimation techniques. Unlike in the case of developed countries, the authors revealed that CBI is not sufficient in lowering inflation in developing countries and Africa. This is, however, reversed in the presence of high levels of banking sector development and institutional quality. Similar findings were earlier documented by Hielscher and Markwardt (2012). The authors argued that political-institutional characteristics - reflected in democracy, accountability, the rule of law and bureaucratic systems - are needed to improve the credibility of the monetary policy regime. Notwithstanding, stagflation in developing countries has been traced to their central banks' legal and fiscal dependence (see Klomp and de Haan, 2009).

Nkem and Akujinma (2017) evaluated the relationship between financial innovation and bank efficiency and the impact of financial innovation on the efficiency ratio of deposit money banks in Nigeria from 2006 to 2014. Their findings revealed that financial innovation products reflected by the value of transactions on Automated Teller Machine (ATM), web/internet, Point of Sale (POS) and mobile banking have no significant impact on the efficiency ratio of deposit money banks in Nigeria. The surge of mobile money banking in sub-Saharan Africa (SSA) has positively affected economic growth (Ahassan et al., 2021). The growth of financial technology industries in Africa has also spurred financial experts to mark Africa as one of the leading continents in financial innovation. In essence, financial innovation is a fast-growing and multifaceted industry in developing nations. Evidences also suggest that banking sector development and stock market development indicators complement each other in stimulating economic growth in BRIC countries (Guru and Yadav, 2019). Financial innovation via financial service expansion, financial efficiency, capital accumulation, and efficient financial intermediation has been researched to positively affect economic growth (Qamruzzaman and Jianguo, 2018).

The literature on the nexus between financial innovation and central bank independence is rather scanty, perhaps due to the inaccurate proxies for financial innovation and central bank independence. Some studies focused on this line of research argued for a bidirectional causality between the two variables (see Cukierman, 2008). Aayale (2017) established that financial innovation – measured by Research and Development (R & D) expenditure and property rights, as well as patent applications – has a significant impact on the financial performance of BRIC (Brazil, Russia, India and China) and G-6 nations (Italy, Britain, Germany, Japan, France, the United States). Chipeta and Muthinja (2018) ascertained a positive association between financial innovation and the operational performance of Kenyan banks. Similar findings relating to Kenyan banks' performance with financial innovation were earlier found in studies by Muthinja (2016) and Makini (2010).

Using a large sample of actively managed equity funds in Turkey over the period of 2011 to 2018, Azimova (2021) found that activities of mutual funds responded significantly to financial innovation products. This clearly shows the importance of financial innovation in boosting financial sector growth. Lee et al. (2020) evaluated the impact of financial innovation on bank growth and how this growth is affected by the interaction of financial innovation with the various dimensions of institutional environments. With reference to a panel of 40 OECD and non-OECD countries spanning from 1989 to 2011, the authors observed three main findings: First, banks located in countries with higher levels of financial innovation exhibit better growth in assets, loans, and profits. Second, bank regulations, financial reforms, and country governance indicators weakened the relationship between financial innovation and bank growth.

Lastly, globalization strengthened the relationship between financial innovation and bank growth. On the flip side, financial innovation worsens the fragility and performance of the banking industry during a global financial crisis. This effect is larger for countries with a larger securities market and restrictive regulatory framework (see Beck et al., 2016).

To this end, the current study contributes to the literature on the nexus between financial innovation and central bank independence. In view of the relationship between financial innovation and bank growth on the one hand and between central bank independence, inflation and institutional quality as reviewed above, this paper investigates the role of financial innovation, commitment to inflation targeting and the extent of the rule of law observance in explaining the independence of central banks in some selected OECD countries, particularly the group of countries without membership of monetary unions, such as the Euro Area. Moreover, as noted earlier, many of these countries have granted considerable independence to their central banks for seamless conduct of the monetary policy.

