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Content

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Editor's note[1]

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1. This issue of the *Banco de Portugal Economic Studies* includes four studies. The first is an overview that identifies the main communication challenges for central banks, as well as some lessons from the literature and activities carried out over the past 10-15 years. The second assesses the transmission of monetary policy to deposit interest rates in Portugal over the past 25 years. The third examines developments in the average effective personal income tax rate over the last 15 years and the contribution of said tax to income redistribution. The fourth study characterises house price developments in Portugal over the last 15 years, taking the Spanish case as a point of comparison.

2. Communication plays a key role in central banking. The growing multiplicity and complexity of central bank mandates – which since the Great Financial Crisis have largely exceeded the traditional objectives of maintaining financial and price stability – have brought new responsibilities and generated higher expectations from citizens.

These developments have rendered the need to improve the communication of central banks evident, to ensure clearer understanding of their objectives, the means to achieve them and the constraints in their activities. Otherwise, discrepancies may arise between what citizens expect from central banks and what these can actually achieve (commonly referred to as an expectation gap or exaggerated expectations). This poses a threat to the key role of central banks in rebuilding social capital.[2]

Central bank communication with the general public poses new challenges at present. The opening synopsis of this *Banco de Portugal Economic Studies* – by Duarte, Abreu and Gameiro – pinpoints the main features of developments in central bank communication in the period following the Great Financial Crisis, the main challenges posed, and some lessons that can already be drawn from central bank activities.

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1. The analyses, opinions and conclusions expressed in this editorial are entirely those of the editor and do not necessarily coincide with those of Banco de Portugal or the Eurosystem.

2. In this regard, see "Proceedings of the Conference *Rebuilding Social Capital: the Role of Central Banks*", available on the Banco de Portugal's website. This conference took place on 1 April 2022 to commemorate the 175th anniversary of the Banco de Portugal.

3. The study by Bonfim and Queiró examines the transmission of monetary policy to bank deposit rates – in Portugal and, for comparison, in the euro area – taking the 1997-2023 period as a reference. The main findings of the study are:[3]

(i) The transmission of monetary policy to interest rates on new deposits to firms was almost complete in this period: an increase of 100 basis points in the monetary policy rate was associated with an increase of 95 basis points in Portugal and an increase of 92 basis points in the euro area;

(ii) The transmission of monetary policy to interest rates on new deposits to households was partial: an increase of 100 basis points in the monetary policy rate was associated with an increase of 59 basis points in Portugal and an increase of 67 basis points in the euro area;

(iii) The transmission of monetary policy to the total amount of deposits is much smaller than to new deposits, both for firms and households; the authors, focusing on the Portuguese case, explain this result through the (near) lack of transmission to overnight deposits and the natural lag for rolling over term deposits;

(iv) Also with regard to the total amount of deposits, according to the authors, the Portuguese case shows greater transmission to firms than to households, suggesting more competitive pressure in the corporate segment than in the household segment.

4. The results obtained by Bonfim and Queiró confirm those found in the literature on the transmission of monetary policy to deposit rates: the pass-through of a change in the monetary policy intervention rate is greater for firm deposits than for household deposits, and it is greater for term deposits than for demand deposits.

More recently, several studies[4] compare the degree of monetary policy transmission over the 2022-23 tightening period with historical average patterns. Beyer et al. (2024), Messer and Niepmann (2023), and Byrne and Foster (2024) conclude that the pass-through of the monetary policy rate to deposits was smaller and slower in 2022-23 than

3. The study also examines the transmission of monetary policy to lending interest rates. This editor's note focuses solely on transmission to interest rates on bank deposits.

4. The studies referred to in this editorial are the following: Beyer, Robert, Ruo Chen, Claire Li, Florian Misch, Ezgi O. Ozturk, and Lev Ratnovski, "Monetary Policy Pass-Through to Interest Rates: Stylized Facts from 30 European Countries", WP/24/9, International Monetary Fund, January 2024; Messer, Todd and Friederike Niepmann, "What determines passthrough of policy rates to deposit rates in the euro area?", FEDS Notes, Board of Governors of the Federal Reserve System, July 2023; Byrne, David and Sorcha Foster, "Transmission of monetary policy: Bank interest rate pass-through in the euro area", SUERF Policy Brief, No 771, January 2024; Grodzicki, Maciej, Benjamin Klaus and Alessio Reghezza, "Euro area bank deposit costs in a rising interest rate environment", Financial Stability Review, European Central Bank, May 2023; Kho, Stephen, "Deposit market concentration and monetary transmission: evidence from the euro area", WP 2896, European Central Bank.

in previous periods, especially in the case of household term deposits.

These studies also provide some evidence on the factors that may have contributed to this different transmission pattern. Messer and Niepmann (2023) find that banks have little incentive to attract deposits while liquidity is abundant, in particular relative to their capacity to expand lending. Grodzicki et al. (2023) find that the pass-through is lower in the case of larger and more liquid banks, as measured by their ratio of liquid assets to total assets. Beyer et al. (2024) find that the pass-through was weaker in banks with higher liquidity (as measured by the liquidity coverage ratio), banks with lower loan-to-deposit ratios, and more concentrated banking sectors (as measured by the Herfindahl index). Finally, Kho (2023) finds that the transmission of monetary policy to deposit rates in more concentrated banking sectors is slower when monetary policy rates rise (and faster when these rates decline).

Identifying the relative weights of the factors that may account for changes in the monetary policy transmission mechanism for deposit interest rates in terms of magnitude and speed requires further analysis – which will certainly be more complete at a later stage of the current monetary policy cycle – so that more reliable and final conclusions can be drawn.

5. At the same time, the household income tax (IRS) is one of the main sources of public revenue and an essential instrument of income redistributive policy. The study by Riscado, Sazedj and Wemans illustrates developments in the personal income tax in the light of these two perspectives over the period 2009-24.

The effective average personal income tax rate – defined as the ratio of the tax paid to total gross income, including social benefits – increased from 9.0% in 2009 to 13.3% in 2024.[5] The study recalls that during the Economic and Financial Assistance Programme the tax burden increased significantly, as a result, inter alia, of the reshaping of tax brackets and the introduction of an extraordinary surcharge. In the following ten years, the average effective personal income tax rate fell marginally. Indeed, the effect of tax change measures was offset by a significant increase in their tax base, against a background of erosion of the real value of various personal income tax parameters. The study is therefore a major contribution to understanding developments in the average effective personal income tax rate over the last 15 years.

The uneven distribution of income and the progressivity of personal income tax determine the concentration of personal income tax revenue in higher incomes. The study recalls that in Portugal 10% of households earning higher incomes contribute to 54% of the total revenue of this tax. Therefore the increase in the average effective personal income tax rate was a key element in strengthening the distribution capacity of

5. 2024 values are estimates made by the study's authors.

this tax in the period under review.

6. The final study of this issue of *Banco de Portugal Economic Studies* by Lourenço, Moura and Rodrigues analyses house price developments in Portugal over the past 15 years (2008-23). This study offers three main results:

(i) House prices in Portugal in 2023 are estimated to have been around 50% higher in real terms than in 2008;

(ii) Using two econometric methodologies, the authors conclude that in Portugal there is some evidence of house price overvaluation, in the sense that price growth exceeded expectations, considering both the variable's time dynamics and the benchmark macroeconomic determinants;

(iii) Finally, the use of a Bayesian vector autoregressive model suggests that price growth in Portugal translated into an expansion in demand not fully offset by supply.

The study also makes a comparison with house price developments in Spain. It is important to recall that over the period 2000-07 real house prices in Spain increased by 100%,[6] so 2008 corresponds to markedly different situations for the two countries. It will therefore not be surprising that the authors draw different conclusions for Portugal and Spain for the period 2008-23.

7. The Bank for International Settlements (BIS) has recently released its statistical series on global house prices, covering the first quarter of 2024.[7] With regard to advanced economies, three points need to be made here:

(i) House prices, in real and cumulative terms, increased by 32.4% compared to 2010 (5.8% in the euro area, 19.7% in the remaining European economies, 51.7% in non-European advanced economies);

(ii) The sharpest real increases occurred between the second half of 2020 and the first half of 2022 – close to or above 5% in terms of annual change – followed by reductions almost until now (although never exceeding 5%). Generally speaking, in the first of these sub-periods these developments showed a change in housing

6. See *Informe sobra la crisis financiera y bancaria em España (2008–2014)*, referring to house price developments over the period 2000-07 as follows: "Con todo, a pesar del notable aumento de la oferta, los prezos de las vivendas (…) subieron com forza, multiplicándose por dos veces, em términos reales, y por 2,5 em términos nominales, durante esse período". This report by the Banco de España was released on 16 June 2017.

7. "Statistical release: BIS residential property price statistics in Q1 2024", BIS, 29 August 2024. BIS statistical data provides information for both advanced and emerging economies. For the purpose of this editor's note, only information on advanced economies is considered.

preferences during the pandemic phase amid historically low interest rates and, in the second sub-period, the inflation episode and the rise in interest rates;

(iii) In terms of annual change, around 60% of advanced economies experienced real house price increases in the first quarter of 2024;

(iv) In the euro area, still with reference to the first quarter of 2024, the heterogeneity across countries is remarkable, illustrated by countries with year-on-year price growth (Greece, Portugal and Spain, with increases of 7%, 5% and 3% respectively), with basically stable prices (Italy and the Netherlands) and price drops (France and Germany, with 7% and 8% decreases respectively).

The housing sector plays a key role in the economy. Households' home ownership accounts for, on aggregate, the largest share of their wealth and is also the main source of their indebtedness, wherefore house price fluctuations and changes in interest rates on loans for house purchase can significantly affect aggregate household spending. A good way to illustrate this role in the economy is to identify the monetary policy transmission mechanism channels through which the housing sector affects aggregate demand after a rise in the central bank's intervention rate:[8]

(i) Interest rate cash flow channel: a rise in the interest rate entails an increase in interest payments by households with positive net debt,[9] which results in a reduction in expenditure, especially given liquidity constraints (this effect is larger for higher debt levels and lower for higher fixed rate debt shares);

(ii) Investment channel: a rise in interest rates will tend to make housing investment spending less attractive, given its impact on financing costs, thereby cutting aggregate spending;

(iii) Housing wealth channel: a rise in interest rates will tend, all other things being equal, to induce a decline in house prices, corresponding to a loss in non-financial household wealth;

(iv) Credit channel: a rise in interest rates tends to affect the debtors' risk premium, as the probability of default tends to be higher; should this happen, credit standards will tend to tighten, with the resulting effects on spending (consumption or investment).

8. This discussion is based on Natalie Burr and Tim Willems "About a rate of (general) interest: how monetary policy transmits", Bank of England, Quarterly Bulletin, July 2024.

9. This effect tends to prevail over the opposite effect of rising interest receivable from households for which the amount of deposits exceeds possible debts, given the different marginal propensity to consume.

As an essential sector of the economy, the housing sector may be associated with the development of vulnerabilities that in more adverse scenarios could cause damage to the real economy and financial stability. High levels of household indebtedness and sharp drops in house prices played an important role in previous financial instability episodes.[10]

After the Great Financial Crisis, a number of macroprudential measures were developed – which are now being implemented in most European Union countries[11] – to mitigate the risks associated with existing vulnerabilities.[12] It is therefore important that unsustainable price rises are detected and that at the same time macroprudential measures are put in place to mitigate existing risks.

The European Systemic Risk Board (ESRB) publishes a report on a regular basis[13] identifying, for each country in the European Economic Area,[14] the main vulnerabilities in the housing sector. Furthermore, this report assesses the effect of macroprudential policy measures in mitigating these vulnerabilities and assigns a degree of risk to each country. In its most recent assessment, the ESRB assigned a high risk in the housing sector to five countries (Denmark, Luxembourg, the Netherlands, Norway and Sweden), a medium risk to 19 countries (including Portugal) and a low risk to six countries (including Spain).

10. See, for instance, "House of debt: how they (and you) caused the Great Recession, and how we can prevent it from clarifying again" in Atif Mian and Amir Sufi, (2014), The University of Chicago Press; "Leveraged: the new economics of debt and financial Fragility", (2022), editor Moritz Schularick, The University of Chicago Press.

11. "Follow-up report on vulnerabilities in the residential real estate sectors of the EEA countries", European Systemic Risk Board, February 2024.

12. Examples of these are: high or strongly rising levels of household indebtedness, weakening households' ability to service debt, strong house price growth, excessive risk-taking by banks when granting loans for house purchase.

13. See footnote 11.

14. This economic area includes the 27 countries of the European Union plus Iceland, Liechtenstein and Norway.

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Non-technical summary

October 2024

Economic Synopsis
Reaching out to the general public: a challenging journey for central banks

Rita Duarte, Ildeberta Abreu and Isabel Gameiro

Communication plays a key role in the ability of central banks to fulfil their mandate. As independent institutions charged with maintaining price stability, central banks have a duty to communicate with the public. When central banks explain their objectives and decisions, the public is better able to assess their performance and hold them to account. This is crucial for building trust. If people trust the central bank, they will take its actions into account in their own behaviour, making it more likely that the central bank will achieve its objective. Communication also aims to improve the effectiveness of monetary policy. By providing information about the likely path of the economy and policy actions, central banks can influence economic agents' expectations and, ultimately, their economic decisions.

The way central banks communicate changed markedly over the last decades, from secrecy to wide-ranging transparency. Initially, communication efforts focused mainly on expert audiences such as financial market participants, academics, and specialised media. More recently, these efforts have been extended to the general public. In the aftermath of the global financial crisis, central banks faced mounting criticism, a loss of public trust and some questioning of their independence. This led them to recognise the pressing need to reach out to wider sections of society. After all, it is the public who makes most economically relevant decisions and assesses whether central banks are serving society well.

Reaching out to the general public poses a whole new set of challenges. Unlike financial market participants and other expert audiences, the public is generally not very interested in, nor pays much attention to, central bank communication. Inattention translates into a lack of knowledge about what central banks do and why they do it. This is a concern because knowledge is a key driver of trust and enables individuals to form realistic inflation expectations. People have little incentive to pay attention to central banks if the costs of acquiring and processing their messages are too high, or if the benefits are not clear and compelling. Indeed, the complexity of central banks' language and topics combined with low levels of economic and financial literacy make their communication inaccessible to a large part of the public. Both factors also make people less aware of the benefits of being informed.

How can central banks communicate in order to reach out to the general public? The literature and the experiences of central banks reviewed in this synopsis provide a few clear answers. First, one size does not fit all. Knowing the target audience and tailoring the message is key. Second, use simple language and relatable messages to improve outreach and comprehension. Third, make the most of different channels, including traditional media, to reach audiences with different information consumption habits. Fourth, engage directly with the public rather than just speak. Last, but not least, provide educational resources to help bridge the gap in citizens' knowledge of economic and financial issues. Importantly, all these efforts can also benefit the communication with expert audiences and improve central banks' information sets.

Designing communication in this way is central banks' best chance of influencing people's beliefs and behaviours. A recent and rapidly growing body of research tentatively suggests that simple, relatable and tailored communication and greater proximity to citizens can have a positive impact on their trust in central banks. Another key finding is that the provision of simple information, such as the inflation target, current inflation, or forecasts, can lead to meaningful changes in households and firms' inflation expectations. Nevertheless, messages need to be repeated regularly to have long-lasting effects. Communicating with the public is not without risk, however. It must strike the right balance between being simple but accurate, being clear but conveying uncertainty and tapping into issues that people care about but within central banks' mandate.

Like other central banks, the Banco de Portugal's communication practices have changed significantly in recent decades. Since 2017, communication was simplified and tailored, and direct engagement with the general public was notably stepped up. The Bank strengthened its presence in both traditional and digital media to reach out to people of different ages, interests, and educational backgrounds. One area in which the Banco de Portugal stands out is the promotion of financial and economic literacy, which is considered a strategic priority. The available indicators of trust and proximity suggest that the Banco de Portugal's strategy for engaging with the public is paying off. However, significant gaps in knowledge remain. As for other central banks, progress in reaching out to the general public will take time, but the potential benefits are important enough to keep trying.

The journey of reaching out to the public is still in its early days and central banks are likely far from getting it truly right. They will have to continue to experiment, learn and adapt. Besides, more work is needed to have a thorough understanding of the impacts of central bank communication with the general public.

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Economic Synopsis
Reaching out to the general public: a challenging journey for central banks

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October 2024

Abstract
Reaching out to the general public is both critical and challenging for central banks. As with expert audiences, the aim of this outreach is to foster trust and guide expectations. However, communication with the public poses a whole new set of challenges, the main being breaking the veil of inattention. Without a formal script, central banks had to experiment, learn and adapt. This synopsis documents central banks' communication initiatives deployed in recent years, including by the Banco de Portugal, and reviews a rapidly growing literature on their usefulness. The key takeaway is that the public is potentially reachable through simple, relatable and tailored communication. Together with a greater proximity to citizens, well-designed communication may help foster their trust in central banks. Simple and repeated messages may also meaningfully affect their inflation expectations. Overall, these results show some promise, but success is not certain. (JEL: E52, E58, G53)

Keywords: Central bank communication, monetary policy, trust, inflation expectations.

"Central banks have to be understood by the people whom they ultimately serve. This is a key to rebuilding trust." Christine Lagarde[1]

1. The road from secrecy to public engagement

Communication plays a key role in the ability of public institutions to deliver the policies that bear upon society's well-being. This is also the case for central banks. Their communication about monetary policy with various

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1. European Parliament Report on the Council recommendation on the appointment of the President of the European Central Bank, September 9, 2019, https://www.europarl.europa.eu/doceo/document/A-9-2019-0008_EN.pdf.

audiences is crafted to, ultimately, help them deliver price stability. Indeed, central bank communication serves two main purposes.

One purpose is to enhance the effectiveness of monetary policy. The ability of a central bank to affect the economy critically depends on its ability to influence expectations regarding the future path of policy (Woodford 2005). Communication can be used to influence expectations, both by "creating news" and "reducing noise" (Blinder *et al.* 2008). Providing better information on the likely course of the economy and policy actions can help steer expectations, increase the predictability of monetary policy, and reduce uncertainty. This better enables households and firms to make decisions and may improve policy effectiveness and the economy's overall performance.

The other purpose is to foster trust (*i.e.*, the subjective belief that the central bank will work to deliver on its mission). Trust underlies both the legitimacy of central banks as independent public institutions and the efficacy of their policies. When central banks explain their objectives and decisions, the public is more capable to assess their performance and hold them to account. This democratic accountability, along with central banks' success in achieving their objectives, will ultimately lead to trust. If the public trusts the authorities, they will incorporate authorities' actions in their own behaviour. Central banks are therefore more likely to achieve their objectives. Trust will also make the public more willing to accept actions that impose short-term costs but deliver longer-term benefits. In the words of Haldane (2018) "Credibility and trust are the secret sauce of central banking."[2] Preserving them is essential for macroeconomic stability.

Prior to the 1990s, central banking and monetary policy were enclosed by secrecy. The conventional wisdom was that policymakers should say as little as possible, and say it cryptically (Blinder *et al.* 2008). In 1975, the Federal Reserve (Fed) was sued for not making its decisions public immediately after each meeting. At that time, the Fed argued that immediate disclosure would cause inappropriate and harmful market reactions and undesirable precommitment (Goodfriend 1986). The theoretical rationale for secrecy was that ambiguity would enable policymakers to create monetary surprises and stimulate the economy (Cukierman and Meltzer 1986). The case was ultimately decided in favour of the Fed which, like other major central banks, continued to resist transparency until late 1980s. As famously stated by Greenspan (1988) "(. . .) since I became a central banker I have learned to mumble with great incoherence. (. . .) if you think what I said was clear and unmistakable, I can assure you you've probably misunderstood me."

Since then, central bank communication has taken great leaps forward towards openness and transparency. This communication revolution occurred in two distinct waves.

The first wave took place in the 1990s, as many central banks were granted greater independence to pursue price stability. Following the experience of high and volatile

2. The two concepts are entwined, but not exactly the same. Trust is a broader concept as it captures a central bank's social capital. Credibility is the reputation for doing what it says it will do. One might trust a central bank, but still doubt that it will achieve its objective in certain occasions, for instance due to factors beyond its control.

inflation in the 1970s and early 1980s, a social consensus emerged that price stability was a common good. However, its achievement depended on delegating monetary policy to independent central banks to shield decisions against pressures of short-term political agendas (Draghi 2018). The theoretical rationale was that this would avoid inconsistent policies over time. For monetary policy to achieve better economic outcomes, the central bank must also publicly commit to its objectives and be accountable to its promises (Reis 2013). The adoption of inflation targeting by various central banks in the 1990s (*e.g.*, Reserve Bank of New Zealand, Bank of Canada, Bank of England (BoE)) was another catalyst for higher transparency. A key feature of this framework is precisely a clear communication of the inflation objective.

During this first wave, central banks were increasingly willing to talk about their objectives, decisions, and reaction functions. Communication became more extensive and timelier. This coincided with the advent of new information technologies, which allowed central banks to launch websites to disseminate information faster and to a larger audience. At this stage, they primarily targeted expert audiences such as financial market participants, academics, and specialised media.

Communication tools included press releases, press conferences, speeches, interviews, parliament hearings, publication of central bank' forecasts, or disclosure of voting records. The BoE was one of the forerunners of transparency. It started publishing economic forecasts four times per year in 1993. It also began releasing a statement after each policy meeting in 1997 and advanced the publication of the meeting minutes in 1998. Unlike others, the European Central Bank (ECB) held a post-meeting press conference since its start – which includes a statement and a Q&A session – to explain its decisions. The Fed was more of a laggard in some respects. The release of the statement after every meeting took place in 1999 and the meeting minutes started to be published before the subsequent policy meeting in 2005. After the 2008 global financial crisis, efforts to communicate with experts were stepped up. Central banks released more and better information.

A vast body of literature – reviewed in Blinder *et al.* (2008) and Masciandaro *et al.* (2024) – suggests that communication about monetary policy with expert audiences has been largely successful. Overall, results show that central bank communication moves financial markets, increases the predictability of monetary policy, shapes experts' expectations, and helps achieve central banks' objectives. While the literature does not identify an optimal degree of transparency, evidence shows that greater openness is generally desirable if communication is consistent and well designed.

The second wave of the communication revolution unfolded in the aftermath of the large economic disruptions caused by the financial crisis. Central banks faced mounting criticism, a decline in public trust and some questioning of their independence. Despite the ensuing large increase in communication efforts, a lack of understanding and trust in central banks was still evident a decade after the crisis. As Haldane (2017) pointed out, a twin deficit problem had emerged – a deficit of public understanding and a deficit of public trust. Faced with these entwined deficits, many central banks acknowledged

the pressing need to reach the large parts of the society they had previously missed.[3] After all, it is the public that makes most economically relevant decisions and assesses whether central banks are serving society well. Communication to a wider public was seen as necessary to enhance trust and support for independent central banks, especially in an era of rising populism. It could also help anchor households and firms' inflation expectations and contribute to monetary policy effectiveness. The COVID-19 pandemic and the inflation surge in 2021–22 reinforced this trend to reach out to the wider public.

Communication with non-experts required a different approach, as these audiences are more segmented and less likely to be interested in central bank topics. This called for simple explanations of central bank objectives and tasks, complemented with deeper engagement with the public and more education (Haldane *et al.* 2021). On a practical level, the way forward for central banks was to experiment, learn and adapt. Central banks resorted to inputs from surveys, behavioural economists, psychologists, and experiences in other areas of public policy to design a strategy to reach a wider audience. Moreover, societal and technological changes (*e.g.*, how information is shared and consumed) pushed them to find new tools and channels.

Communication initiatives have taken multiple forms, with different central banks embracing different approaches. Yet, a few trends can be identified. One notable trend is the use of layered communications, such as adding plain-language and jargon-free synopses of the prime communication products or using visuals (*e.g.*, infographics and videos). Central banks increased their use of digital contents and platforms – websites and social media – that enable new forms of interaction with the public. A further trend is a move towards a more direct, two-way dialogue and engagement with people from various backgrounds. Last but not least, many central banks developed educational resources to help students, teachers and adults learn about the economy, their finances and the central bank.

The usefulness and success of these initiatives is the focus of a rapidly expanding literature.[4] Although the literature focuses on communication about monetary policy, its findings likely apply to communication about other central bank tasks. This synopsis will conduct a selective review of this literature and of central banks' practices to draw lessons on how to best reach out to the public and on the potential benefits of doing so. It will also document how the communication of the Banco de Portugal has evolved in recent decades to better reach out to the wider public. The synopsis is structured as follows. The next section explains the multiple challenges of communicating with the general public. Section 3 outlines the insights on how to best reach out. Section 4 reviews evidence on how effective central bank communication is in influencing the public's trust and expectations. Section 5 focuses on the experience of the Banco de Portugal. The final section wraps up the main findings and highlights areas where there is still a lot more to learn.

3. During the parliamentary hearings for the appointment of the President of the ECB, Christine Lagarde stated that reinforcing communication with the public would be one of the priorities of her presidency (Lagarde 2019).

4. This literature is surveyed in Blinder *et al.* (2024).

2. Challenges in communicating with the general public

Unlike financial market participants and other expert audiences, the wider public is generally not very interested nor pays much attention to central bank communication. This likely reflects hurdles in both the sender and the receiver side that get in the way of the diffusion and understanding of central banks' messages. These barriers present the greatest challenges for policymakers that seek to reach out to the general public.

2.1. Lack of attention and knowledge

In general, people have a weak desire to be informed about central bank issues. In the euro area, 55% of the respondents to the ECB Knowledge & Attitudes Survey 2021 mentioned that they were not interested in information about the ECB. This low desire to be informed about the ECB is also documented in surveys of German and, to a lesser extent, Dutch households (Hayo and Neuenkirch 2018; van der Cruijsen *et al.* 2015).

A weak desire to be informed means that people do not pay much attention to central bank or other economic matters. In today's competition for attention, even salient central bank news can go largely unnoticed. A striking example is the announcement of the outcome of the latest monetary policy strategy review carried out by the Fed and the ECB. Despite several listening events conducted during the review and a wide news coverage of its outcome, people in the US and the euro area remained mostly unaware of the changes in the monetary policy strategy (Coibion *et al.* 2023; Ehrmann *et al.* 2023). There is also evidence that the public does not track economic variables such as inflation closely (Binder 2017; Coibion *et al.* 2018).

Inattention breeds lack of knowledge about what central banks do and why they do it. Surveys confirm that the public's self-assessed and objective knowledge about central banks and monetary policy is limited at best. For example, around half of the respondents to the ECB Knowledge & Attitudes Survey rated their knowledge of the ECB as bad. Objective knowledge is no different. Large knowledge gaps hold even for New Zealand despite more than 30 years of inflation targeting (Hayo and Neumeier 2021). In the US, Coibion *et al.* (2020a) find that at least half of firms and households have no idea what inflation rate the Fed is trying to achieve in the long run. Only around 20% correctly pick 2%. Similar results are found for the ECB. Only a few survey respondents correctly identify ECB's inflation target (Dräger and Nghiem 2023; Bottone *et al.* 2021), although a larger share is aware that its primary objective is to maintain price stability (Brouwer and de Haan 2022a; Hayo and Neuenkirch 2018). Nonetheless, people often associate the ECB with tasks that go beyond its mandate. Two-thirds of respondents to the ECB Knowledge & Attitudes Survey thought that its job is to stabilise the foreign exchange rate of the euro and almost 40% mention financing governments. Similarly, only 34% of German households know that European governments do not have a say in setting key interest rates (Hayo and Neuenkirch 2018). Knowledge about who sets the interest rate is also limited among UK households (Haldane and McMahon 2018).

Public knowledge (or the absence of it) is shaped by individuals' socio-economic characteristics. In general, knowledge significantly increases with education, income

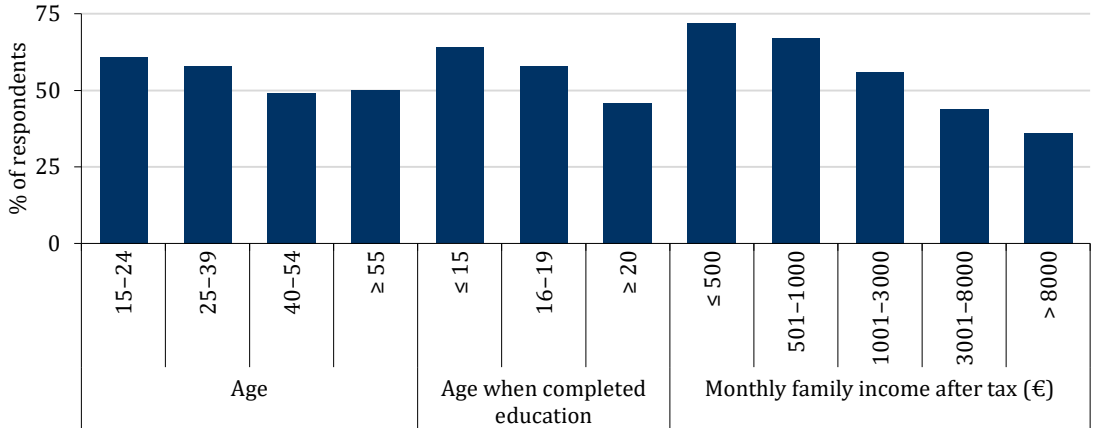

FIGURE 1: Share of euro area citizens that rate their knowledge of the ECB as bad

Source: ECB Knowledge & Attitudes Survey 2021.
Note: Respondents that assess their knowledge of the policies of the ECB and of the Eurosystem as rather or very bad, *i.e.* 1–4 on a scale of 1 (know nothing at all) to 10 (know a great deal).

and, to a lesser extent, age (Figure 1; Blinder *et al.* 2024). It is also generally higher for men. Moreover, studies show that knowledge is positively correlated with people's desire to be informed (van der Cruijsen *et al.* 2015; Blinder and Krueger 2004). In the case of the ECB, knowledge also varies greatly across euro area countries, which poses specific challenges for its communication with the public.

2.2. *Why people are inattentive and uninformed*

Being inattentive to information about central banks and monetary policy can be a rational choice. The rational inattention theory, first developed by Sims (2003), is based on the idea that people optimally allocate attention to different sources of information via a cost-benefit analysis (see Maćkowiak *et al.* (2023) for a literature review). The public has little incentive to pay attention to central banks' communications if the costs of acquiring and processing information are too high or if the benefits are not clear and compelling.

Central banks typically use complex language because their tasks are intricate and hard to explain. This complexity is among the perceived costs of paying attention. Complexity is usually assessed by looking at readability measures based on sentence and word length. One of the most widely used is the Flesch-Kincaid grade level, which indicates the number of schooling years necessary to understand a text (Kincaid *et al.* 1975). According to this metric, the readability of ECB interventions improved somewhat after the global financial crisis, but readers need around 14 years of formal education to understand them (Figure 2). Public interventions and meeting minutes of other major central banks also generally require readers to have tertiary education (ECB 2021). While this level of semantic complexity may be appropriate for an expert audience, it is not for the general public.

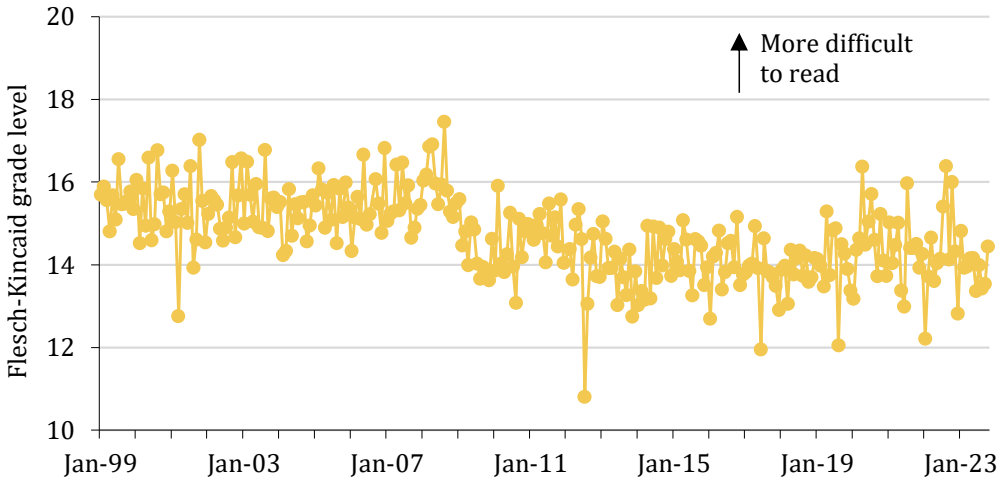

FIGURE 2: Readability of public interventions by ECB Executive Board members

Sources: ECB and ECB staff calculations.
Notes: Flesch-Kincaid grade level score – number of years of education required to be able to understand the text. The score is computed as 0.39 (words/sentence) + 11.8 (syllables/word) – 15.59. A score above 12 requires tertiary education. Monthly median. Includes speeches, statements, presentations, remarks and lectures.

