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Abstract

Since the crisis financial regulators and supervisors have been given increased independence from political bodies. But there is no clear evidence of the benefits of these reforms on the stability of the banking sector. This paper fills that void, introducing a new dataset of reforms to regulatory and supervisory independence for 43 countries from 1999-2019. We combine this index with bank-level data to investigate the impact of reforms in independence on financial stability. We find that reforms that bring greater regulatory and supervisory independence are associated with lower non-performing loans in banks' balance sheets. In addition, we provide evidence that these improvements do not come at the cost of bank efficiency and profitability. Overall, our results show that increasing the independence of regulators and supervisors is beneficial for financial stability.

Key words: Agency independence, financial stability, banking supervision, banking regulation, regulatory agencies.

JEL classification: E58, G28.

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1   Introduction

Policymakers consider the independence of banking regulators and supervisors crucial for financial stability. The rationale for regulatory and supervisory independence is that governments have an incentive to adopt a less stringent regulation and supervisory approach to boost their electoral support at the cost of financial instability (Quintyn and Taylor, 2002; Herrera et al., 2019). Delegating these responsibilities to independent agencies would therefore isolate regulation and supervision from the electoral cycle. The independence of supervisors from governments is therefore one of the pillars of the Basel Committee's core principles for effective banking supervision (Basel Committee on Banking Supervision, 2012),[1] and compliance to this principle is regularly assessed by the International Monetary Fund and the World Bank.[2]

Yet, regulatory and supervisory independence (RSI hereafter) is not widespread. As reported by the IMF (IMF, 2010; Adrian and Narain, 2019), RSI is the Basel Core Principle that has the lowest degree of compliance across the countries it examines. This reticence has been coupled with mounting political interferences on regulatory and supervisory decisions, suggesting that the delegation of these policies to unelected agencies is perceived as politically costly. Recent cases include the appointment of the head of the Turkish supervisory authority, the removal of the governor of the Russian central bank, the resignation of the head of the Latvian financial regulator and the political clash preceding the re-appointment of the governor of the Bank of Italy.[3] As the independence of regulators and supervisors might entail high political costs, it is then crucial to understand whether it is actually beneficial for financial stability.

In this paper we aim to address this question. We investigate whether reforms that increase regulatory and supervisory independence enhance financial stability.[4] To this end, we introduce a new database on reforms to the degree of independence of regulators and supervisors from governments. Using a hierarchical linear model, we test whether reforms which increase independence lead to better financial stability outcomes on a panel of more than 3000 banks in 43 countries from 1999 to 2019. We first look at whether changes in RSI are associated with increases in bank non-performing loans, which are a proxy of financial stability. Then, we investigate whether the same reforms are related to changes in bank efficiency, profitability

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[1]Similarly, the Financial Stability Board includes the need for sufficient independence for supervisors among its recommendations to improve the intensity and effectiveness of supervision (Financial Stability Board, 2010).

[2]As part of their Financial Sector Assessment Program.

[3]These cases have been documented by several journalistic sources: Reuters (2015) "Turkey names veteran Islamic banker as head of regulator", 15 May 2015. Wall Street Journal (2002) "Putin Shakes Up Central Bank; Move May Speed Bank Reforms", 18 March 2002. Bloomberg (2011) "Latvian Bank Regulator Resigns After Bank Suspension, BNS Says", 28 November 2011. Concerning the Italian case, the reason for the clash was specifically related to the assessment of the Bank of Italy's banking supervision, which some politicians criticised. See Reuters (2017) "Bank of Italy's Visco gets second term despite Renzi dissent", 27 October 2017.

[4]While we acknowledge the relevant distinction between regulation and supervision, as pointed out, among others, by Barth et al. (2004) and Eisenbach et al. (2019), in this paper we will use the two terms interchangeably. Our choice is led by the fact that, in the field of banking, banking regulation and supervision often rest in the same institution.

and lending.

We find that regulatory and supervisory independence is associated with a significant improvement in financial stability. Following a reform that increases independence, banks hold less non-performing loans. This relationship holds for both large and small banks and for different specifications of the baseline model. The result on financial stability is robust once we replace non-performing loans with the volatility of returns on assets, which measures bank risk-taking and serves as an alternative proxy of financial instability. After a reform increasing independence, bank risk-taking is significantly lower. Moreover, we show that the benefit of independence for financial stability does not come at the cost of lower bank efficiency and profitability. Reforms in independence are associated with an improvement in bank efficiency and have no effect on bank profitability. However, we notice that independence leads to a decrease in bank lending, suggesting that more independent agencies might adopt a more stringent approach.

This paper contributes to three main strands of the literature on banking and financial stability. First and foremost this work enriches the literature on regulatory and supervisory independence and financial stability, which is considerably smaller than the literature on central bank independence and inflation (for a review, see Masciandaro and Romelli, 2015). In particular, our work is the first to provide evidence on the link between independence and non-performing loans at bank-level. Previous works highlighted a positive relationship between RSI and financial stability indicators aggregated at country level (Klomp and de Haan, 2009; Dincer and Eichengreen, 2013). Estimates based on bank-level data are however more precise for two reasons. First, they allow to control for bank-specific characteristics. Second, they reduce the potential endogeneity bias as the instability of an individual bank is less likely to drive a reform than instability at aggregate level. An exception is Doumpos et al. (2015), who use data at bank-level and find that central bank independence is associated with higher soundness, measured by bank Z-scores. However, they measure the impact of independence on financial stability using an index of central bank independence. This index is not ideal to measure RSI since it is based on criteria for the independence of monetary policy and not supervision (see Cukierman et al., 1992 for details),[5] and since not all central banks are in charge of regulation and supervision (Fraccaroli, 2019; Masciandaro and Romelli, 2018).

Second, this work provides new evidence on the link between RSI and bank efficiency, profitability and lending. Our results on efficiency are in line with the ones of Barth et al. (2013b), who show that bank efficiency is enhanced where the supervisor is more independent and experienced. Nevertheless, they use a broader definition of independence, which encompasses independence from the court and aspects of accountability. Our estimates on lending complement the ones of Dincer and Eichengreen (2013), who show that more independent supervisors are associated with lower bank credit-to-GDP.

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[5]For example, a central bank is more independent if it has price stability as its primary mandate.

Thirdly, we contribute to the literature by providing a new indicator of the independence of regulators and supervisors. To our knowledge, our index has the advantage of focusing more specifically on the isolation of the agency from politically-elected bodies compared to other indicators. The index by Barth et al. (2013b) is based, among other aspects, on which institution the supervisor is accountable to (government, parliament...) and whether the supervisor is legally liable for its actions. The independence of the agency from the courts, however, does not necessarily relate to political independence, especially in countries where the court is independent and checks and balances robust.[6] The index by Dincer and Eichengreen (2013) is based on two criteria: whether the supervisor is part of the Ministry of Finance or the central bank and whether its budget relies on the parliament or government. While their index focuses on political independence, our measures relies on a broader set of criteria including the body in charge of the appointment and removal of the head of the agency, the length of her term and the ability of the agency to issue regulation without government approval.

The remainder of this paper is structured as follows. The next section provides the theoretical background for the choice of non-performing loans as an indicator of financial stability and its link with RSI. Section 3 describes how we measure the independence of regulators and supervisors. Section 4 outlines our empirical model, whereas section 5 describes the data used. Section 6 presents and discusses the empirical results alongside a set of robustness checks. The last section concludes.

2 Regulatory-Supervisory Independence and Financial Stability

This section provides the theoretical background underlying the relationship between RSI and financial stability. It first motivates why we choose bank non-performing loans as an indicator of financial stability among other variables. Then, it outlines the link between RSI and non-performing loans.

2.1 Non-Performing Loans as a measure of financial stability

We use the share of bank non-performing loans over total gross loans (NPLs henceforth) as an indicator for financial stability. NPLs have the advantage of being a direct target for regulators and supervisors, who aim to reduce them. Moreover, NPLs are a key indicator of financial instability, as they capture excessive risk taking in the banking sector (Koetter et al., 2014).

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[6]This decision is also informed by the findings on the relationship between central bank independence and checks and balances. A number of works found that central bank independence is less effective when checks and balances are weak, highlighting the importance of analysing these variables as separate (Acemoglu et al., 2008; Keefer and Stasavage, 2003; Moser, 1999). Moreover, the relationship between accountability and independence is not always clear, as more accountability could both enhance and hinder independence (see Fraccaroli et al., 2018 and Briault et al., 1998 for a discussion).

NPLs affect negatively the funding cost for the bank, and often result in a reduction of its lending, passing the costs onto firms and households. Therefore, a systemic increase of NPLs across banks in a country can be detrimental for both credit growth and economic growth.