3. Methodology and Data

3.1 Estimation Technique

The study utilized static panel estimators – fixed-effect and random-effect versions. The study also relied on the panel quantile regression approach to investigate the relationship between financial innovation and central bank independence while controlling for other probable determinants of central bank independence in 14 Organization for Economic Cooperation and Development (OECD) member countries over the period from 2006 to 2019. The countries captured include the United States, Australia, Czech Republic, Canada, Israel, Poland, Denmark, Japan, Korea Republic, Norway, United Kingdom, Mexico, Iceland, and Turkey.

The static panel estimators were employed considering the small size of observations across time and space/cross-sections. The fixed-effect estimator assumes

heterogeneity in country-specific characteristics given the observed variation of central bank independence exhibited by the selected OECD countries. On the other hand, the random-effect estimator assumes a uniform intercept for all the cross-sectional units but that the intercept follows a random distribution. Hausman's test determines the choice of static panels, suggesting a null hypothesis that the random-effect estimator is more efficient than the fixed-effect estimator.

Moreover, as Koenker and Bassett (1978) initially proposed, quantile regression provides estimates of the linear relationship between explanatory variables and a specified quantile of the dependent variable. One important special case of quantile regression is the least absolute deviations (LAD) estimator, which corresponds to fitting the conditional median of the response variable.

A typical panel quantile regression can be specified as:
$$y_{it} = x'_{it}\beta_\tau + \varepsilon_{it} \text{ and } \text{Quant}_\tau(y_{it}/x_{it}) = x'_{it}\beta_\tau$$

Where y_{it} is the response variable (the index of central bank independence, in this case); x_{it} is a vector of explanatory variables (which, in this case, stand for financial innovation, deviation of actual inflation from the target level and the rule of law index); β_i is a vector of parameters to be estimated; ε_{it} is a vector of disturbance terms; $\text{Quant}_\tau(y_{it}/x_{it})$ identifies the τth conditional quantile of y_{it} given x_{it}.

3.2 Data Description

3.2.1 Measures of Central Bank Independence

Legal independence is a reasonable proxy for actual independence, provided there is sufficient respect for the rule of law in the country under consideration. There is a reason to believe that, at least as far as central bank legislation is concerned, the law is a poorer indicator of actual practice in less developed countries (LDCs) than in industrial economies. This study adopts the

legal central bank independence (CBI) index computed for 182 countries over the period of 1970 to 2014 in the study by Garriga (2016). Therefore, the current study extends the CBI data till 2019 using the simple moving average approach. The computed CBI follows Cukierman, Webb, and Neyapti's (CWN) criteria. The CWN CBI index is based on a weighted aggregation of 16 legal indicators in four categories regarding the tenure of the bank's governor, policy formation, objectives, and limitations on lending to the government, using the criteria and weights in CWN. The index varies between 0 and 1, with larger values indicating greater independence. A central bank is legally more independent when the governor's term in office is longer; the appointment and dismissal procedures are more insulated from the government; the mandate is more focused on price stability; the formulation of the monetary policy lies squarely with the central bank, and the provisions on direct central bank lending are restrictive. This index fails to add measures of limits on the reappointment of the CEO, measures of provisions affecting (re)appointment of other board members similar to those affecting the CEO, and the restrictions on government representation on the board, and intervention of the government in exchange rate policy formulation as suggested in the literature. However, the legal CBI index computed in Garriga (2016) represents the most comprehensive data on CBI that spans the longest period and covers the most number of countries, which is useful for conducting a panel study (see Agoba et al., 2017).