Moreover, complexity is not just about long sentences and words. The extensive use of jargon does not make things easier either. McMahon and Naylor (2023) propose a novel measure of conceptual complexity based on the span of technical jargon terms and the number of topics covered. They run an experiment among UK individuals and find that conceptual complexity reduces understanding more than semantic complexity. This holds even for those with higher education, which suggests that conceptual complexity may also affect communication with expert audiences.

As Haldane (2017) pointed out, complexity makes central bank communication inaccessible to a lion share of the public. The more so, given poor average levels of economic and financial literacy. According to the OECD/INFE survey of adults, the average financial literacy score in the euro area is 65 out of 100, suggesting an insufficient understanding of basic financial concepts and a limited adoption of prudent financial behaviours and attitudes (Figure 3). Looking at a basic concept like inflation, while more than 80% of people understand its relationship with the cost of living, fewer are aware of the loss of purchasing power in one year's time caused by a positive inflation rate. In addition to low literacy levels, it is important to acknowledge that people may face other type of constraints – namely cognitive ones – when processing and making use of information.

Attention to central bank messages depends not only on the costs of acquiring and processing information but also on the perceived benefits of doing so. The two are closely entangled. Complexity and low levels of economic and financial literacy make people less likely to seek information about central banks. It also makes them less aware of the relevance of monetary policy for their day-to-day decisions. Furthermore, when inflation is low and stable – as was the case for decades in advanced economies – people can afford to be inattentive. Central banks' success in stabilising inflation reduced the

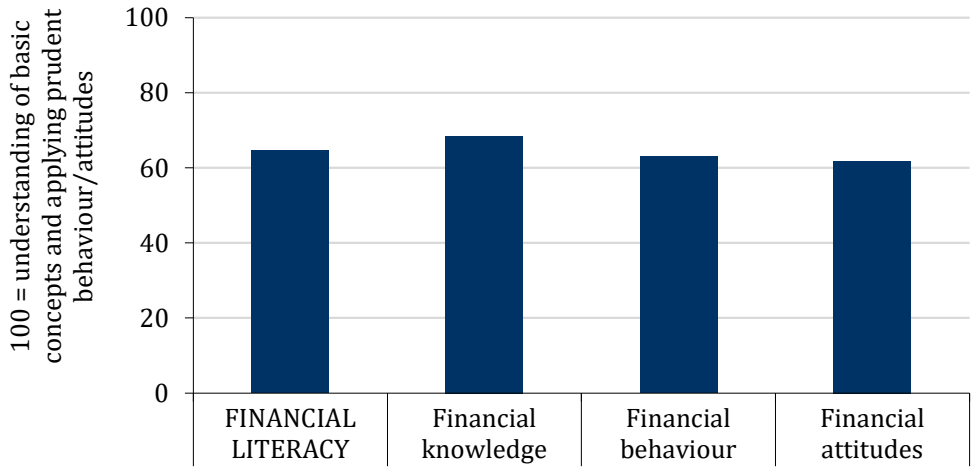

FIGURE 3: Financial literacy in the euro area

Sources: OECD/INFE 2023 international survey of adult financial literacy, Eurostat and authors' calculations.
Notes: Financial literacy – sum of financial knowledge, behaviour and attitudes scores. Scores are rescaled to 0–100. A value of 100 corresponds to understanding basic financial concepts and applying prudent principles in financial behaviour/attitudes. Euro area excl. AT, BE, SI and SK, weighted by population in 2023.

incentives of households and firms to track prices and monetary policy closely (Coibion *et al.* 2020a).

However, the public's inattention can quickly reverse when economic conditions change, as was the case with the inflation surge in 2021–22. In the Jan-23 ECB Consumer Expectations Survey, almost two-thirds of euro area households said that they were paying more attention to inflation than one year ago and only 20% were inattentive (Weber *et al.* 2024). Empirical research resorts to different proxies for inattention to inflation such as the share of people who do not know its level (Bracha and Tang 2024), internet search intensity for the term "inflation" (Korenok *et al.* 2023), and the response of short-term expectations to past forecast errors (Pfaüti 2024) or to provided information about the inflation rate/target (Weber *et al.* 2024). Regardless of the measure used, results confirm that the public's attention to inflation is contingent on its level. Moreover, attention may change abruptly once certain thresholds are hit. For example, (Pfaüti 2024) finds that US households' attention to inflation doubles when it exceeds an estimated threshold of 4%. Central bank communication is particularly important during periods of higher inflation and may be facilitated by increased public attention.

3. Insights on how to reach out to the general public

To communicate effectively with the public, central banks need to reduce the costs of acquiring and processing information and make sure the public understands the content and relevance of their messages. This is important because lack of knowledge may stand in the way of building trust and lead to unrealistic expectations (as shown in section 4). Drawing from communication theory and behavioural insights, central

banks have explored different ways to improve their communication with the general public. This section outlines what seems to work best to get their attention and enhance understanding and knowledge, based on central banks' experience and empirical evidence to date.

Keep it simple, short and clear

Speaking in a way that most people understand can go a long way in reducing perceived costs of paying attention. Rational inattention models that embed linguistic complexity in individuals' optimal attention allocation choices show that simple communication raises the share of people paying attention to central banks (Haldane *et al.* 2021; McMahon and Naylor 2023). Keeping it simple usually entails using shorter sentences and words, concrete nouns and action verbs and avoiding unnecessary adjectives and adverbs. This makes texts easier to read and remember. Simpler and shorter is a good starting point but may miss out on other sources of complexity. To get through to the general public, central banks need also to use clear and jargon-free language and focus on more down-to-earth topics such as price rises.

Many central banks have sought to simplify their prime communication products to engage a broader share of the population. The BoE was at the forefront of these efforts. After mid-2015, the Monetary Policy Report (former Inflation Report) was considerably shortened and simplified. According to the Flesch-Kincaid score, the number of years of schooling required to understand the report declined from around 15 to 12 years. However, the conceptual complexity index proposed by McMahon and Naylor (2023) has not followed the same downward trend. The ECB redesigned the statement explaining its decisions following its strategy review in Jul-21. The new Monetary Policy Statement explains the rationale for the decisions in less technical terms and is easier to read (around 13 years of schooling). In the case of the Fed, the grade level of the press conference opening statement also declined to around 13 years (De Pooter 2021).

Keeping it simple is not uncontended, however. The main objection is that delivering messages that are too simplistic and convey a false sense of certainty could make people overly confident about future economic developments and central banks' power over them. In the model set up by Haldane *et al.* (2021), when households are surprised by unforeseen developments, they stop paying attention to central bank communication. The authors' conclusion is that simplified communication needs to be complemented with explanation, engagement and education if central banks are to reach the public and maintain this reach over time.

Know your audience and tailor the message

Communicating with the public means speaking to people with different levels of knowledge and information. Thus, one size does not fit all. To be effective, communication needs to be tailored to specific audiences. One way to do that is to use a layered approach to communication with different degrees of complexity and detail. The simplest layer is targeted to the wider public and generally includes streamlined

contents written in plain language accompanied by infographics or videos. Cognitive and brain science has shown that visuals help people understand and retain complex information. They are also more attention-grabbing.

The use of layered communication was initiated by the BoE in Nov-17 with the publication of a visual summary of the Monetary Policy Report. Many central banks followed its lead since then. In 2024, nearly 70% of central banks surveyed by the Central Banking Institute reported layering their key publications to help users with different levels of expertise access key messages (Central Banking 2024). An example is the ECB's Monetary Policy Statement at a glance launched in Jul-21, which explains policy decisions in an abridged, accessible and visual format. Many central banks also make available videos, infographics and explainers targeted to the wider public.

Available evidence shows that layered contents tailored to the general public are in fact easier to understand. The ECB's statement at a glance is accessible to readers with around 8 years of schooling. The readability of BoE's visual summary is close to 6 years (McMahon and Naylor 2023). A formal evaluation of BoE's layered communications corroborates this. Using an experiment, Bholat *et al.* (2019) find that the visual summary of the Monetary Policy Report increases the public's comprehension by 25% relative to the technical summary of the same report. Self-reported comprehension also increases, confirming previous results by Haldane and McMahon (2018).

Make it relatable to people's lives

Communication that resonates with people is more likely to draw their attention and help build connection and trust. Behavioural insights based on learnings from psychology and economics offer useful hints (so-called nudges) to create relatable contents. A powerful way to do it is by getting personal. Linguistic nudges, such as the use of first and second person pronouns (we/you) instead of third person abstractions make people feel they are being addressed as individuals and make them more likely to respond. Relatability is also enhanced by story-based communications. Framing the messages as a narrative – defined by Shiller (2017) as a simple story or explanation that speaks to people's concerns or emotions – brings authenticity to contents and is more likely to capture people's attention. Linking messages to trending topics or people's day-to-day life experiences – *e.g.*, explaining currency depreciation through the cost of holidays abroad – gives people something they can relate to and learn from.

Several central banks have resorted to these relatable features in their communication with the general public. For example, the BoE made available a set of online contents to answer questions about the rising cost of living in 2022 and what the Bank was doing about it. The ECB ran a campaign for younger people on social media in 2023 called "Stability is our thing", which explained core aspects about the ECB and its work in a personal and relatable way. Another example is the imaginative use of music videos by the Bank of Jamaica to help explain its inflation targeting policy.

In their experimental study, Bholat *et al.* (2019) assess a relatable summary of the Monetary Policy Report designed jointly by the BoE and the UK's Behavioural Insights

Team. They find that it outperforms a comparable version of the visual summary by 19% when it came to improving public's comprehension.

Make the most of different channels

Among the general public, distinct audiences have different information consumption habits. Central banks need to explore all the channels at their disposal to reach out to and maximise engagement with each audience. Most people continue to get their information about central banks via traditional media, especially television but also radio and press. In the euro area, 36% of respondents to the Dec-23 ECB Consumer Expectations Survey got information about the ECB on television and radio. For a majority of them this was their only source of information (Figure 4). Direct channels such as social media are a relatively less relevant source of information, but still important to reach some segments such as the youngest.

Central banks continue to rely largely on traditional channels to diffuse their communications (Central Banking 2024). In particular, the ECB even strengthened its presence on television and radio in 2022, following up on its commitment to focus more on the wider public (ECB 2022). A singular example is the "Centrally Speaking" show produced and aired on national television by the Bank of Jamaica to explain central bank issues.

Economic research tends to overlook the role of the media in filtering and diffusing central bank messages to the wider public. The main question for central banks is whether and how they can increase news coverage. There is some evidence that more ECB speeches is associated with a higher ECB presence in non-specialised media (Hwang *et al.* 2023). Research also provides hints on how to design communications to raise media coverage. Ferrara and Angino (2022) find a statistically significant negative relationship between the language complexity of ECB's speeches/press

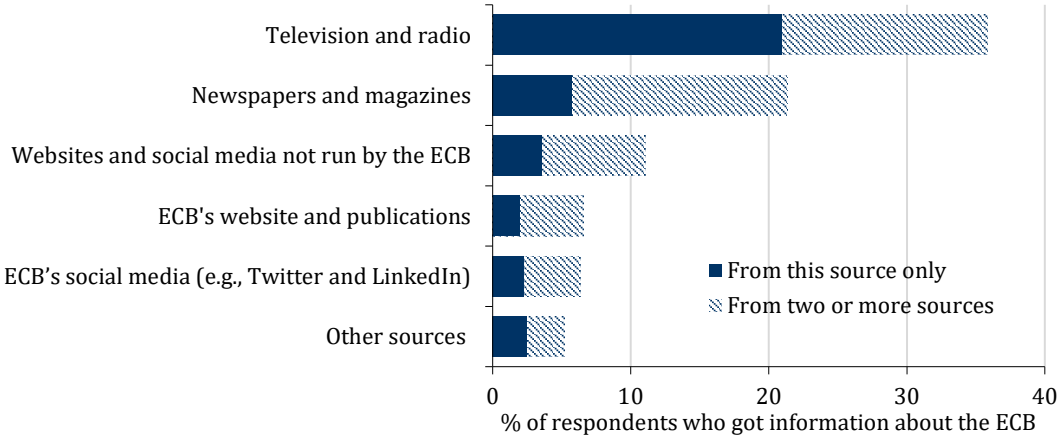

FIGURE 4: Information sources about the ECB in the euro area

Sources: ECB Consumer Expectations Survey (Dec-23) and authors' calculations.
Notes: Percentage of respondents who answer yes to the multiple-choice question "In the past month, have you seen or heard information about the ECB from any of the following sources?". For each item a yes/no response is possible. Euro area excl. CY, EE, HR, LT, LU, LV, MT, SI and SK.

conferences and their media coverage. Munday and Brookes (2021) estimate a model for BoE's communications via the print media and find that simple and story-based communications increase news coverage the most. The main takeaway is that carefully drafted communications can make central bank's messages more newsworthy. This raises the likelihood that people see, hear, or read about central banks (Lamla and Vinogradov 2019, 2022).

Communication delivered directly to the public is also worthwhile, not only to reach specific audiences, but also to avoid hurdles related to intermediated communication (*e.g.*, inadequate news' content and tone or biased reporting). Central banks have boosted their online presence in recent years. Most have made their websites more user-friendly and explored various social media platforms. Facebook is the main social platform used by central banks, followed by LinkedIn and X/Twitter (Central Banking 2024). Nonetheless, the number of central banks' followers is generally small and engagement rates are relatively low. Central banks initially used social media to release information and later began to create contents specifically designed for these platforms. Some use social media to interact directly with the public. On occasion, a few have resorted to using influencers to amplify their messages (*e.g.*, the YouTuber Simon Clark at the "ECB Forum" 2018).

The understanding of how the use of social media impacts central banks' outreach to the general public is still limited. Gorodnichenko *et al.* (2021) examine Fed's communications on X/Twitter and find that users are more likely to engage with tweets about monetary policy or economic conditions. However, the most active in direct engagement with the Fed are a relatively small number of users classified as media and economists. Lamla and Vinogradov (2022) test whether BoE's policy announcements raise the share of individuals informed about the policy decision among its followers on X/Twitter and find that the effect is not statistically significant. This may reflect the fact that BoE's followers are more informed to begin with. Again, communication clarity is key to generate higher engagement rates, as shown by Ferrara and Angino (2022) for ECB's tweets.

Engage directly with people

Typically, central banks have been better at speaking than listening. Yet, sociology and behaviour research suggest that direct engagement is as important as providing information to build trust. Interacting with the public provides an opportunity for people to be heard by those who make decisions that affect them. It also allows policymakers to talk directly to the people they serve. Establishing a two-way communication can yield relevant insights into people's perceptions and concerns, which may enrich central banks' economic analysis and help them draft communications in a way the public can relate to.

Currently, many central banks organise direct dialogue events. The "Citizens' Panels" hosted by the BoE since 2018 are a notable example. These panels, held in different regions across the UK, gather people from all backgrounds to listen to their views and concerns on current economic conditions and policy issues. The

feedback has been very positive. Most panellists report that these events increased their understanding of BoE's responsibilities (90%) and of the economy (76%) (Haldane *et al.* 2021). The insights collected have helped the BoE understand how recent shocks (*e.g.*, the rise in the cost of living) affected people and informed its economic analysis and policy decisions. The BoE also holds regular forums with young people, local charities, and community groups. Other examples of direct engagement with the public include the "Fed Listens" and the "ECB & You" broadcasts. A small number of central banks use social media channels to interact directly with the public (*e.g.*, live Q&A sessions such as the "#AskECB" on X/Twitter). A few central banks go further and have two-way collaboration initiatives with the civil society (*e.g.*, the Bank of Canada nominated a diverse Advisory Council to shortlist iconic Canadians to feature on bank notes that were previously proposed by the public).

Support economic and financial education

Driven by the premise that higher education lowers the costs of paying attention and facilitates understanding, many central banks have increased the supply of educational resources. Although education is not their primary responsibility, central banks can help bridge the gaps in people's understanding of key economic and financial concepts. Citizens have mentioned they would like central banks to play a more active role in this regard (*e.g.*, in the listening events of the ECB's strategy review or BoE's "Citizens' Panels").

Several central banks host educational pages in their websites or have dedicated sites such as the "FedEd". Many offer online games, quizzes and free classroom materials. Some central banks have education programmes with schools to improve the financial and economic literacy of the population. Many central banks also offer on-site activities such as school visits, museums or visitor centres, and students' competitions.

To date, a formal evaluation of the impact of specific educational efforts carried out by central banks is still missing. However, a recent analysis of 76 studies on the impact of financial education interventions suggest they have positive effects on financial knowledge and financial behaviours (Kaiser *et al.* 2022).

4. Impact of communication on the public's beliefs and behaviours

Reaching out to the public is one thing, influencing their beliefs and behaviours is quite another. The main question is whether central bank communication is able to foster people's trust or influence their expectations and, ultimately, their economic decisions. This section conducts a selective review of the rapidly growing research on communication-induced changes in people's beliefs and behaviours.

A large body of research resorts to experimental methods in a quasi-laboratory setting such as randomised control trials (RCT) in surveys of households and firms. In these experiments some randomly selected respondents are provided with information (treatment) while others are not (control group). The information treatments can take different forms: a short text, a chart, a policy statement or a news article. Comparing

answers to specific questions before and after the treatment to those of the control group allows to investigate the causal effects of central bank communication with the public. Much of this literature focuses on inflation expectations, but a few studies look at trust in central banks. The main advantage of RCTs is that they provide a stronger identification compared to other methods such as event studies or regression analysis. An obvious caveat of RCTs is that information is directly delivered to individuals, which is harder to happen in real life. Other caveats relate to the use of survey data to measure trust and inflation expectations of households and firms. Despite advances in the setup and design of surveys, this continues to pose several challenges. In particular, the level and heterogeneity of responses in surveys may be influenced by multiple factors such as the wording or the cognitive demands of questions.

4.1. Trust in central banks

The global financial crisis took a heavy toll on people's trust in public institutions, including central banks, which in some cases only partially recovered. According to the Eurobarometer, trust in the ECB tends to co-move with that in other European institutions (Figure 5). The recovery in citizens' trust in the ECB came to a halt over the pandemic and the recent inflation surge, though there are tentative signs of improvement more recently.

Public trust in central banks has been challenged by recurrent crises and the ensuing deterioration of economic conditions (Bursian and Fürth 2015), but also by societal changes. In the past, people used to trust public institutions even if they did not know what these institutions did or why. In today's digital age, where information is more

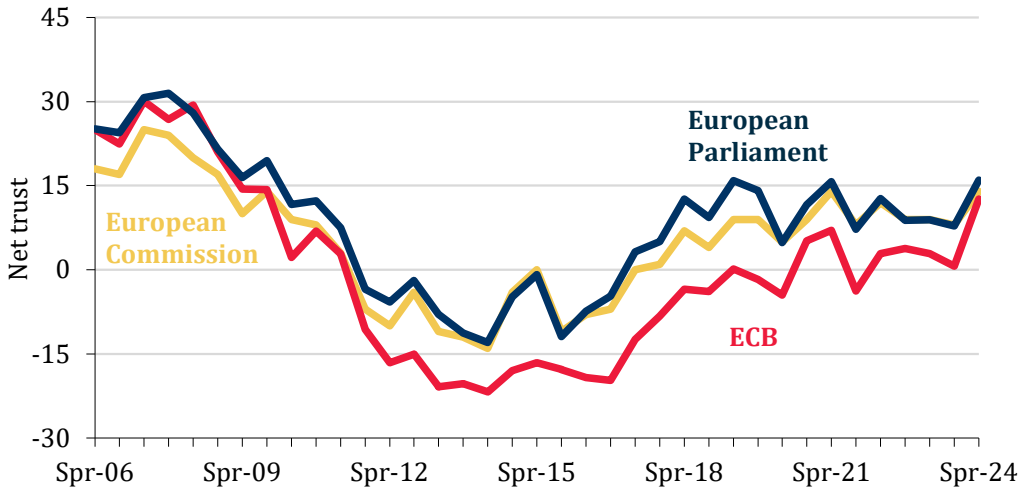

FIGURE 5: Euro area citizens' trust in the ECB and other European institutions

Sources: European Commission Standard Eurobarometer, Eurostat and authors' calculations.
Notes: Net trust – difference between the percentage of respondents who tend to trust and those who tend not to trust the institution. Euro area weighted by population in 2023. Data for the European Commission refers to the European Union.

widely available and people tend to rely more on their peers, the nature of trust has changed. Trust has become more decentralised and personal (Haldane 2017).

Central bank communication may influence trust indirectly by improving people's knowledge about central banks. Indeed, evidence suggests that knowledge is a key driver of trust. Several studies document a statistically significant relationship between greater central bank/financial knowledge and higher trust in the ECB (van der Cruijsen and Samarina 2023; Brouwer and de Haan 2022b; Mellina and Schmidt 2018). Similar results are found for the BoE and the Reserve Bank of New Zealand (Haldane and McMahon 2018; Hayo and Neumeier 2021). As one would expect, trust is also shaped by individuals' socio-economic characteristics. Those with higher education and income levels tend to put more trust in central banks (van der Cruijsen and Samarina 2023; Hayo and Neuenkirch 2014), while differences across gender and age are less clear.

The direct impact of communication on trust is still relatively under researched and available results are mixed. Some experimental studies suggest that simple and relatable communication can help strengthen public trust. Bholat *et al.* (2019) find that the relatable summary of the BoE's Monetary Policy Report significantly improves participants' trust in the Bank, in contrast with other communication variants. Other studies also find a significant impact of tailored communication on public trust in the BoE and the ECB among university students (Haldane and McMahon 2018; Mochhoury 2023). Dräger and Nghiem (2023) report that providing German consumers with qualitative information about inflation and monetary policy raises their trust in the ECB. The effect is stronger for those less informed about these topics prior to the treatment.

Another group of studies find no role for central bank communication on building trust. Experimental studies fielded in German and Dutch surveys find that households who were shown a chart plotting euro area inflation and the ECB's target (Hayo and Méon 2024) or provided with information about policy instruments (Brouwer and de Haan 2022a) do not tend to trust the ECB more. A possible interpretation is that people may find it hard to relate and understand the information provided and, as such, do not change their beliefs about the central bank. A few non-experimental studies investigate other types of communication. Looking at the number of speeches from Eurosystem officials, Hwang *et al.* (2023) find evidence that more speeches negatively impact citizens' trust in the ECB, despite a higher media coverage. In a similar vein, Hayo and Neuenkirch (2014) conclude that German people who got information about the ECB through newspapers in 2011 are more distrustful. The authors associate this with a prevalence of a negative coverage of the ECB in German media at the time.

Directly engaging with the general public may be the extra mile to go for enhancing trust in central banks. Although there is no formal assessment of the impact of these initiatives, the feedback from participants has been encouraging. For instance, 75% of participants in BoE's "Citizens' Panels" report that these events increased their trust in the Bank (Haldane *et al.* 2021). Diversifying the protagonists of central bank communication may also help. D'Acunto *et al.* (2021) show that diverse Fed officials are better able to relate to and be trusted by underrepresented groups, such as women.

On balance, these results tentatively suggest that carefully designed communications and higher proximity to citizens might help foster their trust in central banks. However,

success is not certain and other factors outside the control of the central bank may get in the way.

4.2. Inflation expectations

A recent and growing body of research shows that short-term inflation expectations of households and firms are systematically biased upwards compared to realised inflation or expectations of professional forecasters. Another well-documented fact is the high degree of cross-sectional dispersion of households and firms' expectations. These stylised facts hold across different countries and periods (Weber *et al.* 2022). Disagreement about future inflation is found to be related to systematic differences across socio-economic characteristics of households (D'Acunto and Weber 2024). People with lower education and income and women tend to have higher inflation expectations. This is also generally the case for elderly people (*e.g.*, Gomes *et al.* 2024). Lower financial knowledge also translates into higher inflation expectations (*e.g.*, Quelhas 2024). In the case of firms, there is evidence that cross-sectional disagreement is related to the type of industry (*e.g.*, firms in the food sector have higher inflation expectations than firms in financial services), but not to firm size (Candia *et al.* 2024).

Longer-term inflation expectations of households and firms generally deviate from central banks' targets and co-move with short-term expectations, suggesting an imperfect degree of anchoring. Despite this, D'Acunto *et al.* (2024) claim that the ECB's objective has some traction as a guide for euro area households' inflation expectations because their bias and dispersion are smaller for longer horizons. The literature suggests that there is a link between the anchoring of inflation expectations and public trust.[5] Households with higher levels of trust in the ECB are reported to have, on average, inflation expectations that are more aligned with its target (Brouwer and de Haan 2022b). On the other hand, inflation expectations of individuals with high levels of trust tend to be less responsive to short-term economic developments (Stanisławska and Paloviita 2021).

Less is known on how subjective inflation expectations are formed and updated. Research so far suggests that households form expectations differently from rationality assumptions embedded in many economic models. There is evidence that individuals use rules of thumb based on limited and selective information like price signals of frequently purchased items or lifetime memories of inflation. Inattention and differences in cognitive abilities also likely play a role in shaping inflation expectations (D'Acunto *et al.* 2024; Weber *et al.* 2022). A key takeaway for central banks' communication is to encourage people to use the "right" heuristic to better manage expectations (King 2005).

The literature that studies how central bank communication affects inflation expectations of households and firms mostly resorts to RCTs. Some studies investigate the impact of different communication formats. Haldane and McMahon (2018) find

5. The degree of anchoring of inflation expectations is often used as proxy for central bank's credibility, while trust is measured through surveys. As mentioned in footnote 2, credibility and trust are closely related concepts and may be hard to disentangle empirically.

that layered contents boost the chances that people update their economic expectations towards the BoE's forecasts. An experiment conducted for Irish households reveals that inflation expectations adjust more towards the ECB's target in response to audiovisual mediums (audio, photo, or video) than to a written statement (Ash *et al.* 2024). Another strand of research focuses on the type of information provided rather than the format. A key finding is that households meaningfully update their inflation expectations when provided with simple pieces of publicly available information, such as current inflation, the inflation target or central bank/professional inflation forecasts (Coibion *et al.* (2022) for the US; Ash *et al.* (2024) for Ireland; Kostyshyna and Petersen (2023) for Canada). Evidence for firms is scarcer mostly due to fewer available surveys, but closely resembles that of households. Firms adjust their inflation expectations when presented with recent economic data, the inflation target or forecasts by professional forecasters or other firms (Coibion *et al.* (2018) for New Zealand; Coibion *et al.* (2020b) for Italy). Revisions of inflation expectations are larger for those households and firms with higher and more uncertain inflation expectations prior to the experiment. Additionally, the provision of information about inflation forecasts and the central bank target seems to move households and firms' inflation expectations more than other information, such as economic activity (Coibion *et al.* 2022, 2018). In any case, most studies show that the effects of communication on inflation expectations dissipate rather quickly, in general within six months.

The results of studies based on non-experimental methods are not as clear cut. Some studies suggest that more intensive media coverage of central banks improves the accuracy of inflation expectations of households, especially of those who use traditional media (Conrad *et al.* 2022; Lamla and Lein 2014). The tone of the news matters as much as its volume. Lamla and Lein (2014) show that when the tone of inflation news is bad, the gap between inflation expectations of German consumers and professional forecasters widens. In contrast, Lamla and Vinogradov (2019, 2022) find that inflation expectations of US and UK households are little affected by media coverage of monetary policy announcements.

A final issue is whether households and firms act on their inflation expectations. There is clear empirical evidence supporting causal effects from inflation expectations on economic decisions, including from the above mentioned RCTs. However, the size and direction of the effects are quite heterogenous and appear to be context-dependent (*i.e.*, not always in line with simple theoretical results). This strand of research is thoroughly discussed in D'Acunto *et al.* (2024) or Coibion *et al.* (2020a).

Overall, the above evidence provides some additional clues for central bank communication with the public. First, simple and tailored communication can potentially lead to significant changes in people's inflation expectations. But it needs to be repeated regularly to generate long-lasting effects. Second, information campaigns to the wider public designed to clarify the central bank target and how inflation is expected to evolve towards it can be a powerful add-on to regular communications.

5. Communication practices at the Banco de Portugal

Communication practices at the Banco de Portugal changed markedly over recent decades. As in other central banks in advanced economies, this took place in two phases.

After the Banco de Portugal became part of the Eurosystem, there was a noticeable increase in communication initiatives. However, these initiatives were less focused on monetary policy than those of other central banks, as the ECB was responsible for communicating policy decisions. This first phase saw a rise in the number of speeches, interviews, press releases and publications. The increase was particularly evident after the global financial crisis, partly reflecting the adverse macroeconomic environment but also the enlargement of the Bank's responsibilities and tasks, such as becoming the national resolution and macroprudential authority. The number of public interventions by the Governor increased from 8 per year on average until 2008 to 19 per year until 2016 (Figure 6). At the same time, there was a diversification of the protagonists with an increasing number of interventions from other members of the Board. The number of press releases also rose sharply from an average of 8 per year in the period 2000–08 to 99 in 2009–16.

The Banco de Portugal was not immune to the public criticism and decline of trust that affected many central banks after the global financial crisis. According to a survey conducted in 2017, the average trust in the Bank was 53 out of 100 and citizens saw the Bank as detached from them (Figure 7). The survey also showed that people had a limited understanding of Banco de Portugal's mission and tasks. The two only tasks that were identified by a large majority of respondents were issuing banknotes and supervising banks.

These twin deficits of public understanding and trust were at the root of a new phase of the Banco de Portugal's communication policy. A crucial element of the new

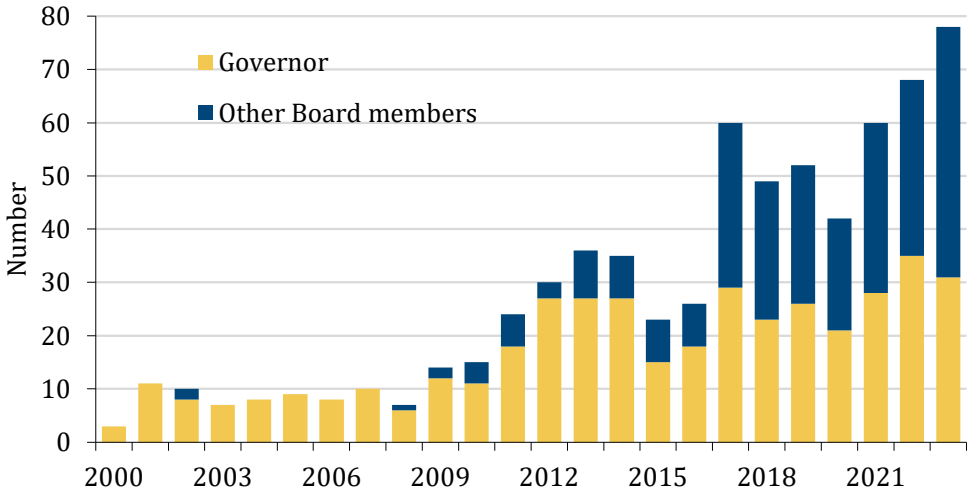

FIGURE 6: Public interventions by the Board members of the Banco de Portugal

Source: Banco de Portugal.
Note: Includes speeches, interviews and opinion articles.

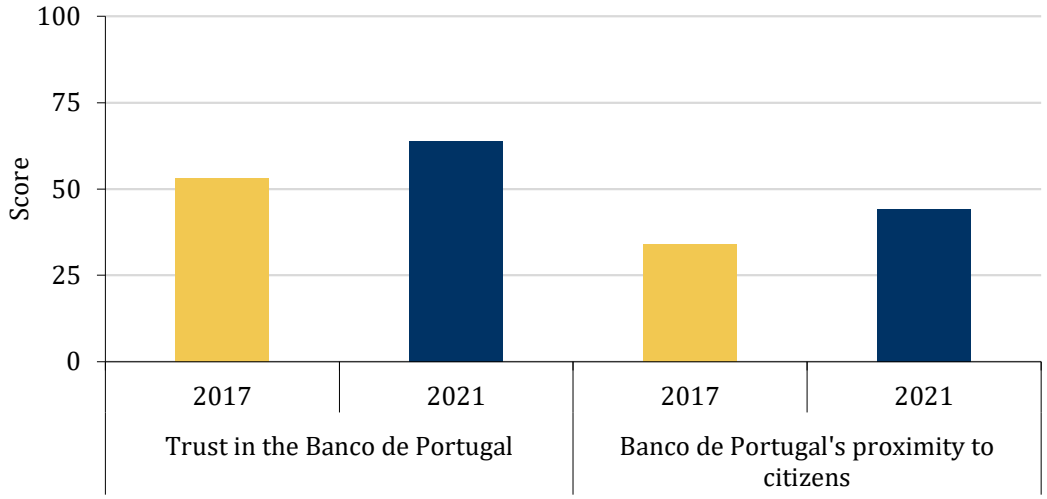

FIGURE 7: Citizens' perceptions about the Banco de Portugal

Sources: Marktest "*Estudo sobre reputação do Banco de Portugal, dez-17*" and "*Estudo de imagem e reputação do Banco de Portugal, mai-21*".
Notes: Respondents rate their agreement, on a scale from 1 (totally disagree) to 10 (totally agree), with the statements "The Banco de Portugal is a trustworthy institution" and "The Banco de Portugal is an institution close to citizens". Mean value rescaled to 0–100.

strategy was the centralisation of all communication responsibilities in a dedicated department in 2017. The Bank started to implement multi-year communication plans focused on increasing public trust. A key pillar of these plans was to improve people's understanding about the Bank's mission and tasks, making use of the many insights on how to reach out to the public described in section 3.