In line with this, a number of works use NPLs to assess the effectiveness of bank regulation and supervision. Delis and Staikouras (2011) show that effective supervision and market discipline requirements are key to reduce bank NPLs. Hirtle et al. (2016) find that banks that receive more supervisory attention, measured in hours spent by the US Federal Reserve supervisors on individual institutions, have lower NPLs. NPLs have also been used at macro level to compare the performance of different types of supervisory governance across countries (Dincer and Eichengreen, 2013; Koetter et al., 2014; Fraccaroli, 2019).

Furthermore, the share of NPLs is a more convenient indicator than the (more widely used) occurrence of banking crises to assess the effectiveness of regulation and supervision for financial instability. The occurrence of systemic crises, captured by a year dummy that equals 1 when a crisis occurs in a country, has been largely used in the literature since the emergence of historical databases such as the ones by Reinhart and Rogoff (2009), Laeven and Levine (2009) and Jordà et al. (2017). However, this index is not as informative as NPLs. One reason is that, since it accounts solely for the occurrence of a crisis, it does not provide information on those events where crises were prevented. The same reasoning applies to the number of bank crises, which is another indicator of banking instability. In addition, NPLs already incorporate partially the occurrence of a systemic crisis as recessions are associated with peaks in NPLs.

2.2 The link between Regulatory-Supervisory Independence and Non-Performing Loans

Having assessed the relevance of regulation and supervision for NPLs, it is now crucial to understand how RSI can affect them. Independent regulators and supervisors may reduce bank NPLs through a number of channels.

First, politically independent regulators are more likely to limit banks' risk-taking behaviour in lending than their politically dependent peers. Unregulated banks find it profitable to minimise the costs of screening and monitoring when lending, which in turn increases the probability of a loan to turn non-performing. Regulators and supervisors can disincentivise risky lending through changes in capital adequacy rules (Gale, 2010) and regular onsite supervision (Eisenbach et al., 2019),[7] or through more targeted policies such as mandating a minimum write-offs on NPLs (Baudino and Yun, 2017). Political interferences on lending can exacerbate the risk-taking channel, as politicians have an electoral incentive not to limit

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[7]Eisenbach et al. (2019) find that a 100 percent increase in supervisory hours on a bank is associated with a reduction of 3 percentage points in the probability of severe distress for a bank. According to the authors, this is "consistent with a mechanism where banks de-risk in response to increased supervision" (Ibid., page 3) and is associated with a reduction in the probability of high loan loss provisioning.

credit growth. Herrera et al. (2019) show both theoretically and empirically that, when credit expands, regulation is politically costly for governments. Similarly, Dinç (2005) shows that government-owned banks tend to increase their lending in election years relative to private banks, while Sapienza (2004) finds that state-owned banks charge lower interest rates to firms located in areas where the political party that runs the state-owned banks is stronger. Independent agencies have therefore the inherent advantage of isolating regulation and supervision from this incentive structure.

A complementary channel is that a more independent supervisor could mitigate bank lending to politically connected firms, whose loans are generally more risky for two reasons. First, banks may lend to firms based on their connections rather than on their degree of risk. In support of this argument, Khwaja and Mian (2005) show that politically connected firms have 50 percent higher default rates and that the same firms receive a favourable treatment exclusively by government banks, and not by private ones. Second, politically connected firms and banks are more likely to be bailed out by the government in case of distress, which provides an incentive for moral hazard (Faccio et al., 2006). Independent regulators and supervisors could mitigate these two effects that increase risky lending by requiring higher standards when screening loan applications and by applying no distinction between firms that are politically connected or not.

Second, isolating regulators and supervisors from the electoral cycle allows them to set more credible and time-consistent plans to restructure existing NPLs. This argument is analogous to the time-inconsistency framework proposed by Kydland and Prescott (1977) and applied to monetary policy by Barro and Gordon (1983), which provides the basis for central bank independence (Alesina and Summers, 1993). Regulators and supervisors can induce banks to reduce the NPLs in their balance sheets through write-offs, direct sales or out-of-court workouts. For these policies to be credible, they need continuous guidance and monitoring over time. This may not be possible if the agency is politically dependent and hence subject to the shifts in policy preferences driven by the electoral cycle. For instance, if a politically dependent regulator sets a minimum write-off on NPLs, market operators may expect this threshold to decrease when elections are approaching, to incentivise bank credit or banks' campaign contributions.

Third, RSI isolates the agency from the pressures of the private sector that lobbies the government. Ignatowski et al. (2015) show that banks use lobbying expenditures and political connections to have a preferential regulatory treatment in case of distress. If the regulator is independent from the government, the benefits of lobbying the government to obtain a more lenient regulatory or supervisory treatment are substantially reduced, if not nonexistent. However, it is important to notice that RSI does not make supervisors immune from the lobbying pressures of the private sector directly on them. In fact banks could influence or even capture independent supervisors through bribes or job offers (the so-called 'revolving doors'

phenomenon).[8]

Given these considerations, we need an index of independence that measures precisely the degree of isolation of regulators-supervisors from political pressures. As described in the Introduction, existing indexes are not ideal to capture this aspect. In the next section we propose a new index of RSI that fills this gap.

3 Measuring Regulatory and Supervisory Independence

3.1 Index of Regulatory-Supervisory Independence

Based on the analogy with monetary policy, Quintyn and Taylor (2002) propose a set of elements to determine the independence of supervisors from political interferences: institutional, regulatory and budgetary independence. Institutional independence measures the degree of institutional separation between the agency and the electoral bodies. Regulatory independence captures the extent to which the government can interfere with regulatory activities. Budgetary independence is the extent to which the government can affect the resources assigned to the supervisor through its approval of the budget.

We build on these aspects to create an indicator of the independence of regulators and supervisors. To measure institutional independence we look at the procedures to appoint and remove the head of the regulatory authority, as well as the length of her term. For regulatory independence we look for the presence of statutory provisions that require the approval of the government for regulators to issue secondary binding legislation. To quantify budgetary independence we look at provisions that allow the government to affect the resources assigned to the supervisor through its approval of the budget. We intentionally focus on the government ability to determine the funding, rather than on the source of funding: as argued by the OECD (2016), "the source of funding - fees, general revenues or a mix of the two – is less important than the way in which funding needs are determined, appropriated and spent" (p. 13).

We combine these three criteria in a single indicator in a similar fashion to the index of central bank independence of Cukierman et al. (1992). In order to fill these criteria, we rely on a number of data sources which we describe in Section 5. Since we focus on the changes in this index rather than on its raw values, we include the details on how the index was constructed in the Appendix. Table 9 in the Appendix summarises the criteria used to quantify these aspects and how we combine them. Figure 4 in the Appendix presents the geographical distribution of the index.

Despite their similar theoretical underpinning, the delegation of regulation and supervision to independent bodies has been slower than the one for monetary policy. Figure 1 shows the

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[8]While evidence on revolving doors is scant, Lucca et al. (2014) show that this phenomenon seems to be more consistent with a regulatory schooling mechanism rather than a quid-pro-quo one.

evolution of the average independence in regulation and supervision and in monetary policy (central bank independence) over time in our sample. The index of regulatory and supervisory independence is the one introduced in this paper (and detailed in Section 8.3 of the Appendix), while the index of central bank independence is the one constructed by Cukierman et al. (1992) and updated by Garriga (2016). As shown in the figure, central bank independence displays a positive trend and grows steadily and at a relatively quick pace since the early 2000s. On the contrary, RSI increases more slowly and presents a discontinuous pattern, with two major jumps in 2003 and in 2011.

Figure 1: *The evolution of Regulatory and Supervisory Independence and Central Bank Independence*
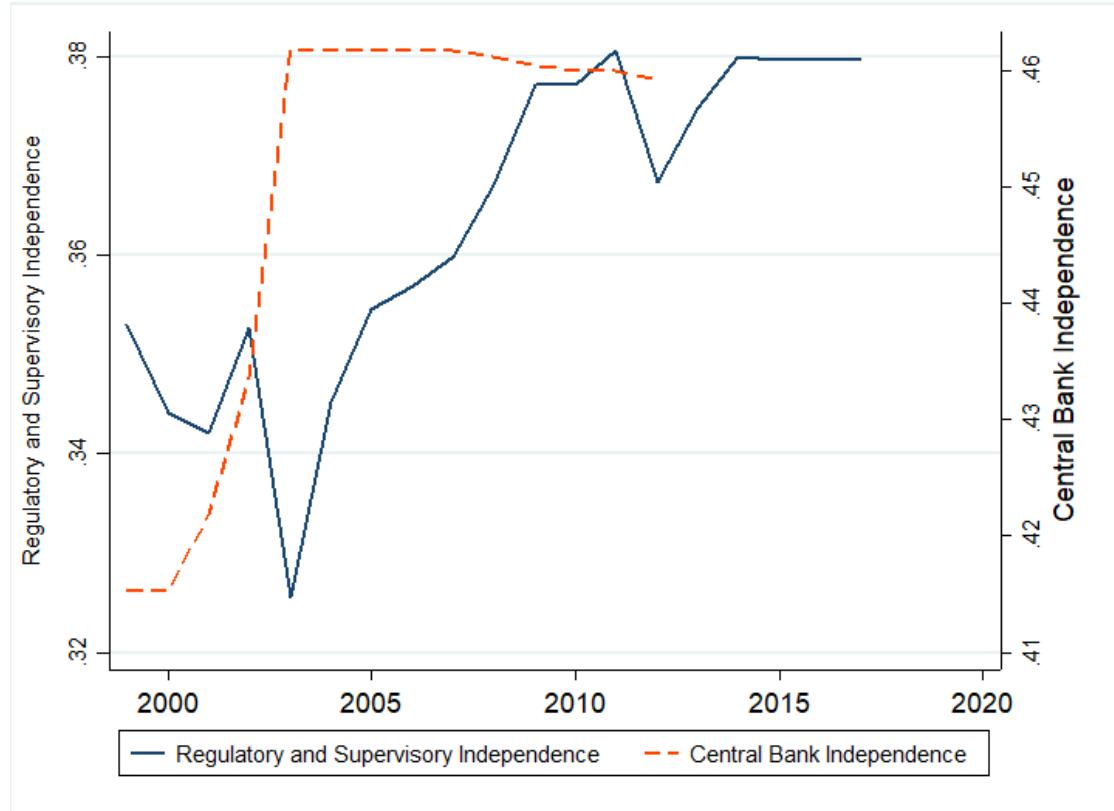
Note: *Own elaboration on own data and on data from Garriga (2016) for the central bank independence index. Both indexes are weighted.*