3.2.2 Measures of Financial Innovation and Other Control Variables

Gauging innovative activity in the financial sector is more challenging (see Aayale, 2017), as patents in the financial sector rarely exist and not at all in the European Union. Research and Development (R&D) expenditures are typically not collected for financial institutions or data on research staff. This lack of data has impeded the rigorous stud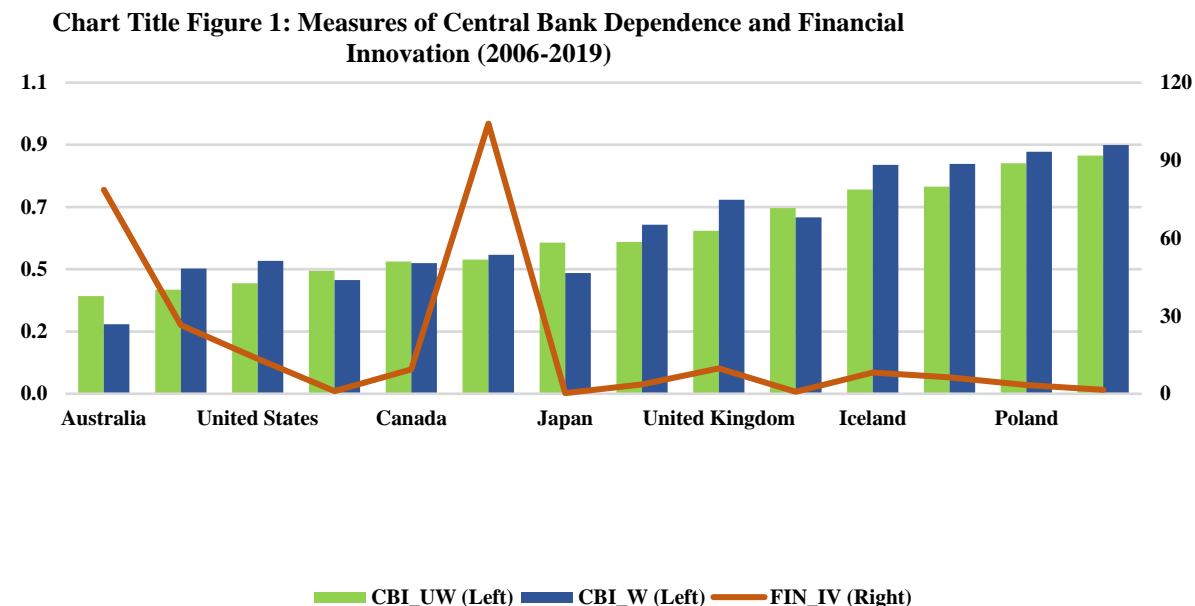y of financial innovation across countries. However, this study collected data on R&D expenditures in the financial intermediation industry from the Analytical Business Enterprise Research and Development database (ANBERD). ANBERD was developed to provide a consistent, internationally comparable dataset of enterprise R&D expenditures across industries and over time and builds on data provided to the OECD by its member countries through the joint OECD/Eurostat R&D survey. The current study relied on the World Bank's computed rule of law score. The rule of law score ranges between -2.5 (no compliance with the rule of law) and +2.5 (perfect compliance with the rule of law). This study also computed the inflation gap as the difference between the actual inflation data obtained from the World Bank's World Development Indicators (WDI) and the inflation target data retrieved from reliable online sources.

4. Empirical Results and Discussion

4.1. Preliminary Analysis

4.1.1. Graphical Representation

Europe – particularly the group of non-Euro Area members - outperformed other regions in terms of the degree of central bank independence (CBI) index ranging between 0.6 and 0.9, particularly for the weighted measure of CBI (see Figure 1). The Asian continent – represented by Japan, Israel and the Korean Republic - took the second lead with the CBI index in the range of 0.4-0.6, while North America – represented by Canada and the United States – occupied the third position with an average CBI index of approximately 0.5 over the period from 2006 to 2019. Comparatively, the CBI values are far from the lower index in the range of 0.1-0.3 in many African countries, including Nigeria. This stresses that advanced economies, on average, have a considerable level of central bank independence over developing countries in Africa, most especially for the weighted and unweighted measures of CBI (see, Agoba et al., 2017; Balls et al., 2018).