Simpler and more targeted communication

Besides a further increase in public interventions by Board members (Figure 6), the language used in these interventions was simplified. For example, the readability of speeches by the Bank's Governor improved and, in some cases, readers no longer need a tertiary education to be able to understand them (Figure 8). Interviews with newspapers and magazines (larger markers in Figure 8) are typically more accessible than speeches.

The Banco de Portugal also began to use layered communication for several of its publications. Texts of a more technical nature were complemented with visuals such as videos and infographics. More recently, the Bank started to publish accessible summaries of the main messages of the Economic Bulletin and the Financial Stability Report. According to the Flesch-Kincaid score, the Economic Bulletin summary is accessible to readers with around 9 years of formal education. This is significantly less complex than the Bulletin's main text, even though its readability also improved in recent years (*e.g.*, from 15 years in Dec-19 to around 13 years in Dec-23). Layered communication has also been applied to some website contents, namely those explaining monetary policy.

The Bank launched other new contents targeted to the wider public, such as explainers and, since 2020, podcasts as these became increasingly popular. From 2017 to

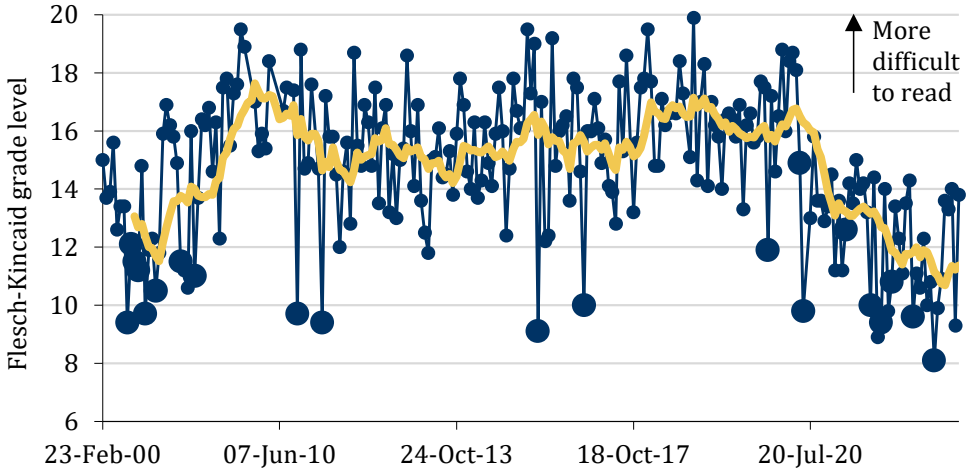

FIGURE 8: Readability of public interventions by the Governor of the Banco de Portugal

Sources: Banco de Portugal and authors' calculations.
Notes: Flesch-Kincaid grade level score – number of years of education required to be able to understand the text. The score takes into account sentence and word length. A score above 12 requires tertiary education. The score was adapted to Portuguese texts by Moreno *et al.* (2023) and computed using the software "*ALT – Análise de legibilidade textual*" (available at https://legibilidade.com). Yellow line – moving average of 10 observations. Includes speeches, opinion articles and interviews (larger markers) in Portuguese.

2023, the number of videos, infographics, explainers, and podcasts more than doubled to around 100 per year.

More channels to reach the wider public

Given its long-standing role as primary source of information for the public, the Banco de Portugal has strengthened its presence in traditional media. Over the past two years, the Governor gave numerous interviews on television to explain economic conditions and monetary policy decisions. This follows the recognition in the ECB's monetary policy strategy review that national central banks' governors should play a more active role in explaining policy decisions to the citizens of their countries. The Bank also started to live stream the press conferences of key publications on its digital channels.

The Banco de Portugal expanded its digital presence to reach out to people of different ages, interests, and educational backgrounds. The Bank launched a new website in 2017 and gradually joined social media platforms, namely LinkedIn (Dec-16), X/Twitter (Feb-17), YouTube (Mar-17) and Instagram (Sep-18). Initially, social media were primarily used to inform a larger audience about the release of statistical data and publications. As social media presence expanded, these platforms were also used to raise awareness and engage with the wider public. The Bank created new contents to explain its tasks and economic and financial concepts and used more interactive formats such as Instagram polls. Presently, social media engagement remains one-sided, but there are plans to start replying to public inquiries soon.

The number of followers of the Banco de Portugal in social media has risen steadily, suggesting a mounting interest of the wider public in central bank topics. In any case,

it remains quite modest relative to total social media users in Portugal. Still, the Bank's social media presence compares favourably with other European central banks (Figure 9).

Getting closer and talking to people

The experience of the listening events hosted by the Banco de Portugal as part of the ECB's monetary policy strategy review in 2020–21 triggered changes in the engagement with society. Proximity and direct engagement with society was reinforced since then, going beyond prior consultative initiatives (*e.g.*, "*Fórum de Pagamentos*" and "*Fórum de Supervisão Comportamental*") and informal dialogues with leading firms and business associations. Promoting proximity and building trust is the motto of Banco de Portugal's Strategic Plan for 2021–25.

The Bank launched some initiatives catering to different objectives, formats, and target groups. One such example is the "*Encontros com a Comunidade*" which entails listening to local economic agents across the country, with the participation of the Governor and other central bank officials. Another initiative is the "*Fórum de Economia*" bringing together stakeholders from academia, business associations, trade unions, public and private entities to discuss the findings of analyses published by the Bank.

Enhancing financial and economic literacy

Financial literacy has been a strategic priority of the Banco de Portugal for over a decade, making it a pioneer among central banks in this domain. Since 2011, the Bank and other financial supervisors are jointly responsible for the National Plan for Financial Education, branded as "*Todos Contam*". The plan aims to contribute to improve the financial knowledge of the population and foster the adoption of appropriate financial

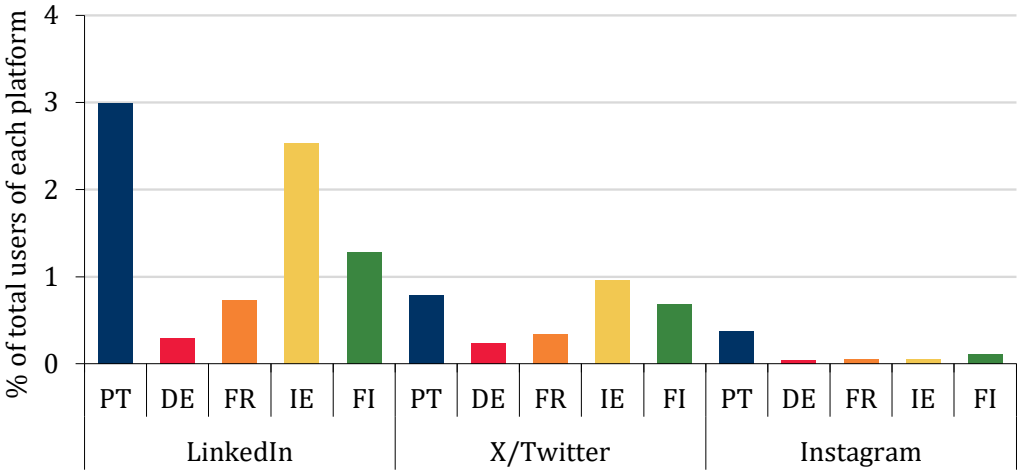

FIGURE 9: Central banks' social media followers

Sources: Central banks social media accounts and DataReportal (https://datareportal.com).
Notes: Banco de Portugal (PT), Deutsche Bundesbank (DE), Banque de France (FR), Central Bank of Ireland (IE), and Suomen Pankki (FI). Data as of 18-Feb-24 for central bank followers and Jan-24 for total users.

behaviours. The promotion of financial literacy is entwined with the Bank's mandate of banking conduct supervision. The Bank established a dedicated business unit and a website (https://clientebancario.bportugal.pt/en). Financial literacy initiatives are mainly targeted at students in lower and upper secondary education, teachers, and individuals from more vulnerable groups such as the elderly, the unemployed and migrants. The Bank provides training courses, lectures, workshops, teaching and learning materials. It also promotes digital awareness campaigns. A recent example is the "*#ficaadica*" campaign about the safe use of digital channels, firstly aimed at young people and later extended to adults.

More recently, the Bank also set as a priority to help citizens better understand the economy, its tasks and those of the Eurosystem. Various initiatives have been promoted for different target groups. In the case of university students, the Bank offers sessions with experts on different central bank topics. In 2022, it launched "StatFlix", an e-learning programme on the main statistics of the Portuguese economy and the euro area for economics and management students. Another example is the pedagogical campaign ran on social media in 2023 called "*#simplesassim*", designed to explain to the general public the rationale underpinning recent monetary policy decisions.

The Money Museum plays a key role in reaching out to the public and helps promote financial and economic literacy. Resorting to innovative methods, it provides valuable insights into the history of money and the tasks of a central bank. Interactive areas like the financial learning centre engage visitors in games focusing on saving and budget management. In 2023, the museum received more than 80 000 visitors, a fifth of whom were school children. The museum also offers various online resources aimed at children. It created a series of online radio episodes and set up agreements with national magazines to feature monthly sections covering topics such as the fundamentals of money and budget management during school holidays. It also has a dedicated Instagram account, enhancing the museum's outreach and impact.

Contests have also proven to be very popular and useful tools in raising awareness and stimulating knowledge about core central bank tasks among young people. Examples of contests promoted by the Bank jointly with other institutions include the "Generation €uro Students' Award" about monetary policy, the competition "*Todos Contam*" to promote financial education projects in schools and the "European Statistics Competition".

Assessing public engagement

To get a general and quantified view of Banco de Portugal's communication efforts to reach out to the general public, the various initiatives were aggregated into a single index as proposed by Gardt *et al.* (2021). This engagement index is based on scores of 21 indicators grouped into four categories: information, education, consultation, and collaboration. For each indicator, the score reflects whether the central bank has a specific type of initiative (*e.g.*, run a museum). Figure 10 shows the engagement index computed for the Banco de Portugal using the coding framework provided by Gardt *et al.* (2021), together with the indices computed by these authors for other central

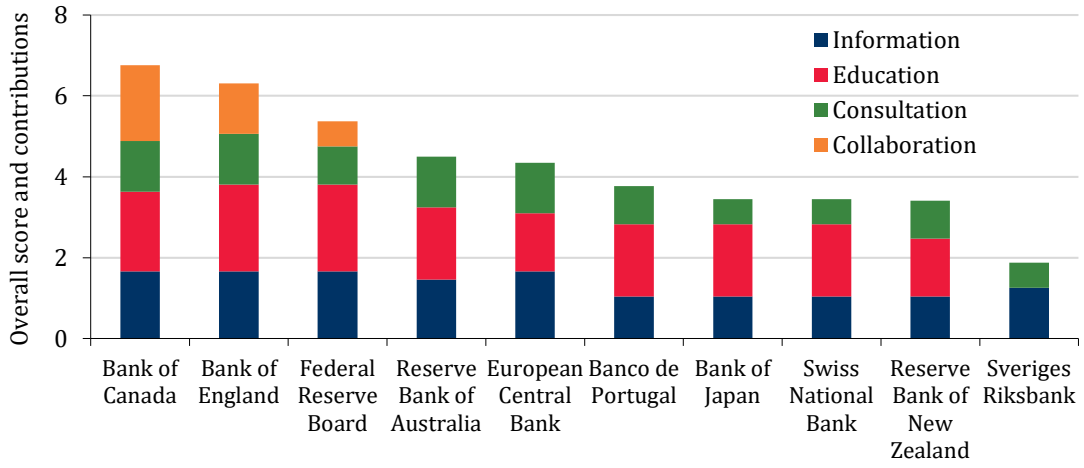

FIGURE 10: Central bank engagement index

Sources: Gardt *et al.* (2021) and authors' calculations.
Notes: Information (explainers, social media accounts or respond to public inquiries); education (financial literacy efforts, educational materials, museums or student competitions); consultation (efforts in gathering views or feedback from the public); collaboration (two-way initiatives such as partnerships or joint campaigns). Overall score – 0 to 10 scale; average of the four categories. Data as of May-21.

banks. Engagement activities vary across central banks, suggesting that there is no single optimal policy. Banco de Portugal's efforts to engage with the public as of 2021 are close to those of the ECB, but somewhat below the higher-ranking central banks. Looking at the education category, Banco de Portugal score is more comparable to that of the higher-ranking banks, reflecting the significant investment in financial and economic literacy. An update of the Bank's engagement index to include initiatives adopted between 2021 and 2023 shows a rise in the overall score (from 3.8 to 5.2). This improvement was common to all categories except collaboration, due to the absence of two-way initiatives.

There are tentative indications that Banco de Portugal's new communication strategy to engage with the public may be paying off. A survey conducted in 2021 showed that trust in the Bank and proximity to citizens rose around 10 points since 2017 (Figure 7). Over this period, trust in other European institutions also rose. Regardless of this, significant gaps in knowledge about the Banco de Portugal's tasks remain. This suggests that, like for other central banks, progress in reaching out to the general public will be slow and the Bank will have to continue to experiment, learn and adapt.

6. The road ahead

Over the last three decades, the way central banks communicate underwent a revolution: from secrecy to wide-ranging transparency and from experts to the wider public. The Banco de Portugal was no exception. Communication with the public is not only a democratic imperative but may also improve the efficacy of monetary policy.

How should central banks communicate in order to reach out to the public and guide their beliefs? The literature and central banks' experiences provide a few clear answers: (i) use simple and relatable messages and repeat them regularly, (ii) focus on

clarifying the inflation target and how inflation is expected to evolve towards it, (iii) tailor communication to the target audience, attending to the disadvantaged groups, (iv) make the most of various channels including traditional media, (v) engage directly with people and (vi) help bridge citizens' knowledge gaps about economic and financial matters. This is central banks' best chance of fostering trust and guiding households and firms' inflation expectations. All these efforts might also benefit the communication with expert audiences and improve central banks' information sets.

Communicating with the public is not without risk, however. It must strike the right balance between being simple but accurate, being clear but conveying uncertainty and tapping into issues that people care about but within central banks' mandate. In any case, there are limits on what communication with the public can realistically be expected to achieve. Success should not be measured by the ability to reach everyone, but rather to reach beyond the minority of experts who form the core of central banks' audiences (Haldane and McMahon 2018).

The journey of reaching out to the public is still in its early days and much remains to be learnt about the impacts of central bank communication practices (*e.g.*, which formats or contents are more helpful). In addition, more work is critical to have a thorough understanding of how households and firms form their expectations and how these affect their decisions. This requires more and better data about inflation expectations, especially for firms. Lastly, emerging trends such as the continuous reshaping of the media landscape and the increasing use of artificial intelligence may call for a revisiting of some of the current findings. Progress in reaching out to the public will take time, but the potential benefits are important enough to keep trying.

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Banco de Portugal Economic Studies, Vol. X, No. 4

Non-technical summary

October 2024

Deposit interest rates and monetary policy transmission

Diana Bonfim and Leonor Queiró

The monetary policy transmission mechanism is complex and multidimensional. Banks play a key role in this transmission mechanism. Through monetary policy operations, banks' funding costs and returns are shaped by central bank decisions. Banks will then pass through these changes to the economy.

Most of the literature on monetary policy transmission through banks has focused, until recently, on how monetary policy is transmitted through credit markets. When monetary policy tightens, banks' funding costs increase and this leads banks to charge higher rates on the loans they offer. Credit decreases at the intensive and extensive margin, i.e., firms and households borrow smaller amounts and are less likely to borrow overall. This credit contraction reflects not only a contraction in credit supply but also of credit demand, as investment opportunities deteriorate with higher interest rates, due to a decrease in the net present value of projects.

More recently, the literature on monetary policy transmission has also focused on the right-hand side of banks' balance sheets. The pricing of deposits also plays a key role in the transmission of monetary policy. When monetary policy tightens, the spreads that banks offer on their deposits widen, leading to deposit outflows, as deposits become a less competitive savings instrument. The outflow of deposits leads to a contraction in lending (deposit channel of monetary policy).

During the 2022-2023 tightening cycle, a public debate has emerged about the speed at which banks increased deposit interest rates. In this article, we examine the transmission of monetary policy through deposits in Portugal during the last 25 years. We find that the pass-through of monetary policy to bank deposit interest rates is incomplete. To do so, we estimate deposit betas, which capture how much banks increase deposit interest rates as a response to a tightening in monetary policy rates. Adjustments in interest rates reflect not only current monetary policy decisions but also expectations about their future path. As in many products, price adjustments may be sluggish and gradual.

We find that a 100 bps point increase in monetary policy rates is linked to a 95 bps increase in new deposit rates for firms and 59 bps for households, over a year (65 bps, when both segments are considered). These estimates reflect the average pass-through effect between 1997Q4 and 2023Q4. Deposit betas are higher for corporate deposits with

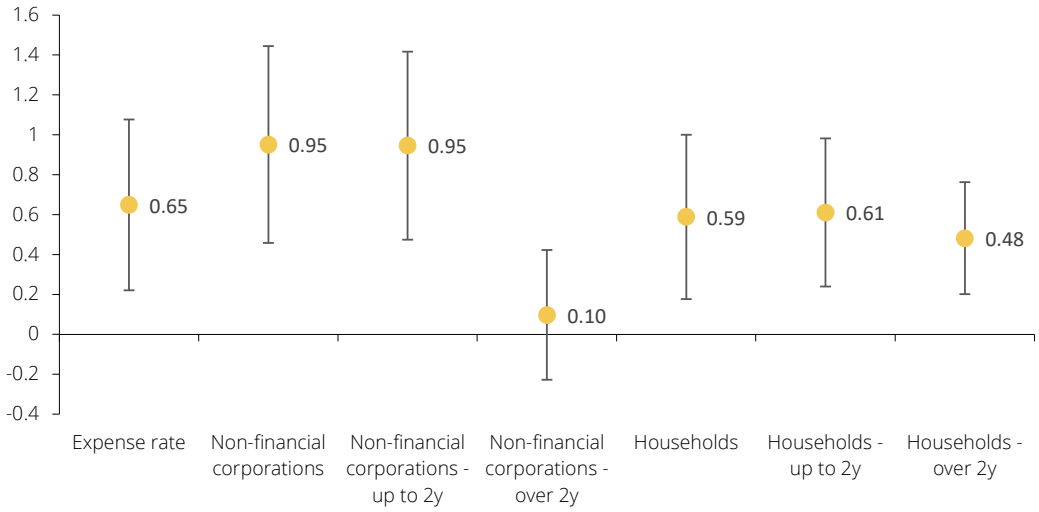

FIGURE 1: Deposit betas, by deposit type, new business.

Source: Banco de Portugal and authors' calculations.
Notes: Deposit betas capture how much banks increase deposit interest rates as a response to a change in monetary policy rates. Estimated using new deposits. Confidence intervals at 95% level.

an agreed maturity of up to two years. This is the segment in which monetary policy passed through more strongly. For corporate deposits with longer maturities, the interest rate sensitivity to monetary policy is much smaller. The pricing of household deposits is less sensitive to monetary policy. Most of the reaction is also concentrated in deposits with an agreed maturity of up to two years.

Banco de Portugal
Banco de Portugal Economic Studies, Vol. X, No. 4

Deposit interest rates and monetary policy transmission

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Banco de Portugal

October 2024

Abstract
Banks play a key role in the transmission of monetary policy. Traditionally the analysis of the transmission mechanism has focused on banks' lending activities. However, deposits also play an important role in the transmission of monetary policy. We characterize the deposit market in Portugal and examine the pass-through of monetary policy to bank deposits. We find that there is an incomplete pass-through of monetary policy to deposit interest rates. A 100 bps increase in money market interest rates is reflected in an average 65 bps increase in new deposit rates over a year, i.e., the deposit beta is 65 bps. For the euro area, the corresponding deposit beta is 87 bps, suggesting a stronger pass-through. A similar exercise for credit suggests that the magnitude of the pass-through of monetary policy to loan rates is weaker (58 basis points). (JEL: E5, G21.)

1. Introduction

When the European Central Bank (ECB) changes monetary policy rates or adopts other monetary policy decisions, the transmission mechanism that will ultimately ensure that the price stability objective is achieved is complex and multidimensional. Indisputably, banks play a key role in this transmission mechanism. Through monetary policy operations, banks' funding costs and returns are shaped by central bank decisions. Banks will then pass through these changes to the economy.

Most of the literature on monetary policy transmission through banks has focused, until recently, on how monetary policy is transmitted through credit markets. When monetary policy tightens, banks' funding costs increase and this leads banks to charge higher rates on the loans they offer. Credit decreases at the intensive and extensive margin, i.e., firms and households borrow smaller amounts and are less likely to borrow overall. This credit contraction reflects not only a contraction in credit supply but also of credit demand, as investment opportunities deteriorate with higher interest rates, due to a decrease in the net present value of projects.

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More recently, the literature on monetary policy transmission has shifted its focus to the right-hand side of banks' balance sheets. The pricing of deposits also plays a key role in the transmission of monetary policy. Drechsler et al. (2017) show that when monetary policy tightens, the spreads that banks charge on their deposits widen, leading to deposit outflows, as deposits become a less competitive savings instrument. The outflow of deposits leads to a contraction in lending (deposit channel of monetary policy).

During the 2022-2023 tightening cycle, a public debate has emerged about the speed at which banks increased deposit interest rates. This led to the popularity of the concept of deposit betas, initially proposed by Drechsler et al. (2017). This concept allows to estimate the magnitude of the pass-through of monetary policy to deposit rates. In this article, we apply this methodology and examine the transmission of monetary policy through deposits in Portugal, using data for the period 1997Q4 up to 2023Q4. We find that the pass-through of monetary policy to bank deposit interest rates is incomplete. A 100 basis point increase in money market interest rates is reflected in an average 65 bps increase in new deposit rates, over a year. This compares to a slightly stronger pass-through in the euro area of 87 bps.

We also estimate the sensitivity of new loan interest rates to monetary policy. We find that the pass-through to loan rates is quite similar, thereby not sustaining the hypothesis of asymmetric pass-through in loans and deposits, through the business cycle.

The paper proceeds as follows. First, we describe the Portuguese deposit market and establish a set of stylized facts. Afterwards, we implement the methodology proposed by Drechsler et al. (2021) to compute the pass-through of monetary policy to deposit rates (the so-called deposit betas) for different deposit segments in Portugal. We extend the analysis to the euro area and we also examine the pass-through of monetary policy to loan interest rates.

2. Deposit market in Portugal: structural characteristics and recent evolution

In December 2023, total deposits held by banks in Portugal amounted to 341 billion euros (79% of banks' assets, 87% of their liabilities, and 107% of GDP). Deposits are the main financing source of banks and the main savings instrument of households and firms. Household deposits account for 63% of the total, while deposits of non-financial corporations account for 23%. The remainder refer to deposits of other financial institutions (12%) and public administrations (2%).

Figure 1 shows the evolution of deposits since the earliest period for which data is available (1979). Household deposits have always accounted for the largest share of total deposits. Deposits from firms have increased over the years, with a marked increase during the pandemic. Both household and corporate deposits have decreased since the record highs reached during the pandemic. The precautionary savings accumulated during this period have been used to finance investment and consumption, supporting the recovery of economic activity. In December 2023, household deposits were still

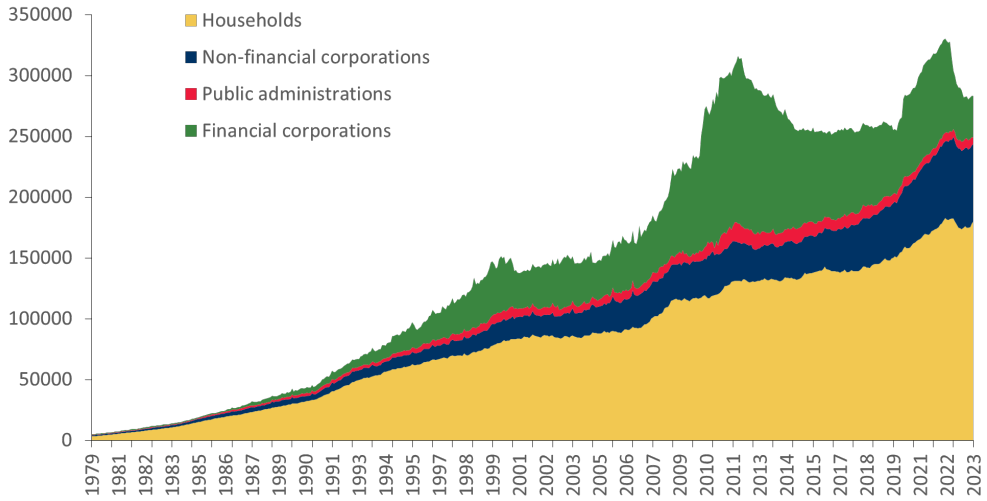

FIGURE 1: Deposits in Portugal, by institutional sector.

Source: Banco de Portugal.
Notes: The last observation refers to December 2023. The unit is million euros.

19.3% higher than immediately before the pandemic (February 2020). Non-financial corporations' deposits were 44.8% higher.

The decrease in deposits has been mostly concentrated in the recent period of monetary policy interest rate hikes. Household deposits started to decrease in August 2022, soon after the beginning of the hiking cycle (July 2022). They have decreased by 1.6% since that peak. Non-financial corporations' deposits reacted more slowly but more strongly, having decreased by 4.7% since the peak recorded in December 2022.

Deposits from other financial corporations also account for large amounts. These deposits display more cyclical variation, having reached peaks during the euro area sovereign debt crisis and the pandemic.

Most household deposits are deposits with agreed maturity or time deposits (Figure 2). This is traditionally the most important savings instrument in Portugal. Over the last four decades, deposits with agreed maturity accounted for more than 70% of total household deposits, on average. However, during the low-interest rate period that marked the previous decade, the share of these deposits decreased, reaching 50% in early 2022. As interest rates on deposits were at or close to zero for all types of deposits, households became broadly indifferent between overnight and agreed maturity deposits. Since interest rates began to increase, households gradually adjusted. Even though total deposits from households decreased throughout 2023, reflecting competition from other savings instruments, deposits with agreed maturity have been increasing. While total deposits decreased by 1.6% since July 2022, deposits with agreed maturity have increased 7.8%. The increase has been especially pronounced for deposits with agreed maturity between 1 and 2 years (38.4%).

Deposits of non-financial corporations display a different composition. Firms typically prefer to have liquid claims. On average, only one-third of deposits have agreed maturity (Figure 3). This percentage also decreased during the last decade of very

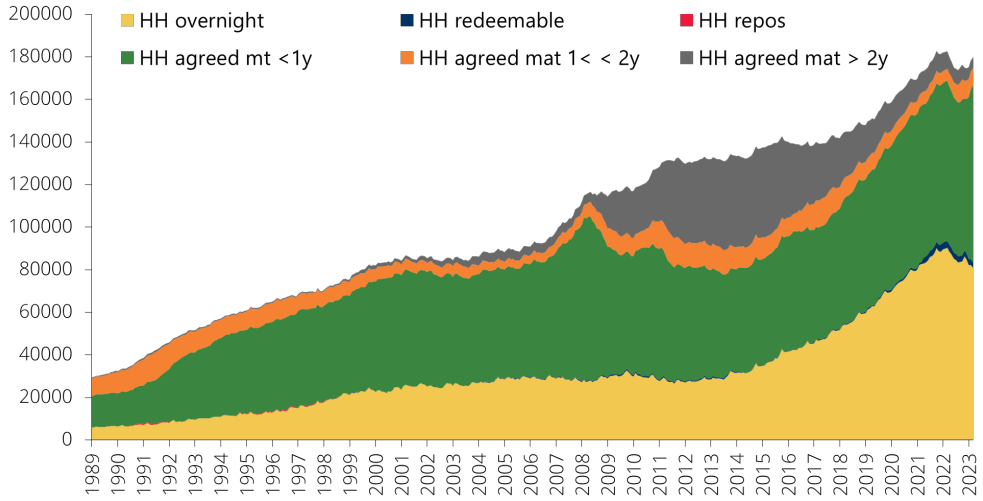

FIGURE 2: Household deposit stock in Portugal, by type of deposit.

Source: Banco de Portugal.
Notes: The last observation refers to December 2023. The unit is million euros. HH refers to households.

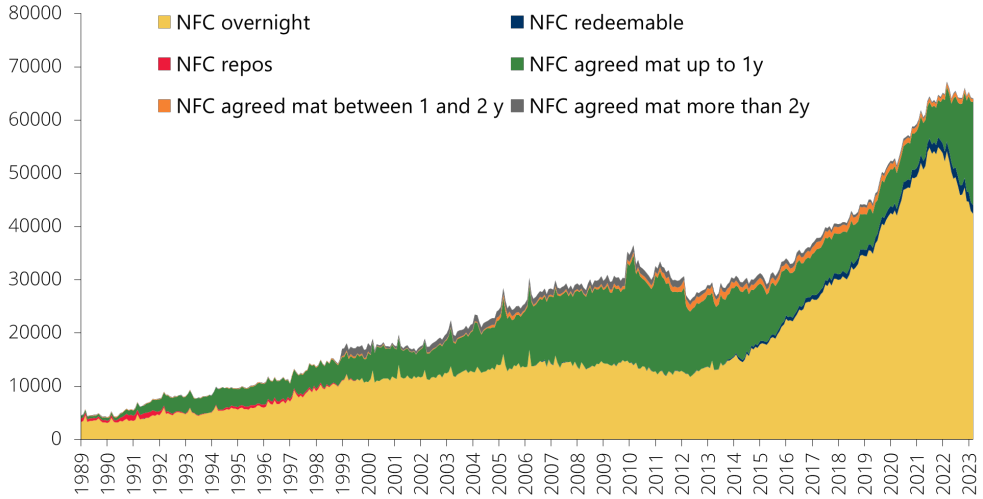

FIGURE 3: Non-financial corporations deposit stock in Portugal, by type of deposit.

Source: Banco de Portugal.
Notes: The last observation refers to December 2023. The unit is million euros. NFC refers to non-financial corporations.

low-interest rates. In mid-2022, only 12% of corporate deposits had agreed maturities. Since then, these deposits increased markedly and represented 31% of deposits by December 2023.

The recent developments in deposit growth and composition reflect, among other factors, changes in monetary policy. The main refinancing rate increased from 0% in June 2022 to 4.5% in September 2023. This is the fastest and steepest monetary policy tightening episode since the creation of the euro area. Even though deposit interest rates did not go below zero during the past decade, unlike in other euro area countries, they were very close to zero, at all maturities and for all types of deposits (Figure 4). Since

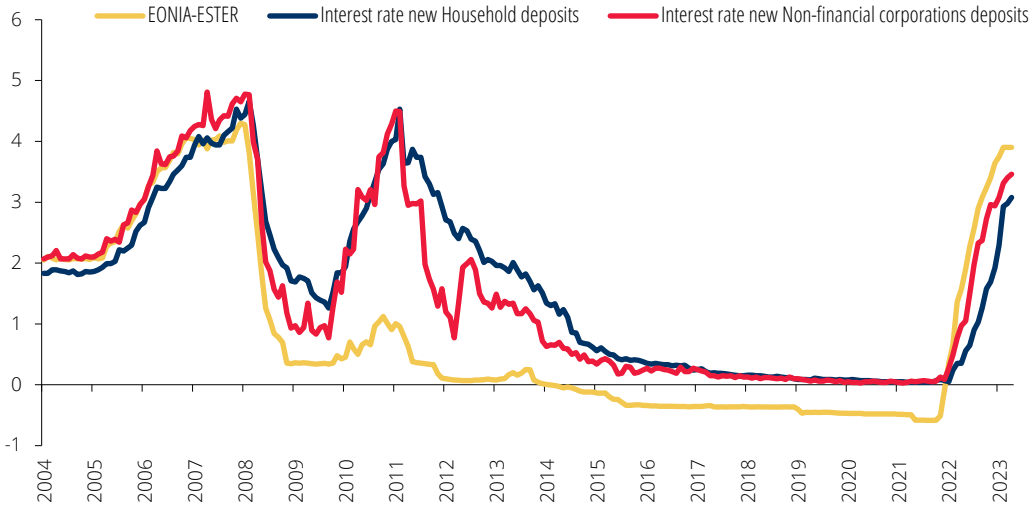

FIGURE 4: Monetary policy and deposit interest rates (new business).

Source: ECB for EONIA-ESTER and Banco de Portugal for interest rates on deposits.
Notes: The interest rates on deposits refer to new business and to agreed maturity deposits. The last observation refers to December 2023.

the end of June 2022, rates on new deposits increased 3.01 p.p. for households and 3.40 p.p. for firms. These increases were comparable to those in the euro area, where similar interest rates on deposits increased 2.99 and 3.81 p.p., respectively.