There are political economy considerations that explain the reticence toward strengthening the independence of regulation compared to the one of monetary policy.[9] One reason is that it is harder to find a quantifiable and targetable definition of the objective of regulators and

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[9]This can also be seen in the recent establishment of financial stability committees in a number of countries. Edge and Liang (2017), who document the increase in financial stability committees around the world, show that there is considerable government involvement. For example, in four countries the government sets the countercyclical capital buffer with advice from the central bank.

supervisors than it is with monetary policy. As argued by Tucker (2018) and (2016), this makes the delegation of regulation and supervision more difficult from a political economy perspective, as it may pose an obstacle to the accountability of unelected regulators. The distributional effects of financial stability policies are also perhaps more obvious and directly connected to the policy - for example being denied a loan due to limits on high LTV mortgages - than with monetary policy. Given the potential benefits but potential political and accountability difficulties, it is therefore critical to understand from an empirical perspective whether reforming independence is indeed beneficial for financial stability.

Moreover, as shown by Aklin and Kern (2020), historically reforms that increased central bank independence have been followed by a weakening of financial regulation. Weaker financial regulation allows governments to expand credit in strategic sectors for electoral purposes and therefore compensates for the loss of control on monetary policy. The descriptive evidence of Fig. 1 provides additional evidence in favour of this argument, showing that the independence of regulators and supervisors was weakened in the early 2000s, when governments granted higher independence to central banks. An additional explanation, which does not necessarily clash with the previous one, is that the early 2000s were characterised by the blurring of boundaries among financial sectors - banking, insurances and securities - and the emergence of financial conglomerates, which led to rethink the organisational structure of regulation and supervision (Quintyn et al., 2007).

3.2 Reforms in RSI

We are going to focus on reforms that increased independence rather than on the raw index. The rationale for this choice is the distinction between de jure and de facto independence. While our index is de jure, as it is based on legal provisions, looking at changes in this index provide us with a clearer view of actual -i.e. de facto- independence. This is motivated by the qualitative evidence of the International Monetary Fund's Financial Sector Assessment Program, which assesses (among other Basel Core Principles) the independence of supervisors in member states on a regular basis.

The assessments offer a clear qualitative perspective of the relationship between de jure and de facto independence in the countries examined. The German regulator, the BaFin, is an example of low de jure and high de facto independence. The BaFin, has a relative low independence score in our index. This is because it is under the legal and technical supervision of the Federal Ministry of Finance, which is also in charge of approving the discharge of its budget. This is acknowledged by the International Monetary Fund in its regular Financial Sector Assessment (IMF, 2016).[10] However, in the same assessment the IMF found no evidence

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[10]In particular, the IMF assessment states that 'there is potential for indirect influence of government and industry in the execution of BaFin's supervisory objectives through the budget approval process and the mandatory approval of BaFin's internal organisation and structure by the MoF' (IMF, 2016 p. 77).

of the Ministry of Finance influencing BaFin's supervisory decisions. Therefore, the lack of de jure independence may not necessarily result in lower de facto independence from political power. Similarly, the IMF raised concerns on the de jure independence of the Australian Prudential Regulatory Authority (APRA), as the Parliament has the power to disallow the prudential standards set by the regulator. However, since this veto power has never been used to date, the assessment of the APRA's de facto independence is overall positive (IMF, 2019).

The Turkish Banking Regulation and Supervisory Agency (BRSA) is an example in the opposite direction, with high de jure and low de facto independence. The IMF acknowledges that the agency (BRSA) enjoys a high degree of de jure independence. Nevertheless, it also notes that there are 'several channels of interaction between the BRSA and the government that, considered together, may accommodate political influence' (IMF, 2017, p. 30).

Following these considerations, we create a dummy variable that takes a value of one in every year in which a country implements a reform that increases the independence of regulators and supervisors, and zero otherwise. This approach has the advantage of comparing countries that increased independence with those that did not. According to Acemoglu et al. (2008), who adopt a similar strategy to study the impact of reforms in central bank independence on inflation, this approach has the advantage of being simple and transparent. The drawback of this indicator, however, is that it assumes that each reform strengthens independence by the same magnitude.

The occurrence of reforms for each year is summarised in Fig. 2, where the blue bars represent the number of reforms per year in our sample and the red dotted line represents the average number of reforms over the full time period, that is 2.65 per year. Most reforms take place in 2003 and 2011. Although it is likely that the high values of 2011 and 2012 are a reaction to the financial crisis, it is interesting to notice that a significant number of reforms took place in the pre-crisis period. The peak in 2003 is in line with the one displayed in Masciandaro and Quintyn (2011) and Romelli (2018), who report similar figures for reforms in the institutional architecture for financial supervision and in central bank independence respectively. In line with Romelli (2018), reforms decrease after 2013 and we find no reform in our sample from year 2016 on.

Figure 2: Reforms increasing Regulatory-Supervisory Independence, 1999-2019
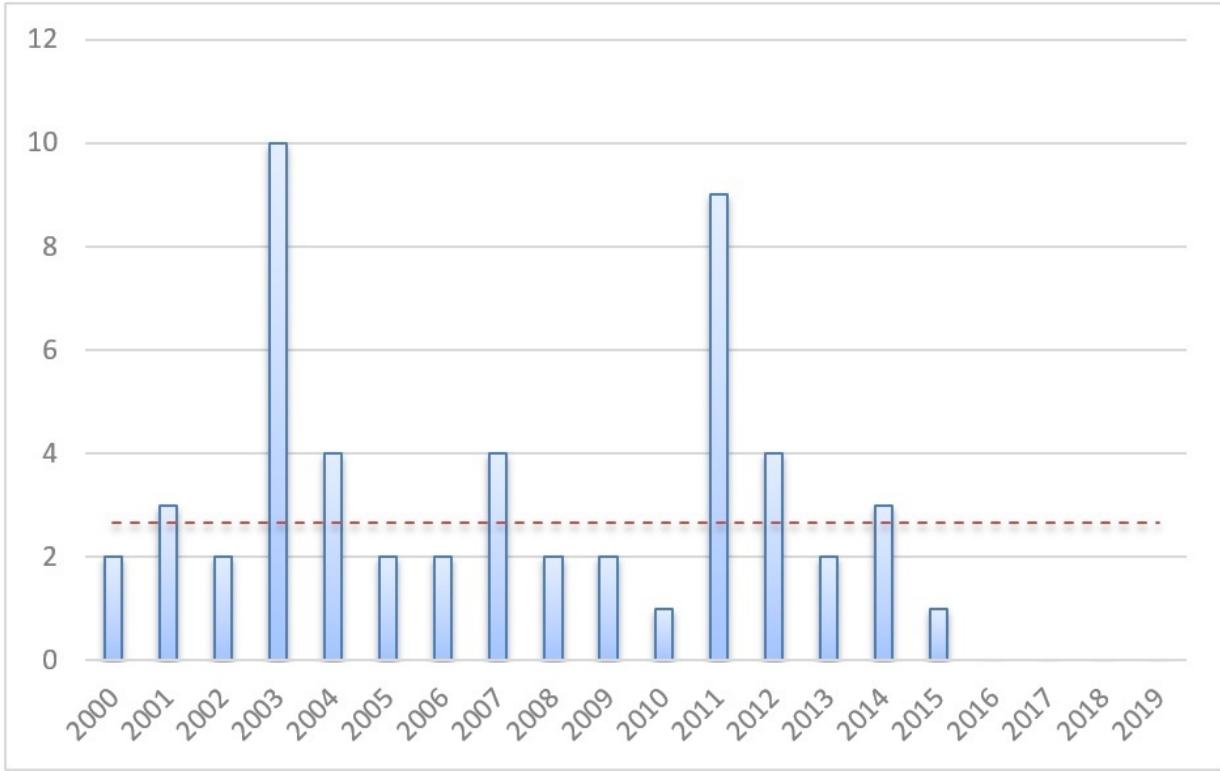
Note: The bars in light blue display the number of reforms that increasing RSI for each year. The dashed red line indicates the average number of reforms increasing RSI per year.

