

12th biennial IFC Conference: “Statistics and beyond: new data for decision making in central banks”

22-23 August 2024

Granular data for the needs of central banks: the case of Central Bank of Morocco¹

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¹ This contribution was prepared for the conference. The views expressed in this publication are those of the authors and do not necessarily represent the official views of the Committee, its members, or the BIS.

Granular data for the needs of central banks: case of Central bank of Morocco

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Abstract

The recent global financial crisis has highlighted the need for financial system supervisors to have granular, high-frequency and high-quality data to carry out their missions. Accordingly, several initiatives have been launched and more particularly that of “data gaps initiative” of the Financial Stability Board that put forward several recommendations, among which the development of the granular data to supplement regulatory and aggregated reporting. This data covers credits (loan-by-loan), payment incidents, non-financial corporation’s financial statements, as well as security-by-security to ensure better coverage of macroeconomic statistics. This paper aims to present the central bank of Morocco’s experience using granular data for its various missions in recent years. A focus will be placed on the different range of granular information, the credit register, the central balance sheet office, the bank accounts register, and the different studies and models developed to assess the quality of the banks' credit portfolio, the level of financial inclusion, classification and scoring of customers as well as the impact of monetary policy decisions and financial stability monitoring.

Introduction

Economies and financial systems have become increasingly globalized in recent decades. While this trend enabled countries to enjoy a certain degree of prosperity, it also entails risks for financial stability and for the effectiveness of the public authorities’ decisions especially financial system supervisors. These risks, which became apparent during the global financial crisis of 2008, call for an innovative approach of supervision, based not only on macro aggregates, but also on granular data.

Since the 2008 crisis, several initiatives and research studies have concluded that, while data was not the main source of the crisis, the absence of granular data in some ways amplified it. As a result, the availability of this data was made necessary and materialized in the first and second phases of the Data Gaps Initiative (DGI).

Currently, central banks have access to granular data covering a wide range of areas, including loan-by-loan, security-by-security, cross-border financial flows, real estate transactions, card payments and other means of payment. These data are increasingly used to ensure effective micro-prudential supervision, but also to monitor the impact of the decisions taken by monetary authorities, particularly in terms of monetary policy, financial inclusion, or the indebtedness of economic units.

However, given the rapid pace of financial activities’ development (fintech, electronic money, bitcoins, etc.), monetary and financial authorities need to make efficient use of granular data. This use should be accompanied not only by the utilization of new technologies, but also by the availability of human resources profiles and skills capable of transforming these data into lessons and insights for the various missions of central banks.

I. Granular data as new paradigm at central banks

Since the early 80s, the financial systems have benefited from developments in information and communications technology. These have led not only to shorter transaction processing times, but also to the introduction of new tools based on increasingly complex mathematical algorithms, extremely high-volume transactions, and the growth of financial speculative activities, all of which require greater supervision efforts. The result has been a sustained expansion of financial activities, and the emergence of new actors and activities. To keep pace with this development, national and international regulators have put in place several initiatives and directives, including the Basel agreements, Solvency, MiFID (...). However, the rapid pace of growth in financial activities, in particular speculative activities, ultimately led to housing bubble burst and the financial crisis of 2008.

Over and above its negative impact on the global economy, this crisis had the merit of prompting the regulatory authorities to rethink their supervisory approach and adopt a micro-prudential approach to complement the macro-prudential one in place until the eve of the crisis. Moreover, the events of 2008 highlighted the role that data can play in times of crisis. While the financial crisis was not the result of a lack of appropriate economic and financial statistics, it did reveal a significant lack of information and data gaps on key financial sector vulnerabilities relevant to financial stability analysis (IMF-FSB 2009). For this reason, several initiatives were launched, notably the DGI, to provide high-quality, high-frequency granular data as a prerequisite not only for micro prudential supervision, but also for the effective implementation of economic policies, and more specifically the missions of central banks, which are the main players involved.

In particular, the first phase of the DGI (2009-15) highlighted the importance of complementing macro-level aggregates with distributional information. In fact, as indicated in the DGI report, the analysis of sectoral data for risk assessment purposes based on aggregates can be misleading insofar as the aggregate data do not provide distribution's insights of phenomena from one institution to another (FSB and IMF (2009), Recommendation N° 15).

As a result, and thanks to technological advances, large volumes of data are currently being collected by central banks, not only for their vital role in compiling statistics, but also for the needs of financial supervision. However, the major challenge today lies in the effective use of this data in policymaking.

II. Granular data: interest for the central banks

Nowadays, the challenge for central banks no longer lies in the availability of granular data, but rather in the efficient use of this data to draw lessons and conclusions capable of enhancing the effectiveness of monetary policies and supervision (Caruana 2017). As Borio (2013) points out, we need to visualize both the forest and the trees that make it up, a view supported by Draghi (2016), who argues in his speech that aggregates and aggregate data will continue to play an important role, but we need a magnifying glass to analyze them in depth, alluding to the importance of granular data.

At present, this granular data covers a wide range of areas, including credit, debt instruments, currency transactions, bank accounts, payment incidents and so on. While these data are exploited and compiled by central banks to further refine their missions and for other work, this paper aims to give a brief overview of the use of these data for the main missions of central banks, notably monetary policy, financial stability, and financial inclusion. Granular data are used to assess the transmission of monetary policy decisions and their

impact on the credit trajectory, which is a leading indicator of growth. In addition, and still in the context of monetary policy, these data make it possible to calculate borrowers' lending rates and to assess the additional debt burden that may result from a restrictive monetary policy. In terms of financial stability, the availability of loan-by-loan data and a security-by-security data makes it possible not only to effectively monitor the indebtedness of economic agents and the asset quality of financial institutions, but also to conduct more rigorous stress tests by implementing more realistic scenarios.