Figures 5 and 6 show the correlation between the increase in deposit rates and deposit inflows in the euro area. The increase in household deposits does not seem to be significantly larger in countries that increased interest rates more. However, for deposits of non-financial corporations, there seems to exist a positive correlation. In countries where deposit interest rates for firms increased more markedly, there was also a larger inflow of deposits.

3. The transmission of monetary policy through deposits: deposit betas

3.1. Channels of monetary policy transmission

Banks play a key role in the transmission of monetary policy. There is a vast literature on the bank lending and bank-balance sheet channels (Bernanke and Blinder, 1988; Bernanke and Gertler, 1995; Kashyap and Stein, 1994, 1995, 2000; Stein, 1998; Kishan and Opiela, 2000; Jiménez et al., 2012), as well as on the bank risk-taking channel (Adrian et al., 2019; Maddaloni and Peydró, 2011; Jiménez et al., 2014; Ioannidou, Ongena, and Peydró, 2015; Martinez-Miera and Repullo, 2016; Dell'Ariccia, Laeven, and Suarez, 2017; Paligorova and Santos, 2017; Bonfim and Soares, 2018). There are also attempts to integrate these channels (Bittner et al., 2023, Wang et al., 2022).

More recently, it has become clear that banks' funding structure is also relevant for the transmission of monetary policy. Drechsler et al. (2017) show that when monetary policy tightens, the spreads that banks offer on their deposits widen (defined as the difference

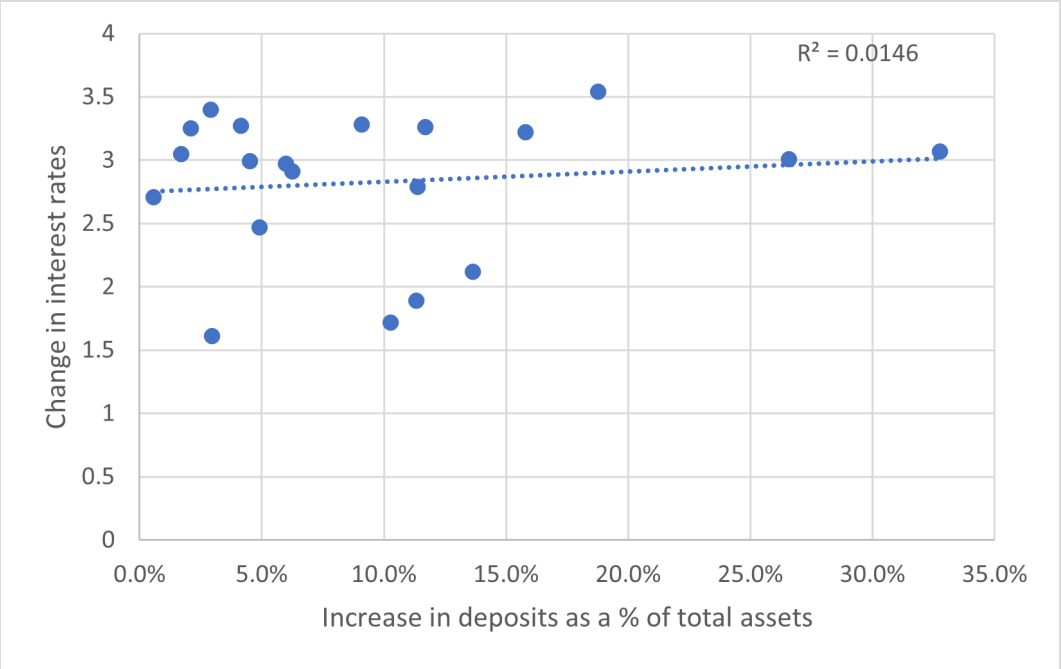

FIGURE 5: Change in interest rates and deposit inflows in the euro area - households.

Source: ECB and authors' calculations.
Notes: The x-axis displays the deposit inflow between June 2022 and December 2023, as a percentage of total bank assets in June 2022 for each euro area country. The y-axis displays the change in interest rates on deposits with agreed maturity during the same period.

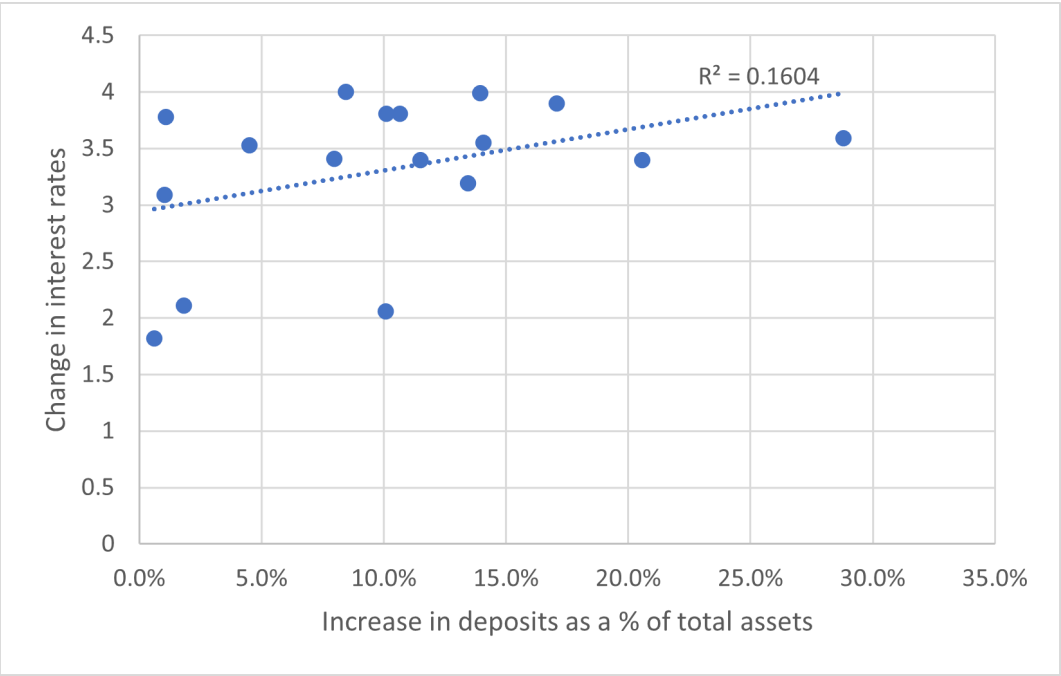

FIGURE 6: Change in interest rates and deposit inflows in the euro area - firms.

Source: ECB and authors' calculations.
Notes: The x-axis displays the deposit inflow between June 2022 and December 2023, as a percentage of total bank assets in June 2022 for each euro area country. The y-axis displays the change in interest rates on deposits with agreed maturity during the same period.

between the market interest rates and the deposit interest rate. i.e., the yearly income on the deposit franchise per unit of deposits). This creates a deposit outflow, as deposits become a less competitive savings instrument. This deposit channel of monetary policy works through the market power that banks have in deposit markets. Drechsler et al. (2021) show that banks are insulated from interest rate risk created by their maturity mismatch if they actively match the sensitivities of their income and expenses.

3.2. Methodology

To examine the transmission of monetary policy through deposits in Portugal, we follow Drechsler et al. (2021) and estimate deposit betas using the following specification on a panel of Portuguese banks:

$$\Delta\text{Deposit expenses}_{i,t} = \alpha_i + \eta_T + \sum_{\tau=0}^{3} \beta_{\tau}^{Exp} \Delta\text{Monetary Policy}_{t-\tau} + \varepsilon_{i,t} \quad (1)$$

The coefficient of interest is β. It captures how much banks increase deposit interest rates as a response to a change in monetary policy rates. For instance, a deposit beta of 0.6 means that deposit rates increase 60 bps for each 100 bps increase of monetary policy rates over the past year (as in Drechsler et al. (2021), we aggregate the coefficient over four quarters).

The dependent variable is the quarterly change in deposit expenses (i.e., interest paid to depositors), scaled by average monthly deposits of households and firms in bank i, in quarter t. To compute deposit expenses we use data from Monetary and Financial Statistics on interest rates and deposits. ΔMonetary Policy refers to the change in monetary policy rates. To follow the methodology proposed by Drechsler et al. (2021), we should use the main refinancing rate of the ECB (which would be the equivalent of the Fed Funds rate used in their paper). However, during a large part of our analysis period, this rate has been at zero. During this period, the ECB adopted a wide array of unconventional monetary policy tools that effectively loosened monetary policy beyond this zero lower bound. To overcome this, in our baseline estimates, we report the results using the money market interest rate (EONIA/ESTER), which varies more than the main refinancing rate.

We use three lags of rate changes to capture the cumulative effect of changes over a full year. We control for bank and year fixed effects (α_i and η_T, respectively). Bank fixed effects control for time-invariant bank-specific characteristics that may affect deposit pricing. Year fixed effects control for macroeconomic and financial developments that may also affect deposit pricing, at annual frequency.

3.3. Results

Figure 7 depicts the deposit betas estimated for different deposit products. We first report the results for total deposit expenses and then we report results for deposits of non-financial corporations (overnight and with agreed maturity) and of households (for the same segments). We find that deposit rates show a muted reaction to monetary

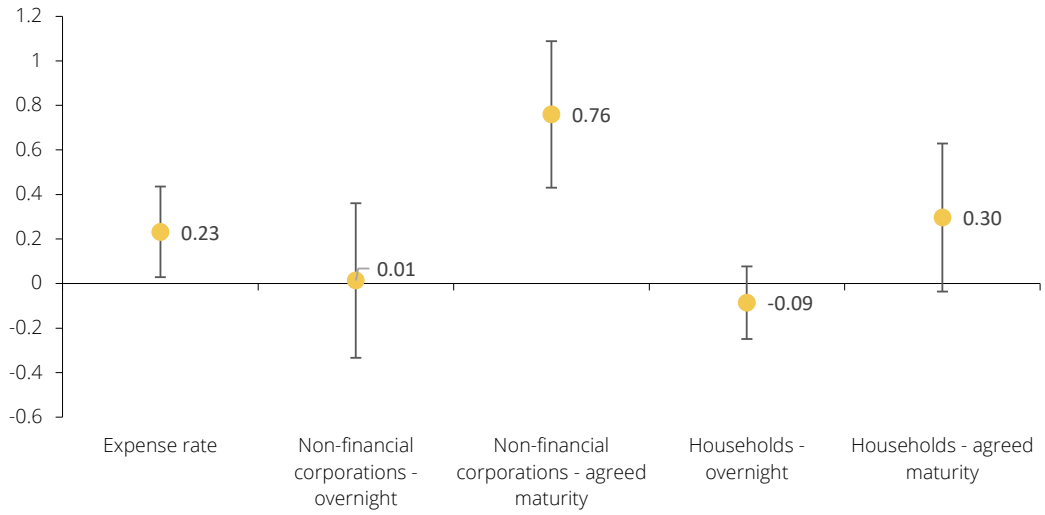

FIGURE 7: Deposit betas, by deposit type, outstanding amounts.

Source: Banco de Portugal and authors' calculations.
Notes: Deposit betas estimated using equation 1. Deposit betas capture how much banks increase deposit interest rates as a response to a change in monetary policy rates. Estimated using outstanding amounts of deposits. Confidence intervals at 95% level.

policy changes when we consider the outstanding amounts of deposits. For total deposit expenses, the deposit beta is 0.23. For each 100 basis points increase in money market interest rates, banks' deposit expenses increase 23 basis points. The small pass-through should reflect the effective zero lower bound on deposit rates (Heider et al., 2019). Even though deposit rates were very close to zero between 2015 and 2021, monetary policy was actually much more accommodative. This means that banks were making losses on deposits for this entire period, as they were offering to depositors rates that were higher than their financing cost in monetary policy facilities.

When we look separately into different deposit categories we observe that deposit betas are close to zero for overnight deposits, both for households and firms (0.01 and -0.09, respectively). This is not surprising, as overnight deposit rates are often very small and are not expected to strongly react to monetary policy decisions. The same cannot be said for deposit betas on deposits with agreed maturities. In this case, we find higher deposit betas. For firms, the deposit beta is 0.76, which means that for each 100 bps increase in money market rates, deposit interest rates on corporate deposits with agreed maturity increase by 76 bps. The beta for similar household deposits is smaller (0.30). This suggests that corporate deposits are more sensitive to pricing and banks manage deposit pricing (on deposits with agreed maturity) more actively to maintain a competitive position.

The repricing of the outstanding amount of total deposits may be somewhat slow, notably for deposits with agreed maturity. In Figure 8 we report deposit betas for new deposits. The overall deposit beta is 0.65. For firms, the deposit beta is 0.95 and for households 0.59. In this analysis. we disaggregate more in terms of deposit maturity. We find that deposit betas are higher for new corporate deposits with an agreed maturity

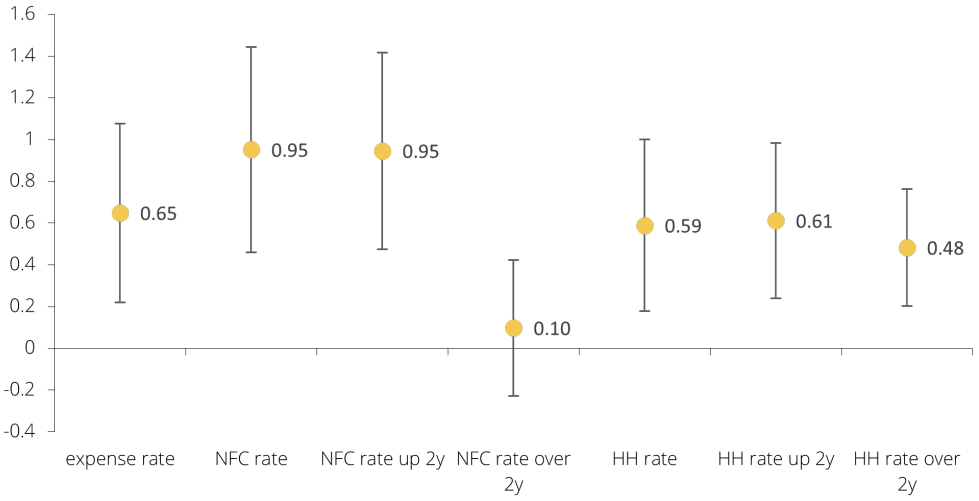

FIGURE 8: Deposit betas, by deposit type, new business.

Source: Banco de Portugal and authors' calculations.
Notes: Deposit betas estimated using equation 1. Deposit betas capture how much banks increase deposit interest rates as a response to a change in monetary policy rates. Estimated using new deposits. Confidence intervals at 95% level. NFC refers to non-financial corporations and HH to households.

of up to two years. This is the segment in which monetary policy passed through more strongly. For new corporate deposits with longer maturities, the interest rate sensitivity to monetary policy is much smaller. Again, the pricing of household deposits is less sensitive to monetary policy. Most of the reaction is also concentrated in deposits with an agreed maturity of up to two years.

To make sure that our results are not dependent on the specificities of the empirical design, we replicate the estimate of deposit betas using an array of different methodological choices. Besides computing deposit betas for outstanding amounts and new deposits at the quarterly level, we also run our deposit beta estimates at the monthly level and use monthly averages at the quarterly level. The results remain broadly unchanged.

4. Deposit betas in the euro area

During the 2022-2023 tightening cycle, deposit rates in Portugal have increased, but at a slower pace than in most other euro area countries. That said, deposit rates had been higher than in most other countries during the previous decade. This can lead to differences in deposit betas in Portugal and the euro area.

To examine this, we considered that it could be insightful to estimate Equation 1 for the euro area and compare the results to those obtained for Portugal. Instead of estimating the equation for a panel of Portuguese banks, we estimate it for a panel of euro area countries:

$$\Delta\text{Deposit expenses}_{c,t} = \alpha_c + \eta_T + \sum_{\tau=0}^{3} \beta_{\tau}^{Exp} \Delta\text{Monetary Policy}_{t-\tau} + \varepsilon_{c,t} \qquad (2)$$

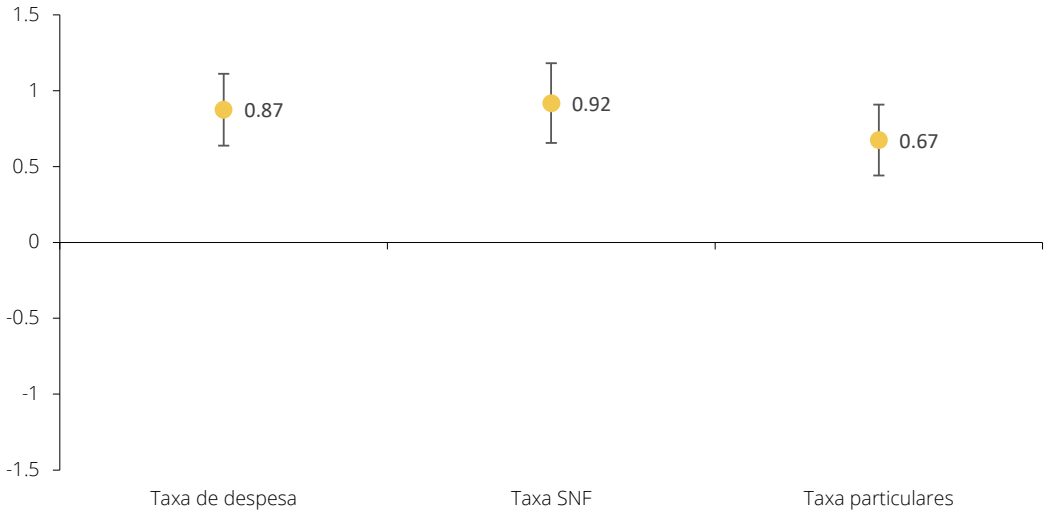

FIGURE 9: Deposit betas for the euro area, new business.

Source: European Central Bank and authors' calculations.
Notes: Deposit betas estimated using equation 2. Deposit betas capture how much banks increase deposit interest rates as a response to a change in monetary policy rates. Estimated using new deposits for each euro area country. The countries included are AT, BE, CY, DE, EE, ES, FI, FR, HR, IE, IT, LT, LV, MT, NL, PT, SI and SK. Confidence intervals at 95% level. NFC refers to non-financial corporations and HH to households.

where instead of bank i we have country c. We use data on interest expenses for Austria, Belgium, Cyprus, Germany, Estonia, Spain, Finland, France, Croatia, Ireland, Italy, Lithuania, Latvia, Malta, Netherlands, Portugal, Slovenia, and Slovakia, for the period September 2004 to December 2023. The results on deposit betas are reported in Figure 9.

The deposit beta for firms in the euro area is 0.92 for new corporate deposits and 0.67 for new household deposits. Deposit betas are slightly higher for corporate deposits in Portugal (0.95, compared to 0.92), suggesting a stronger pass-through of monetary policy to deposit rates. For households, the pass-through seems to be stronger in the euro area than in Portugal (0.67, compared to 0.59 in Portugal).

Kang-Landsberg, Luck, and Plosser (2023) run a similar exercise on U.S. banks, using interest on outstanding deposit amounts. In their data, it is not possible to estimate deposit betas separately for household and corporate deposits. For total deposits, these authors estimate a one-year cumulative deposit beta of 0.4 in the recent rate hike cycle. However, the authors note that this was an exceptionally fast and large increase in the deposit beta, when compared to previous tightening cycles (reflecting the fast and steep increase in monetary policy rates during this cycle).

5. Credit betas

The academic literature and policy analysis have focused on the concept of deposit betas. That said, it is possible to apply the same methodology to examine the pass-through of

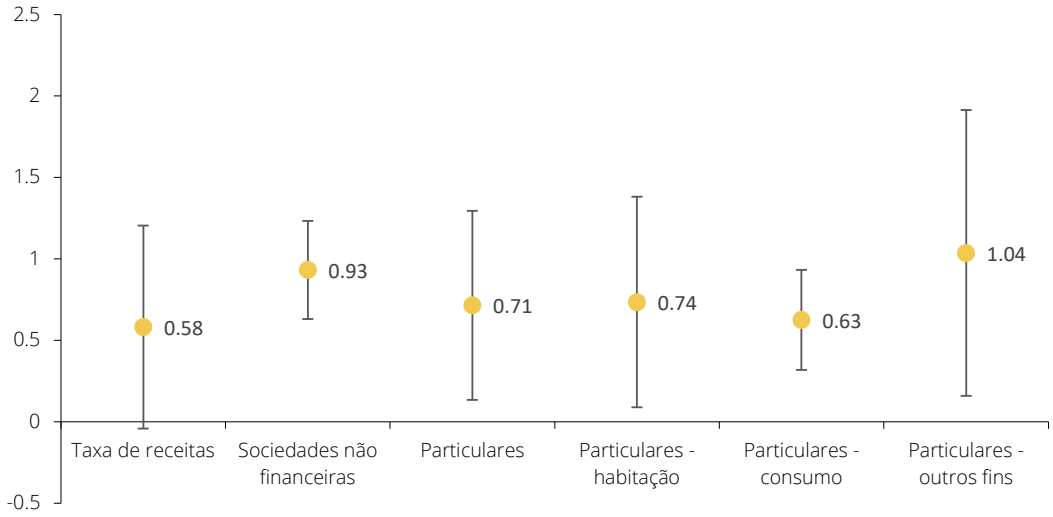

FIGURE 10: Credit betas, by loan type, new business.

Source: Banco de Portugal and authors' calculations.
Notes: Credit betas estimated using equation 3. Credit betas capture how much banks increase loan interest rates as a response to a change in monetary policy rates. Estimated using new business in bank loans. Confidence intervals at 95% level. NFC refers to non-financial corporations and HH to households.

monetary policy to lending rates and compute credit betas.We can adapt equation (1) so that:

$$\Delta\text{Credit revenues}_{i,t} = \alpha_i + \eta_T + \sum_{\tau=0}^{3} \beta_{\tau}^{Rev} \Delta\text{Monetary Policy}_{t-\tau} + \varepsilon_{i,t} \tag{3}$$

The only difference refers to the dependent variable, which now captures credit revenues, scaled by average monthly loans. Credit betas capture how much banks increase loan interest rates as a response to a change in monetary policy rates.

The results for credit betas estimated on new bank loans in Portugal are depicted in Figure 10. The overall credit beta is 0.58, which compares to 0.65 for the overall deposit beta on new deposits. This means that the pass-through of monetary policy was actually stronger for deposits than for loans, during the period considered. For corporate loans and deposits, the pass-through is very similar on both instruments (0.93 and 0.95, respectively). In contrast, banks are faster in adjusting interest rates on bank loans to households than on deposits. We estimate a credit beta of 0.71, which compares to a deposit beta of 0.59.

6. Concluding remarks

The effective transmission of monetary policy requires an adjustment not only on bank loan rates but also on deposit rates. In this article, we estimate deposit betas for the Portuguese economy. These betas capture how much of monetary policy rate changes pass-through to deposit interest rates.

The results show that there is an incomplete pass-through of monetary policy. This is not surprising, as the concept of deposit betas refers to the immediate reaction of deposit rates to monetary policy. Adjustments in interest rates reflect not only current monetary policy decisions but also expectations about their future path. As in many products, price adjustments may be sluggish and gradual.

We find that a 100 bps point increase in monetary policy rates is linked to a 95 bps increase in new deposit rates for firms and 59 bps for households, over a year (65 bps, when both segments are considered). The pass-through to loan rates is similar.

These results are broadly in line with those obtained in the euro area. That said, it should be noted that an important limitation of the analysis is that for most of the estimation period, interest rates were at the zero lower bound. This means that it is challenging to adequately measure monetary policy. The zero lower bound is expected to have conditioned the pass-through of monetary policy, notably to deposits, altering deposit betas. The estimation of deposit betas over longer periods may offer a deeper understanding of this channel of monetary policy transmission.

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Non-technical summary

October 2024

The personal income tax in Portugal: from the sovereign debt crisis to the inflationary shock

Sara Riscado, Sharmin Sazedj and Lara Wemans

The Personal Income Tax (PIT) is a cornerstone of the Portuguese tax system and has been subjected to constant modifications. During the financial crisis, legislative changes were primarily focused on increasing revenue, with some of these measures being rolled back during the post-programme period. More recently, additional tax relief measures have been introduced.

Analyzing the budgetary and redistributive impacts of each set of measures is crucial. However, due to the numerous changes and the interconnected nature of different measures, these analyses often fail to provide a comprehensive overview of the overall changes implemented.

This study uses data from the EU-SILC survey and the EUROMOD microsimulation model to describe the evolution of the main characteristics of Portugal's PIT over the past 15 years. This time frame is divided into three sub-periods: the first marked by the sovereign debt crisis (2009-14); the second covering the economic recovery (2014-19); and the third encompassing the pandemic crisis and the inflationary shock (2019-24). For each of these periods, the study analyzes changes in the effective average tax rate, which measures individuals' tax burden, and the redistributive capacity, which assesses the tax's impact on income distribution.

The evolution of these indicators within each period is broken down into two components: the contribution of policy measures and the contribution of income. The policy measures include both more structural changes to the tax (e.g., altering the number of tax brackets) and simpler adjustments (e.g., updating bracket thresholds). The income effect primarily reflects the impact of changes in the taxable income. Given the progressivity of the tax, an increase in income automatically subjects taxpayers to higher tax rates, increasing the effective average rate even without changes to the tax rules.

The effective average PIT rate, which represents the weight of its revenue in total income (including social benefits), increased from 9% to 14.2% during the adjustment programme, primarily driven by the consolidation measures implemented, contributing 3.7 pp (as shown in Figure 1).

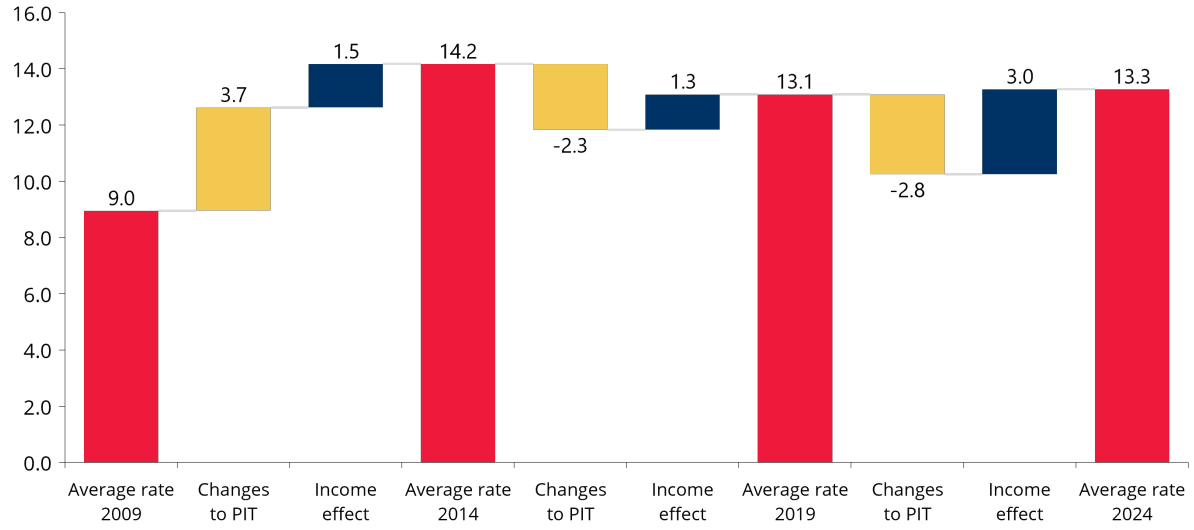

FIGURE 1: Decomposition of average PIT rate developments | Percentage points

Source: Calculations are based on EUROMOD simulations and EU-SILC data.
Notes: The average PIT rate is calculated as the ratio between the simulated tax amounts and total gross income, including social benefits in cash. Changes to the PIT represent the impact of policy measures. The income effect includes the impact of changes in earned income, shifts in population composition, and other policy measures that affect the income simulated in EUROMOD.

In the following period, the average tax rate decreased to 13.1% (-1.1 pp), as the increase in income (+1.3 pp) partially offseted the impact of the policy measures (-2.3 pp).

Between 2019 and 2024, legislative changes also aimed to further reduce the tax burden (-2.7 pp). However, the income effect dominated, leading to an increase in the average tax rate to 13.4%.

In summary, despite the implementation of tax relief measures, the average PIT rate in 2024 remains significantly higher than the levels recorded before the sovereign debt crisis. This can largely be attributed to the lack of adjustment of the tax parameters in line with income growth. The increase in the average rate has enhanced the tax's redistributive capacity, measured by its impact on the Gini coefficient. Thus, although pre-tax income inequality in 2024 is similar to that of 2009, post-tax inequality has decreased over this period.

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The personal income tax in Portugal: from the sovereign debt crisis to the inflationary shock

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Abstract
The personal income tax (PIT) is a crucial source of government revenue and a key tool for implementing income redistribution policies. This study uses the EUROMOD microsimulation model along with data from the EU-SILC survey to examine the evolution of PIT between 2009 and 2024. This timeframe encompasses the sovereign debt crisis, the subsequent recovery, and the recent inflationary shock. In response to the debt crisis, PIT was substantially increased, followed by a period of gradual reversal and the introduction of additional tax relief measures. The findings reveal that the average effective PIT rate stands at 13.3% in 2024, 4.3 p.p. higher than in 2009. Despite efforts to reduce the tax burden, the rise in the average tax rate during the debt crisis was not fully offset in the post-crisis recovery. This was largely due to robust income growth, which was not mirrored by adjustments in tax parameters, diminishing the overall impact of tax relief policies. Additionally, the study highlights that the redistributive capacity of the tax has increased between 2009 and 2024, primarily due to the rise of the average tax rate. (JEL: H24, H23)

1. Introduction

The taxation of individual income is a key element of the Portuguese tax system, playing a pivotal role in both revenue generation and income redistribution. The PIT, in particular, is often recognized for its progressivity (Alves 2012), a feature that strengthens its function as an automatic stabilizer, smoothing the impact of economic cycles (Coady *et al.* 2023). Moreover, PIT is instrumental in reducing income inequality, a central issue in tax policy discussions (Blanchet *et al.* 2022), which is especially pertinent in Portugal, where income distribution is more unequal than the European average.

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The Portuguese income tax system has undergone numerous changes over the years. During the Economic and Financial Assistance Programme (PAEF, in the Portuguese acronym), the need to increase budget revenue led to several modifications in the tax structure. Studies such as Rodrigues *et al.* (2016) conclude that these changes enhanced the redistributive capacity of the tax, as measured by its impact on the Gini coefficient of household disposable income. Since 2015, many of these measures have been reversed, and new tax relief measures have been introduced with various objectives, including incentives for higher birth rates, eliminating distortions, or strengthening middle-class incomes. The reforms implemented during the decade between the financial crisis and the COVID-19 pandemic were analysed by Myck and Trzciński (2022), who found that, even considering a longer period, the cumulative PIT changes from 2009 to 2019 contributed to strengthening its capacity to reduce income inequalities. The high frequency of tax changes in recent decades, combined with the system's complexity, as pointed out by European Commission (2022), make it challenging to gain a clear understanding of the overall evolution of the tax system over the past 15 years.

How can it be explained that PIT revenue remains high despite the tax relief measures introduced after the end of the adjustment programme? How does the average PIT rate in 2024 and its distribution by decile compare to that of 2009? These are some of the questions this study aims to answer. Using the EUROMOD microsimulation model, it analyses the evolution of the average tax rate and the tax's redistributive capacity, referencing four points in time: 2009, 2014, 2019, and 2024. These years were chosen to comprehensively assess the evolution of key indicators during different economic periods: (i) the period of fiscal adjustment or consolidation, between 2009 and 2014; (ii) the period of policy reversals and tax relief, between 2014 and 2019; and (iii) the period marked by the pandemic and inflationary shock, between 2019 and 2024 (Figure 1).

The evolution of the effective tax rate is not only determined by discretionary measures, as it also reflects other factors such as income growth and population composition. Given the progressive nature of the tax, income growth that is not accompanied by an adjustment to the tax brackets and monetary parameters of deductions necessarily results in an increase in the average effective rate. The same situation also occurs, albeit in a more subdued manner, when adjustments are made in line with inflation, but incomes grow faster than this benchmark.