Chart Title Figure 1: Measures of Central Bank Dependence and Financial Innovation (2006-2019)

CBI_UW (Left)　　CBI_W (Left)　　FIN_IV (Right)

Source: The Charts are based on the data compiled from Garriga (2016) and OECD database

On the flip side, financial innovation – measured by the financial sector's research and development (R&D) spending – is highly volatile across the sampled OECD countries. While the United States recorded the largest R&D spending in its financial sector in absolute terms, Denmark had the highest R&D spending in per capita terms. Save for Denmark, an outlier, Europe and Asia have lower R&D spending in the financial sector relative to North America in per capita terms. This suggests that the divergence of financial innovation developments has implications on the degree of central bank independence amongst the non-Euro Area members of the OECD. This ultimately constitutes the main thrust of the current study.

4.1.2. Descriptive Statistics

The data utilized in this study are described in Table 1. The average CBI indexes for the sampled OECD countries are 0.58 and 0.6 for the unweighted and weighted measures, respectively. As noted earlier, the non-Euro Area European countries in the group boosted the CBI performance of the region, as also reflected in the average minimum and maximum values of the weighted and unweighted CBI index. In terms of financial innovation, the R&D spending per capita in the financial sector averaged 19.05 (in natural log terms), boosted by an outlier country – Denmark. The rule of law score[1] For the sampled OECD countries averaged 1.2, which tilts more towards the improved compliance territory with a maximum score of +2.5. This also demonstrates the greater extent to which OECD countries are law-compliant compared to many developing countries in Africa (see Cukierman, 1994; Agoba et al., 2017).

Table 1: Summary Statistics

Variable	Obs.	Mean	Std. Deviation	Coefficient of Variation (%)	Minimum	Maximum

cbi_uw	196	0.5767	0.1644	28.5070	0.3536	0.8613
cbi_w	196	0.5993	0.1964	32.7716	0.2511	0.8990
lfin_iv	196	19.0527	31.3949	164.7793	0.0029	132.1441
roli	196	1.2133	0.7457	61.4605	-0.6700	2.1100
c_inf_t	196	0.3187	2.1555	676.3414	-3.3741	11.3325

Source: Authors' computation from STATA 16.0

There is also improved commitment towards the monetary policy framework largely anchored on inflation targeting in most OECD countries. For example, the average deviation of the actual inflation rate from the inflation target is estimated at 0.3 percentage points. In terms of maintaining the inflation rate close to the targeted level, the United States is the best performer, whereas the least performer in the group is Turkey.[2]. With respect to the coefficient of variation, the highly volatile/less stable series is the inflation gap (that is, the deviation of the inflation rate from the targeted level). In contrast, the two measures of CBI represent the least volatile/more stable series.

4.1.3. Correlation Analysis

The pair-wise correlation coefficients between the variables employed in this study are presented in Table 2. In line with the computation of Garriga (2016), the correlation coefficient between the weighted and unweighted CBI indexes is the highest at 0.94. The two measures of CBI are negatively correlated with both financial innovation and the rule of law score. However, a narrower inflation gap correlates with an improved commitment to the rule of law, as shown by the negative correlation between variables. On a final note, there is a positive association between the deviation of inflation from the targeted level and both measures of CBI. While correlation analysis is not so instructive about the direction and magnitude of the statistical relationship between CBI and its potential determinants considered in this paper – financial innovation, the rule of law and the inflation gap, we resort to regression analysis to achieve this goal.

Table 2: Correlation Matrix

	cbi_uw	cbi_w	lfin_iv	roli	c_inf_t
cbi_uw	1				
cbi_w	0.9437	1			
lfin_iv	-0.4455	-0.4491	1		
roli	-0.6209	-0.4798	0.4641	1	
c_inf_t	0.3329	0.3415	-0.1410	-0.3081	1

Source: Authors' computation from STATA 16.0

4.2.Discussion of Results

4.2.1 Static Panel Results: Fixed Effect and Random Effect Estimators

Across the different measures of central bank independence (CBI) and panel estimators, financial innovation has a negative impact on central bank independence, though the impact coefficients are not statistically significant at the conventional levels. This suggests that the

influence of the growing financial innovation momentum on central bank independence cannot be overlooked. Irrespective of the CBI measures and estimators, the rule of law positively affects central bank independence, and the associated impact coefficients are statistically significant at the conventional levels (1%, 5% and 10%). By implication, the observance of the rule of law is supportive of the independence/autonomy of the central banks of the selected OECD countries.