III. Policy making and granular data: Bank Al-Maghrib was in journey during the last decade

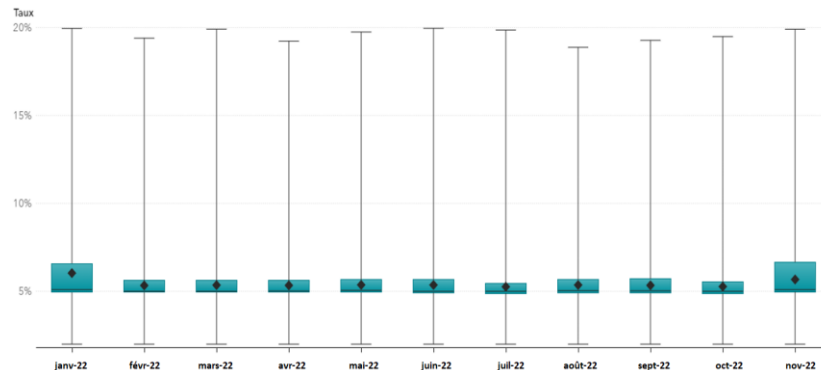
Bank Al-Maghrib (BAM), fully aware of the crucial role of data in decision-making, has launched over the last few years a vast process of reinforcing its statistics, by putting in place several systems to provide granular data. To date, the central bank receives several flows of information, covering a wide range of data domains. Indeed, BAM currently has data on each credit line (credit register), on bank accounts (CCB), on payment incidents on checks and bills (CIP-CIL), and on the financial statements of non-financial companies (CIFEN) as well as on debt securities. In addition, two other registers have recently been operationalized namely the irregular checks and the payment account register (CCP). In addition, and to bring it more in line with international practices, a central credit register is currently being overhauled to meet the Bank's evolving needs in terms of data for its various missions.

Once this data is available, the challenge is to compile it to draw useful lessons and conclusions for decision-making. To this end, several studies are being carried out based on these data, but they are not fully exploited, as is the case with other central banks, due to constraints linked to the quality of the data, the availability of profiles and the technologies adopted for this type of need. Indeed, granular data at Bank Al-Maghrib is mainly used for monetary policy, economic and financial stability, financial inclusion, and for statistical purposes.

Regarding monetary policy, granular data is used to monitor the impact of monetary policy decisions, notably on lending to the non-financial sector, both in terms of demand and the interest rates. As a matter of fact, the credit register currently provides a monthly breakdown of loans distributed by financial intermediaries to the various economic units, with a range of breakdowns giving an in-depth view of the evolution of short-term credit trends. Special attention is paid to changes in lending rates for both businesses and individuals, in response to monetary policy decisions. The granular data reported by banks for the loans distributed makes it possible to estimate the interest rates for each line of credit, and thus to study the impact of decisions by type of business, by size and by type of loan. To examine the impact of increases in monetary policy rate in September 2022, estimations carried out, prior to the availability of data based on aggregate reporting, showed that there were an increasing number of new loans with rates higher than the levels recorded prior to monetary tightening. This is true for both housing loans and consumer loans.

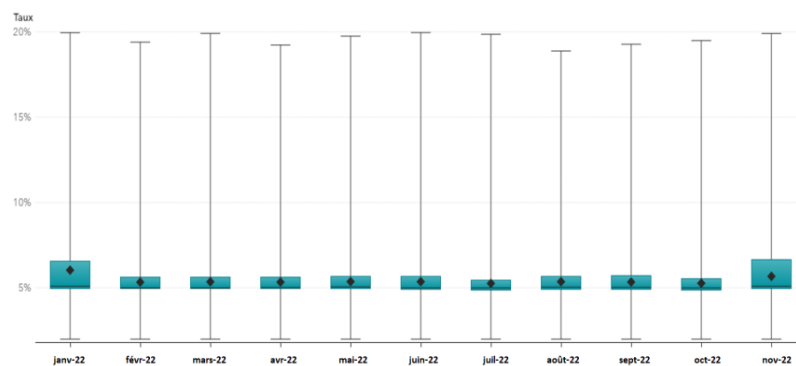
For housing loans, the maximum interest rate for three quarters of loans granted by banks stood at 6.7% in November 2022, compared with 5.6% in October and 5.7% in September.

Housing loans interest rates distribution



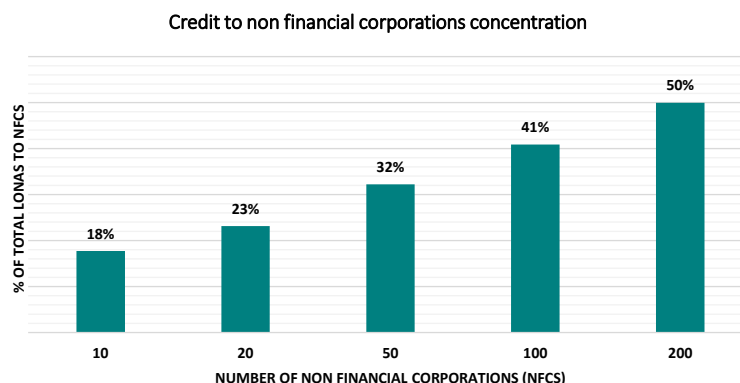
For consumer loans, the signs of rising rates are relatively more visible compared to housing loans. The range of variation in interest rates widened relatively in November, with a 3.4% spread between the median rate and the maximum rate at which 75% of loans were released, compared with spreads of 1.9% in October and 2.3% in September.