Figures 3 and 4 in the Appendix break down the evolution of regulatory and supervisory independence by country, providing a more detailed outlook on where reforms are concentrated. Figure 3 shows how the index of RSI evolved in each country of our sample, whereas figure 4 illustrates the average RSI score for each country in the sample for the period 1999-2019. The charts show that independence is heterogeneously distributed across regions and there are no obvious regional patterns.

4   Model

In order to study the relationship between RSI and financial stability, we apply a hierarchical linear model (HLM). The main advantage of HLM is that, differently from traditional fixed effect models, it takes into account the multilevel structure of the data. This means that HLM models consider observations as correlated within the unit in which they are nested, rather than being independently distributed. For this reason, HLMs have been recently used in the field of banking and finance to estimate the impact of country-level variables on banks or firms

(Mourouzidou-Damtsa et al., 2019; Doumpos et al., 2015; Li et al., 2013; Kayo and Kimura, 2011).

An additional benefit of HLM is that it decomposes the variance attributable to banks and to countries. In this way, the model allows the conditional mean of NPLs to vary not only at bank level but also at country level. HLM hence separates the unobserved heterogeneity driving NPLs at bank and country level. This is particularly relevant since variations in NPLs is potentially driven by different definitions of a loan as non-performing across countries or even across bank, as noted by Bholat et al. (2018) and Beck et al. (2015). HLM therefore has the benefit of reducing substantially the heterogeneity in NPLs attributable to country- and banks-level accounting differences.

Formally, we estimate the following equation:

$$Y_{ict} = \alpha + \beta RSI_{ct-1} + \delta X_{ict-1} + \eta W_{ct-1} + \mu_t + \tau_c + \psi_{ic} + \epsilon_{ict}$$

In the main specification, Y_{ict} is the share of non-performing loans over total loans held in year t by bank i, set in country c. We will then replace the dependent variable with other indicators at bank-level that measure bank risk-taking, efficiency, profitability and lending, as detailed in the following section. RSI is a dummy which equals 1 whenever a reform increases independence of regulators and supervisors in a country in year $t-1$, 0 otherwise. Our coefficient of interest is β, which captures the variation in non-performing loans at time t following an increase in RSI at time $t-1$.

$\boldsymbol{X}_{ict}$ and $\boldsymbol{W}_{ct}$ are vectors of bank-specific and country-specific controls respectively. On the latter, we choose not to use binary variables, such as whether a crisis is occuring, for two main reasons: first, the time period under consideration would be dominated by the global financial crisis, and second, financial crises come about after years of relaxed regulatory standards. Vector $\boldsymbol{X}_{ict}$ includes four bank-specific variables: size, measured as the natural logarithm of banks' total assets, efficiency, measured through the cost-to-income ratio, liquidity (share of liquid assets over total assets) and bank capitalisation (share of total equity over total assets). Vector $\boldsymbol{W}_{ct}$ includes GDP growth, GDP per capita growth, credit to GDP and inflation.

We control for time, country and bank fixed effects with the inclusion of μ_t, τ_c and ψ_{ic} respectively. Fixed effects are particularly important when dealing with NPLs. As documented by Bholat et al. (2018), while there has been substantial convergence in international standards for classifying a loan as non-performing,[11] definitions may still vary across jurisdictions and firms, and within firms across time, making the comparison of banks' assets difficult. Controlling for country and bank fixed effects allows us to capture those differences in NPLs that are specific to the actions of a single bank or to a country's accounting standards. Year

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[11]See for example D'Hulster (2018).

fixed effects capture time-dependent changes in accounting standards which would otherwise remain unobserved.

5 Data

5.1 Reforms in Regulatory and Supervisory Independence

We build a new index of reforms that increase the independence of regulators and supervisors for 41 countries for the period 1999-2019. Following Quintyn and Taylor (2002), we capture changes in three aspects of independence: institutional, regulatory and budgetary independence.

We use a number of different sources to collect information on these aspects and their changes through time. Data from the World Bank's Bank Regulation and Supervision Survey (Barth et al., 2013a) provides us with information on regulatory and budgetary independence. The survey contains the answers of regulators and supervisors on the following questions: 'is government approval needed for the supervisor to issue secondary binding legislation?' and 'is government approval needed on the budget of the supervisory authority?'. If the answer to one of these questions changes from positive to negative, our index will signal an increase in independence. To cover institutional independence, we use information from the same survey, which asks supervisors to indicate the body in charge with the appointment and removal of the head of their institution as well as with the length of her term. We combine the information of the survey with one in the IMF central bank legislation database and the BIS central bank law database.

Finally, to cross-check for institutional changes that do not feature in these database, we combine this information with data from Fraccaroli (2019) on the institutional allocation of supervisory responsibilities, Bodea and Hicks (2015) and Garriga (2016) on major central banking reforms and Quintyn and Taylor (2002) on changes in RSI prior to 2002. This makes our RSI index time-variant for those countries that reformed during the selected time period.

5.2 Bank and Macroeconomic Data

Our model includes a number of bank- and country-specific variables. Bank-level data are from the Bankscope database by Bureau van Dijk. Country-level variables are from the World Bank database, which includes indicators from different institutional sources.

We control for bank size, which we measure as the natural logarithm of bank assets in thousands of US dollars. Bank size is relevant as it is generally associated with lower NPLs. Crucially, larger banks are generally subject to higher supervisory attention, making size an important factor to control for. In addition, we control for a bank's efficiency (cost-to-income ratio), liquidity (liquid assets to total assets), and profitability (equity over total assets).

Based on the literature of the determinants of NPLs (Beck et al., 2015; Nkusu, 2011; Jiménez and Saurina, 2006), we include a number of macroeconomic predictors of banking fragility. In particular, our set of country-level controls includes GDP growth, GDP per capita, credit to GDP and inflation measured by the consumer price index.

Table 7 in the Appendix displays the descriptive statistics for our sample. The definition and source of each variable are available in Table 8 in the Appendix.

6   Results

6.1   Non-Performing Loans

Table 1 shows the results of our baseline specification for the full sample and with NPLs as dependent variable. In column 1 we regress NPLs against the dummy of reforms increasing supervisory independence. From column 2 to 4 we add cumulatively bank- and country-specific controls. An increase in the independence of regulators is associated with a negative and statistically significant reduction in NPLs at the 1% level under all specifications. The size of the coefficient of the full model (Column 4) indicates that a reform which increases supervisory independence is associated with a reduction in NPLs of 2.8% for a bank set in the country of reform. These results therefore highlight a positive link between supervisory independence and banking stability.

Table 1: HLM estimates of RSI reforms with NPLs as dependent variable, Full Sample

VARIABLES	(1)	(2)	(3)	(4)
RSI	-1.690***	-2.928***	-2.716***	-2.798***
	(0.245)	(0.257)	(0.230)	(0.242)
Log(Assets)		-0.509***	-0.290***	-0.325***
		(0.059)	(0.063)	(0.064)
Cost-to-Income Ratio			-0.021***	-0.021***
			(0.003)	(0.003)
Liquidity/Total Assets			0.024***	0.026***
			(0.004)	(0.004)
Equity/Total Assets			0.035***	0.037***
			(0.007)	(0.007)
GDP Growth				-0.275**
				(0.119)
GDP per capita				-0.012
				(0.109)
Credit to GDP				0.045***
				(0.006)
Inflation CPI				-0.330***
				(0.024)
Constant	8.069***	14.039***	11.507***	10.641***
	(1.072)	(1.249)	(1.307)	(1.610)
Observations	45,723	40,150	35,863	35,092
Number of groups	41	41	40	39
Year FE	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In Table 11 in the Appendix we test the robustness of these results by dropping specific countries from the sample. First, in columns 1 and 2, we drop the United States from the sample due to the peculiar structure of supervision in the country, where banks can engage in regulatory arbitrage by switching from state to national charters and viceversa (Agarwal et al., 2014, Rezende, 2014, White, 2011 and Rosen, 2003). Second, in columns 3 and 4 we exclude Greece and Indonesia, since their banks present particularly high levels of NPLs and might therefore influence the results. In columns 5 and 6 we exclude simultaneously all three countries from the sample. Under all specifications the results do not differ from the ones based

on the full sample. In particular, reforms in independence presents a negative and significant coefficients under all specifications which is of comparable size to the one of the full sample.