The EUROMOD microsimulation model, along with its Policy Effects Tool (PET), allow estimating the extent to which legislative changes per se contributed to the tax's evolution. For instance, in Amores *et al.* (2023), this tool was used to isolate the effects of income support measures for families in the context of the recent inflationary crisis in the euro area. This tool takes advantage of the detailed modelling of the functioning of direct taxes and benefits in EUROMOD, including their interactions over a relatively long period (15 years). Additionally, it benefits from data on market income evolution and population characteristics based on representative samples of the Portuguese population from the EU-SILC survey. Combining this information makes it possible to compare tax characteristics under various counterfactual scenarios, combining tax rules and incomes at different points in time. It should be noted that, in line with the more common practice during the period in question, the adjustment of tax brackets in

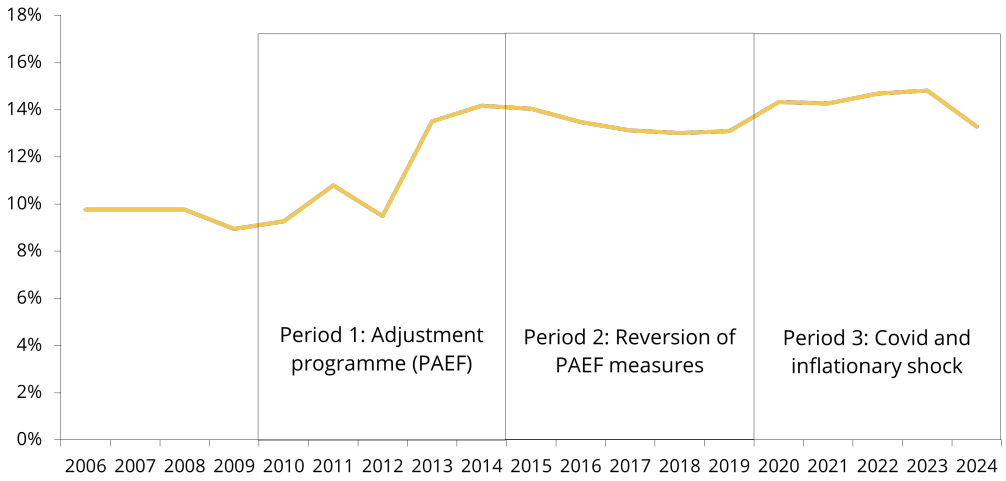


FIGURE 1: PIT average effective tax rate | As a percentage of gross income

Source: Authors' calculations based on EUROMOD simulations and EU-SILC data.
Notes: The average effective tax rate is calculated as a ratio between simulated amounts for PIT and gross disposable income, including social transfers other than in kind.

this study is included within the set of legislative changes, meaning it is considered a discretionary policy measure.

It is important to acknowledge the limitations of the methodology used in this study. First, it relies on representative samples rather than the entire population, leading to a higher degree of uncertainty compared to studies based on administrative tax data. Additionally, EUROMOD is a static model that focuses on first-order effects, meaning it does not account for behavioural responses to legislative changes, such as labour market incentives. For estimates on the impact of PIT changes on labour supply in Portugal, see Narazani *et al.* (2024). Finally, by concentrating solely on PIT, this study does not examine the evolution of the redistributive capacity of social benefits, which is crucial for a comprehensive understanding of redistributive policies in Portugal. For a broader analysis, studies such as those by Hammer *et al.* (2021) and Alves (2012) are recommended.

This article is organized as follows. Section 2 presents the methodology underlying the analysis, namely the EUROMOD microsimulation model and the PET, and briefly describes the dataset used. Section 3 presents the main characteristics of the tax and describes the legislative changes during the period under analysis. Section 4 analyses the evolution of indicators such as the average effective tax rate, the tax's redistributive capacity, and its progressivity, quantifying the impact of policies and income changes on the evolution of these indicators in each of the periods. Section 5 concludes.

2. Data and Methodology

2.1. The EUROMOD Microsimulation Model and EU-SILC

EUROMOD is a static microsimulation model that simulates direct taxes, contributions, and social benefits according to the tax and benefit rules in effect in each EU Member State[1]. By incorporating detailed tax and benefit rules — such as eligibility criteria, family unit definitions, tax brackets and rates, and social transfers — this model calculates the disposable income of individuals and households. Additionally, EUROMOD facilitates the construction of counterfactual scenarios, enabling the assessment of the direct budgetary, distributional, poverty, and inequality impacts of real or hypothetical tax and benefit reforms. However, being a static model, it does not estimate behavioural responses to policy changes.

The simulations conducted with EUROMOD are based on EU-SILC data[2]. This survey is provided by Eurostat and includes cross-sectional and panel data on household income, poverty, social exclusion, and living conditions. It is an annual survey that collects detailed information at both the individual and household levels on various income components — wages, capital and other income, pensions, social contributions, taxes, and other social benefits — as well as on living conditions. The survey also includes information on individuals' demographic and socioeconomic characteristics, such as gender, age, marital status and number of children, education level, and labour market situation, among other.

In this article, cross-sectional data from EU-SILC and EUROMOD are used to calculate the average tax rates in Portugal for each year, as well as the key indicators that characterize PIT in terms of its progressivity and redistributive capacity. The model also allows for isolating the direct effects of policy measures introduced each year.

The most recent EU-SILC survey reflects income data from 2021. The data for the subsequent years is indexed through uprating factors[3]. The EUROMOD tax and benefit systems for 2023 and 2024 were built by applying to the 2022 system the changes introduced by the State Budgets and Laws 32/2024 and 33/2024 of August 7, which modified tax brackets and the value of the specific deduction. Appendix A provides further details on the simulation of PIT in Portugal using EUROMOD.

1. EUROMOD is maintained and developed by the Joint Research Centre of the European Commission. In this study, EUROMOD version i5.0+ was used. For more details, see Sutherland and Figari (2013) and visit https://euromod-web.jrc.ec.europa.eu/.

2. For more details on EU-SILC, visit https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions.

3. Market income is updated using indexation (for example, considering the evolution of average wages in the private and public sectors), while pension values follow the legal updates implemented in each period. For 2024, the uprating factors reflect the projections of Banco de Portugal published in the Economic Bulletin of March 2024.

2.2. The Identification of Policy Effects

In this analysis, it is important not only to evaluate how the average PIT rate has evolved, as well as its progressivity and redistributive capacity at the four considered time points — 2009, 2014, 2019, and 2024 — but also to understand how discretionary policy measures contributed to this evolution. The evolution of these indicators is influenced not only by modifications to the PIT but also by shifts in household incomes, population composition, and adjustments in other components of the tax and benefits system in Portugal. The EUROMOD microsimulation model facilitates the isolation of the effects of discretionary policies on PIT from other influencing factors.

More specifically, using the PET tool of EUROMOD, counterfactual scenarios are constructed based on different assumptions about the parameters of the tax and benefits system. These scenarios allow for the decomposition of changes in the indicators of interest into contributions from income, including pensions[4], composition effects, and changes from discretionary policy measures. Within the policy effects, we further distinguish the impacts of other discretionary measures affecting components of the Portuguese tax and benefits system from those specifically impacting the PIT. Unlike other studies (see, for example, Bargain and Callan (2010) and Paulus and Tasseva (2020)), any change to the parameters of the PIT is considered part of the discretionary policies, given that updates during these years were far from common practice and were more of an exception, as discussed in Section 3.2. This approach implies that, for example, the adjustment of the minimum subsistence threshold to align with the minimum wage, when made, is reflected in the effects of discretionary changes to the PIT[5].

Thus, the variation in the indicators of interest for each period is broken down into the following three effects:

i Effect of nominal income growth and population composition, which includes the automatic stabilization effect of the tax and benefits system;
ii Effect of discretionary changes to the PIT, which encompasses both changes to the tax rules and adjustments to its monetary parameters;
iii Effect of other discretionary policy changes impacting income (e.g., changes to social transfers), which similarly includes modifications to rules and parameters.

To illustrate the methodology followed, we consider the period of interest between year t and year $t + n$. In this context, we construct and compare the following four scenarios — two "real" and two counterfactual. These scenarios can be described as combinations of tax and benefit systems[6] with income distributions and population compositions at different moments in time, as detailed below:

4. The impact of discretionary measures on pensions and their automatic adjustments is treated similarly to a variation in market income.

5. It should be noted that the impact on the PIT from income changes induced by minimum wage increases is included in the contributions from income variation.

6. To ensure the calculation of disposable income at each moment, which depends on changes in both the PIT and other components of the tax and benefit system.

- Scenario A: Tax and benefit system of year t with income and household composition from year t;
- Scenario B: Tax and benefit system of year $t+n$ with income and household composition from year $t+n$;
- Scenario C: Tax and benefit system of year $t+n$ with income and household composition from year t;
- Scenario D: PIT system of year t while other taxes and benefits follow the rules of year $t+n$, with income and household composition from year t.

The three effects mentioned arise from comparing the values assumed by the indicators of interest across the four scenarios. Thus, the impact of nominal income growth and household composition (the effect described in (i)) is determined by subtracting the impact of discretionary policy implementation between t e $t+n$ (Scenario C - Scenario A) from the total variation of the indicator between t e $t+n$ (Scenario B - Scenario A). Similarly, isolating the effect of discretionary changes to the PIT (the effect described in (ii)) requires subtracting the impact on the indicators of discretionary policies that do not pertain to the PIT (Scenario D - Scenario A) from the total policy effects (Scenario C - Scenario A).

Since this study focuses on the main sources of variation in PIT, the impact of other discretionary changes (described in (iii)) is considered alongside the effects stemming from changes in income, collectively referred to as the "income effect" for simplicity. These measures that affect other components of the tax and benefit system have a residual impact on the key indicators analysed, as, with the exception of pensions, other benefits are not subject to PIT, and no changes have occurred to the rules governing social insurance contributions.

Figure 2 provides a summary of the characteristics of the scenarios constructed in this analysis and their connection to the calculation of the relevant effects.

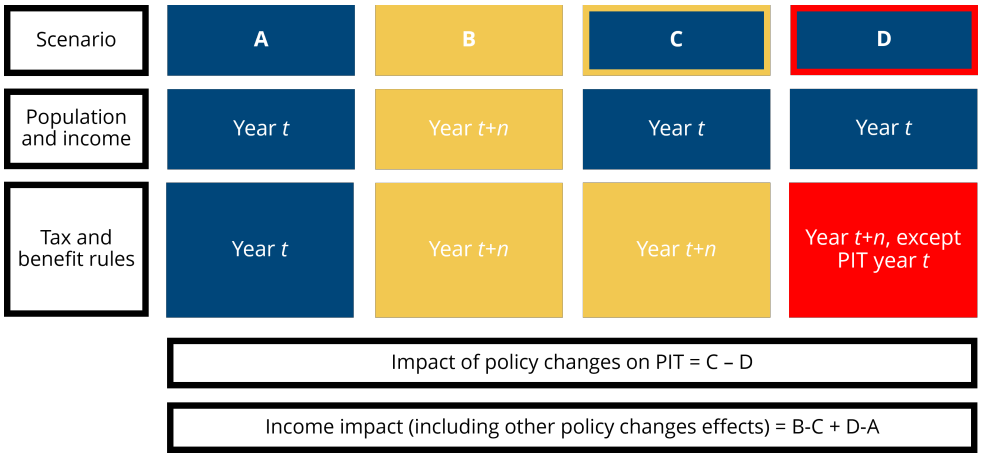


FIGURE 2: Description of scenarios and effects

Note: The blue colour refers to characteristics of year t, while the yellow refers to those of year $t+n$. The red colour is used for hybrid combinations, as in the case of scenario D, which combines PIT rules from t, while the remaining characteristics correspond to year $t+n$.

3. PIT in Portugal

3.1. Brief overview

This section aims to provide a brief overview of how the PIT works and to present some descriptive statistics, comparing it to the euro area average. The data used is from 2019, the last year unaffected by the pandemic crisis and inflation shock.

In Portugal, the PIT applies to income from employment, pensions, property, and capital, while income from other social benefits, such as unemployment benefits or family allowances, is exempt. Property and capital income are typically subject to a withholding tax, and can later be included in the overall tax calculation at the taxpayer's discretion.

For the determination of taxable income, specific deductions are applied to each type of income, averaging 28% of total income (Figure 3). These deductions ensure that income up to a certain threshold is exempt from PIT and that income allocated to social contributions is not taxed. Additionally, the PIT system includes a minimum subsistence threshold, designed to prevent taxation from reducing net income below a certain level.

Tax rates are lower in the autonomous regions of the Azores and Madeira. Municipalities also have a variable participation, allowing them to offer residents a discount by waiving all or part of their 5% share of PIT.

Marginal tax rates rise with income brackets, and after their application, households might be eligible to various tax credits, which represent, on average, 4% of total income. Noteworthy credits, according to their tax expenditure importance, include those for general family expenses, dependants, healthcare, education and training, individuals with disabilities, housing costs, and expenses with invoice requirements (Figure 4).

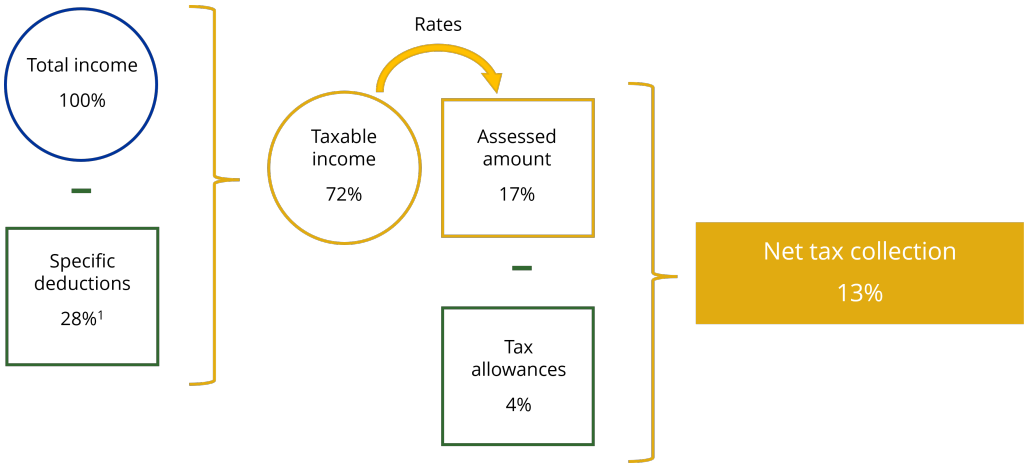


FIGURE 3: PIT in Portugal

Source: Based on the illustration presented in Policy insights from Economic Bulletin of Banco de Portugal, December 2023 and data from the Portuguese tax authority.
Notes: The weight of each component is calculated as a percentage of total income, using data for 2019. These percentages do not change significantly using most recent data (from 2022). (a) This value includes the deduction applied to income earned by people with disabilities and the deduction of losses from previous years.

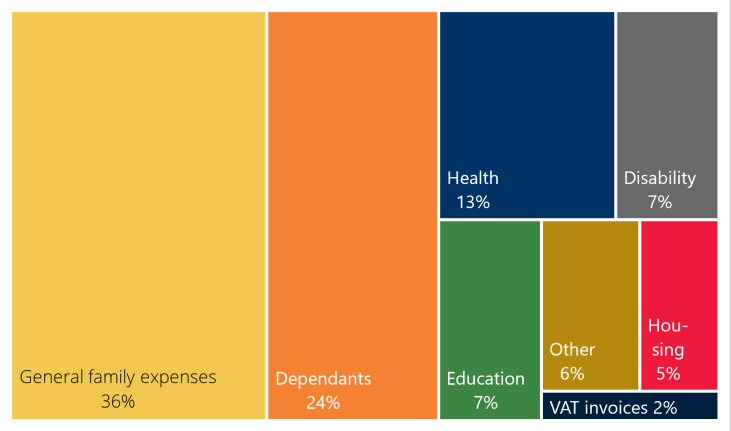


FIGURE 4: Tax credits in 2019

Source: Portuguese tax authority.
Notes: The percentage shows the weight of each component in the total tax credits. These percentages do not change significantly using most recent data (from 2022).

In 2019, PIT revenue amounted to 6% of GDP and 17% of total tax and contributive revenue, roughly equivalent to the total public expenditure on health[7], highlighting the significant scale of PIT revenue. Approximately 70% of households pay PIT, with an average effective tax rate of 13%. However, these figures vary significantly across different income levels (Figure 5).

The progressive nature of the tax, along with the reduction in the percentage of exempt families, leads to rising effective tax rates across the income distribution. Families in the first two deciles are generally exempt due to specific deductions and the minimum subsistence threshold, resulting in nearly zero effective tax rates. The average effective tax rate only exceeds 5% in the fifth decile (where 85% of families already pay tax), surpasses 10% in the 8th decile, and reaches 24% in the last decile.

As a result of this progressivity and the inequality in the distribution of gross income, tax revenue is heavily concentrated in the highest income deciles, with the last decile responsible for half of the total revenue (Figure 6). Nevertheless, disposable income remains significantly concentrated in the last decile, accounting for a quarter of the total disposable income.

Compared to euro area countries, Portugal's average effective tax rate is slightly lower — 13% versus 14% in the euro area — but the concentration of tax burden in the top decile is higher, at 54% compared to 43% in the euro area (Table 1). This difference is due to Portugal's higher concentration of gross income in the top decile (29% versus 26% in the euro area) and a higher average effective tax rate (24% versus 22% in the euro area). Despite the higher tax rate, the concentration of disposable income in the top decile remains higher in Portugal (25% compared to 23% in the euro area), mainly driven by greater inequality in gross income.

7. According to the classification of public administration expenditure by function (COFOG) published by INE (Statistics Portugal).

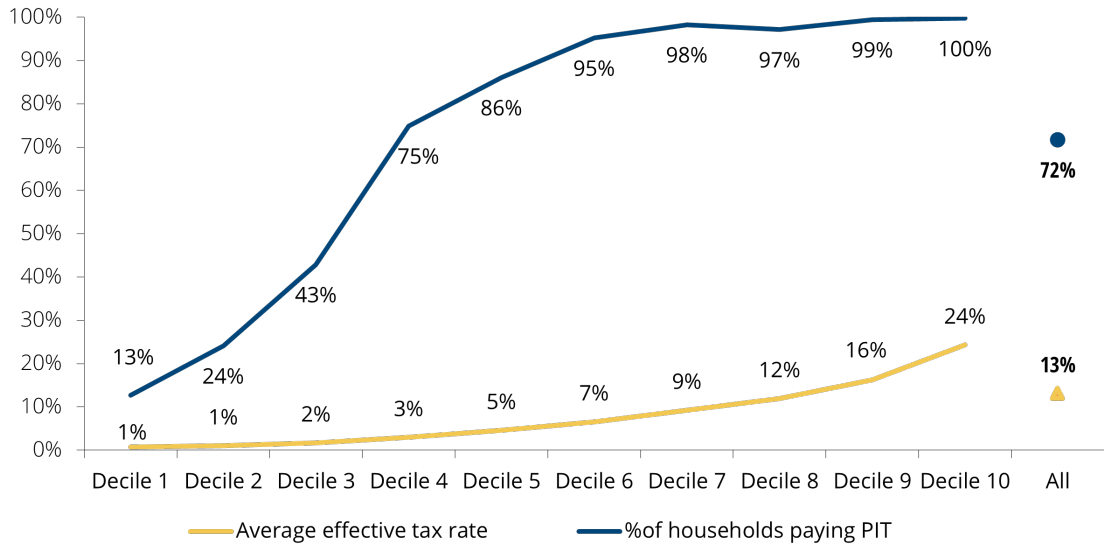


FIGURE 5: Average effective tax rates and percentage of households paying taxes by income decile in 2019

Source: Authors' calculations based on EUROMOD simulations and EU-SILC data.
Notes: The average effective tax rate is calculated as a ratio between simulated amounts for PIT and gross income, including social transfers other than in kind. Households are distributed across deciles based on their equivalized disposable income, using the OECD modified scale.

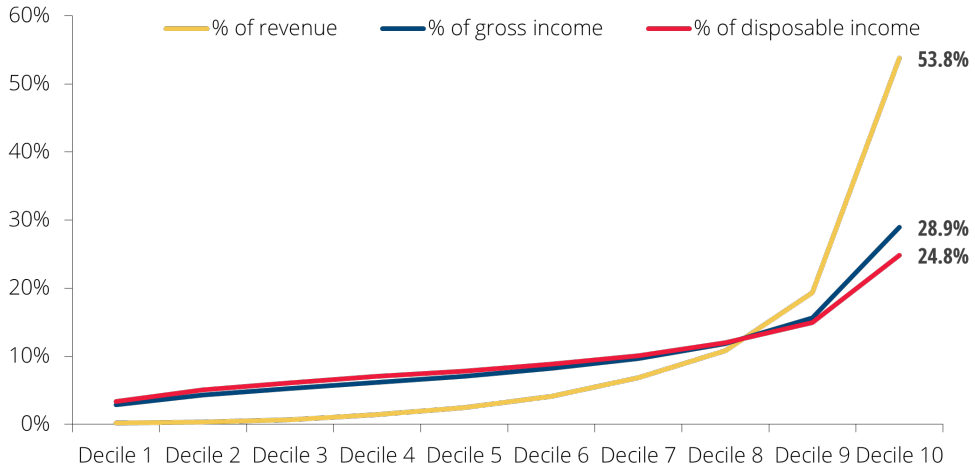


FIGURE 6: Distribution of income and PIT revenue by income decile in 2019

Source: Authors' calculations based on EUROMOD simulations and EU-SILC data.
Notes: Gross income includes social transfers. Households are distributed across deciles based on their equivalized disposable income, using the OECD modified scale.

The effectiveness of the tax in reducing income inequality can be assessed by comparing income distribution inequality[8] before and after the application of PIT. This inequality is typically measured using the Gini coefficient, which quantifies the

8. Income after social transfers is considered, but before social contributions, as these are associated with future benefits, which justifies treating them differently from taxes.

deviation of the income distribution from perfect equality. The Gini coefficient ranges from zero to one hundred, where zero represents perfect equality (everyone earns the same income) and one hundred represents perfect inequality (one person accumulates all the income). Thus, a higher Gini coefficient reflects greater income inequality. The redistributive effect of PIT is determined by comparing the Gini coefficient before and after taxes, formally referred to as the Reynolds-Smolensky index (Reynolds and Smolensky 1977).

Table 2 shows that income inequality in Portugal is higher than the euro area average, both before and after the application of PIT. According to 2019 data, the redistributive effect of PIT in Portugal reduces the Gini coefficient from 36.9 to 31.7, resulting in a Reynolds-Smolensky index of 5.1, compared to a slightly lower index of 4.1 in the euro area. While the average impact of PIT on the Gini coefficient is greater in Portugal, it is not enough to offset the higher level of income inequality compared to the euro area average.

3.2. Main legislative changes

Over the past decades, Portugal's PIT code has undergone several legislative changes. This section describes the most significant reforms in terms of their impact on the average effective tax rate and on its redistributive capacity. For a more detailed analysis,

Deciles	% of PIT revenue			% of gross income			Average PIT rate			% of disposable income		
	EA	PT	PT-EA (p.p.)	EA	PT	PT-EA (p.p.)	EA	PT	PT-EA (p.p.)	EA	PT	PT-EA (p.p.)
1	0%	0%	0	3%	3%	0	1%	1%	-1	4%	3%	0
2	1%	0%	-1	5%	4%	0	3%	1%	-2	5%	5%	0
3	2%	1%	-1	6%	5%	0	4%	2%	-3	6%	6%	0
4	3%	1%	-2	7%	6%	0	6%	3%	-3	7%	7%	0
5	5%	2%	-2	8%	7%	-1	8%	5%	-3	8%	8%	0
6	6%	4%	-2	9%	8%	-1	10%	7%	-3	9%	9%	0
7	9%	7%	-2	10%	10%	-1	12%	9%	-2	10%	10%	0
8	12%	11%	-1	12%	12%	0	14%	12%	-2	12%	12%	0
9	18%	19%	2	15%	16%	1	16%	16%	0	14%	15%	1
10	43%	54%	11	26%	29%	3	22%	24%	2	23%	25%	2
All	**100%**	**100%**		**100%**	**100%**		**14%**	**13%**	-1	**100%**	**100%**	

TABLE 1. PIT and income distribution in 2019 in Portugal and in the euro area

Source: Authors' calculations based on EUROMOD simulations and EU-SILC data.
Notes: Gross income includes social transfers. The average effective tax rate is calculated as a ratio between simulated amounts for PIT and gross income, including social transfers other than in kind. The euro area average is a simple average of the countries. Households are distributed across deciles based on their equivalized disposable income, using the OECD modified scale.

	Gini coef.		Reynolds-Smolesky
	before	after	
Portugal	36.9	31.7	5.1
Euro area	33.4	29.2	4.1

TABLE 2. Redistributive capacity measured by the Reynolds-Smolensky index

Source: Authors' calculations based on EUROMOD simulations and EU-SILC data.
Notes: The euro area average is a simple average of the countries.

see Rodrigues *et al.* 2016 for the period of the adjustment programme, and Rodrigues *et al.* 2018, 2022, and 2023 for the years that followed. The changes implemented included the reversal and reintroduction of measures, particularly regarding the application of the extraordinary surcharge. This section focuses on the differences between the tax in force at four points in time: 2009, 2014, 2019, and 2024.

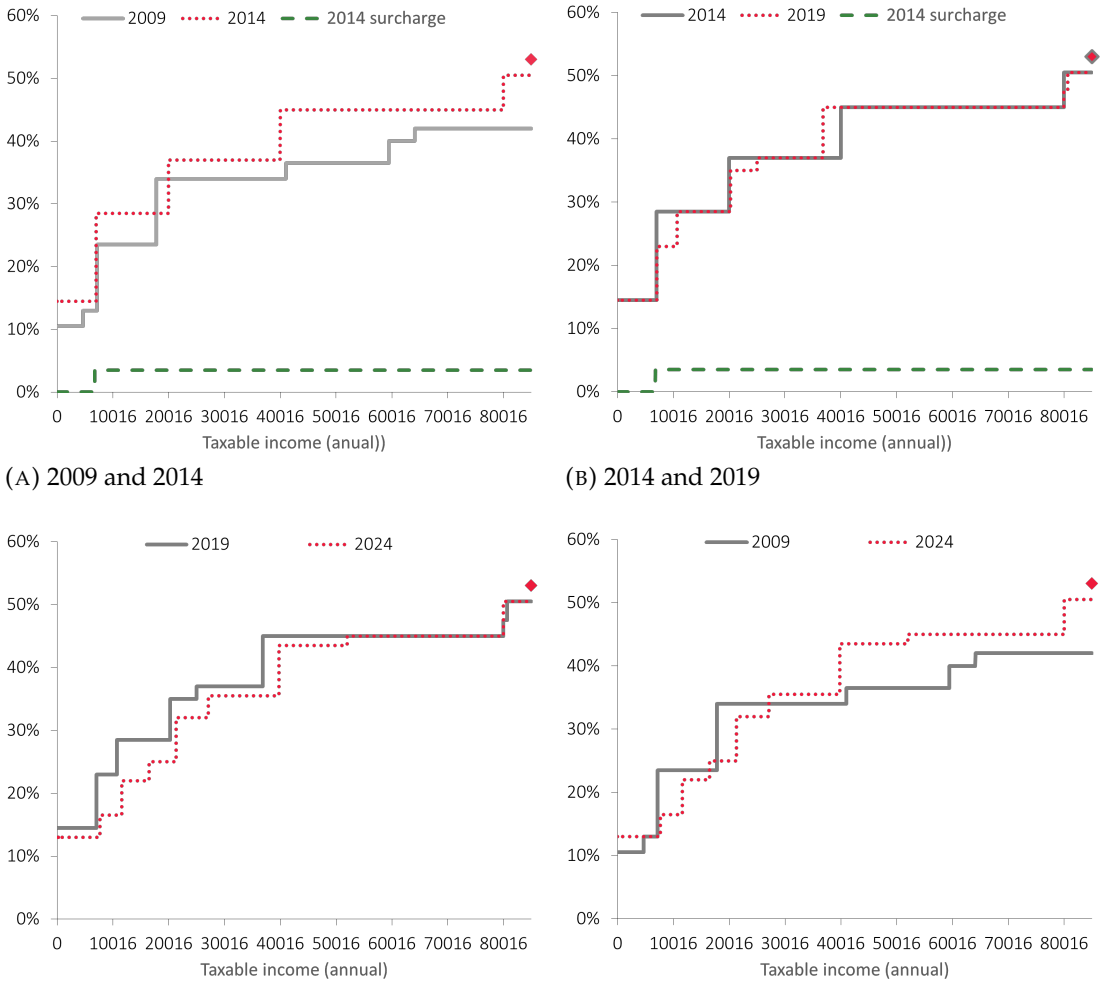
During the adjustment programme, the changes primarily focused on fiscal consolidation. Although the programme officially began in 2011, PIT rate increases had already been introduced in 2010, which is why 2009 is used as the baseline year for the analysis. Between 2015 and 2019, there was a gradual reversal of some consolidation measures applied to PIT. During the pandemic and inflationary shocks, this trend continued, with additional measures implemented to mitigate the impact of inflation, particularly through the adjustment of income bracket thresholds.

The tax schedule, analysed in this section alongside the additional solidarity surcharge[9], has undergone profound changes. Between 2009 and 2014, marginal rates experienced substantial increases. In 2014, alongside these higher rates, an extraordinary surcharge of 3.5% was applied to all taxable income above the minimum wage (Figure 7A). By 2019, the surcharge was eliminated, and marginal rates for the middle portion of the tax schedule were reduced through the creation of new brackets. However, this reduction was partially offset by lowering the lower limit of the penultimate bracket, which diminished the benefit of the lower marginal rates for taxpayers with higher taxable incomes (Figure 7B). Between 2019 and 2024, there was another decrease in marginal rates due to the introduction of additional brackets and the updating of bracket limits (Figure 7C). When comparing the PIT table in effect before the Financial Assistance and Economic Programme to that of 2024, a reduction in intermediate marginal rates is evident, along with a slight increase in the initial marginal rate and a significant rise in the top rates (Figure 7D).

Specific deductions for pension income have been adjusted to align with the tax rules for dependent employment income. Between 2009 and 2014, the base deduction decreased from 6,000 to 4,100 euros per year, becoming equal to that for employment income. Furthermore, the gradual reduction of this deduction with increases in pension amounts was accelerated, falling to 2,800 euros per year for pensions equivalent to two average salaries, compared to 5,900 euros per year in 2009, which was close to the base deduction (Figure 8A). By 2019, the base deduction applied uniformly to all pension amounts, and the gradual reduction was discontinued.

On the other hand, the base deduction for employment income, which in 2009 was indexed to the minimum wage, remained fixed at 4,100 euros per year until 2023, with a 6% update in 2024, resulting in significant erosion of its real value over time. The specific deduction for this income is defined as the greater of the base amount or the social insurance contributions paid by the worker. Thus, in 2024, with the increase in the

9. The additional solidarity surcharge, established in 2012 and still in effect, initially imposed an extra rate of 2.5% on the highest income bracket of the PIT. In 2013, a new additional rate of 5% was introduced for taxable income exceeding 250,000 euros per year.



(A) 2009 and 2014

(B) 2014 and 2019

(C) 2019 and 2024

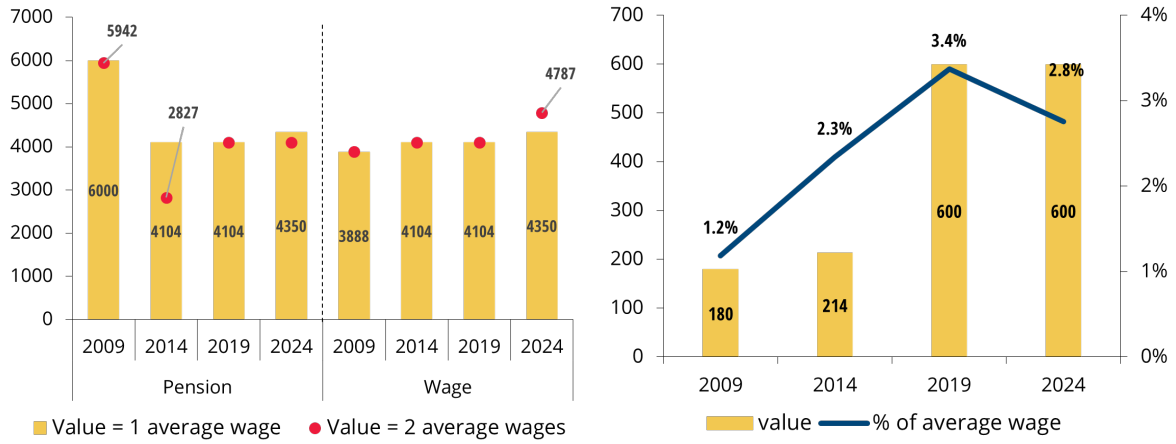
(D) 2009 and 2024

FIGURE 7: Marginal tax rates

Source: PIT legislation.
Notes: These rates only reflect the PIT schedule, including the additional solidarity surcharge, abstracting from the application of the minimum subsistence threshold. The additional solidarity surcharge, in place in all years except for 2009, is equal to 2.5% to collectable income above 80 thousand euros per year and 5% above 250 thousand euros per year. Diamonds reflect the tax rate applied to collectable income above 250 thousand euros per year. The extraordinary surcharge does not take into account the deduction of 145.5 euros per year for each dependant child.

average salary, the specific deduction for an income equivalent to two average salaries exceeds the base deduction, reaching 4,800 euros per year.

Tax credits for dependants have also undergone significant changes. Between 2014 and 2019, these benefits increased substantially but were no longer indexed to the minimum wage. For a child over 3 years old who is not part of a single-parent household, the tax credit nearly tripled during this period. However, between 2019 and 2024, while the nominal value of the benefit remained unchanged, the sharp increase in wages caused its relative value to drop from 3.4% to 2.8% of the average wage (Figure 8B).