Consumer loans interest rates distribution



The operational framework of monetary policy also benefits from the refinement provided by granular data. As part of MLT refinancing operations with the central bank, banks are required to report a portfolio of loans to SMEs as collateral for these refinancing operations. The characteristics of these credit lines are examined in detail in comparison with the granular data reported by the banks within the framework of the CR, to assess the bank's eligibility for these refinancing operations.

In terms of supervision, the usefulness of granular data is currently recognized by all supervisors, due to their virtue in terms of reading the financial institutions positions and exposures. Particularly in the case of credit risk exposures, and as a complement to aggregate reporting on major risks, detailed data enables in-depth analysis of the distribution of exposures. Overall, the results from the credit register of Bank Al-Maghrib show that 10 companies account for 18% of total outstanding corporate loans, rising to 23% for the top 20 companies. The latter are relatively dominated by state-owned companies, which account for 70% of credit to the banking system's top 20 non-financial corporation debtors. In addition, by combining credit data with debt securities data, it is possible to identify the real time position of each credit institution for counterparty risk monitoring purposes.



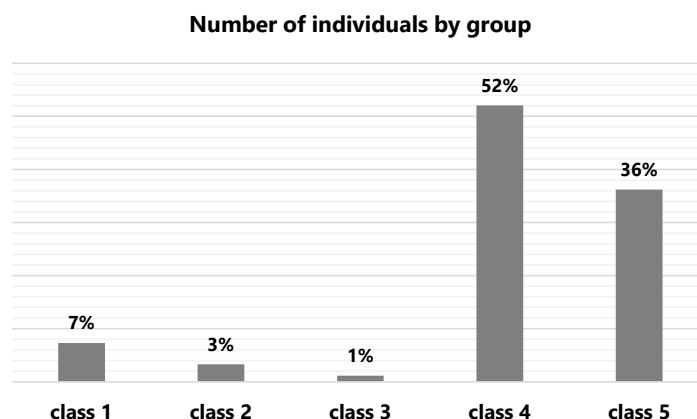
Furthermore, given the importance of the quality of the credit institutions' portfolios, special attention is paid to bank non-performing loans, based on repayment patterns derived from the credit register. Accordingly, companies which have recorded a payment default are monitored over the months following the incident to assess whether the default is temporary or reflect a leading indicator of the borrower's solvency. As a result, calculations allowed to conclude that once a NFCs records a payment default, the company's credit line has a 16% probability of being reclassified as nonperforming loan.

Otherwise, accelerated digitalization over the last two decades has highlighted the need to raise the level of financial inclusion for individuals and small businesses alike, to benefit from a developed financial system. This level of financial inclusion, which is closely monitored as part of the National Strategy for Financial Inclusion (SNIF), is tracked mainly using granular data on target populations. The central bank account database (CCB) currently calculates the level of bank account ownership, which stood at 54% at the end of 2023, an indicator that makes it possible to target geographical areas and profiles of people, by age, gender, and category, who require more effort to be financially included. This, in addition to improving financial inclusion, will also have the effect of increasing the use of digital financial services, which could help to reduce the circulation of cash, which today represents a major problem at national level.

In addition, and to put the financial sector at the service of the economy, especially in a context of successive crises, financial inclusion also means promoting access to adequate financing for individuals and businesses. Therefore, the availability of granular data plays an essential role in examining access to financing. The credit register shows that almost half of all living businesses have a financing line with credit institutions, a figure far from that reported by the World Bank in its annual survey on business access to financing, and thus shows the role of granular data in better reviewing certain phenomena. For individuals, by making it possible to identify those who are already benefiting from financial services, the CR guides public authorities towards the classes of population to target in order to implement targeted actions. Indeed, by the end of 2023, statistics show clearly that rural populations present a significant gap in terms of access to financing, especially for women, and this in a context of encouraging the economic integration of women, mainly those from rural areas.

In addition, as part of the analysis and monitoring of means of payment, the K-means algorithm is used to cluster individuals and companies with check payment incidents. This work resulted in several homogeneous groups based on the profiles of the individuals and their habits in terms of recording incidents and their regularization. Two main groups stand out: the first, comprising 52% of the population studied, has the lowest amounts, the lowest number of incidents and the highest rate of regularization, i.e. a population that has accidentally recorded a payment incident. The second group, representing 36% of the population, is

made up of people with high amounts, a high number of incidents and the lowest rate of regularization, indicating a critical population of people with an unhealthy use of cheques as a means of payment.



On another no less important front, and in line with international best practice of central banks, Bank Al-Maghrib set up in 2007 a central balance sheet office (CIFEN-F). This database is fundamental especially as central banks' missions are being redefined in the wake of the negative repercussions of the recent global financial crisis on both financial systems and the real economy.