In Table 12 in the Appendix we add a dummy to control for the establishment of the Single Supervisory Mechanism in the euro area in the end of 2014. With the creation of the Single Supervisory Mechanism national supervisors of euro area member states started to supervise large banks alongside the European Central Bank. To control for this change, we construct a dummy that takes value of 1 from 2014 onward if a country, and therefore its supervisor, joined the supervisory mechanism, and equal to 0 otherwise.[12] The estimates displayed in Table 12 do not diverge substantially from the main results of Table 1.

6.2   Bank size

The impact of supervision on bank risk-taking may vary depending on the size of banks, since larger banks tend to receive more supervisory attention (Hirtle et al., 2016). We therefore test whether reforms have a different impact on banks that hold more assets, since they are subject to a more intense supervision. To this end, we split the sample into two groups: the first is composed of those institutions whose assets are above their country yearly average and which we define as larger banks, and the second of those equal to or below the country average, which we define smaller banks. We then estimate the baseline model on each subgroup. Results are displayed in Table 2.

Our estimates show that the negative relationship between supervisory independence and NPLs hold for both larger and smaller banks.[13] Under all specifications, the coefficient of reforms in independence is negative and significant at the 1% level. Once we include all controls, the size of both coefficients is similar to the one of the baseline model of Table 1 (2.8), but slightly higher for smaller banks. Overall, these results suggest that the relationship between RSI and NPLs does not vary significantly depending on banks' size.

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[12]An improvement of this measure would be a dummy at bank level, since not all the banks in a specific country are jointly supervised by the ECB and the national supervisors. However, as the criteria for a bank to be under the supervision of the SSM are multiple and not all quantifiable, we will keep this task for a later version of the paper.

[13]The two countries are missing from the sample of larger banks is that Estonia and Latvia have NPLs data on only one bank each. Since this equals the average, it falls under smaller banks. If we categorise these banks as larger, the results do not change.

Table 2: HLM estimates of RSI reforms with NPLs as dependent variable, sample split by bank size

VARIABLES	Larger banks		Smaller banks	
	(1)	(2)	(3)	(4)
RSI	-1.743***	-2.191***	-1.707***	-3.422***
	(0.290)	(0.304)	(0.377)	(0.368)
Log(Assets)		-0.104		-0.357***
		(0.094)		(0.129)
Cost-to-Income Ratio		-0.033***		-0.005
		(0.004)		(0.005)
Liquidity/Total Assets		0.036***		0.020***
		(0.005)		(0.006)
Equity/Total Assets		0.044***		0.028***
		(0.010)		(0.010)
GDP Growth		-0.738***		0.209
		(0.143)		(0.183)
GDP per capita		0.395***		-0.414**
		(0.132)		(0.169)
Credit to GDP		0.018**		0.082***
		(0.008)		(0.011)
Inflation CPI		-0.438***		-0.214***
		(0.030)		(0.037)
Constant	6.254***	10.325***	8.524***	5.953**
	(0.909)	(1.861)	(1.113)	(2.451)
Observations	21,037	16,730	24,686	18,362
Number of groups	39	37	41	38
Year FE	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.3 Robustness Check

As a test for robustness, we replace the dependent variable with an alternative indicator of bank risk-taking which is common in the literature: the volatility of return over assets (ROA) (see for example Mourouzidou-Damtsa et al., 2019; Delis and Staikouras, 2011). We define ROA volatility as the log-transformation of the three-year standard deviation of the ratio of

pre-tax profits to total assets. Following Delis and Staikouras (2011), as a further check, we present results of ROA volatility based on a four-year period. Higher values of ROA volatility imply a more risky position of banks.

Table 3 displays the results with ROA volatility as dependent variable. Columns 1 and 2 show the results for ROA volatility over a three-year window, whereas columns 3 and 4 expand the window to four years. Reforms in supervisory independence remain negatively and significantly associated with bank risk under all specifications. The coefficients indicate that, following a reform that increases independence, banks tend to reduce the volatility of their assets by more than 1.5 percentage points under both definitions of risk-taking (columns 2 and 4).

Table 3: HLM estimates of RSI reforms with ROA as dependent variable

VARIABLES	ROA 3		ROA 4	
	(1)	(2)	(3)	(4)
RSI	-0.801***	-1.573***	-0.998***	-1.857***
	(0.092)	(0.100)	(0.086)	(0.095)
Log(Assets)		-0.056***		-0.065***
		(0.010)		(0.011)
Cost-to-Income Ratio		-0.005***		-0.004***
		(0.001)		(0.001)
Liquidity/Total Assets		0.006***		0.006***
		(0.001)		(0.001)
Equity/Total Assets		0.018***		0.016***
		(0.001)		(0.001)
GDP Growth		0.934***		1.171***
		(0.047)		(0.045)
GDP per capita		-1.022***		-1.236***
		(0.044)		(0.041)
Credit to GDP		-0.018***		-0.022***
		(0.002)		(0.002)
Inflation CPI		0.036***		0.043***
		(0.009)		(0.009)
Constant	-7.173***	-5.859***	-3.342***	-1.755***
	(0.212)	(0.324)	(0.202)	(0.336)
Observations	42,413	36,338	42,673	36,096
Number of groups	41	39	41	39
Year FE	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.4   Bank Efficiency and Profitability

Having found a strong association between RSI and financial stability, we are now interested in understanding whether this comes at the cost of efficiency and profitability. While being beneficial for financial stability, an independent supervisor may act more stringently and harm the efficiency and profitability of the bank.

In this section, we test this hypothesis. To this end, we replace bank efficiency and profit-

ability as dependent variables and explore their relationship with our independence indicator. We measure efficiency with banks' cost-to-income ratio, which is the ratio between operating expenses and operating income. Since the expenses are on the numerator and revenues on the denominator of the ratio, a negative coefficient for RSI would signal an improvement for efficiency. We use net interest margin as an indicator of bank profitability.

Results for bank efficiency are displayed in Table 4. Reforms in independence are negatively and significantly associated with cost-to-income, indicating that bank efficiency improves following a reform in independence. The coefficient indicates that after a reform a bank's cost-to-income decreases of 1.2 percentage points. These findings are in line with the ones of Barth et al. (2013b), who use different measures for independence and efficiency, but find a positive relationship between the two. Their work finds that independence alone and independence coupled with a more experienced supervisory authority enhance bank efficiency. Overall, their evidence combined with the one of this paper suggests that independence enhances bank efficiency. Moreover, these results are linked to the ones of Chortareas et al. (2012), who show that interventionist regulatory and supervisory policies enhance bank efficiency when the overall quality of institutions is higher. We complement this evidence by showing that independence is an important institutional trait to achieve efficiency.

Table 4: HLM estimates of RSI reforms with Cost-to-Income as dependent variable

VARIABLES	(1)	(2)	(3)	(4)
RSI	-2.359***	-2.054***	-1.795***	-1.200***
	(0.354)	(0.377)	(0.367)	(0.380)
Log(Assets)		-3.175***	-3.970***	-3.973***
		(0.090)	(0.096)	(0.097)
Liquidity/Total Assets			0.109***	0.105***
			(0.006)	(0.006)
Equity/Total Assets			-0.134***	-0.126***
			(0.010)	(0.010)
GDP Growth				-1.493***
				(0.179)
GDP per capita				1.715***
				(0.162)
Credit to GDP				-0.094***
				(0.009)
Inflation CPI				-0.241***
				(0.039)
Constant	61.272***	98.249***	107.233***	117.591***
	(1.323)	(1.841)	(1.864)	(2.214)
Observations	45,756	39,908	38,287	37,426
Number of groups	40	40	40	39
Year FE	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5 displays the results for bank profitability, which is measured as the bank's net interest margin. The net interest margin is the ratio between net interest income and total assets and measures the ability of a bank to set the price of loans above interest expenses (Angori et al., 2019).

Moreover, the net interest margin provides as a good proxy for competition in the banking sector. A decrease in net interest margin is generally associated with a decrease in market power, and therefore is interpreted as a result of the growth of competition. However, it should be noted that this is not always the case. A decline in net interest margin is also compatible with a relaxation of the competitive conditions - i.e. an increase in market power and concentration - since this change can be offset by a reduction of interest rate risk, credit

risk and operating costs (Maudos and Fernández de Guevara, 2004; Carbó et al., 2009). For this reason, while the net interest margin is informative about bank profitability, it should not be interpreted as a fully-fledged indicator of competition in the banking sector.

The results in Table 5 show that independence is not significantly associated with net interest margin, which displays a strong correlation with other factors such as bank size, liquidity and equity. These estimates suggest that independence does not hinder or boost bank profitability.