Table 3: Static Panel Estimates of CBI Determinants in some selected OECD Countries

	Unweighted Measure of CBI		Weighted Measure of CBI	
	cbi_uw_fe	cbi_uw_re	cbi_w_fe	cbi_w_re
lfin_iv	-0.0017(0.0017)	-0.0016(0.0018)	-0.0019(0.0021)	-0.0019(0.0021)
roli	0.0484***(0.1658)	0.0308*(0.0163)	0.0583***(0.0199)	0.0433**(0.0195)
c_inf_t	-0.0011(0.0009)	-0.0019(0.0009)	-0.0013(0.0011)	-0.0014(0.0012)
constant	0.5207***(0.0199)	0.5419***(0.0428)	0.5318***(0.0239)	0.5497***(0.0548)
R^2	0.3948	0.3969	0.2482	0.2533
Hausman's test	28.03[0.0000]		11.64[0.0087]	

Source: Authors' computation from STATA 16.0

Note: ***, **, * indicate the significance of coefficients at 1%, 5% and 10%, respectively; the values in parentheses are the standard errors associated with the regression coefficients. The values in block brackets are probabilities.

Across the different measures of central bank independence and panel estimators, the deviation of the inflation rate from the inflation target has a negative and insignificant effect on central bank independence. The lower the actual inflation rate (or, the narrower the inflation gap), the higher the independence of central banks in the selected OECD countries. This supports the earlier findings that a lower inflation rate is consistent with greater central bank independence (see Garriga and Rodriguez, 2019). The Hausman's test statistic suggests accepting the null hypothesis that a random effect estimator is more efficient than a fixed effect estimator.

This is supported by the higher coefficient of determination associated with random effect estimates over the fixed effect estimates. The insignificant impact of the main variable of interest (financial innovation) makes the consideration of alternative estimators plausible.

4.2.2 Quantile Panel Regression Result

Contrary to static panel estimators, the quantile panel regression results show that financial innovation exerts a positive and significant influence over central bank independence, particularly for the first and second quantiles. This suggests that financial innovation might not all be harmful to the independence of central banks of the selected OECD countries. This statistical significance of the impact coefficients at the first and second quantiles indicates that financial innovation guarantees a significantly

higher effect on central bank independence (CBI) at the lower quantiles (first and second) than thus its impact at the last quantile of the CBI index distribution. This result is more instructive and interesting when compared with the static panel results (fixed and random effect estimates), which assume no quantile effects; that is, they show that the responsiveness of central bank independence to financial innovation developments is symmetric across quantiles. However, this may not always be the case since the countries considered in this study have considerable variation in central bank independence and financial innovation levels.

Table 4: Panel Quantile Estimates of CBI Determinants in some selected OECD Countries

	Unweighted Measure of CBI			Weighted Measure of CBI		
	cbi_uw_25	cbi_uw_50	cbi_uw_75	cbi_w_25	cbi_w_50	cbi_w_75
lfin_iv	0.0063 (0.0057)	0.0008 (0.0093)	-0.0016 (0.0099)	0.0171** (0.0071)	0.0235*** (0.0085)	0.0014 (0.0159)
roli	-0.1264*** (0.0172)	-0.1482*** (0.0284)	-0.1826*** (0.0299)	-0.0935*** (0.0216)	-0.2013*** (0.0258)	-0.1366*** (0.0484)
c_inf_t	0.0053 (0.0049)	0.0060 (0.0081)	0.0162* (0.0085)	0.0106* (0.0061)	0.0099 (0.0073)	0.0136 (0.0137)
constant	0.5946*** (0.0207)	0.7579*** (0.0339)	0.9009*** (0.0359)	0.5800*** (0.0259)	0.7830*** (0.0309)	0.9286*** (0.0579)
R^2	0.2270	0.2453	0.2561	0.1357	0.2186	0.1523

Source: Authors' computation from STATA 16.0

Note: ***, **, * indicate the significance of coefficients at 1%, 5% and 10% respectively; the values in parentheses are the standard errors associated with the regression coefficients.