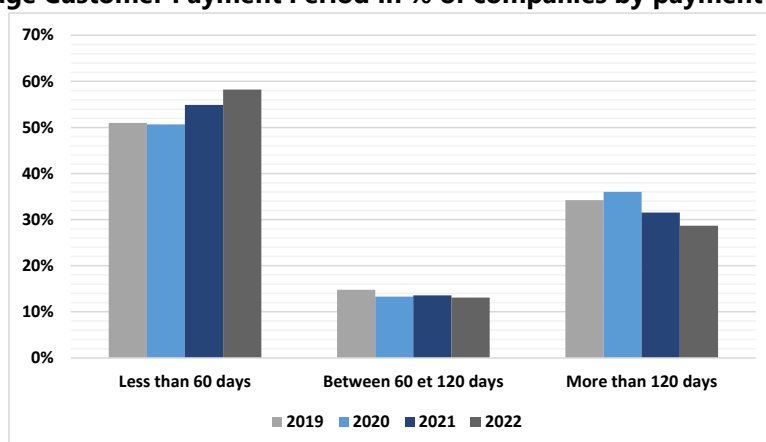
These data are therefore used in research studies to assess the effectiveness of monetary policy and to better understand the channels through which monetary decisions feed through to the financial and real sphere, and in particular to the balance sheets of non-financial corporations. This impact, known in economic literature as the balance sheet channel, has been materialized by Bernanke and Gertler (1995) as part of the broad credit channel. In the case of Morocco, the balance sheet channel seems to be effective, implying a decrease in the indebtedness of non-financial corporation during monetary policy tightening, although the extent of this drop varies according to company size (H. Bennouna, T. Chmielewski, M. Doukali 2019). In addition, as part of the monitoring of macroeconomic and financial stability, other studies have used NFCs granular data to assess changes in the financial vulnerability of the Moroccan NFCs sector over a fifteen-year period (2006-2019). The result is a relatively stable vulnerability index over the entire period, despite a slight rise observed from 2014 onwards in line with sluggish economic growth (S. Benazzi, H. Bennouna, T. Chmielewski 2021)."

In addition to the research work that is carried out on an ad hoc basis, the central balance sheet is also used primarily to monitor companies' payment habits and to track their debt and financial structure. In fact, given the scale of trade credit, payment delays are of particular importance and are monitored as part of the bank's economic and financial report, but also as part of the Payment Delays Observatory's (ODP) report.

In terms of trends, inter-company payment delays had been steadily deteriorating since 2012, with overall averages exceeding 150 days, well above the regulatory timeframe of 90. However, the latest figures for the 2022 financial year show that the trend is improving, with an overall reduction in average payment delays for both suppliers and customers.

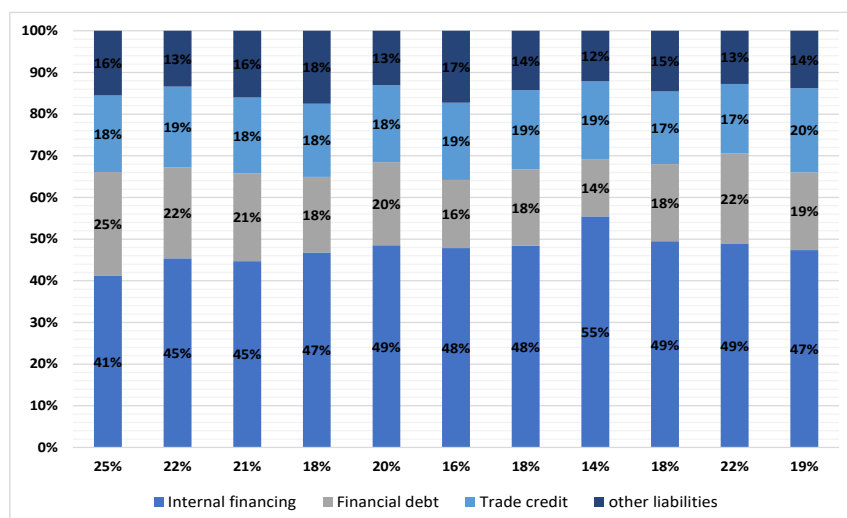
This improvement trend is reflected in an increase in the proportion of companies paid within the statutory timeframe, reaching 58% in 2022, compared with 55% in 2021 and 51% in 2020. At the same time, the proportion of companies that are significantly late in paying their bills and exceed regulatory deadlines has fallen to 20% in 2022, compared with 24% in 2021 and 26% in 2020.

Average Customer Payment Period In % of companies by payment period



In terms of indebtedness and given the functioning of the balance sheet channel in Morocco, the financing sources of NFCs are regularly monitored, not only to assess their use of credit, but also to have a more global view of companies' preferences in terms of financing sources, by analyzing changes in their financial structure. Over the past ten years, an average of 32% of companies have reported a debt to the financial system as part of their balance sheet, while almost half of companies rely on internal resources for their financing needs, with equity capital and partners' contributions predominating.

Non Financial Corporations financing structure



In terms of statistics, the availability of detailed data makes it possible to refine aggregates and optimize requests for information from banks. For example, credit and debt aggregates are made more reliable by using credit-by-credit and security-by-security data, in terms of sector repair, credit type and debt maturity.

In addition, since the financial crisis of 2008, monitoring the real estate sector has become a priority, due to the risks for the financial system and the global risks that materialized during the bursting of real estate bubbles (United States 2008, Japan 1986). As a result, the analytical frameworks of monetary policy and financial stability are enriched by analyses of the real estate market. To this end, Bank Al-Maghrib, in conjunction with land registry data (ANCFCC), has developed a real estate asset price index. This quarterly

index reflects price trends and the number of real estate transactions nationwide and in major cities, for three types of property: residential, urban land and commercial. They also cover six categories: apartment, house, villa, urban land, commercial premises and office.

Property prices are also an important indicator to monitor in the context of macroprudential policy. Indeed, in the absence of such a policy, a spiral can be set in motion between the volume of loans distributed and asset prices via the financial gas pedal mechanism, leading to speculative bubbles, as in the 2008 subprime crisis. In addition, granular data on real estate transactions are used to calculate LTV (Loan-To-Value) to assess the risk of real estate loans by financial institutions.

Conclusion

While granular data is seen as a valuable asset, it should not replace conventional data sources, but rather serve as a complement to conventional, formal statistical techniques. In this way, granular data represents a data revolution that complements traditional data analysis techniques - reinforcing and supporting previous methodologies - to deliver evidence-based results.