Table 5: *HLM estimates of RSI reforms with Net Interest Margin as dependent variable*

VARIABLES	(1)	(2)	(3)	(4)
RSI	0.395	-1.851	-0.734	-0.631
	(5.531)	(5.981)	(0.551)	(0.582)
Log(Assets)		-4.222***	-0.549***	-0.524***
		(0.532)	(0.148)	(0.150)
Liquidity/Total Assets			-0.036***	-0.037***
			(0.009)	(0.010)
Equity/Total Assets			0.063***	0.062***
			(0.014)	(0.014)
GDP Growth				-0.208
				(0.279)
GDP per capita				0.113
				(0.255)
Credit to GDP				-0.021*
				(0.013)
Inflation CPI				0.027
				(0.058)
Constant	7.845	59.347***	12.990***	14.721***
	(7.375)	(15.230)	(2.403)	(2.765)
Observations	49,652	43,201	41,193	40,301
Number of groups	41	41	41	40
Year FE	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.5 Bank Lending

Since a more independent supervisor could be also more stringent, we test the relationship between RSI and bank lending. Dincer and Eichengreen (2013) find that more independent supervisors are associated with lower NPLs but also with less credit provision in a country. Following Micco and Panizza (2006), we measure the growth rate of loans as the difference between the natural logarithm of loans at time t and at time $t-1$. We replace the dependent variable with the growth rate of loans at bank level.

The results of the regression are displayed in Table 6. The coefficient of RSI is negative and significant, indicating that an increase in independence is associated with a 0.18 percent decline in bank lending (Column 4). These results therefore support the hypothesis for which higher independence could result in a more stringent approach toward bank lending. It is important to note that these estimates do not necessarily indicate that independent supervisors is detrimental for lending. The behaviour of independent supervisors on bank lending could vary depending on whether the economy is experiencing an economic expansion or contraction.

Table 6: HLM estimates of RSI reforms with Loan Growth as dependent variable

VARIABLES	(1)	(2)	(3)	(4)
RSI	-0.193***	-0.190***	-0.199***	-0.177***
	(0.013)	(0.013)	(0.011)	(0.011)
Log(Assets)		-0.010***	-0.012***	-0.011***
		(0.001)	(0.001)	(0.001)
Cost-to-Income Ratio			0.000	0.000*
			(0.000)	(0.000)
Liquidity/Total Assets			0.001***	0.001***
			(0.000)	(0.000)
Equity/Total Assets			-0.001***	-0.002***
			(0.000)	(0.000)
GDP Growth				-0.029***
				(0.005)
GDP per capita				0.026***
				(0.005)
Credit to GDP				-0.001***
				(0.000)
Inflation CPI				0.009***
				(0.001)
Constant	0.060**	0.182***	0.181***	0.257***
	(0.028)	(0.032)	(0.030)	(0.040)
Observations	42,717	42,717	38,057	37,197
Number of groups	41	41	40	39
Year FE	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7 Conclusions

The role of regulatory and supervisory independence has been for long overshadowed by research on the independence of monetary policy. As recent episodes of financial instability and political pressures have recently brought banking regulation and supervision into the spotlight, the need for studies on this type of independence has gained prominence. The empirical evidence in this paper addresses this need and is informative on the actual benefits and costs of having an independent regulator and supervisor. In this sense, our findings are relevant in light of the continuous push by international bodies for higher regulatory and supervisory independence.

In particular, this paper finds that increased regulatory and supervisory independence is associated with higher financial stability. Following an increase in RSI, banks hold lower shares of NPLs and less volatile assets in their balance sheets. In addition, it shows that independence does not come at the cost of lower efficiency or profitability for banks. However, it finds that banks tend to issue fewer loans when the independence of the supervisor is strengthened.

By introducing a new indicator of reforms in regulatory and supervisory independence, this paper opens a number of avenues for future research. As the index proposed in this paper can be decomposed into institutional, regulatory and budgetary independence, future works could explore these aspects in greater depth. How has each of these aspects evolved over time? Are they interrelated? And do they have a different impact on how regulators and supervisors interact with banks? All these are potential questions that can be explored with this new index.

In addition, the RSI indicator allows the study of the evolution of the independence of central banks and agencies, on which this paper brings new evidence, and the relationship between them. This is particularly interesting in light of recent reforms that have delegated supervision to independent central banks.

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8 Appendix

## 8.1 Regulatory and supervisory independence, by country

Figure 3: Regulatory and supervisory independence, by country, 1999-2019
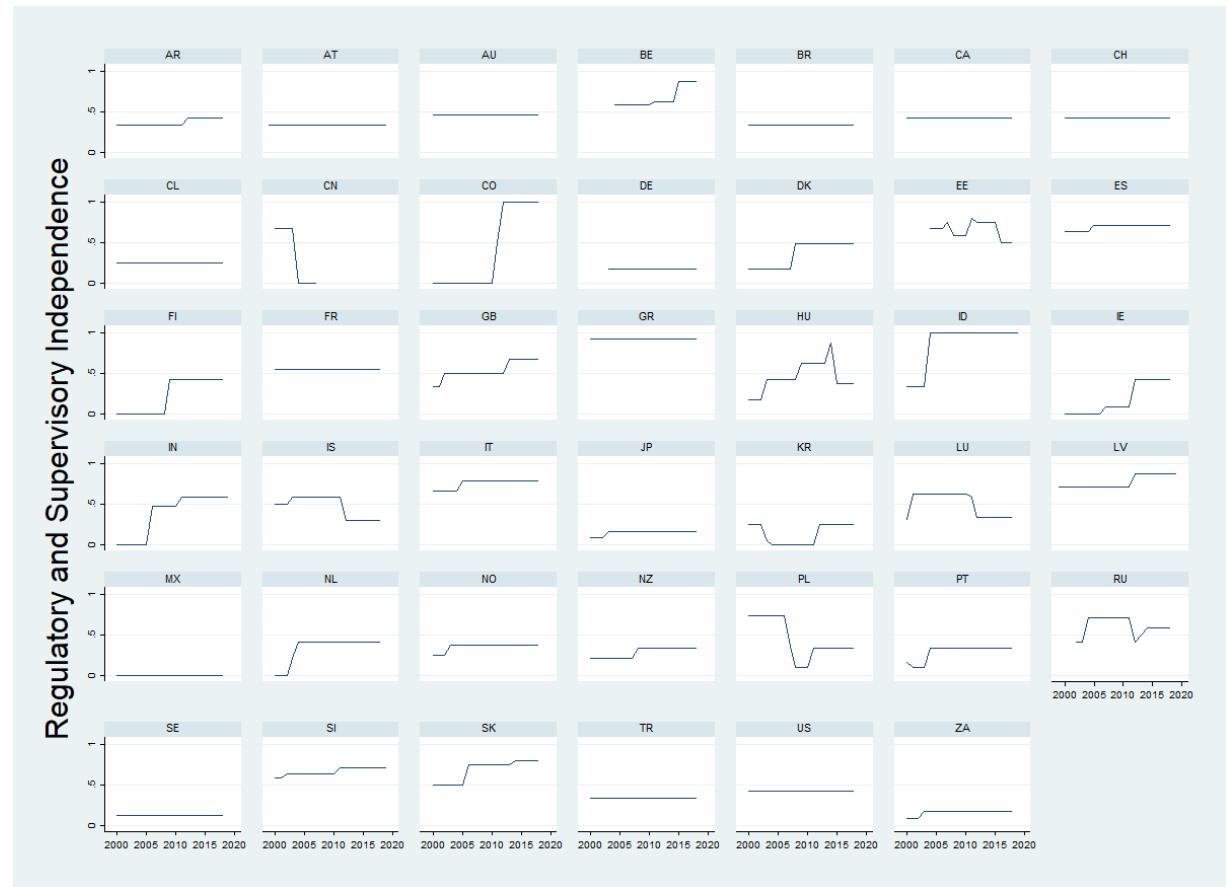
Figure 4: Regulatory and supervisory independence, within-country averages 1999-2019
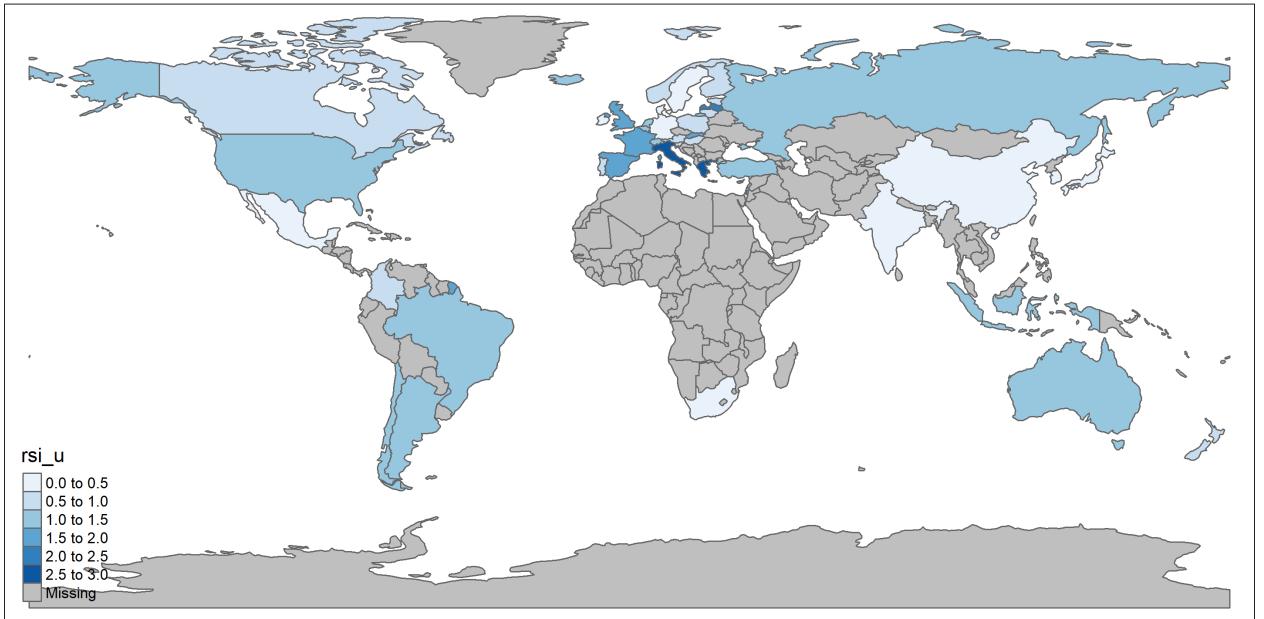
8.2 Variables description