Also conflicting with the a priori expectation is the observed inverse relationship between the rule of law score and CBI measures (weighted and unweighted). This relationship is true irrespective of the measures of CBI used. Meanwhile, there is an observed improvement in the rule of law effect on central bank independence in descending order from the last to the first quantile, particularly in the case of the unweighted measure of the CBI. This result suggests that non-Euro Area OECD countries with improved compliance with the rule of law could demonstrate better CBI performance than countries with little compliance. Therefore, we can conclude that the variation in the observance of the rule of law has significant effects on CBI performance across the three quantiles, as indicated by the statistical significance of the impact coefficients for both measures of CBI at the 1% level.

Similarly, this study uncovered a positive relationship between the inflation gap and both measures of CBI. This result, however, conflicts with the conventional wisdom that higher CBI is associated with a narrower gap between the actual inflation and inflation target. The current result suggests that a high CBI index is not always associated with stable inflation, except with an improved institutional and policy environment. This is a gap that this study presents for subsequent studies in this line of thought. The fact can be tested by including the interaction between the measures of institutional quality (such as the rule of law) and inflation as a control variable in

the CBI model.[3]. Aside from validating the robustness of results, studies focused on this area could be instructive about the direct and indirect effects of compliance with the inflation target rule on central bank independence. In addition, the coefficient of determination suggests the superiority of the quantile regression of the unweighted CBI index over that of the weighted measure of CBI.

5. Concluding Remarks

This study utilized the static panel estimators (fixed-effect and random-effect) and the panel quantile regression approach to examine the relationship between central bank independence and its determinants. The study sampled 14 OECD countries over the period 2006 to 2019. Generally, the current study suggests that the relationship between central bank independence and financial innovation, as well as the two control variables (commitment towards inflation targeting rule and the rule of law index), is sensitive to the choice of estimators and measures of central bank independence, as was also found out by Agoba et al. (2017). In specific terms, the results of fixed-effect and random-effect panel estimators showed that financial innovation has a negative impact on central bank independence, even though the impact coefficients are not statistically significant at the conventional levels. Improved observance of the rule of law is positively related to central bank independence, particularly when the static panel results are considered.

Moreover, the lower the actual inflation rate (or the narrower the inflation gap), the higher the independence of central banks in the selected OECD countries when static panel results are considered. Considering the panel quantile regression approach, we observed that financial innovation has a positive and significant effect on central bank independence. It can, therefore, be concluded that the variation in the observance of the rule of law has significant effects on CBI performance across the three quantiles, as

indicated by the statistical significance of the impact coefficients for both measures of CBI at the 1% level. Similarly, this study uncovered a positive relationship between the inflation gap and both measures of CBI. This result, however, conflicts with the conventional wisdom that higher CBI is associated with a narrower gap between the actual inflation and inflation target. This is an important gap that this study presents for subsequent studies. The fact can be tested by capturing the interaction between the measures of institutional quality (such as the rule of law) and inflation in the CBI model.[4]. Aside from validating the robustness of results, similar studies in this area could be instructive about the direct and indirect effects of compliance with the inflation target rule on central bank independence.

In addition, considering the case sensitiveness of using different panel estimators and CBI measures (weighted and unweighted indexes), this study offers the following recommendations. First, the significant positive effect of financial innovation notwithstanding, the extent of financial innovation developments could threaten the independence or autonomy of central bankers in the selected OECD countries. Hence, there is a need for the central banks to work out plans to resolve areas of conflict between financial innovation and central bank independence, just as is the case with the European Central Bank (ECB)[5]. Second, there is a need for improved observance of the rule of law among the selected OECD countries, as this is key to enhancing central bank independence. Third, there is also a need for the selected OECD countries to remain committed to achieving their inflation targets. This reflects the degree to which their central bankers can independently conduct the monetary policy business in their respective domains.

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