However, central banks are facing new and increasingly complex challenges, such as the expanding weight of bitcoin, fintech's, the growing need to estimate the impact of climate change on the financial sector and to extend the scope of supervision to non-financial institutions due to the growing use of digital money. Thus, the use of granular data is set to intensify to cover these new intervention areas beyond the traditional missions of central banks.

However, the use of such data is proving increasingly complicated, not only because of the problems of data quality and standardization of declarations for the sake of inter-country comparability, but also because of the prerequisites in terms of highly skilled human resources to draw the lessons from this significant data windfall. What's more, central banks are increasingly exposed to the risk of data leakage, due to the data at their disposal, which generally includes personal data, and this means that security measures need to be continually reinforced.

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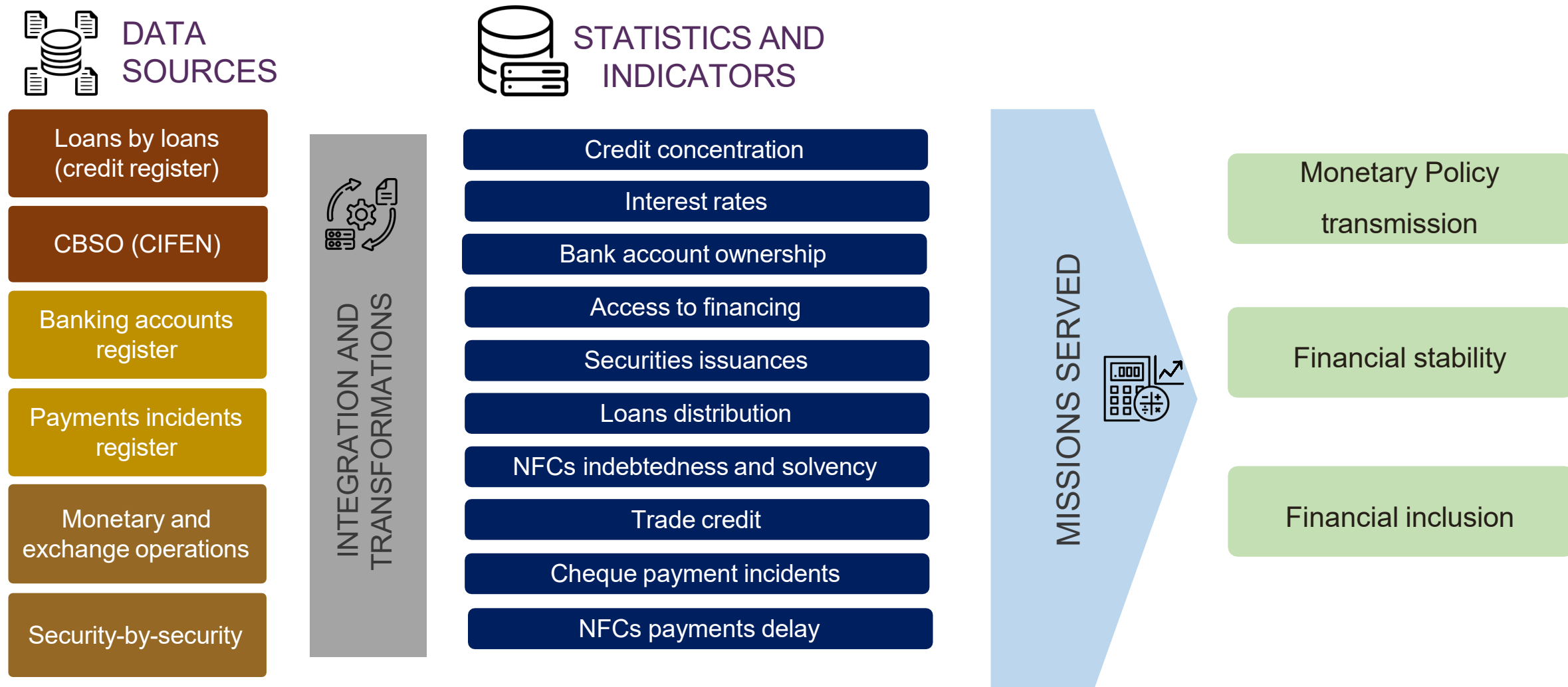
Granular data for the central Bank needs Case of Bank Al-Maghrib

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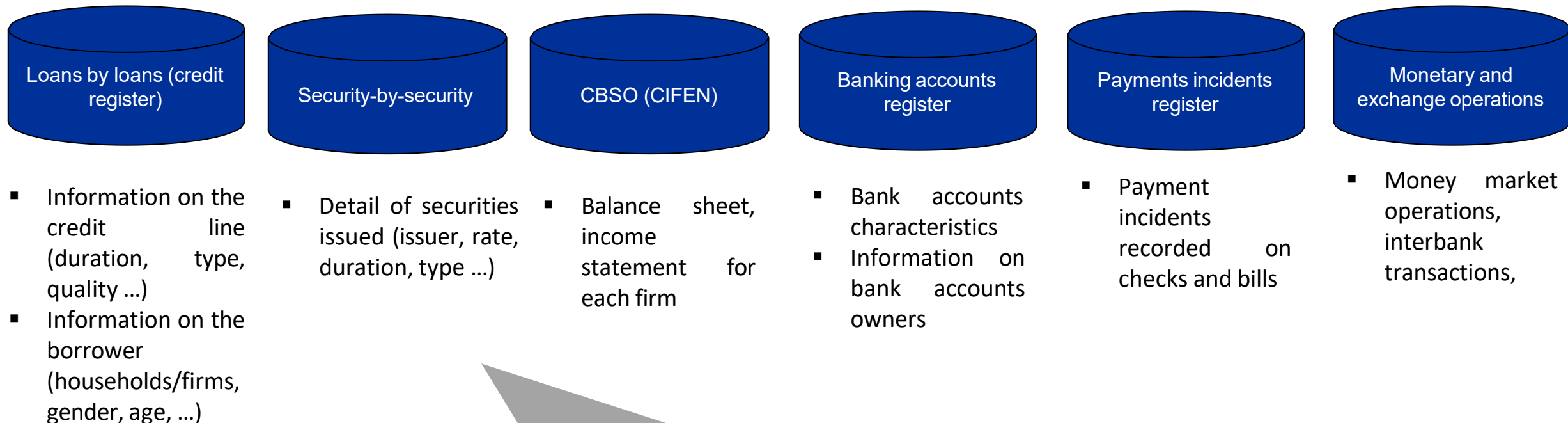
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BASEL, August 22-23