Table 7: Summary Statistics

	Mean	Std. Dev.	Min	Max	N
RSI	.0312	.174	0	1	120474
NPLs	5.815	10.793	0	100	46516
Log(Assets)	13.380	2.447	2.737	21.977	50645
Cost-to-Income Ratio	63.444	17.966	0	100	46624
Liquidity/Total Assets	15.828	18.101	0	100	48103
Equity/Total Assets	16.452	18.945	7.351	100	50507
GDP Growth	2.107	2.911	-14.724	25.557	115164
GDP per capita	1.519	2.907	-14.559	24.765	115164
Credit to GDP	97.970	53.845	.19	312.15	108611
Inflation CPI	3.793	6.546	-4.480	85.742	115035
ROA 3 (log)	-3.306	2.755	-19.39	6.061	42911
ROA 4 (log)	-2.765	2.706	-19.39	6.061	43180
Net Interest Margin	5.683	8.697	0	99.469	49851
Loan Growth (log)	.045	.387	-15.386	11.539	43402

Table 8: Variables descriptions and sources

Variable	Definition
RSI	Dummy variable equal to 1 if a reform increases independence of banking supervisors and regulators in time t and country c, and 0 otherwise.[a]
Non-Performing Loans (%)	Nonperforming loans as a percent of loans before reserves.[b]
Log(Assets)	Logarithm of total assets owned by the company (thousands, USD). as carried on the balance sheet and defined under the indicated accounting principles.[b]
Cost-to-Income Ratio	Operating expense as a percent of operating income.[b]
Liquidity/Total Assets	Liquid assets over total reported assets.[b]
Equity/Total Assets	Equity capital to total reported assets.[b]
Return on Assets	Return on average assets; net income as a percent of average assets.[b]
Net Interest Margin	Difference between interest income and interest expenses over total assets[b]
Loan Growth	Logarithm of total loans (thousands, USD) at time t minus logarithm of total loans at time $t-1$.[b]
GDP growth (annual %)	Annual % growth rate of GDP at market prices based on constant local currency.[c]
GDP per capita growth (annual %)	Annual % growth rate of GDP per capita based on constant local currency.[c]
Credit	Domestic credit to private sector as a % to GDP.[c]
Inflation	Annual % change in inflation measured by the consumer prices index.[c]

Letters denote the data sources. *a* denotes variables elaborated by the authors; *b* denotes variables from the BankFocus BvD database; *c* from the World Bank WDI database.

8.3 Index of Regulatory-Supervisory Independence

8.3.1 Coding criteria

To capture institutional, regulatory and budgetary independence, we identify a number of common characteristics in the statutes of the regulators that allow for cross-country comparison. These criteria are summarised in Table 9. While we extract this information from the statutes, for regulatory and budgetary independence we complement the data already contained in the World Bank's Bank Regulation and Supervision surveys of 2011 and 2019 (Barth et al., 2013a).

Institutional independence is based on the appointment, removal and term length of the head of the regulatory authority. We use the same coding for the appointment and removal variables, which is similar to the one used by Cukierman et al. (1992) to measure central bank independence. In the majority of countries the executive, e.g. the Minister of Finance or the head of the government (President or Prime Minister), is in charge of the appointment and removal of the head of the agency. We consider these arrangements as the least independent and assign them a score of 0. Some Eastern European countries, such as Latvia, Lithuania, Poland, Russia and Slovenia, assign this function to their parliaments, which appoint or remove the supervisor through simple majority. We consider these arrangements as more independent and assign them a score of 0.25, as the decision is the output of a broader consensus which often also involves minority parties. In this setting the government cannot appoint a person in line with its own policy preferences, but rather someone that meets the preferences of the majority in parliament, which may diverge from the ones of the executive. In the same way, if the government does not agree with a policy of the regulator, it cannot simply remove her from the office, but needs to find the consensus of other parties. Other countries foresee procedures that involve multiple political bodies, such as the executive and the parliament, or the executive and the head of state (e.g. the king) or all three of them. For example the case of Brazil, where the governor of the central bank, which is also the supervisory authority, is appointed by the President of the Republic upon the approval of the Federal Senate. We assign a score of 0.5 to those cases, as in this setting the government's or legislators' preferences are balanced by the preferences of another actor. This decision is further supported theoretically and empirically by the works of Moser (1999) and Keefer and Stasavage (2003), who found that, as long as there are two veto players with different preferences, an independent central bank can act without provoking an override by the legislators. If the process is mixed but involves an institution which is not involved in the electoral cycle, e.g. the central bank, we assign a higher score: 0.75. This is the case of Argentina, where the head of the Superintendency is designated by the executive based on the suggestion of the board of the central bank. Similarly, in New Zealand the appointment is made by the Minister of Finance on the recommendation of the Board of the central bank. The same score is applied to cases where the appointment is in the hands of

the head of state, whenever this role does *not* also coincide with the head of the government, e.g. the monarch or the president of the republic in Germany or Italy. Finally, we assign the highest scores to those countries where these powers are fully in the hands of institutions which are not involved in the electoral cycle, such as central banks. These arrangements are relatively rare. The few examples include Iceland, where both the appointment and removal of the head of the FSA are the prerogative of the board of the agency itself, and Estonia in 1999, when the head of the supervisory agency was appointed by the board of the Estonian central bank upon proposal of the central bank's governor. As a third element of institutional independence, we look at the length of the term. In line with Cukierman et al. (1992), we associate longer terms of office to higher independence: the longer the term, the more isolated the supervisor from the electoral business cycle. An institutional independence index is then computed as the average of these three elements, each of which goes from 0 to 1.

Regulatory independence measures the possibility for the government to interfere with regulatory activity. This criterion is a dummy, which equals 1 if the agency does *not* need government approval to issue secondary binding legislation and 0 otherwise.

Budgetary independence measures the possibility for the government to affect the resources assigned to the supervisor through its approval of the budget. Similarly to regulatory independence, budgetary independence is captured by a dummy, which equals 1 if the agency does *not* need government approval on the budget and 0 otherwise.

Table 9: Index of Regulatory-Supervisory Independence

Dimension of Independence	Subcriteria	Question	Coding
Institutional Independence	Appointment	Which authority is in charge of the appointment of the head of the supervisory authority?	0 if Executive; 0.25 if Parliament; 0.5 if more than one political body; 0.75 if mixed (political and non-political bodies) or head of state; 1 if central bank and/or other agency
	Removal	Which authority is in charge of the removal of the head of the supervisory authority?	0 if Executive; 0.25 if Parliament; 0.5 if mixed political; 0.75 if mixed or head of state; 1 if central bank and/or other agency
	Term	How long is the mandate of the supervisor (years)?	0 if not specified or ≤ 3 years; 0.25 if 4 years; 0.5 if 5 years, 0.75 if 6 years; 1 if $\geq$ 6 years
Regulatory Independence		Is government approval needed for the supervisor to issue secondary binding legislation?	0 if Yes, 1 if No.
Budgetary Independence		Is government approval needed on the budget of the supervisory authority?	0 if Yes, 1 if No.

The three dimensions of independence are then summed up for each country, which is assigned a single RSI score. We construct the RSI index for 41 countries for the period 1999-2019. We collect information for the construction of our index from a number of sources. We use statutory data from the World Bank's Bank Regulation and Supervision Survey (Barth et al., 2013a), the IMF central bank legislation database and the BIS central bank law database.