(A) Specific income deductions | Euros

(B) Tax credits for dependants | Euros and percentage of average wage

FIGURE 8: Change in PIT parameters

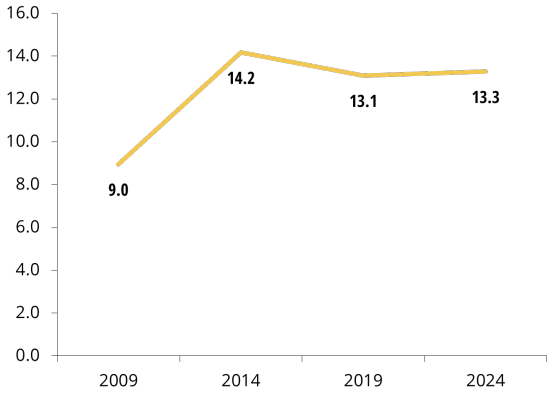
Sources: PIT legislation and simulations using the EUROMOD hypothetical household tool described in Hufkens *et al.* (2019).
Notes: The values considered for the average monthly wage were: 1266€ in 2009, 1278€ in 2014, 1482€ in 2019 and 1813€ in 2024. Tax credits for dependants are those applied to a child above 3 years old not living in a single-parent household.

Between 2009 and 2014, notable changes included the increase in the withholding tax on capital income from 20% to 28% and the introduction of limits on tax benefits. In the following period, the tax credit for general family expenses (capped at 250 euros per taxpayer per year) replaced an individualized benefit per taxpayer, and the limits for healthcare and education expense credits were reduced. From 2019 to 2024, the minimum subsistence threshold was reformed to prevent the taxation of incomes around the minimum wage at marginal rates approaching 100%. Additionally, the *'IRS Jovem'* (PIT for youth) was introduced, which in its 2024 version exempts 100% of income earned in the first year of employment for young people up to age 26 (30 for PhD holders), with a cap of 20,400 euros per year. This exemption and its limit gradually decrease until the fifth year of work.

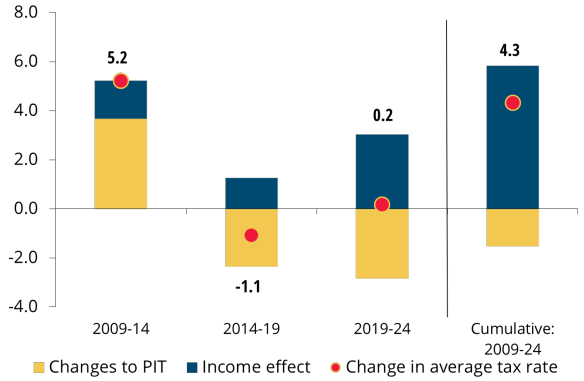
4. PIT developments: the role of policies and income growth

4.1. Average effective tax rate

The average effective PIT rate underwent significant changes over the period analysed. Between 2009 and 2014, this rate increased by 5.2 p.p., from 9% to 14.2% (Figure 9A). This sharp increase highlights the substantial tax burden imposed during the economic and financial assistance programme, with policy changes accounting for approximately 70% of this rise (Figure 9B). The legislative measures with the greatest impact on the average effective rate during this period were the restructuring of tax brackets (+2.2 p.p.) and



(A) Average effective rate | Percentage



(B) Decomposition of the change in the average effective rate | Percentage points

FIGURE 9: Change in the average effective tax rate and the impact from policy measures

Source: Authors' calculations based on EUROMOD simulations and EU-SILC data.
Notes: The average effective tax rate is calculated as a ratio between simulated amounts for PIT and gross income, including social transfers other than in kind. Changes to PIT account for the impact of policy measures. The income effect includes changes on gross incomes, population composition and other policy measures with an impact on disposable income as simulated in EUROMOD.

the implementation of the extraordinary surcharge (+0.9 p.p.), representing around 60% and 25% respectively of the estimated total impact of the tax changes.

In the following years, significant tax relief measures were introduced, contributing to a reduction of the average effective rate by 2.3 p.p. between 2014 and 2019 and by 2.7 p.p. between 2019 and 2024. The reduction in the first period is largely explained by the removal of the surcharge (-1 p.p.) and adjustments to tax rates and brackets (-0.5 p.p.). In the most recent period, the restructuring of tax rates continued to play a central role, accounting for nearly 75% of the legislative impact (-2 p.p.), while the reform of the minimum subsistence level had a more modest effect (-0.3 p.p.). Despite these significant changes, they did not result in a substantial reduction in the average effective tax rate due to the previously mentioned counterbalancing effect of income growth. In fact, between 2014 and 2019, there was a 1.1 p.p. reduction in the average effective rate, followed by near stabilization through 2024. This means that in the latest period, the significant nominal income growth entirely offset the impact of the discretionary tax reduction measures on the average effective tax rate.

Thus, in 2024, the average effective rate is slightly below the level observed at the end of the adjustment period, and around 4 p.p. higher than in 2009. Although the tax relief measures implemented over the past decade have been more substantial than the consolidation measures implemented before, they have not resulted in a lower average effective tax rate due to the income effect, which has pushed taxpayers into higher tax brackets as their nominal income increased.

A comparison of the average effective PIT rates in 2024 and 2009 by income decile, reveals an upward trend, with more pronounced increases in higher deciles (Figure 10). The average effective PIT rate in the lower deciles remained quite low, rising by less than 1 p.p., while the increase in the fourth decile reached 2.5 p.p. and about 5 p.p. in

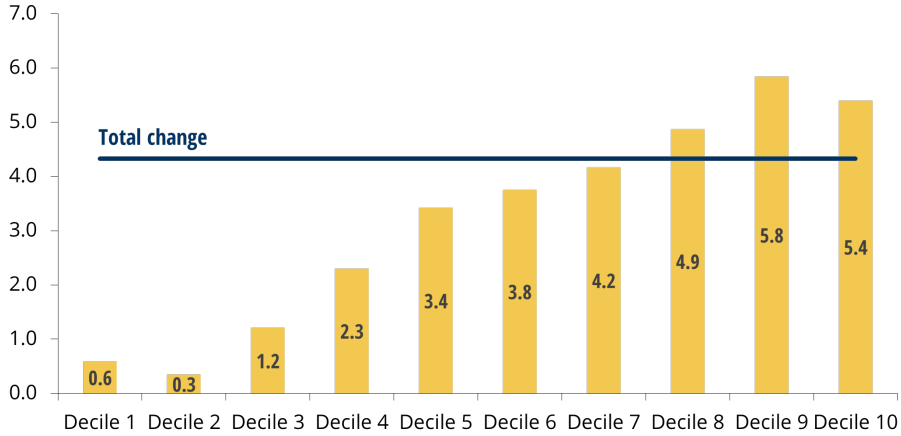


FIGURE 10: Change in the average effective tax rate between 2009 and 2024 by income decile | Percentage points

Source: Authors' calculations based on EUROMOD simulations and EU-SILC data.
Notes: Households are distributed by deciles taking to account the equivalised disposable income in each year as opposed to being anchored to the base year, since the focus of the analysis is the tax structure.

the top three deciles. The strong concentration of the tax burden in the higher deciles, as discussed in section 3, means that the overall increase in the population's average effective tax rate aligns more closely with the changes observed in the top deciles.

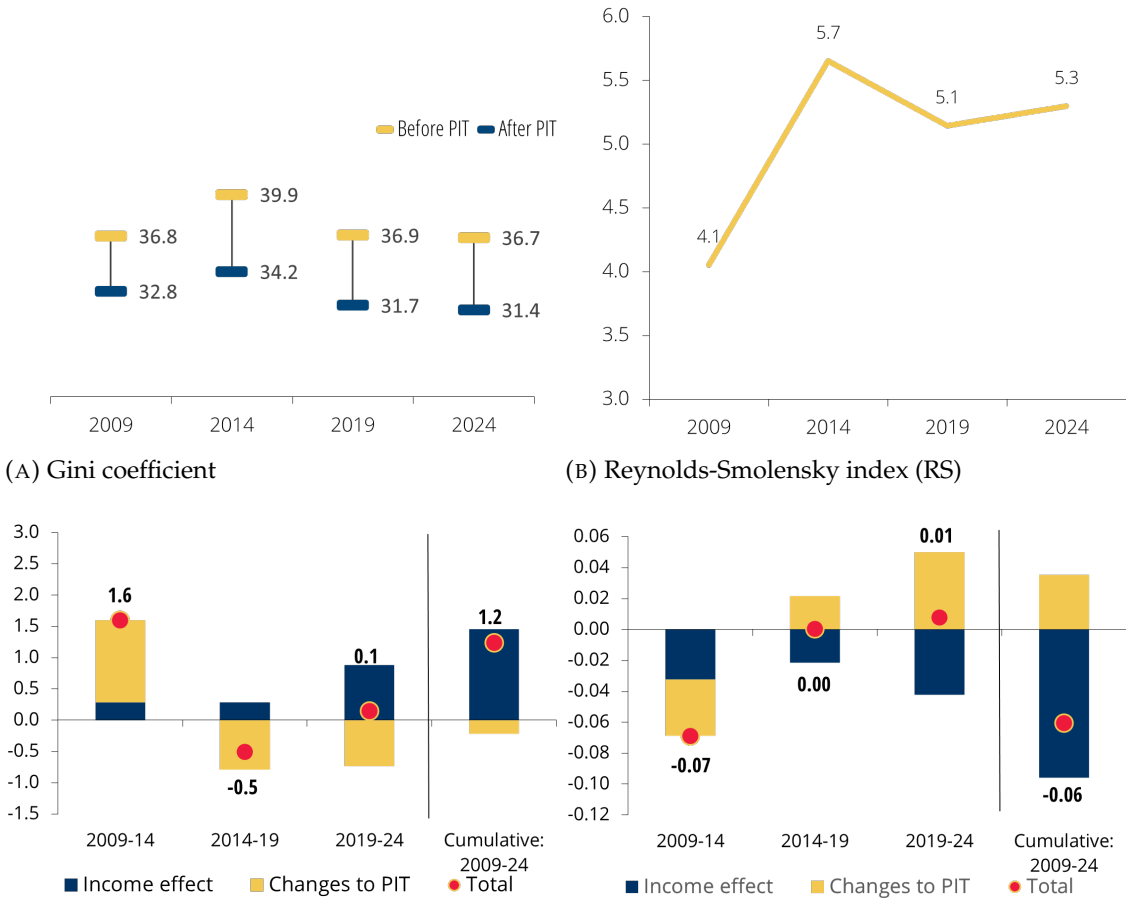
4.2. PIT redistributive capacity

As described in section 3, the Portuguese economy exhibits higher income inequality than the euro area average. Since the PIT is a key instrument for reducing this inequality, it is crucial to analyse how its redistributive capacity has evolved over time and to assess the impact of various tax reforms.

In 2024, the pre-tax level of inequality, measured by the Gini coefficient, is the same as in 2009. However, post-tax inequality is lower, indicating an increase in the tax's redistributive capacity (Figure 11A). The Reynolds-Smolensky index, which measures the difference between the Gini coefficient before and after taxation, increased between 2009 and 2014, followed by a slight reduction until 2019, and then stabilized through 2024 (Figure 11B). It's worth noting that between 2009 and 2014, during the adjustment programme, pre-tax inequality rose significantly. This increase was not fully offset by the PIT's enhanced redistributive capacity, leaving post-tax inequality higher than in 2009.

As in the previous section's analysis, we can assess whether this evolution in inequality indicators results from legislative measures or income effects. Indeed, between 2009 and 2014, more than 80% of the increase in the Reynolds-Smolensky index was attributable to policy changes (Figure 11C). In the following periods, policy measures would have cancelled out this rise if incomes had not changed. However, income growth, particularly in recent years, contributed positively to the tax's redistributive capacity, allowing the PIT in 2024 to be more redistributive than in 2009.

Policy measures influence the redistributive capacity of the PIT by altering both its size — reflected in the average tax rate — and its concentration across income levels, i.e.,



(A) Gini coefficient

(B) Reynolds-Smolensky index (RS)

(C) Redistributive capacity decomposition (RS)

(D) Progressivity decomposition (Kakwani)

FIGURE 11: PIT redistributive capacity

Source: Authors' calculations based on EUROMOD simulations and EU-SILC data.
Notes: The Gini coefficient measures the distance between income distribution in a given population and a perfectly equal distribution, ranging from 0 to 100. The Reynolds-Smolensky (RS) index is equal to the difference between the Gini before and after PIT. These indicators may differ from those estimated directly with EU-SILC data, as they are calculated based on taxes and social benefits simulated on EUROMOD and not on values reported by households. Changes to PIT account for the impact of policy measures. The income effect includes changes on gross incomes, population composition and other policy measures with an impact on disposable income as simulated in EUROMOD. Figure 11C decomposes the change in the RS index. Figure 11D decomposes the change in progressivity (Kakwani index), which is calculated as the difference between the concentration index of the tax and the Gini coefficient before PIT.

the tax's progressivity[10]. This progressivity is typically measured by the Kakwani index, which is defined as the difference between the tax's concentration — measured by the Gini coefficient of the tax distribution — and the pre-tax income Gini coefficient.

As shown in the section 3, during the adjustment program, legislative measures led to a significant increase in the average effective tax rate, which enhanced its redistributive capacity but made it less progressive. This was primarily due to the reduction in the number of tax brackets (Figure 11D). Subsequent changes reversed this trend, making

10. The Reynolds-Smolensky index can be proxied by the product of the net average tax rate (total tax over post-tax income) and the Kakwani, ignoring typically small re-ranking effects.

the tax more progressive. However, income growth, while keeping tax rules unchanged, reduced the tax's progressivity, as the burden became more concentrated in the lower deciles of the population. This happens because the erosion of the real value of tax deductions impacts the lower half of the income distribution more severely.

5. Conclusion

This study contributes to a better understanding of the evolution of household income taxation in Portugal over the past fifteen years. Following a period of significant PIT increases during the adjustment programme, a series of tax relief policies have been introduced since 2015. Despite these measures, PIT revenue has continued to rise, and although the average effective tax rate is now similar to the euro area average, the tax burden remains more heavily concentrated on higher incomes. This has generated political and social pressures to further reduce PIT in order to increase workers' disposable income and mitigate distortions induced by the tax, particularly in the labour market. Therefore, providing a comprehensive view of the tax's evolution, including quantifying the impact of all implemented measures, is crucial to inform and enrich the public debate.

The findings reveal that the average effective PIT rate in 2024 is 4.3 p.p. higher than the level observed before the adjustment period. Interestingly, this increase is not directly attributable to legislative changes but rather to income growth, coupled with the absence of proportional adjustments to PIT brackets and parameters. In fact, if income growth had not occurred, the policy measures implemented would have more than offset the increases seen during the adjustment period. This rise in the average effective tax rate has, in turn, enhanced the tax's redistributive capacity. As a result, while pre-tax income inequality remains at the same level as in 2009, post-PIT inequality is now lower.

In summary, the analysis underscored that while legislative changes to PIT have played a significant role in recent years, income growth has had a more prominent role. Without changes to tax rules, income growth leads to an increase in the average effective tax rate and reduces the progressivity of the tax system.

Future tax reforms, in addition to being aligned with existing budgetary constraints, would benefit from being framed by the policy developments of recent years to provide a more comprehensive analysis. The absence of automatic indexing of PIT brackets and parameters enhances fiscal policy flexibility and reinforces PIT's function as an automatic stabilizer. However, it is crucial to regularly assess the impact of the declining real value of tax brackets and deductions on the average effective tax rate and income distribution, particularly during periods of high inflation. Moreover, evaluating potential reforms should consider the entire tax and benefits system to fully understand their effects on redistributive capacity. Finally, it is essential to examine how these changes affect the labour market to ensure a holistic approach to tax policies and their broader impacts.

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Appendix A: PIT simulation in EUROMOD

The PIT is a complex tax, and its modelling in EUROMOD assumes a simplified version of the tax design. This need for simplification is largely determined by the information available in the EU-SILC survey or imputed based on other surveys[11], which only includes some of the elements used by the tax authority in calculating the tax.

The modelling of PIT in EUROMOD for Portugal is presented in Rodrigues *et al.* (2022), with the most relevant simplifications being the following:

i) It is assumed that all capital income is taxed at the withholding tax rate and that all property income is included in the overall tax calculation, which differs from reality, as taxpayers can choose whether or not to include these incomes.

ii) Regarding the deductions from taxable income, only those related to people with disabilities, employment income, pensions, and *IRS Jovem* are considered by th simulations.

iii) Regarding tax credits, those related to dependants, general family expenses (considering the maximum value for all households), health and education expenses (starting from 2019), interest (without the limit based on when the loan was taken, i.e., reflecting the rules that apply to loans contracted before 2011), rents, and people with disabilities are included in the simulations.

Taking into account the information provided in the State Budget reports and the statistics published by the tax authority, the main unmodelled tax expenditure is the regime for non-habitual residents. The tax expenditure associated with this regime increased from around 494 million euros in 2017 to 1,209 million euros in 2022 (the most recent year in the tax authority's statistics), which is equivalent to about 7% of PIT revenue in 2022.

For this article, an additional simplification of the tax system was applied by using the tax rates in force on the mainland for households residing in the Autonomous Regions. This adjustment was made because data on the region of residence has only been available in EUROMOD since 2018, and including it solely for the more recent years would incorrectly attribute it to a policy change. However, the impact of differentiated rates on overall tax revenue is minimal, affecting it by only 1%. Additionally, the discounts that some municipalities grant to their residents as part of their 5% variable participation in PIT are also not considered.

This set of tax system simplifications, combined with the fact that income and household characteristics used are extrapolated from the EU-SILC survey rather than being the actual figures reported to the tax authority, results in a discrepancy between the tax revenue estimated by EUROMOD and the figures recorded in general government national accounts (Figure A.1). Half of the difference observed in recent

11. For example, education and health expenses are imputed from the household expenditure survey. A first attempt to impute these expenses into the databases used in EUROMOD was carried out in Barrios *et al.* (2016), taking into account the age of the reference individual, household composition, and income quintile.

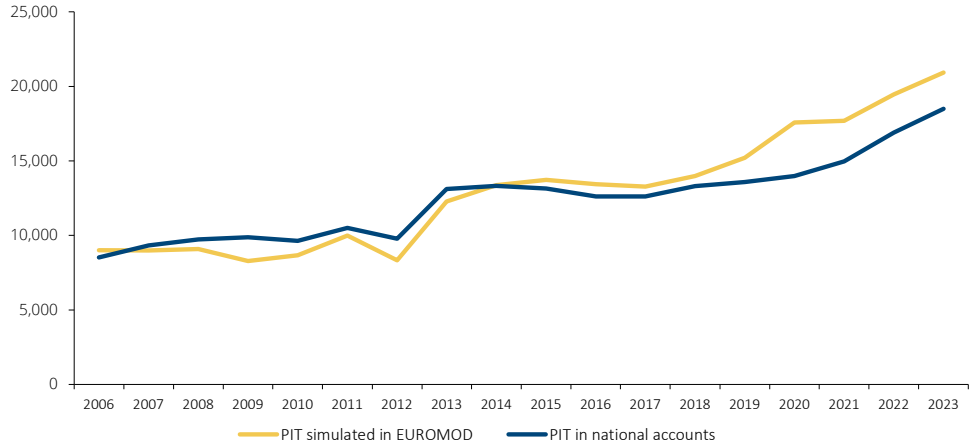

FIGURE A.1: Comparison between PIT simulated in EUROMOD and collected revenue | Millions of euros

Source: Statistics Portugal (INE) and authors' calculations based on EUROMOD simulations and EU-SILC data.

years can be attributed to the exclusion of the regime for non-habitual residents, as mentioned earlier.

Moreover, EUROMOD aims to simulate the total PIT paid on income for a given year, including both the withholding tax applied in that year and the refunds or payments due in the following year (related to the income earned in that year). In contrast, the tax recorded in national accounts reflects the refunds and payments issued within the same year.

Appendix B: Methodology

Formally, the methodology described in section 2 adapts the decomposition proposed by Bargain and Callan (2010) and more recently developed by Paulus and Tasseva (2020) to isolate the effects of various sources of variation on the evolution of inequality indicators such as the Gini coefficient. By combining microdata with microsimulation models (including EUROMOD), Bargain and Callan (2010) decompose the total variation of the indicators of interest between years t and $t+n$ into policy effects, other effects, and nominal effects as follows (adapting the authors' notation to the present exercise):

$$\Delta I = \underbrace{I[d_{t+n}(p_{t+n}, y_{t+n})] - I[d_t(p_t, y_t)]}_{\text{Total effect}} =$$

$$\underbrace{(I[d_{t+n}(p_{t+n}, y_{t+n})] - I[d_{t+n}(p_{t+n}, \alpha * y_t)])}_{\text{Other effects}} + \underbrace{(I[d_{t+n}(p_{t+n}, \alpha * y_t)] - I[d_t(\alpha * p_t, \alpha * y_t)])}_{\text{Policy effect}} +$$

$$+ \underbrace{(I[d_t(\alpha * p_t, \alpha * y_t)] - I[d_t(p_t, y_t)])}_{\text{Nominal effect}}$$

where I represents the indicator of interest, which depends on the disposable income generated by the tax and benefits system at a given point in time, d. The function d varies according to two arguments: the parameters of the tax and benefits system,

p, and the incomes and composition of families, represented by y. The multiplicative factor α is used in the formulation proposed by Bargain and Callan (2010) to evaluate the contribution of discretionary policies net of effects related to the indexing of tax and benefits systems. This factor is applied both to policy parameters and to incomes at t, updating them for the moment $t+n$. Thus, in the category of other effects, we find the impact of population composition between t and $t+n$, while the effect of the nominal updating of parameters and incomes is measured through the nominal effect. As mentioned earlier, updating the PIT policy parameters was not a common practice during the period under analysis, so any change is considered in the effect of policies, which corresponds to α equal to 1[12]. Assuming that α is equal to 1 simplifies the decomposition described above to the following expression:

$$\Delta I = \underbrace{I[d_{t+n}(p_{t+n}, y_{t+n})] - I[d_t(p_t, y_t)]}_{\text{Total effect}} =$$
$$= \underbrace{(I[d_{t+n}(p_{t+n}, y_{t+n})] - I[d_{t+n}(p_{t+n}, y_t)])}_{\text{Nominal and composition effects}} + \underbrace{(I[d_{t+n}(p_{t+n}, y_t)] - I[d_t(p_t, y_t)])}_{\text{Discretionary policies effect}}$$

At this point, discretionary policy effects can be decomposed into discretionary effects on the PIT and other discretionary effects on the remaining components of the tax and benefit system as follows:

$$\Delta I = \underbrace{I[d_{t+n}(p_{t+n}, y_{t+n})] - I[d_t(p_t, y_t)]}_{\text{Total effect}} =$$
$$= \underbrace{(I[d_{t+n}(p_{t+n}, y_{t+n})] - I[d_{t+n}(p_{t+n}, y_t)])}_{\text{Nominal and composition effects}} + \underbrace{(I[d_{t+n}(p_{t+n}, y_t)] - I[d'_{t+n}(p_{t+n}, y_t)])}_{\text{Discrecionary effect on PIT}} +$$
$$+ \underbrace{(I[d'_{t+n}(p_{t+n}, y_t)] - I[d_t(p_t, y_t)])}_{\text{Other discretionary effects}}$$

where d' differs from d with respect to the rules and parameters of the PIT, considering those that were in effect in year t, everything else constant.

It should also be noted that the nominal and composition effect is conditional on the tax and benefits system at time $t+n$, while the discretionary policy effects depend on the base distribution, that is, the distribution of incomes and population composition at time t.

12. Bargain and Callan (2010) argue in their analysis for the use of the average variation of gross income between t e $t+n$ to decompose the variation of inequality indicators. However, there is no consensus on the appropriate choice of the factor α (for more details, see Paulus *et al.* (2020)).

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Non-technical summary

Outubro 2024

Housing markets in Portugal and Spain: Fundamentals, overvaluation and shocks

Rita Fradique Lourenço, Afonso S. Moura e Paulo M. M. Rodrigues

Since 2013 and until the end of 2023, housing prices in Portugal grew by 83% in real terms. This contrasts with a growth of 28% in Spain during the same period. Has there been any reconfiguration of the housing market in the two countries that may help explain this behaviour of prices? In particular, have macroeconomic dynamics in the two countries been so different as to justify such discrepancy?

In recent years, Portugal and Spain have faced similar adjustment processes in their economies, particularly in the aftermath of the European sovereign debt crisis. In the period between the 2008 financial crisis and the beginning of the recovery of activity in 2013, prices (in real terms) fell by an annual average of 4% in Portugal and more than 8% in Spain. In the following years, between 2014 and 2023, housing prices experienced a recovery that saw an average annual growth of 6% in Portugal and less than 3% in Spain.

This study uses two methodologies to assess whether housing prices are in line with what is "expected" according to the main macroeconomic dynamics. The procedure by Phillips and Shi (2020) allows testing the hypothesis of price overvaluation in the housing market in Portugal and Spain. Similarly, a quantile regression exercise helps detect periods when house prices are misaligned with macroeconomic determinants.

The conclusion of these two exercises points in the same direction: in Portugal, prices were showing signs of overvaluation by the end of 2023, while this behaviour was not observed in the Spanish market. Figure Phillips and Shi (2020) shows that the signs of overvaluation in housing prices in Portugal have persisted since early 2017, in contrast with the behaviour of prices in the Spanish market.

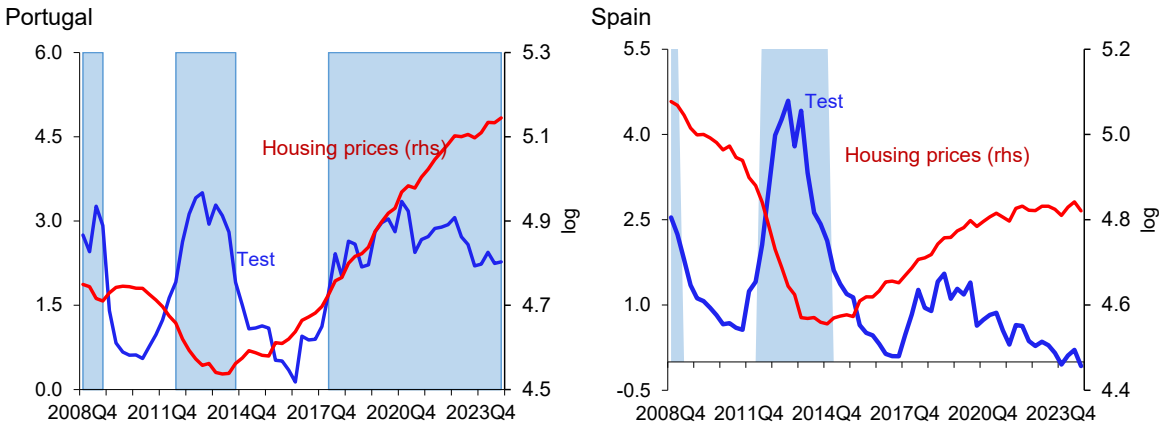

GRÁFICO 1: Over or undervaluation periods - Phillips and Shi (2020) test results and house prices evolution.

Note: Left-hand scale —- Value of the Phillips and Shi (2020) test. Right-hand side scale — House price index in logs. Shaded areas indicate periods in which the series of results from the Phillips and Shi (2020) test (represented by the blue line) reject the the null hypothesis of no signs of overvaluation (or undervaluation) in price. For more details see Appendix A.
Sources: Authors' calculations.

Additionally, a structural Bayesian vector autoregressive model is estimated, characterizing the housing market with a demand and a supply curve. This analysis suggests that growth in house prices in Portugal, for most of the period considered, is mainly driven by demand forces, with supply being unable to counterbalance this effect. In the Spanish case, the demand pressure is mitigated by the contribution of supply, particularly in the pre-pandemic period.

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Housing markets in Portugal and Spain: Fundamentals, overvaluation and shocks

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October 2024

Abstract
Since 2013, real housing prices have increased by more than 80% in Portugal and less than 30% in Spain. What could explain such discrepancy, given that both economies have experienced similar macroeconomic dynamics in recent years? Using two complementary methodologies — the Phillips and Shi (2020) test and quantile regressions to estimate the conditional quantiles of house prices — it is observed that housing prices in Portugal display signs of overvaluation since 2017, which is not the case for Spain. Furthermore, it is also observed that housing prices in Portugal are "misaligned" relatively to what macroeconomic determinants would predict. Additionally, the contribution of demand and supply shocks to the dynamics observed in each country is quantified using a structural Bayesian vector autoregressive model with sign restrictions. It is concluded that housing price growth in Portugal is mainly driven by demand forces, with supply being ineffective in counterbalancing these pressures, unlike in Spain.
(JEL: C11, C22, R31)

1. Introduction

Since 2013[1] until the end of 2023, housing prices in Portugal increased by 83% in real terms. This contrasts with a growth of only 28% in Spain during the same period. Are there economic fundamentals that explain such discrepancy? In particular, have the macroeconomic dynamics in the two countries been so distinct as to justify this difference?

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1. The first quarter of 2013 represents the trough of the Portuguese economic cycle following the euro area sovereign debt crisis. Aguiar-Conraria *et al.* (2024) classify this cycle as having 10 quarters, with a peak in the third quarter of 2010 and a trough in the first quarter of 2013.

In recent years, Portugal and Spain have faced similar adjustment processes in their economies, particularly following the financial and European sovereign debt crises. Following these two crises, housing prices in both countries contracted — although by different magnitudes. Between the 2008 financial crisis and the start of the economic recovery in 2013, prices (in real terms) decreased by an annual average of 4% in Portugal and more than 8% in Spain. In the period between 2014 and 2023, after a period of economic recovery, the Covid-19 pandemic crisis was followed by an inflationary shock in 2022 and a subsequent increase in key interest rates by the European Central Bank (ECB), in an unusual context of war in Ukraine. During this period, housing prices recovered, reaching an average annual growth of 6% in Portugal and less than 3% in Spain (Figure 1).

Given this price behaviour, the goal of this study is, firstly, to describe the macroeconomic dynamics underlying the evolution of the housing markets in both countries in recent years. Beyond this characterization, which helps to better understand whether such price behaviour can be rationalized by economic fundamentals, the second part formally tests this hypothesis —– using a test that detects overvaluation and quantile regressions. Additionally, using a structural Bayesian vector autoregressive (BVAR) model, the contribution that demand and supply forces have had on market equilibrium during each period is estimated.

The use of the methodology developed by Phillips and Shi (2020) allows testing for price overvaluation in the housing markets of Portugal and Spain. Similarly, quantile regressions help identify periods during which housing prices are possibly misaligned with macroeconomic determinants. Specifically, it is considered that misalignment occurs when price growth exceeds what is expected for the right tail of the conditional distribution — i.e., periods during which prices grew more rapidly than expected

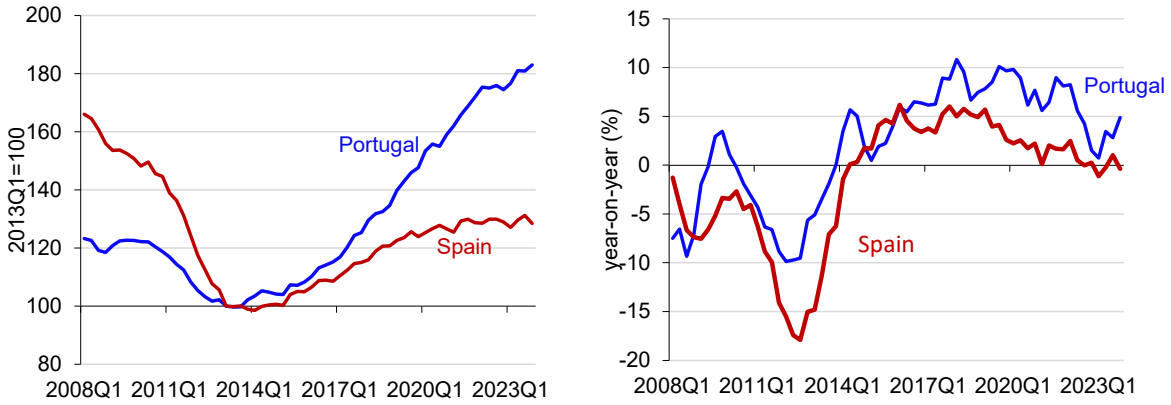


FIGURE 1: Evolution of house prices (left) and the respective year-on-year growth rate in Portugal and Spain in real terms

Note: House prices correspond to a hedonic price index (i.e., adjusted for house quality: price per square meter, size, and location) for newly constructed and existing houses acquired in the residential market. In the case of Portugal, the aggregate house price index has been calculated by the Instituto Nacional de Estatística (INE) since 2009 and, before that, by *Confidencial Imobiliário*.
Sources: INE, *Confidencial Imobiliário*, ECB, and authors' calculations.

based on a conditional quantile on the right side of the distribution. The conclusion of these two exercises points in the same direction: in Portugal, prices exhibited signs of overvaluation by the end of 2023, whereas this was not observed in Spain.[2] Note that signs of housing price overvaluation in Portugal has persisted since early 2017, according to the results of the Phillips and Shi (2020) test, consistent with what was observed by Rodrigues *et al.* (2022). The same test does, however, not detect overvaluation in the price behaviour of the Spanish market.