- Central banks, to achieve their missions have always used the aggregates as statistical tool. However, the 2008 global financial crisis, and its implications on the global economy and financial systems, has highlighted the needs for supervisors for more granular, timelier and more reported more efficiently.
- “...Looking at the details beyond the aggregates enriches our understanding of economic phenomena and at the same time increases our flexibility to respond to unexpected policy needs, contributing to even better statistics.” [Mario Draghi, ECB President, 8th ECB Statistics Conference, 2016.](#)
- Central Banks collect, process and disseminate a wide set of statistical data in accordance with their missions :
 - **Monetary policy** : credit channel, banks' loan portfolio and the rating associated to it to evaluate the impact of measures on firms' access to finance
 - **Financial stability** : Subsector indebtedness, contagion risks, impacts of new phenomena (climate changes), credit concentration, banking system portfolio quality, shadow banking
 - **Financial inclusion** : Access to financing for individuals and SMEs, use of financial services,
 - **Statistical purpose** : Mapping aggregates and micro data for quality purposes, better understanding of statistical aggregates (more breakdowns)
 - ...



- The experience of bank Al-Maghrib started in the 2000s with the creation of the central balance sheet office and the credit register

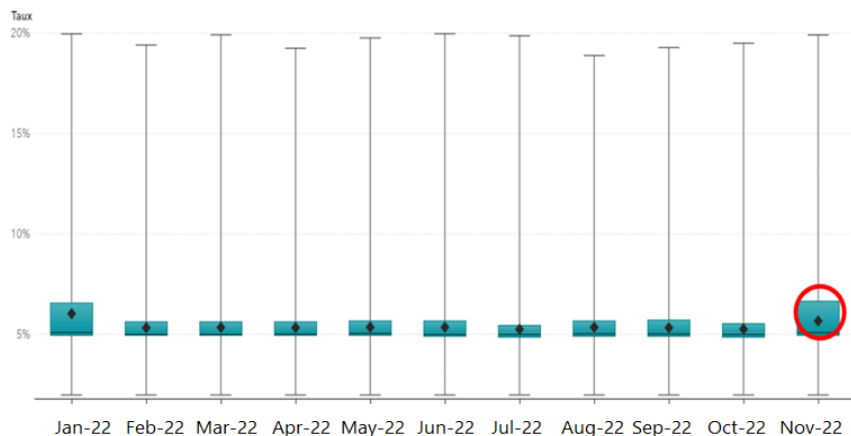


Granular data reported is compiled at the central bank to serve the different missions of the central bank (monetary policy, financial stability, financial inclusion, ...)

■ Monetary policy transmission

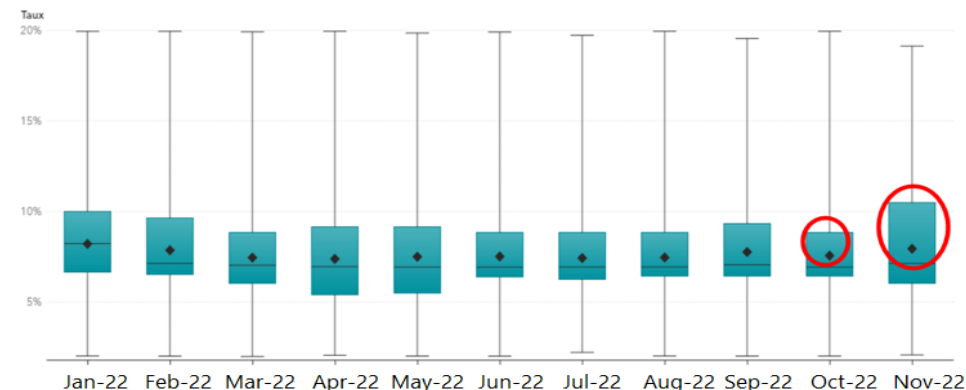
- Granular data is used to monitor the impact of monetary policy decisions, notably on lending to the non-financial sector
- The loan-by-loan data is used to compute monthly flow of credit and interest rates applied.
- To examine the impact monetary policy tightening in September 2022, estimations carried out, prior to the availability of data based on aggregate reporting showed that there were an increasing number of new loans with rates higher than the levels recorded prior to monetary tightening.

Housing loans interest rates distribution



For housing loans, the maximum rate for three quarters of loans granted by banks stood at 6.7% in November 2022, compared with 5.6% in October and 5.7% in September.