8.3.2   Example of Regulatory-Supervisory Independence

We provide an example to better clarify how the index works. The United Kingdom underwent two major reforms in its regulatory-supervisory architecture between 1999 and 2019, which are reflected in the changes to our RSI index. Table 10 summarises the evolution of the index, revealing a growing trend towards independence.

Table 10: Construction of the RSI index, example of the UK

	Regulator-Supervisor		Institutional		Regulatory	Budgetary	**RSI Index**
		Appointment	Removal	Term			
1999-2001	Bank of England	0	0	0.5	1	0	**1.17**
2002-2012	Financial Services Authority	0	0	0	1	1	**2**
2013-2019	Prudential Regulatory Authority (Bank of England)	0	0	1	1	1	**2.33**

Before the establishment of the Financial Services Authority (FSA), the Bank of England did not have full budgetary independence and its governor was appointed for a five year term (renewable). RSI increased when regulation and supervision were moved to the FSA, as the agency enjoyed higher budgetary independence: the FSA in fact financed its work charging fees to the firms it regulated.[14] However, the FSA's institutional independence decreased as its statute did not specify the length of the chair's mandate. This was a change with respect to the Bank of England, whose Governor had a statutory mandate of five years in the 1990s.

With the Banking Reform of 2013, the Bank of England was put back in charge of supervision, through the new Prudential Regulatory Authority, which has been established as part of the central bank. The current setting is the one with the highest RSI score. This is because the Bank of England governor has now a mandate of eight years and enjoys regulatory and budgetary independence from the government.

Two important caveats apply to our RSI index. First, as it focuses on political independence, our index does not capture independence from the private sector. Some works show that governance affect the probability of regulators and supervisors to be captured by the entitites they supervise, with potential implications for financial stability (Gabillon and Martimort,

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[14]The FSA's general powers to raise these fees were set out in Schedule 1, Part III, paragraph 17 of the Financial Services and Markets Act (FSMA).

2004; Boyer and Ponce, 2012; Agarwal et al., 2014; Fraccaroli, 2019). In this paper we restrict our analysis to independence from political bodies. Second, our index does not capture the degree of *supervisory power*, which is generally intended by the literature as the amount of responsibilities/powers in the hands of the regulator (e.g. licensing, or removing bank managers...). Our decision is informed by the literature: empirical evidence in Beck et al. (2006) show that the more powerful the supervisor, the more frequent the corruption in lending. According to them, the explanation for this counterintuitive result is that powerful supervisors are also more dependent on the government. Their wide range of responsibilities could in fact be driven by the need for the government to enlarge its scope of action through a powerful and weakly independent supervisor.

8.3.3 Comparison with other measures

There exist a number of indexes that have been used to capture RSI, which however contain a number of deficits.

Klomp and de Haan (2009) is a pre-financial crisis effort; they estimate the relationship between central bank independence and financial stability from 1985 to 2005 and find a significant positive relationship. In their paper RSI is measured using the index of on central bank independence central bank independence built by Arnone et al. (2007). This has two major shortcomings. First, they use the index also for countries where central bank is not the supervisor. Second, this index largely focuses on aspects of monetary policy, which does not necessarily reflect independence in supervision. In contrast, the index we propose in this paper focuses on the independence of the regulator-supervisor.

Dincer and Eichengreen (2013) investigate the impact of supervisory independence and of the allocation of supervisory responsibilities to either a central bank or an agency on financial stability. Differently from Klomp and de Haan (2009), their analysis account for those cases in which the central bank is not in charge of supervision. For these countries, they build an alternative index based on two criteria: (1) whether the supervisor is explicitly part of the Ministry of Finance; (2) whether the supervisor has its own revenue or must rely on a political body for its operating funds. While their approach represents an improvement in the literature, some elements of weakness persist. For countries where the central bank supervises, they use the measure of independence developed by Cukierman et al. (1992) which, similarly to Arnone et al. (2007), also focuses on monetary policy. In addition, it is not clear how they choose whether the supervisor is part of the Ministry of Finance. Countries have different legal definitions of the link between the two institutions, which makes the comparison cumbersome.[15]

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[15]For example, the German BaFin and the Dutch DNB are both 'under the supervision of the Ministry of Finance', the Icelandic FSA is 'under the auspices of the Minister', the Colombian SF and the Chilean SBIF are both superintendencies, and the Japanese FSA is an external organ of the Prime Minister Office. It is not

Barth et al. (2013b) create an alternative index of supervisory independence, but focus on the effect on bank efficiency. They find that bank efficiency is enhanced where the supervisor is more independent and experienced. Their measure is built on three elements: (1) the political bodies to which the supervisor is accountable, (2) whether the supervisor is legally liable for its actions and (3) the length of the statutory term of the supervisor. While we also include the third element in our index, we exclude the first two as they are more related to the accountability of the supervisor, rather than its independence. A more accountable agency is not necessarily a less independent one, and higher accountability can also lead to higher independence (see Tucker, 2018 for a discussion).

Our index will instead focus on independence from political bodies and intentionally excludes aspects related to accountability. This is because the relationship between accountability and independence is not clear cut (Briault et al., 1998; De Haan et al., 1999): in a democracy for an agency to be independent there need to be checks and balances in place, and more accountability does not necessarily mean less independence. For example, the possibility of judicial power to affect supervisory decisions enhances the accountability of the regulator while limiting its discretion. This has been perceived as a reduction of independence. For example, Barth et al. (2013b) include both aspects of accountability and legal liability in their index of regulatory independence. However, higher levels of accountability and legal liability do not necessarily undermine the regulator's *political* independence. This decision is also informed by the findings on the relationship between central bank independence and checks and balances. A number of works found that central bank independence is less effective when checks and balances are weak, highlighting the importance of analysing these variables as separate (Acemoglu et al., 2008; Keefer and Stasavage, 2003; Moser, 1999). We therefore take a different approach and carefully exclude the degree of court involvement from our index.

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clear how each of this case should be categorised. This is particularly true when compared to other casess Moreover, before the Asian crisis supervision in Japan and Korea was conducted by Ministry departments.

8.4 Baseline Model with reduced sample

Table 11: HLM estimates of RSI reforms with NPLs as dependent variable, excluding US, GR and ID

	No USA		No Greece & Indonesia		No US, Greece & Indonesia	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
RSI	-1.613***	-2.662***	-1.736***	-2.792***	-1.670***	-2.656***
	(0.277)	(0.284)	(0.242)	(0.242)	(0.274)	(0.284)
Log(Assets)		-0.406***		-0.326***		-0.408***
		(0.085)		(0.064)		(0.085)
Cost-to-Income Ratio		-0.033***		-0.021***		-0.033***
		(0.004)		(0.003)		(0.004)
Liquidity/ Total Assets		0.033***		0.026***		0.034***
		(0.005)		(0.004)		(0.005)
Equity/Total Assets		0.048***		0.038***		0.049***
		(0.009)		(0.007)		(0.009)
GDP Growth		-0.411***		-0.287**		-0.423***
		(0.140)		(0.119)		(0.140)
GDP per capita		0.107		-0.004		0.115
		(0.128)		(0.110)		(0.128)
Credit to GDP		0.041***		0.045***		0.042***
		(0.008)		(0.006)		(0.008)
Inflation CPI		-0.371***		-0.333***		-0.374***
		(0.029)		(0.024)		(0.029)
Constant	8.226***	8.818***	7.844***	10.496***	7.979***	8.687***
	(2.408)	(2.493)	(1.059)	(1.618)	(2.370)	(2.499)
Observations	34,209	24,538	44,551	35,064	33,037	24,510
Number of groups	40	38	39	38	38	37
Year FE	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 12: HLM estimates of RSI reforms with NPLs as dependent variable, controlling for SSM, Full Sample

VARIABLES	(1)	(2)	(3)	(4)
RSI	-1.288***	-2.618***	-2.474***	-2.479***
	(0.264)	(0.277)	(0.246)	(0.280)
SSM dummy	1.581	2.164	1.704	1.233
	(2.174)	(1.871)	(1.844)	(2.255)
Log(Assets)		-0.555***	-0.315***	-0.331***
		(0.061)	(0.065)	(0.066)
Cost-to-Income Ratio			-0.010***	-0.011***
			(0.004)	(0.004)
Liquidity/ Total Assets			0.028***	0.030***
			(0.004)	(0.005)
Equity/Total Assets			0.040***	0.043***
			(0.007)	(0.007)
GDP Growth				-0.556***
				(0.204)
GDP per capita				0.405**
				(0.201)
Credit to GDP				0.049***
				(0.008)
Inflation CPI				-0.245***
				(0.027)
Constant	7.288***	13.528***	10.137***	8.569***
	(1.328)	(1.414)	(1.479)	(1.934)
Observations	38,239	34,506	30,454	29,683
Number of groups	41	41	40	39
Year FE	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1