Another contribution of the study is to estimate a structural bayesian vector autoregressive (BVAR) model that characterizes the housing market along a demand and a supply curve. By imposing prior distributions on the elasticities of each curve, which combine sign restrictions with the possibility of guiding model estimation using elasticity estimates from existing literature, specific structural shocks are identified for each of the curves, for each period. This analysis suggests that house price growth in Portugal, for most of the period considered, has been driven by demand forces, with supply being unable to counterbalance such effect. In Spain, however, this demand pressure is mitigated by supply contributions, particularly in the pre-pandemic period.

Overall, there are signs of overvaluation in price growth in Portugal but not in Spain. Additionally, in the case of Portugal, housing prices can also be said to be misaligned with the macroeconomic fundamentals considered in the analysis, thereby confirming the more atypical behaviour of this market in Portugal in recent years. Moreover, by decomposing the market forces driving prices, the study can also assist in the design of correctly targeted public policies.

However, some caveats of the analysis need to be highlighted. The complexity of markets requires that all exercises performed necessarily simplify reality. For example, there is geographical heterogeneity within each country that impacts the dynamics of each city; and the rental market also plays an important role in the dynamics of the housing market. However, due to data constraints, these dimensions are abstracted from in this study. It is also important to note that when comparing Portugal and Spain, that the Spanish economy is significantly larger than the Portuguese. Nevertheless, as presented in the following sections, both economies have a significant weight of the tourism sector, considerable cultural proximity, and similar demographic changes. Additionally, the construction sector in each country has a similar weight in their GDPs.

The remainder of the article is organized as follows. Section 2 discusses the evolution of some macroeconomic variables that may underlie the dynamics observed in the housing markets in Portugal and Spain; Section 3 presents empirical results that identify the existence of overvaluation in price behaviour over the period of analysis and determine whether prices are growing in an "extreme" manner; Section 4 identifies the contribution that demand and supply shocks have had on the dynamics observed in

2. "Conditional quantile" refers to the predicted price movements based on the behaviour observed from a set of explanatory variables at a specific quantile of the conditional distribution. In the analysis conducted, due to the number of available observations, the 80th percentile is defined as the threshold above which price movements are considered "misaligned" with fundamental behaviour. Section 3.2 provides a detailed explanation of the quantile regression model used.

these markets; finally, Section 5 concludes. An appendix provides a brief description of the overvaluation test proposed by Phillips and Shi (2020) - Appendix A; a brief description of a quantile co-integration test - Appendix B; and an analysis of the robustness of the results of the historical decomposition of demand and supply shocks based on the number of transactions - Appendix C.

2. Overview of recent macroeconomic dynamics in both countries

In this section, the macroeconomic dynamics of both countries is characterized, providing better context for understanding the behaviour of the housing market, followed by a description of changes in this market. However, before proceeding, it is important to briefly describe the two main variables that are used in this article to characterize the behaviour of the housing markets in both countries: house prices and residential investment (residential gross fixed capital formation).

The house price indices for both countries follow the hedonic pricing methodology, which aims to control for potential biases arising from differences in the quality of the houses (price per square meter, size, and location) sold between periods. These indices aggregate the price trends of both newly constructed houses and existing ones acquired in the residential market. The indices are compiled by the respective national statistics institutes and, in the case of Portugal, by *Confidencial Imobiliário* for the period before 2009. In both cases, the indices are deflated using the respective private consumption deflators.[3]

Regarding the residential gross fixed capital formation, the series refers to real investment in residential constructions (apartments or houses) and is compiled by the respective national statistics institutes in accordance with the European System of Accounts (ESA).

2.1. Macroeconomic dynamics

Between 2008 and 2023, the evolution of GDP, residential investment (residential GFCF), and disposable income per capita was globally similar in Portugal and Spain, as shown in Figure 4. Unemployment, housing credit stock, and short-term real interest rates also showed similar trends.[4]

In the five years following the financial crisis, up to the recovery in 2013, both economies experienced an average annual GDP contraction of 1% and a more significant decline in housing investment, around 12% in both countries (Figure 4). Regarding labour market conditions, it is observed that after the crisis, the labour force registered a significant reduction, partly due to increased emigration flows and population aging,

3. The methodology for several EU countries can be found in `ec.europa.eu/eurostat/cache/metadata/en/prc_hpi_inx_esms.htm` and in the case of *Confidencial Imobiliário*, an independent portuguese databank, in https://www.confidencialimobiliario.com/.

4. The unemployment rate in Spain is markedly higher than in Portugal for most of the period shown in Figure 3. Despite the difference in the level of the rates, their trends have exhibited similar dynamics.

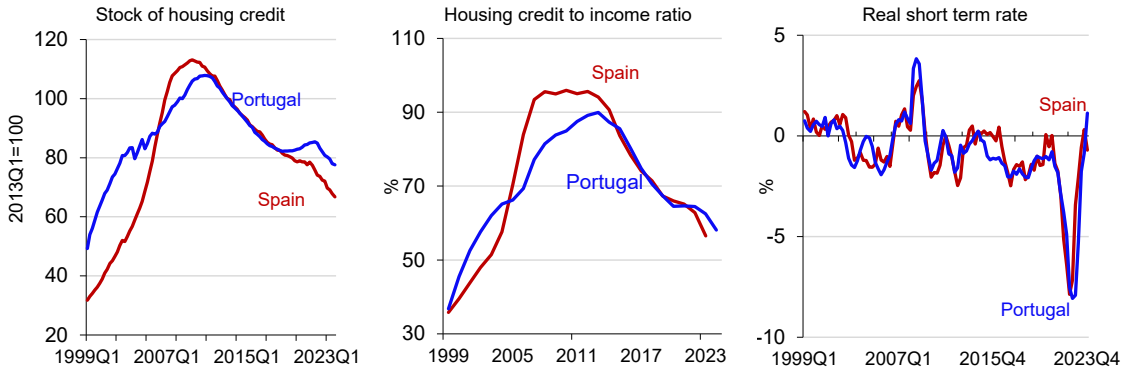


FIGURE 2: Credit market.

Note: The real interest rate is given by the 3 month EURIBOR and deflated by the private consumption deflator of each country.
Sources: ECB, INE and authors' calculations.

and that the unemployment rate rose sharply, peaking in 2013 (Figure 3). However, despite the relatively similar evolution of determinants in both countries during this period, the decline in housing prices in Portugal was half the value observed in Spain — an annual average of 4% compared to 8%, respectively.

The following years, from 2014 to 2023, were particularly challenging for both economies. After a period of economic recovery, there was the Covid-19 pandemic, followed by an inflationary shock in 2022 that led to an increase in the ECB policy interest rates after a long period of very low rates. In these 10 years, activity grew by 2% per year on average in both countries, and residential investment also grew but at a slightly faster pace in Spain than in Portugal (4% and 3%, respectively). The unemployment rate decreased in both countries, excluding the pandemic period, and later "stabilized".

In the period 2014-2023, as already mentioned, housing prices rose by an annual average of less than 3% in Spain and more than two times that in Portugal. It is

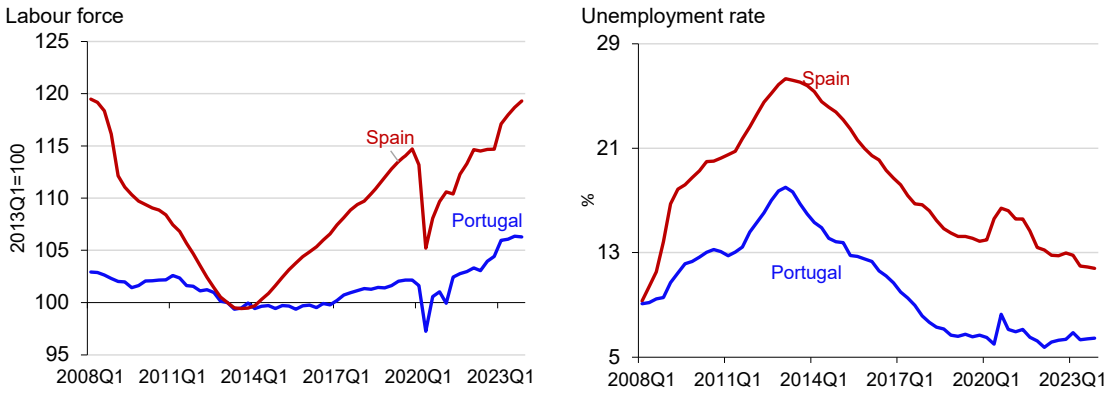


FIGURE 3: Labour market.

Sources: Banco de Portugal and ECB.

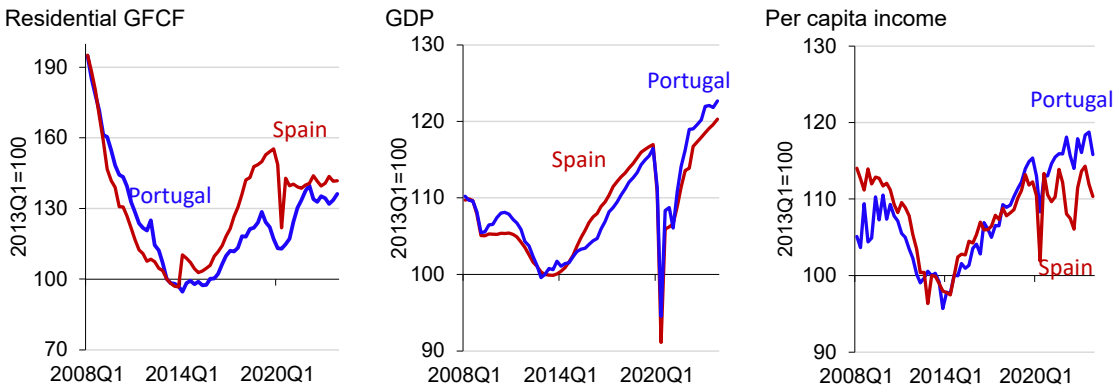


FIGURE 4: Residential GFCF, GDP and per capita disposable income.

Note: Data in real terms (disposable income is deflated by the private consumption deflator of each country).
Sources: Banco de Portugal, ECB and authors' calculations.

important to note that the increase in housing prices in Portugal, especially since 2017, has contributed to the deterioration of accessibility to the housing market, both for acquisition and rental, especially in the metropolitan areas of Lisbon and Porto; see (Rodrigues *et al.* 2023).

Finally, given its relevance for the housing sector, it is important to examine the evolution of credit in more detail. During the transition to the single currency and up until the financial and sovereign debt crises, Portugal and Spain experienced episodes of very high growth in mortgage credit. This occurred in both economies within a framework of reduced banking loan costs and strong, sustained growth in household disposable income, leading to increased household indebtedness. The ratio of housing loans to disposable income rose from about 30% in 1999 to around 90% in 2013 in both countries.

In contrast, after the financial crisis, there was a significant slowdown in housing credit (Figure 2). The crisis had negative effects on both supply, with a considerable tightening of banking conditions and requirements for credit access, and on demand for housing credit. By the end of 2023, the ratio of housing loans to disposable income was below 60% in both countries.

2.2. *Housing markets reconfiguration*

In recent years, there have been significant changes in the housing markets of both countries. These include demographic changes, as well as other changes following the financial crisis. According to the Census, the percentage of younger families owning houses has substantially decreased between 2011 and 2021 — from 70% to around 35% in Spain and from 60% to 40% in Portugal.[5] Loan applications from these younger households, likely with higher risk profiles (for example, due to greater job instability),

5. Families where the age of the household representative is below 35 years.

have declined. Credit conditions have become more stringent in terms of loan amounts and terms (Costa 2023; Gavilán 2022; Rodrigues *et al.* 2023).[6]

Another demographic change that has been observed is an increase in the number of households, combined with a decrease in household size. Currently, there is a larger number of single-person households, couples without children, and single-parent families (Figure 5).

Regarding the resident population, although Census data shows a decrease in the resident population in Portugal of about 1% between 2011 and 2021, the situation varies depending on the region considered: while the Porto metropolitan area also registered a reduction of 1%, the population of the Lisbon metropolitan area, on the contrary, increased by 2% (Rodrigues *et al.* 2023). In the case of Spain, the data show an increase of less than 1% in the population, but increases of 4% and 3% in the Community of Madrid and Catalonia, respectively, which, according to Álvarez-Román and Garcia-Posada (2021), had a positive effect on price growth.

There has also been a diversification in the use of residential buildings for tourism, and the growing demand from foreigners and immigrants in Portugal and Spain contribute to an upward price pressure. Online platforms that facilitate customer access and short-term rental management have made housing investments to accommodate tourists more attractive to a wide range of investors. This reality not only increases demand in the real estate market but also enhances the return on investment in tourist accommodations, as short-term rentals for tourists (if occupancy rates are adequate) offer substantially higher returns than permanent rentals to the local population. This argument is somewhat supported by the rapid growth in the number of businesses associated with local accommodation in a short period of time — for instance, in Lisbon, the number of properties registered for short-term rentals increased from twelve thousand in 2013 to over ninety-four thousand in 2019 (Gonçalves *et al.* 2023). Barcelona and Madrid are among the cities with more local accommodations listings.

For foreigners choosing to live or invest in Portugal and Spain, there has been significant growth in real estate investment in recent years. In Portugal, the stock of real estate investment held by non-residents represented 12% of GDP in 2023, compared to 4% in 2008.[7] In Spain, foreigners bought 125 thousand homes in 2023, mainly in the most touristic areas, representing 19% of the total transactions, up from 7% in 2007 (Gavilán 2024). Overall, the pressure from foreigners on housing prices is greater in the metropolitan areas of Lisbon and Porto, but the impact on the median house value seems to be globally limited, the existence of some spillover effects cannot be ruled out (Figure 6).

On the other hand, there has been a contraction of supply, which also contributes to an upward price pressure, which was observed in both countries over the past decade.

6. In July 2018 the Bank of Portugal, as the national macroprudential authority, implemented a measure targeting new credit contracts with consumers that introduced limits on the Loan-to-Value (LTV) ratio, the Debt Service-to-Income (DSTI) ratio, and loan maturities. In Spain, the Loan-to-Price ratio (LTP) has significantly decreased in recent years.

7. According to the external statistical data from Banco de Portugal.

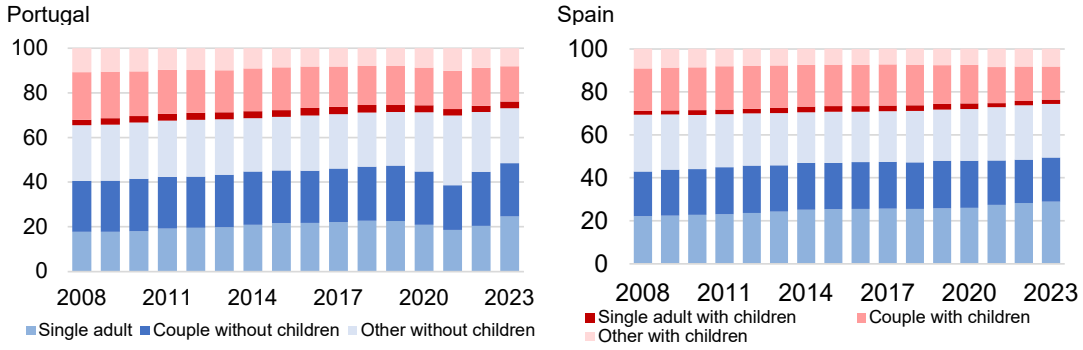


FIGURE 5: Household composition
Sources: Eurostat and authors' calculations.

According to Spanish government statistics, there was a substantial reduction in housing construction in Spain between 2012 and 2022, compared to the period between 2001 and 2011 — a reduction from 5 million to 800 thousand housing units. The same occurred in Portugal, where there was a decrease from 700 thousand to about 150 thousand housing units (Figure 7).

However, despite this phenomenon being common to both countries, construction dynamics over the past two decades are not exactly identical. Note that the slowdown in construction in Portugal appears to have begun in the early 2000s, whereas this decline is observed in Spain only later in that decade. Similarly, when the decline in construction occurs, it is much more abrupt in Spain, whereas in Portugal it is more gradual. In both cases, however, the lowest annual values are seen between the financial crisis and the sovereign debt crisis, with only modest recoveries following the latter.

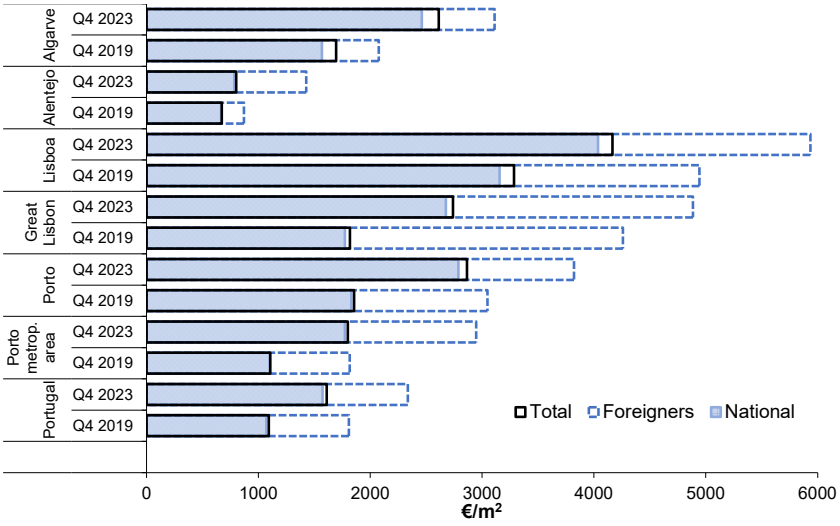


FIGURE 6: Median sales prices of dwellings by tax residence of the purchaser: Portugal
Source: INE

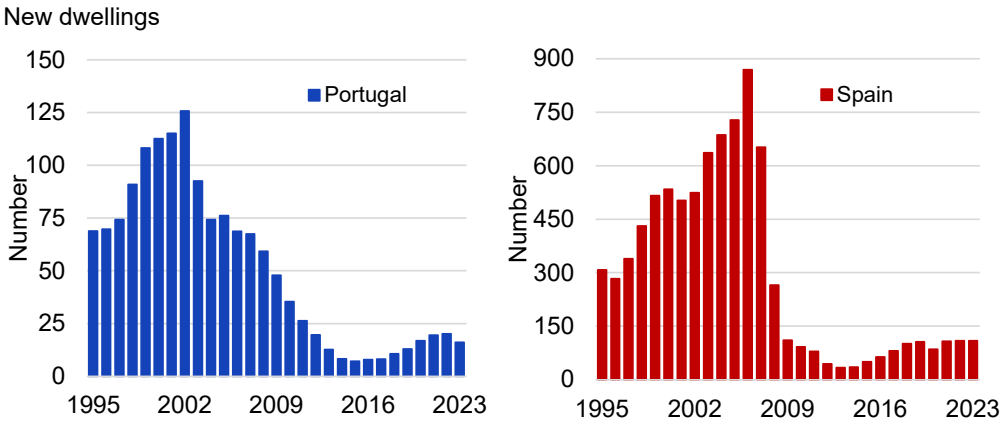


FIGURE 7: Construction of residential dwellings

Sources: INE, London Stock Exchange Group and authors' calculations.

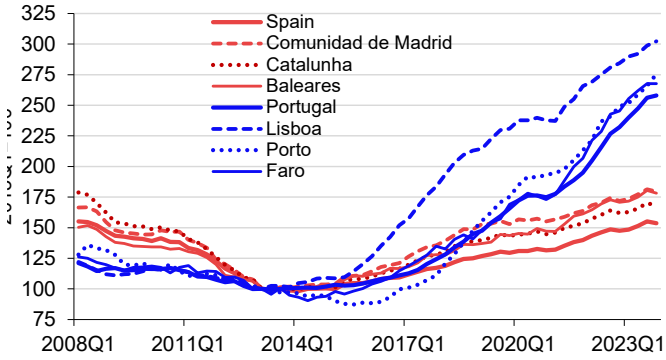


FIGURE 8: Evolution of house prices in selected regions

Note: The median prices in euros per m² at the local level, compiled by INE, are only available since 2019. Therefore, in this figure, and to compare the evolution of housing prices in various regions of Spain and Portugal since 2008, we used the price index series by municipality from *Confidencial Imobiliário*. Sources: *Confidencial Imobiliário* and Instituto Nacional de Estadística (Spain).

The economic impact of the international financial crisis and the sovereign debt crisis led to financial restrictions in the construction sector, resulting in a loss of the sector's installed capacity. The construction sector in Spain has accounted for 6.5% of total employment since 2020, almost half of what it was during the boom years of the 2000s. In Portugal, the construction sector represents 7% of total employment in 2023, down about 3 percentage points from the mid-2000s. The slowdown in construction is also partly due to the slower, more complex but necessary urban rehabilitation process across all regions. The housing stock shows some aging dynamics, with more rehabilitation and less new construction (Rodrigues *et al.* 2023).

Together, these factors contribute to an increase in market frictions due to the recomposition of existing demand, which may help explain the evolution of prices at both regional and national levels (Figure 8).

3. Analysing housing price dynamics: two complementary methodologies

In the previous section, it was concluded that despite the relatively similar evolution of the described macroeconomic variables in both countries, housing prices have exhibited distinct dynamics in the two cases — more pronounced in upward cycles but more contained in downward cycles in Portugal. In this section, we formally test whether prices have deviated from the values that would be "expected" based on what the macroeconomic variables considered would indicate for each period.

To this end, we use two methodologies. The first is based on the approach proposed by Phillips and Shi (2020), which allows for the detection of periods that may be associated with price overvaluation.[8] The second allows, with a quantile regression approach, for the detection of housing prices misalignments with the considered macroeconomic determinants.[9] These two methodologies are seen as complementary in the analysis conducted: the first test has a purely statistical aspect, capturing periods of sharp growth (or decline) that deviate from the "normal" behaviour of prices; the second exercise has a more explanatory nature, comparing the observed behaviour of prices against what would be predicted based on the behaviour of a set of explanatory variables.

3.1. Results of the Phillips and Shi econometric test

This methodology is based on the fact that asset prices can be explained by two components: the market fundamental and the non-fundamental component. The latter, when it exists, typically causes explosive price behaviour that temporarily dominates the time series dynamics. It is precisely this explosive behaviour that the approach aims to detect.

The procedure by Phillips and Shi (2020) begins with the application of a test (GSADF) that identifies multiple episodes of overvaluation over the time series, considering different start and end points of the time window. It then uses another test (BSADF) to monitor in real time the formation and collapse of overvaluation episodes (the blue line in Figure 9 shows the results of the BSADF for the considered period). The results from the GSADF and BSADF tests are compared with critical values, which are determined via bootstrap. When the values of the test exceed the critical values, it indicates the presence of overvaluation (shaded blue areas in Figure 9).

Figure 9 presents the application of the test for Portugal and Spain for the period between 1988Q1 and 2023Q4. Shaded areas point towards the existence of possible overvaluation episodes.

The application of the test for Portugal suggests the possible start of an overvaluation episode in the first half of 2017 (as previously reported by Rodrigues *et al.* 2022).

8. Appendix A provides a detailed description of the methodology by Phillips and Shi (2020).
9. This methodology was inspired by the work of Machado and Sousa (2006).

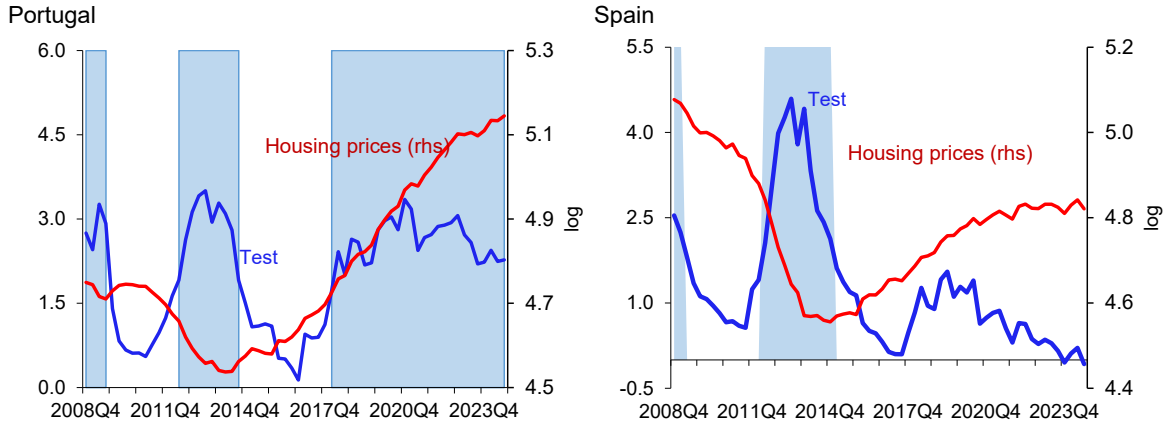


FIGURE 9: Over or undervaluation periods – Phillips and Shi (2020) test results and house prices evolution.

Note: Left-hand side scale —- Value of the Phillips and Shi (2020). Right-hand side scale — House price index in logs. The shaded areas indicate periods during which the series of results from the Phillips and Shi (2020) test (represented by the blue line) rejects the null hypothesis of no signs of overvaluation (or undervaluation) in price behaviour. For more details see appendix A.
Sources: Authors' calculations.

3.2. *Results of the quantile regression*

To complement the previous analysis, which detects overvaluation in prices in Portugal but not in Spain, a quantile analysis is conducted. This approach allows for the examination of different parts of the data distribution (such as the right and left tails of the housing price distribution), rather than just the mean, as is typical with traditional linear regression. This is an important feature because the impact of a variable on housing prices can differ in a context of lower prices compared to higher prices.

The estimated model is,

$$\begin{aligned} Q_{\ln(HP_t)}\left(\tau \mid \mathcal{F}_{t-1}\right) &= \alpha_0(\tau) + \alpha_1(\tau) rdipcc_t + \alpha_2(\tau) rmmi_t \\ &\quad + \alpha_3(\tau) GFCFresid_t + \alpha_4(\tau) loan_t + \alpha_5(\tau) unemp_t \end{aligned} \tag{1}$$

where τ is the quantile of interest, $ln(HP_t)$ corresponds to the natural logarithm of the real house price index (obtained with the private consumption deflator) at time t, $rdipc_t$ is the natural logarithm of real per capita disposable income at time t, $rmmi_t$ is the short-term real risk-free interest rate at time t, $GFCFresid_t$ is the natural logarithm of residential gross fixed capital formation at time t, $loan_t$ is the natural logarithm of real loans for housing purchase at time t, and $unemp_t$ is the unemployment rate at time t.[10] The empirical analysis covers the period from the first quarter of 1988 to

10. Including foreign direct investment in real estate as a determinant in the quantile regression for Portugal does not qualitatively alter the conclusions.

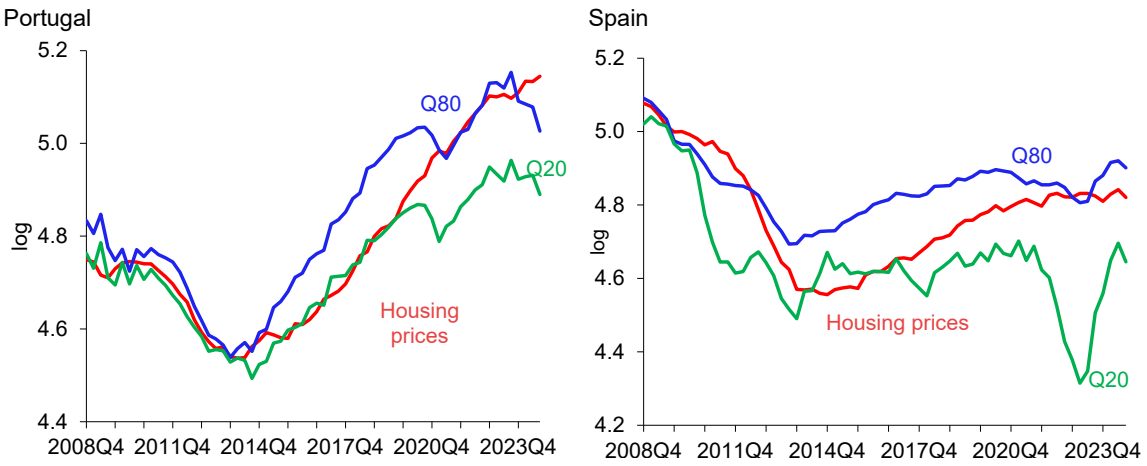


FIGURE 10: Results of the quantile regressions.
Sources: Authors' calculations.

the fourth quarter of 2023.[11] Since the variables used in equation 1 are non-stationary (confirmed through unit root tests), it is necessary to test for quantile cointegration. Following Xiao (2009), a quantile cointegration test is conducted by applying a CUSUM test to the residuals of equation 1. Based on the results of this test, the null hypothesis of cointegration cannot be rejected.[12] Thus, equation 1 can be seen as a long-term equilibrium specific to each quantile τ.

Figure 10 presents the results of the model estimates for each country, for the 0.2 and 0.8 quantiles, and the natural logarithm of the observed real housing price index over the period (the 0.2 and 0.8 quantiles are chosen as limits due to the length of the series). The estimated conditional quantiles suggest signs of overvaluation from the end of 2020 onwards.[13] In Spain, on the other hand, housing prices are consistent with the determinants, i.e., there does not appear to be overvaluation.

Overall, the results suggest signs of overvaluation in Portugal, as both approaches point to housing prices being misaligned with their fundamentals. In Spain, this is not the case, which is consistent with Álvarez-Román and Garcia-Posada (2021).

11. Given that the number of observations is relatively small, particularly when analyzing price behaviour in the tails of the distribution, the quantile regression analysis was conducted at the 0.2 (left tail) and 0.8 (right tail) quantiles to ensure a reasonable number of observations for model estimation.

12. For Portugal the test results are 0.4530 for τ = 0.2, and 0.5137 for τ = 0.8, and for Spain 0.7131 τ = 0.2, and 0.8228 for τ = 0.8. The critical values for the CUSUM test for significance levels of 90%, 95%, and 99% are for τ=0.2, 1.1448, 1.2468, and 1.4102, respectively, and for τ=0.8, 1.1510, 1.2452, and 1.4233, respectively.

13. Given that the estimated quantiles are conditional on the data available at the time of their estimation (i.e. reflecting the specific economic situation at the time), an exercise that recursively calculates the conditional quantiles makes it possible to detect signs of overvaluation since 2017 (in line with the results presented in the 3.1 section) — see Rodrigues *et al.* (2022).

4. Decomposing market dynamics into supply and demand shocks

After concluding in the previous sections that in the recent period there is overvaluation in the behaviour of prices in the Portuguese market (which is not observed in the Spanish case), this section quantifies the market forces that have influenced such behaviours. To do this, a structural BVAR model is estimated through which the forces that have had the greatest impact on market dynamics are formally quantified.

It is important to mention how this exercise should be reconciled with the results obtained in section 3.2. In that section, we saw that prices are evolving above what is predicted by a series of explanatory variables for the 0.8 quantile of the distribution. This means that the historical behaviour and consequent impact on prices of these variables do not seem to be compatible with the most recent evolution of the market. It may be the case that this is justified by the existence of other variables, not so commonly used in the literature, that are influencing market dynamics.

The goal of the BVAR estimated in this section is precisely to capture, in a reduced form, any force impacting the market (and not just a set of pre-selected variables), as long as such a force impacts either the demand (curve) or the supply (curve) in the market. Similarly, section 3.1 only identifies periods of price overvaluation, while this section identifies the forces that drive this behavior (both in periods of overvaluation as well as in periods of more stable behavior).

The model only identifies, in a reduced form, historical demand and supply shocks in each market. The methodology does not allow to distinguish the exact origin of demand or supply shocks — for example, a demand shock could have its root in a demographic phenomenon or instead a change in interest rates, yet the model classifies both as demand shocks only. This limitation of the model can also be considered useful: this methodology is able to capture any shock that has occurred, without this being explicitly dependent on the inclusion of certain variables in the model, which would always make the model's results dependent on the variables included.

This exercise is important since the implementation of public policies that have an effective impact on the housing market depends on several factors, but largely on being correctly targeted. Understanding which forces have historically put the most pressure on the housing market equilibrium — that is, from which side: demand or supply — becomes crucial in designing measures that alleviate such pressures.