Consumer loans interest rates distribution

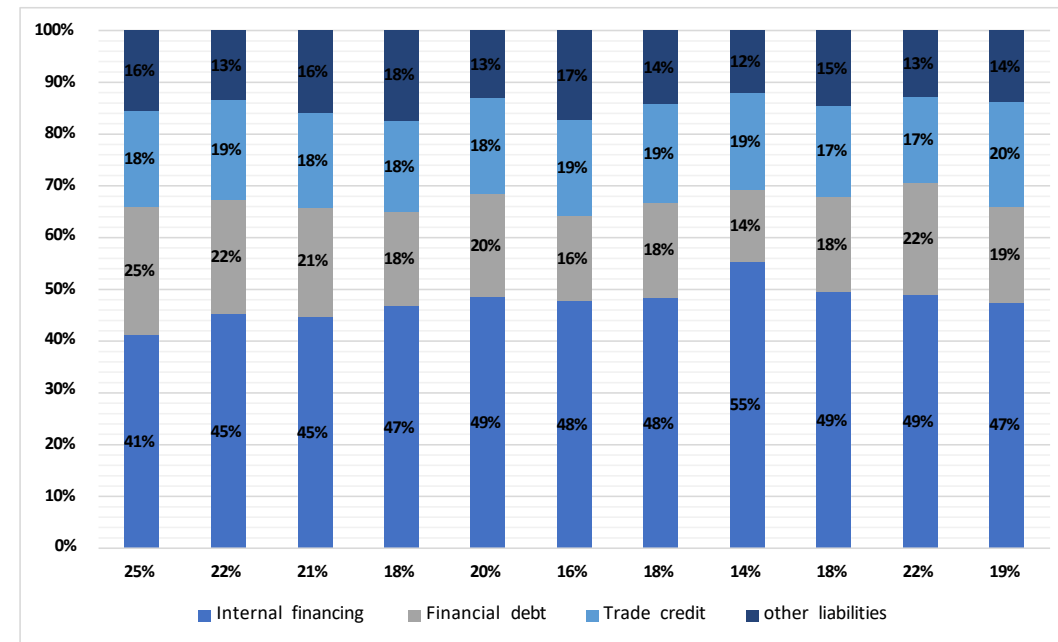


For consumer loans, the range of variation in interest rates widened relatively in November, with a 3.4% spread between the median rate and the maximum rate at which 75% of loans were released, compared with spreads of 1.9% in October and 2.3% in September.

■ Monetary policy effectiveness : Testing the Balance sheet channel effectiveness

- The degree of response to monetary policy decisions depend on the weight of financial debt of NFCs.
- CBSO data shows the internal financing is the main source of financing (47%) followed by trade credit (20%) and by financial debt (19).
- The figure shows that in 2021, financial debt experienced a slight increase explained by several financing programs launched by government in response to COVID crise.

NFCs liabilities structure in %

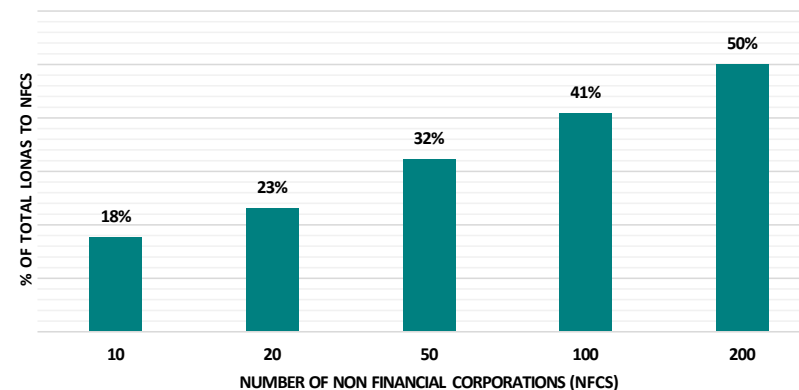


- **Financial structure of NFCs respond to monetary policy decisions** : during the monetary policy tightening, NFCs reduces their financial debt. ((H. Bennouna, T. Chmielewski, M. Doukali 2019). A 100 bps increase in the interbank rate generate a decrease in the financial debt ratio of around 0.04%. The impact depends on the size of the firm.

▪ Banking system individual exposures

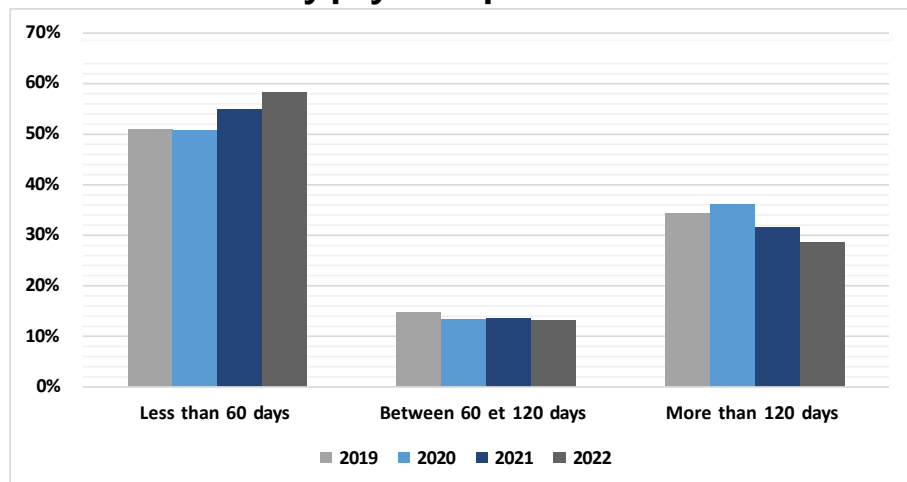
- Using granular data as complement of aggregated reporting to supervise the counterpart risk is more relevant (aggregated reporting is not exhaustive)
- 10 companies account for 18% of total outstanding corporate loans, rising to 23% for the top 20 companies.
- More breakdowns can be provided by using granular data (private NFC, state owned NFC, credit distribution ...).

Credit to non financial corporations concentration



▪ Payments delays and its implications for financial stability

Average Customer Payment Period In % of companies by payment period



- Knowing that payments delay can lead to business failure which represent a risk for financial stability, the issue of trade credit is crucial for the central bank.
- CBSO granular data is used to analyze the phenomenon:
 - Payments delays exceeded 150 days during the 2010s. However, the trend has been improved during last years.
 - The proportion of companies paid within the statutory timeframe have increased reaching 58% in 2022, compared with 55% in 2021 and 51% in 2020.
 - Compagnies that are significantly late in paying their bills and exceed regulatory deadlines has fallen to 20% in 2022, compared with 24% in 2021 and 26% in 2020.

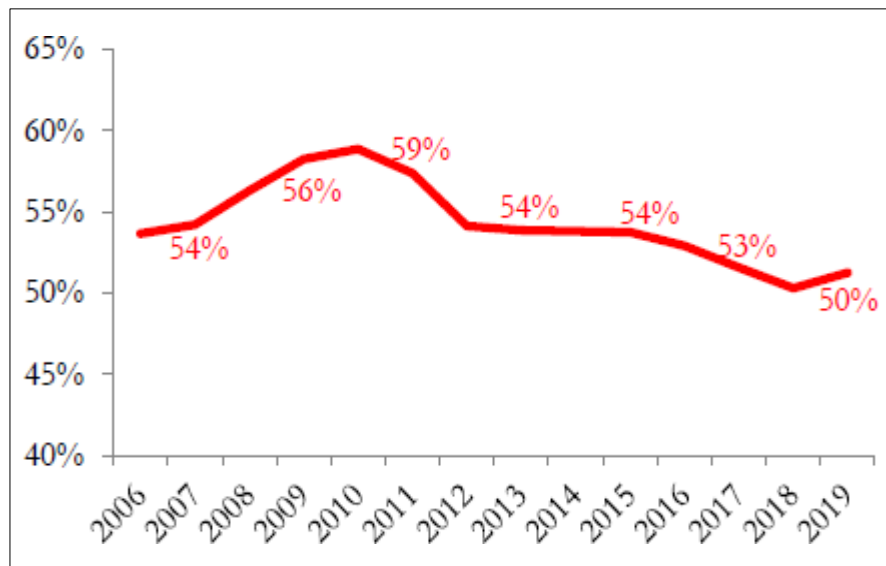
■ NFCs vulnerability analysis

- Businesses vulnerability is a special and important topic for central banks regarding its impacts on the whole economy including financial system
- A study has been carried out using CBSO data in 2021 to examine the NFCs vulnerability using for axes : Solvency, liquidity, profitability and debt service capacity.

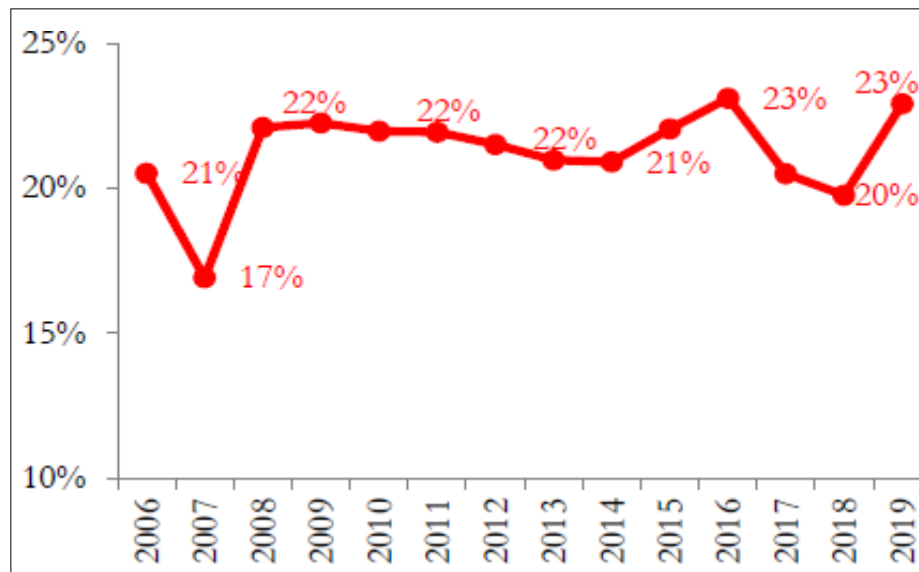
Conclusion

- ✓ At least 5 firms among 10 are vulnerable using one axe
- ✓ Corporate vulnerability index (CVI) remained relatively stable (2006-2019)
- ✓ a slight increase from 2014, linked to the sluggish economic growth
- ✓ by source of vulnerability, NFCs are mainly exposed to liquidity risks and relatively limited capacity to cover their interest charges, followed by solvency and profitability risks.

Share of vulnerable businesses



Corporate Vulnerability Index : CVI »



- **Financial inclusion**

- Regarding the financial services digitalisation, financial inclusion of individuals and businesses especially SMEs has become crucial for central banks
- The availability of granular data on loans and banking accounts uses allow to monitor financial inclusion and to target population with no access or no use of financial services

Bank
Account
register

- Banks account ownership
- (53% at the end of 2023)
- Geographical breakdown, gender, Promote the use of banking account rather than cash

Credit
register

- Access to financing (half of firms have access to financing and about 10% of adult population)

- Other uses

Clustering	Classification of populations according to their credit reimbursement behavior, the cheque incident
Statistical purpose	Refinement of macro aggregates and deepening the understanding of reporting
Real estate development and risks	Real estate index (IPAI) to monitor the prices for the needs of financial stability and monetary policy

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