4.1. Methodology and data

This section identifies the supply and demand shocks that have influenced prices and quantities in the housing market in both Portugal and Spain. To this end, we followed the methodology developed by Baumeister and Hamilton (2015) and estimated a structural BVAR model to describe the dynamics of this market in each country. The estimation of this model allows us to historically decompose the contribution that

supply and demand shocks have had on the dynamics observed at each moment in the Portuguese and Spanish markets. [14]

The VAR model considered in the analysis for each country, in its structural form, can be represented as,

$$\boldsymbol{A}^c \boldsymbol{y}_t^c = \boldsymbol{B}_0^c + \boldsymbol{B}^c(L)\boldsymbol{y}_{t-1}^c + \boldsymbol{\varepsilon}_t^c, \tag{2}$$

where $\boldsymbol{y}_t^c = (\Delta p_t^c, \Delta q_t^c)'$ is a 2×1, $c = \{Portugal, Spain\}$, p_t^c is the price level at time t, and q_t^c is the quantities built at time t. $\boldsymbol{B}_0^c$ is a vector of constants and $\boldsymbol{B}^c(L)$ is a polynomial matrix in L associated with the lags of $\boldsymbol{y}_t^c$. Additionally, $\boldsymbol{\varepsilon}_t^c$ represents a 2×1 vector of structural shocks i.i.d $N(0, \boldsymbol{D})$, where $\boldsymbol{D}$, the variance-covariance matrix, is diagonal.

Defining $\varepsilon t^c = (\varepsilon d, t^c, \varepsilon_{s,t}^c)'$, the first equation of the system corresponds to a demand curve in the market, and the second to a supply curve. Thus, assuming that the matrix of contemporaneous relations $\boldsymbol{A}^c$ is,

$$\boldsymbol{A}^c = \begin{bmatrix} -\beta^c & 1 \\ -\alpha^c & 1 \end{bmatrix}, \tag{3}$$

the model can be represented by the following demand and supply equations for housing in the market, respectively:

$$\Delta q_t^c = b_{10}^{d,c} + \beta^c \Delta p_t^c + \sum_{i=1}^{l} b_{11}^{i,d,c} \Delta p_{t-i}^c + \sum_{i=1}^{l} b_{12}^{i,d,c} \Delta q_{t-i}^c + \varepsilon_{d,t}^c \tag{4}$$

$$\Delta q_t^c = b_{20}^{s,c} + \alpha^c \Delta p_t^c + \sum_{i=1}^{l} b_{21}^{i,s,c} \Delta p_{t-i}^c + \sum_{i=1}^{l} b_{22}^{i,s,c} \Delta q_{t-i}^c + \varepsilon_{s,t}^c. \tag{5}$$

Thus, β^c can be interpreted as the demand elasticity, while α^c as the supply elasticity [15]. To identify the demand and supply shocks in this system, sign restrictions were used on these elasticities so that the assumed premise is that the demand curve has a negative slope ($\beta^c < 0$) and the supply curve a positive slope ($\alpha^c > 0$). [16]

In addition to sign restrictions on the elasticities, prior distributions were also used to guide the possible values of β^c and α^c, so that the probability is not uniform for all values that respect the sign restrictions. To this end, a truncated *Student-t* distribution

14. This methodology, with slight adaptations, has already been applied by the authors to various markets. For instance, Baumeister and Hamilton (2015) apply it to the U.S. labour market; Baumeister and Hamilton (2018) analyze the impact of monetary policy decisions on economic fluctuations; and Baumeister and Hamilton (2019) study the behaviour of supply and demand shocks in the oil market and their impact on the global economy. A more detailed explanation of the methodology and the model estimation process can be found in these studies.

15. Since both elasticities are associated with price changes and the corresponding response of quantities in period t, they can be interpreted as contemporaneous or short-term elasticities

16. That is, a positive demand shock increases, *ceteris paribus*, the quantities and equilibrium prices, while a positive supply shock increases, *ceteris paribus*, the quantities, but decreases the equilibrium prices. The magnitude of the impact that each shock has on the respective market equilibrium depends on the ratio of elasticities, $\frac{\beta^c}{\alpha^c}$. A more detailed explanation can be found in Brinca *et al.* (2021), where the authors apply a similar methodology to the dynamics of the U.S. labour market during the Covid-19 period.

was assumed for both demand and supply, with the following values: (i) for housing demand elasticity, β^c, both in the Portuguese and Spanish cases, a conservative approach encompassing a broad range was chosen. In this sense, a location parameter of -0.6, a scale parameter of 0.6, and 3 degrees of freedom were chosen. Since this elasticity is truncated at negative values, it means that the prior distribution places a 90% probability of being included in the range [-2.16; -0.11] for both countries; (ii) for supply elasticity, the existence of more studies attempting to quantify this elasticity allows for more precise guidance. Thus, the results of Cavalleri *et al.* (2019) were used, defining the location parameter for Portugal at 0.84 and for Spain at 1.17. [17] [18] The scale parameter and degrees of freedom are identical to those chosen for demand (0.6 and 3, respectively), meaning that a 90% probability is assigned to the supply elasticity in Portugal being between [0.17; 2.34] and in Spain between [0.29; 2.63].

Regarding the data used in this exercise, and given that the correct estimation of the model requires a relatively long time series, residential investment was used for quantities Δq_t^c, as it presents a longer time series than housing transactions in both the Portuguese and Spanish cases. For prices Δp_t^c, the (real) housing price index was used. Both variables are quarterly and enter the model in year-on-year variations. The time period included starts in the first quarter of 2000 and ends in the fourth quarter of 2023. The model includes 8 lags of the variables ($l = 8$).

It is important to clarify some points regarding the use of residential investment as a proxy for equilibrium quantities in each country's market. Residential investment is, in many studies, used directly as a representative variable of the market supply. However, in this exercise, the use of residential investment should be interpreted differently. In each period, supply and demand forces interact such that from this interaction arises the decision to increase or decrease residential investment, with the respective consequences on the equilibrium price. In other words, residential investment is seen in this exercise as a result of the market equilibrium, not as an independent supply force. Nevertheless, despite the data limitation that the number of transactions presents for both countries, a robustness analysis conducted in Appendix C shows that the historical decompositions, in the case of using transactions instead of residential investment, do not differ substantially from those presented in the next section 4.2.

4.2. Results

The identification of demand and supply shocks, through sign restrictions and prior distributions guiding the values of the elasticities, allows for an analysis of how each

17. The use of results obtained by Cavalleri *et al.* (2019) is due to the fact that this is a study that calculates long-term housing supply elasticities using an error correction model for OECD countries, with 0.84 for Portugal and 1.17 for Spain. The standard errors associated with these coefficients in that study indicate upper limits for the 95% confidence intervals of these estimates of 1.46 and 1.49, respectively.

18. Cavalleri *et al.* (2019) find a long-term housing supply elasticity using an error correction model for OECD countries, with values of 0.84 for Portugal and 1.17 for Spain. The standard errors associated with these coefficients in the study suggest upper limits for the 95% confidence intervals of 1.46 and 1.49, respectively.

of these market components has contributed to its equilibrium — an analysis entitled historical decomposition. In addition, the estimation of the model also allows for the estimation of impulse-response functions (IRFs), which answer a different question to that of the historical contribution of each shock. Impulse-response functions show how prices and quantities respond, on average, to demand and supply shocks.

Figure 11 shows IRFs for Portugal and Spain. This first analysis allows us to identify similarities between the two countries: the response of prices and quantities seems more pronounced to demand shocks than to supply shocks. It should be noted that the effects on both prices and quantities quickly become statistically insignificant following supply shocks, which is not the case with demand shocks, which seem to have long-lasting effects. Also noteworthy is the less pronounced percentage effect on prices than on quantities, in this case for both types of shocks.

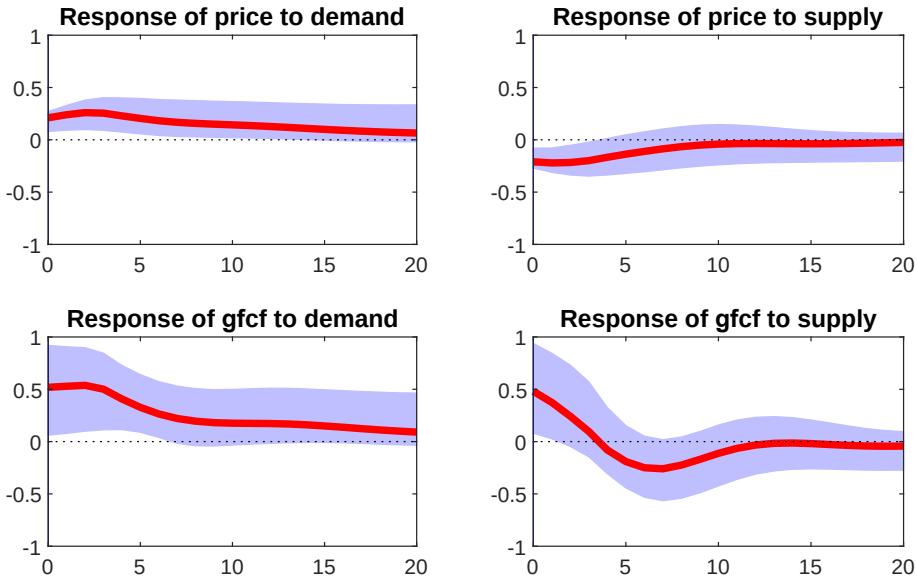
However, for a characterization of the evolution of prices and quantities, historical decompositions are a more informative exercise. Figure 12 shows the historical breakdowns of price growth and housing investment in each country, showing the respective contributions for price and quantity developments that can be attributed to either demand or supply shocks in each market. Several conclusions can be drawn from these graphs.

Between 2008 and 2013, the forces in both markets generally seem to have similar behaviours: demand markedly pulling residential investment growth to negative values, while supply oscillates between negative and positive contributions. Consequently, in both cases, the contribution of demand to price growth is clearly negative, while the contribution of supply oscillates between positive and negative values.

From 2014 until the beginning of the Covid-19 pandemic in 2020, residential investment in Portugal enters a period of continuous growth above the historical average growth. The decomposition indicates that this growth is mainly driven by demand forces. The contribution of supply oscillates between negative and positive values, being statistically insignificant for most of the period. Similarly, price growth is markedly driven by demand forces. Supply is unable to counterbalance this effect, also contributing, in some periods, albeit slightly, to price growth.

This narrative contrasts with the decompositions calculated for the Spanish market. After some fluctuations in the 2014-2015 period, residential investment growth also showed continuous growth above the historical average in the country. However, in this case, although most of the contribution comes from the demand side, the supply also continuously contributes positively to this growth. This explains that while demand is markedly pushing prices upwards, the supply is somewhat counterbalancing this pressure (unlike the Portuguese case). Note how, between 2016 and early 2020, price growth in Spain would have been more pronounced if only demand shocks influenced market equilibrium. This contrast led to a more pronounced price growth, compared to its historical average, in Portugal than in Spain during this period.

From early 2020 to the end of 2023, the model indicates that in the Portuguese case, there continues to be considerable pressure on prices from the demand side, without the supply being sufficiently effective to counterbalance this trend. There was a slowdown



(A) Portugal

(B) Spain

FIGURE 11: Impulse-response functions of prices and housing investment to a demand (left column) and a supply (right column) shock.

Note: The size of the simulated shock is one standard-deviation. In blue, credible intervals of 95%.
Source: Authors' calculations.

in residential investment during the Covid-related quarters, followed by a strong

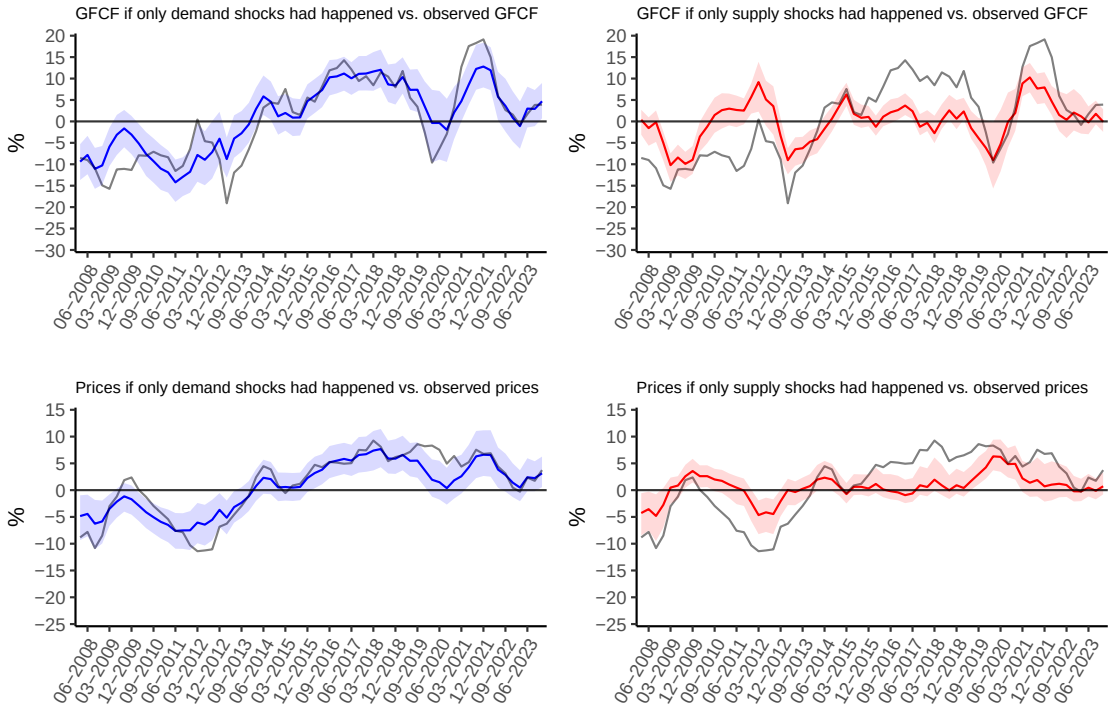
recovery (again, mostly driven by demand) in 2021. Since mid-2022, the restrictive monetary policy cycle initiated by the ECB led to a slowdown in both residential investment and prices, although by the end of 2023, the latter were already resuming an accelerating trajectory, once again driven by demand pressure. In Spain, on the other hand, since the pandemic, prices have grown below or in line with its historical average (i.e. around zero on the graphs). Initially, supply constraints put slight pressure on prices to accelerate, but weak demand counterbalanced this trend. In the most recent period, neither demand nor supply has been creating considerable pressure on prices.

Summing up, the historical decompositions indicate that, both in Portugal and Spain, house price growth has been driven mainly by demand forces. However, results highlight how supply has not been able to counterbalance such pressure in the Portuguese case. On the other hand, in Spain, especially in the pre-pandemic years, the positive effect of supply on GFCF had a negative impact on prices.

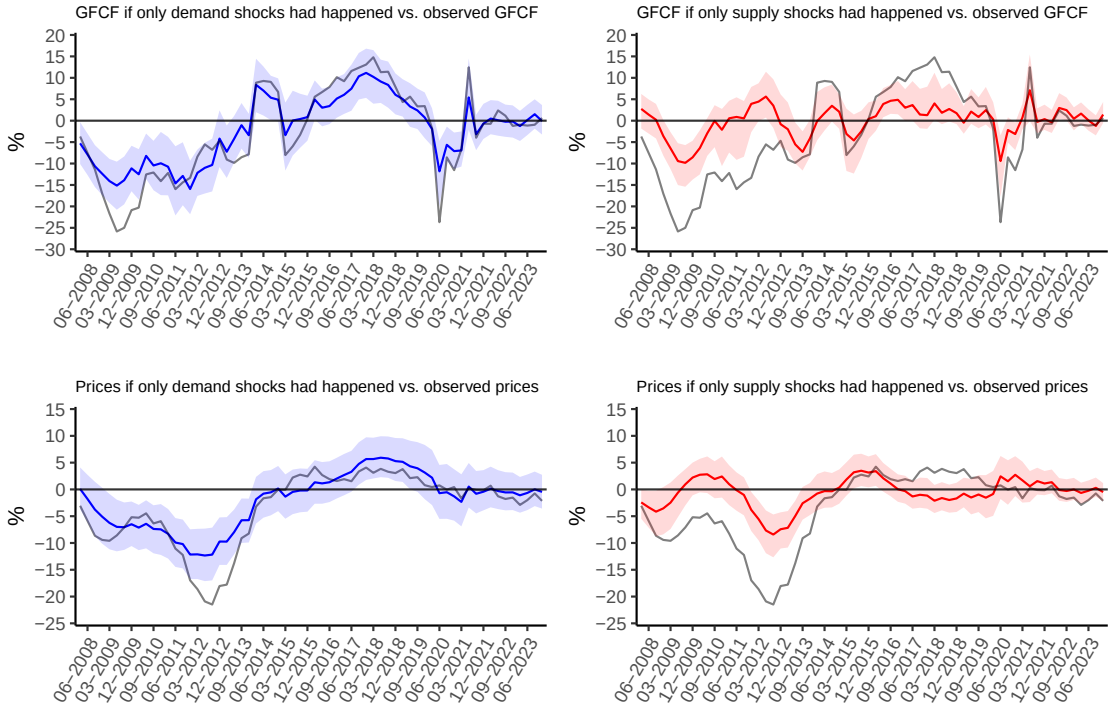
5. Conclusion

The Portuguese and Spanish economies have been marked by common macroeconomic dynamics between 2008 and 2023: the financial and sovereign debt crises in the euro area, followed by the pandemic crisis and, more recently, rising inflation. It was also observed that the relevant determinants for the housing market evolved similarly in both countries. Despite this, using the test by Phillips and Shi (2020), it was found that since 2017 there has been signs of overvaluation in prices in Portugal. A complementary analysis using quantile regressions allows us to conclude that housing prices are misaligned compared to what is predicted by macroeconomic determinants. In contrast, both approaches indicate that there is no overvaluation of prices in Spain.

Finally, the contribution of supply and demand forces to market equilibrium in each country was described and quantified. This analysis reveals that, in general, unlike in Spain, the growth of housing prices in Portugal is mainly driven by demand forces, with supply not fully counterbalancing this pressure. In this context, the type of analysis conducted in this article is considered an important prerequisite for designing effective public policies.



(A) Portugal



(B) Spain

FIGURE 12: Historical decompositions of the growth rate of residential GFCF and house prices.

Note: The grey lines represent the observed growth rates of GFCF and prices, subtracted from their historical averages, respectively. The blue and red lines represent the contribution of demand and supply shocks to each of the growth rates of the variables. The shaded areas represent the corresponding one standard deviation credible intervals.
Source: Authors' calculations.

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Appendix A: Description of Phillips and Shi (2020)

A.1. The Phillips, Shu and Yu test

The test procedure introduced by Phillips, Shi and Yu [PSY] (2015) is implemented in three steps:

1. test the null hypothesis that there are no mildly explosive periods in the sample against the alternative that there is at least one such period;
2. if the test rejects, then date-stamping the mildly explosive period(s) in the sample follows;
3. setting the results in the context of a rational asset pricing model and using fundamentals proxy variables to assess whether or not the detected periods of mild explosivity are consistent with departures from house price fundamentals.

A.2. Methodology of the PSY procedure

To implement the procedure we consider, as suggested by PSY, a starting fraction r_1 and an ending fraction r_2 of the total sample, with window size $r_w = r_2 - r_1$, and fit the augmented Dickey-Fuller (ADF) test regression,

$$\Delta y_t = \alpha_{r_1,r_2} + \varphi_{r_1,r_2} y_{t-1} + \sum_{i=1}^{p} \vartheta^i_{r_1,r_2} \Delta y_{t-i} + \varepsilon_t \tag{A.1}$$

where p is the lag order chosen on sub-samples using some information criteria (e.g. BIC or AIC) and $\varepsilon_t \sim i.i.d.(0, \sigma^2_{r_1,r_2})$. The number of observations used to run the regression is $T_w = [r_w T]$ and we denote the unit root t-statistics, i.e., the t-statistics that tests the null hypothesis $H_0 : \varphi = 0$, computed from (A.1) as $ADF^{r_2}_{r_1}$.

PSY (2015) introduce two statistics to detect overvaluation episodes, namely the backward $\sup ADF$ (BSADF) and the generalised $\sup ADF$ (GSADF), which are defined as,

$$BSADF_{r_2}(r_0) = \sup_{r_1 \in [0, r_2 - r_0]} \left\{ ADF^{r_2}_{r_1} \right\}$$

and

$$GSADF(r_0) = \sup_{r_2 \in [r_0, 1]} \{ BSADF_{r_2}(r_0) \}$$

where the endpoint of the sample is fixed at r_2 and the window size is allowed to expand from an initial fraction r_0 of the total sample r_2. PSY suggest that r_0 is chosen to minimise size distortions, according to the rule $r_0 = 0.01 + 1.8/\sqrt{T}$, where T is the sample size. This procedure defines a particular BSADF statistic and the GSADF statistic is computed through the repeated implementation of the BSADF test for $r_2 \in [r_0, 1]$. Critical values are obtained by simulation (in Table B.1 we provide the critical values used in our empirical application). Limit theory of the procedure and small sample performance have been provided by PSY.

The null hypothesis of no mildly explosive periods is based on the GSADF statistic and date-stamping of the periods is accomplished through the BSADF statistic: the start and end points of a bubble, $r_{1,s}$ and $r_{1,f}$ are estimated subject the minimum duration conditions,

$$\widehat{r}_{1,s} = \inf_{r_2 \in [r_0,1]} \left\{ r_2 : BSADF_{r_2}(r_0) > scv_{r_2}^{\beta_r} \right\}$$

and

$$\widehat{r}_{1,f} = \inf_{r_2 \in [\widehat{r}_{1,s} + \delta \log(T)/T,1]} \left\{ r_2 : BSADF_{r_2}(r_0) > scv_{r_2}^{\beta_r} \right\}$$

where $scv_{r_2}^{\beta_r}$ is the 100(1-β_T)% right-sided critical value of the BSADF statistic based on $[r_2 T]$ observations and δ is a tuning parameter that can be chosen based on the sampling frequency. A tuning parameter of 1 implies a minimum duration condition of $\log(T)$ observations. A mildly explosive period is declared if and when the BSADF test has been above its critical value for at least [$\widehat{r}_{1,s}T$]+[$\log(T)$] observations. Conditional on a first mildly explosive period having been found and estimated to have terminated at $\widehat{r}_{1,f}$ the procedure is then repeated in search of a second and possibly more such periods. PSY show that subject to rate conditions, the sequential procedure provides consistent estimates of the origination and termination dates of one or more bubbles (see also Homm and Breitung, 2012).

The final element of the PSY procedure assesses whether the mildly explosive periods detected are bubbles.

A.3. Philips and Shi test

Phillips and Shi (2020) propose a bootstrap procedure that combines the procedures of Harvey et al. (2016) and Shi et al. (2018). It is designed to mitigate the potential influence of unconditional heteroskedasticity and to address the multiplicity issue in recursive testing. Let $\tau_0 = \lfloor T r_0 \rfloor$ and τ_b be the number of observations in the window over which size is to be controlled.

Step 1: Using the full sample period, estimate the regression model (2) under the imposition of the null hypothesis $H_0 : \rho = 0$ and obtain the estimated residual, say e_t.

Step 2: For a sample size $\tau_0 + \tau_b - 1$, generate a bootstrap sample given by,

$$\Delta y_t^b = \sum_{j=1}^{p} \hat{\varphi}_j \Delta y_{t-j}^b + e_t^b \tag{A.2}$$

with initial values $y_i^b = y_i$ with $i = 1, ..., j+1$, and where the $\hat{\varphi}_j$ are the OLS estimates obtained in the fitted regression from Step 1. The residuals $e_t^b = w_t e_l$ where w_t is randomly drawn from the standard normal distribution and e_l is randomly drawn with replacement from the estimated residuals e_t.

Step 3: Using the bootstrapped series, compute the PSY test statistic sequence $PSY_t{}^{b}{}_{t=\tau_0}^{\tau_0+\tau_b-1}$ and the maximum value of this test statistic sequence,

$$\mathcal{M}_t^b = \max_{t \in [\tau_0, \tau_0+\tau_b-1]} (PSY_t^b) \tag{A.3}$$

where $t \in [\tau_0, \tau_0 + \tau_b - 1]$.

Step 4: Repeat Steps 2-3 B times.

Step 5: The critical value of the PSY procedure is now given by the 95% percentiles of the $\mathcal{M}_t^b$ sequence.

Step 2 implements a Wild bootstrap to address heteroskedasticity; and Steps 3-5 replicate the PSY recursive test sequence and create critical values that account for multiplicity in the test sequence recursion.

Appendix B: Testing for Quantile Cointegration

Following Xiao (2009), considering $\psi_\tau(u) = \tau - I(u < 0)$ and the quantile regression residual

$$\varepsilon_{t\tau} = y_t - Q_{y_t}(\tau|\mathcal{F}_{t-1}) = y_t - \Theta(\tau)'Z_t = \varepsilon_t - F_\varepsilon^{-1}(\tau),$$

it follows that $Q_{\varepsilon_{t\tau}}(\tau) = 0$, where $Q_{\varepsilon_{t\tau}}(\tau)$ is the $\tau - th$ quantile of $\varepsilon_{t\tau}$ and $E\psi_\tau(\varepsilon_{t\tau}) = 0$.

Hence, the cointegration relationship may be tested by directly looking at the fluctuation in the residual process $\varepsilon_{t\tau}$ from the quantile cointegration regression. In the case of cointegration the residual process should be stable and the fluctuations in the residuals should reflect only equilibrium errors. Otherwise, the fluctuations in the residuals can be expected to be of a larger order of magnitude. Thus, cointegration can be tested based on $\varepsilon_{t\tau}$. If the following partial sum process is considered,

$$Y_T(r) = \frac{1}{\omega_\psi^* \sqrt{T}} \sum_{j=1}^{[rT]} \psi_\tau(\varepsilon_{j\tau})$$

where ω_ψ^{*2} is the long-run variance of $\psi_\tau(\varepsilon_{j\tau})$, under appropriate assumptions, the partial sum process follows an invariance principle and converges weakly to a standard Brownian motion $W(r)$. Choosing a continuous functional $h(.)$ that measures the fluctuation of $Y_T(r)$ (notice that $\psi_\tau(\varepsilon_{j\tau})$ is indicator based), a robust test for cointegration can be constructed based on $h(Y_T(r))$. By the continuous mapping theorem under regularity conditions and the null of cointegration,

$$h(Y_T(r)) \Rightarrow h(W(r)),$$

see Xiao (2009) for details.

In this context the classical Kolmogorov-Smirnoff and the Cramer-von Mises type measures are of particular interest. Under the alternative of no cointegration these statistics diverge to ∞. In Table A.1, we report results for the application of this approach using the Kolmogorov-Smirnoff metric, thus the test is $\sup |Y_T(r)|$.

Appendix C: Historical decomposition of demand and supply shocks with number of transactions

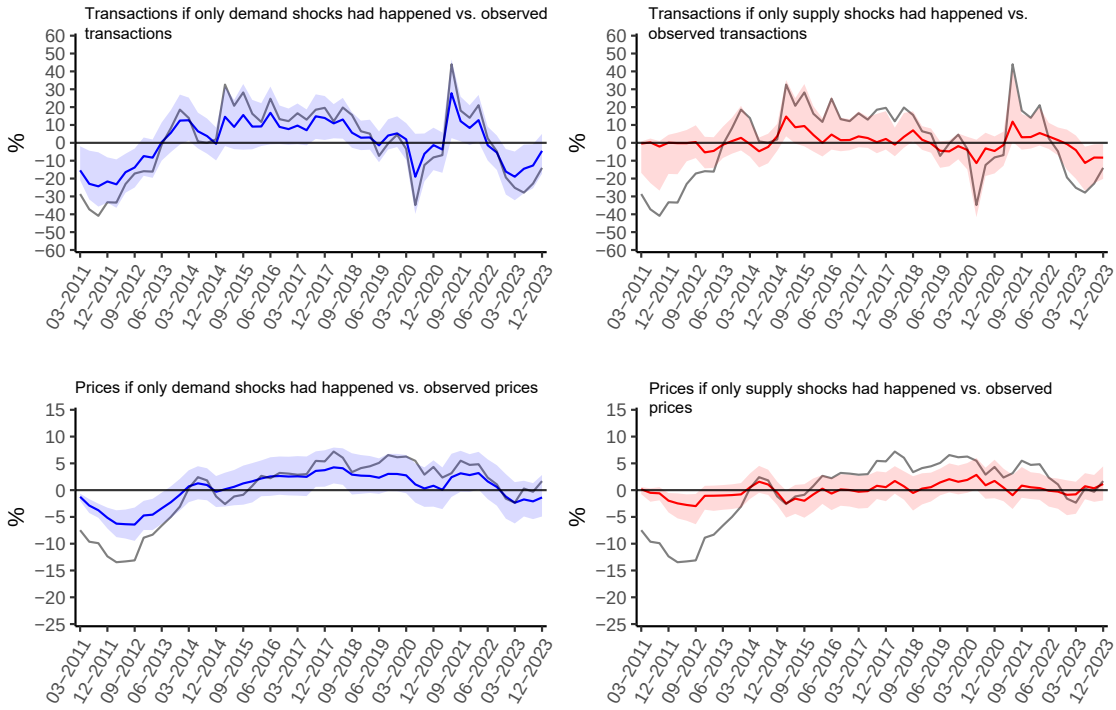
This section presents a robustness analysis in which, in the structural BVAR model presented in section 4, GFCF is replaced by the number of housing transactions.

As previously mentioned, the number of transactions would be the most appropriate variable to use as a *proxy* for the equilibrium quantities transacted on the market. In practice, however, for both countries, the number of transactions is a series that covers a short period of time, which makes the model's estimation less robust. For example, for the same number of *burn-ins* used in the model in section 4, Geweke's diagnosis fails in the Portuguese case when using the number of transactions, which means that the algorithm that simulates the *a posteriori* distribution of elasticities did not converge to the objective within the *burn-in* period.

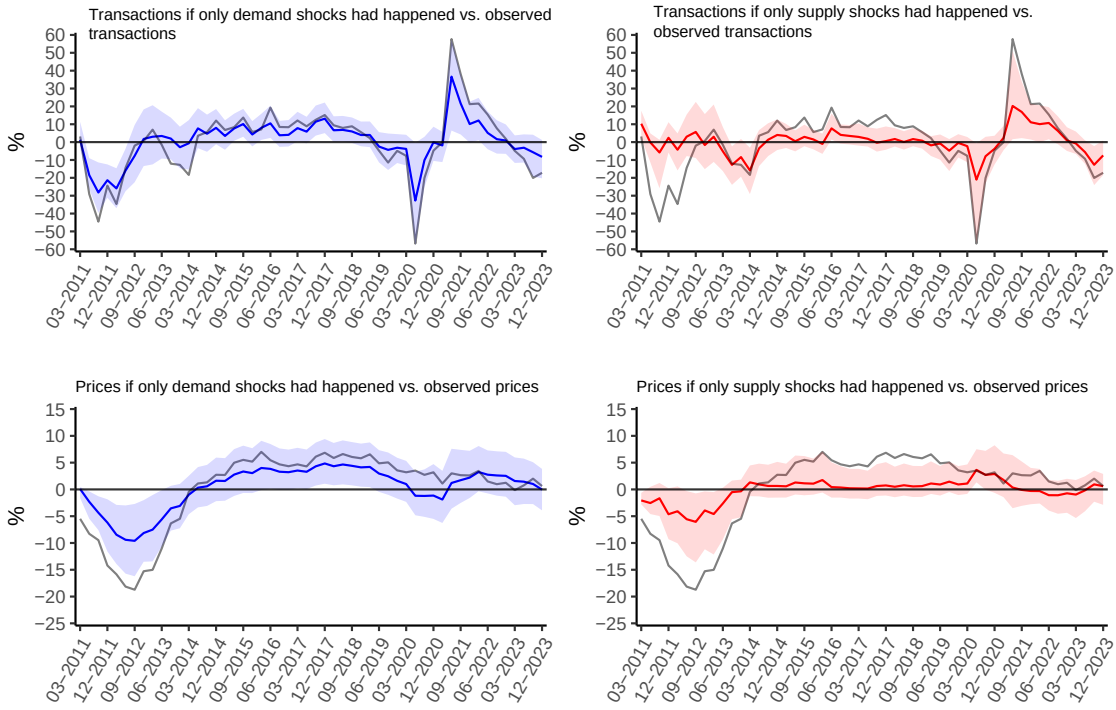
Even so, and just as a robustness exercise, Figure C.1 shows the historical breakdowns between demand and supply contributions to the Portuguese and Spanish market equilibrium, using the number of transactions and the price index. The model uses quarterly data from the first quarter of 2009 until the end of 2023.[19]

The main conclusions remain unchanged. Prices in both countries between 2014 and the beginning of 2020 were markedly pressured by demand, with supply not being effective in counterbalancing this pressure. In the most recent period, after a substantial drop in transactions driven by falling demand following the ECB interest rate hikes, Portugal is already showing a recovery in transactions, again driven by a recovery in demand, while transactions in the Spanish market continue to slow down, with demand still contracting.

19. Unlike the model presented in section 4, in this case we used 4 quarters of lags for the endogenous variables, instead of 8 quarters, in order to avoid losing an additional year in the model's estimation.



(A) Portugal



(B) Spain

FIGURE C.1: Historical decompositions of the growth rate in the number of transactions and house prices.

Notes: The gray lines represent the growth rates of transactions and prices, subtracted from their historical averages, respectively. The blue and red lines represent the contribution of demand and supply shocks to each of the variables' growths. The shaded areas represent the respective credible intervals of one standard deviation.
Source: Authors' calculations.

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