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The Influence of Fiscal Hedging and Refinancing Risk Management on Public Debt Maturity in the Euro Area

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1. Introduction

According to De Graeve and Mazzolini (2023), between 25 and 75% of maturity variation is not dependent on debt level and shocks, meaning countries often reshuffle the maturity composition of their debt, and an important reason for this reshuffling is cost minimization. A specific maturity can become attractive compared to either its historical rate or to the rate associated with other maturities. This factor rationalizes between 56 and 87% of maturity fluctuation in debt reshuffling.[1] Our research explores two possible explanations for the remaining variation in maturity that are not addressed in their paper: fiscal hedging and refinancing risk considerations.

The main contribution of the aforementioned authors' article was the construction of a database of sovereign debt for 20 OECD countries. For both daily and quarterly intervals, the authors compiled the nominal and market value of outstanding debt (ordered in maturity brackets), the yield curves associated with the government bonds, and other statistics related to debt such as rollover or buyback shares. We aim to exploit this database in order to understand the determinants of the observed general increase in debt maturity in the Euro Area in the last decades. We preface our empirical section by a theoretical contextualization looking at fiscal hedging and risk management in the context of public debt. Given that various empirical and theoretical studies associate fiscal hedging properties with long-term debt, we conduct a statistical analysis of the hedging potential of Euro Area countries' debt structures to determine whether this could be a factor shaping the upward trend of debt maturity. Additionally, we examine the communication strategies regarding debt management in Euro Area countries and contrast it with the observed evolution of their debt structure. While the core of our work will relate to fiscal hedging, this notably allows us to study the potential impact of refinancing risk in shaping the maturity structure of sovereign debt, as it is another potential issue where issuances of longer-term debt have traditionally been used as a solution.

Our work is limited by the fact that the De Graeve database contains only the 10 biggest economies (sorted by GNI) out of the 20 Euro Area members, and those are essentially restricted to Western Europe; they will henceforth be designated as the EURO10 countries. The missing pieces are the Baltics, the Balkans, as well as the smaller member states (Cyprus, Malta, and Luxembourg). The period studied will be confined to Q1 2002 – Q4 2020; the lower bound corresponds to the earliest complete government spending data that was available to extract from Eurostat, and 2020 is the end of the database coverage.

[1] The percentage variations mentioned in this paragraph represent different assumptions that lead to five different sets of SVAR restrictions, and thus five different identifications.

2. Risk management theory

a. Introduction to cost minimization and yield curvature

Despite not being in the limelight of our work, we will offer a short introduction to cost minimization principles because of their importance in shaping the maturity profile of public debt.

A country's public debt issuances are characterized by different yields depending in significant part on the maturity of the bond. In usual cases, the yield curve is upward sloping, meaning that an increase in the maturity of the debt is accompanied by an increase in the yield of the bond. There are of course exceptions to this general tendency; in fact, the "inverted" yield curve is commonly thought of as a premonition of recession, where yield only decreases with maturity.[2] As of November 2024, no country in the Euro Area has a completely inverted yield curve.[3] Nevertheless, many of those countries present elements of inversion. This is notably the case for yields for maturities up to 2-3 years, which seemingly follow forecasts of progressively descending interest rates of the ECB's main refinancing operations (MRO) until 2026.[4]

The yield curve is a result of secondary market exchanges of the government's outstanding debt (Jonasson & Papaioannou, 2018). The upward-sloping yield curve derives at least in part from the risk premia generally associated with longer maturities.[5] Therefore, while we will see how long-term debt can provide "hedging" (insurance) properties to the states emitting it, it can represent a risk for investors on the other side of the bargain. Simply put, a government pursues cost minimization if it prioritizes the issuance of bonds with low risk premia, but this implies a "trade-off" between two types of minimization: expected cost and risk (Missale, 1999). This is due to the risk-averse orientation of the aggregate sum of investors' decisions.

As such, cost minimization and risk management are classically perceived as the two main components of debt management. For this reason, most developed countries' proclaimed debt management goal is some combination of cost minimization and an

[2] However, this generalization can be nuanced, as both modelling and stylized facts tend to show that it may not be verified when the monetary policy is more focused on closing the output gap than the inflation gap; in practice, a lower interest rate spread between long and short-term yields, even with perfect inversion, is an indicator that the inversion should not be thought to automatically imply an incoming recession (Davis & Michl, 2024).

[3] Among European countries, only Iceland and Norway currently have a perfectly inverted yield curve.

[4] The MRO rate is projected to drop 150 basis points from the end of 2024 until 2026. See: European Central Bank (2024), « The ECB survey of professional forecasters. Third quarter of 2024 ».

[5] Another important element being the forecast inflation rate.

acceptable level of risk (Storkey, 2001). The next section will give a brief overview of the classifications that can be used for risk types in this context.

b. Classifications of risk

Classifications of risk, both in the literature and in public communications by government agencies, often do not offer the clearest distinctions. As economic phenomena are usually very multifaceted, significant overlaps between types of risk appear; we nevertheless attempt a synthetic summary of the common elements in those classifications.[6]

The first type of risk to usually be mentioned is market risk, which "relates to changes in market prices such as interest and exchange rates" (Danmarks Nationalbank). Of its two main components, exchange rate risks aren't a major preoccupation for Euro Area countries, given that none of them currently emit foreign denominated debt (Eurostat, 2023). This greatly simplifies our study, as a significant layer of complexity emerges for debt management with foreign currency. Interest rate risks, on the other hand, represent one of the main challenges for debt managers in the Euro Area. As we will see in a subsequent section, interest rate risk may change with debt maturity, and therefore influence the practices of policy makers in this regard.

Refinancing risk, which will be one of the focal points of this paper, refers to the possibility that part of the debt that arrives at maturity cannot be rolled over, or only at an unusually high price. Rollovers for governments are an integral part of debt management, and are even more ubiquitous than in the private sector.[7] In general, a debt with a shorter maturity structure and rollover peaks concentrated in defined time intervals is considered to be the most vulnerable to this type of risk.[8] On the other hand, with longer-term debt, less refinancing would need to be operated during transitory periods with abnormally elevated borrowing interest rates.

For this reason, average time to maturity (ATM) is often used in refinancing risk assessment studies. It is however only one rough estimator of a country's exposure, as it does not tell anything about the smoothness of the repayments' due dates' distribution, or signs of liquidity and "appetite" shortages on the markets, which should also be watched for as potential magnifiers of refinancing risk, especially when the maturity profile is uneven (Jonasson & Papaioannou, 2018). ATM is nevertheless frequently mentioned in

[6] Deboutte & Debergh (2006) is one of the starting points for this classification along with Jonasson & Papaioannou (2018), but other monographs and presentations by debt agencies cited in our sources also contributed to it.

[7] States differ from private companies in that the latter's ratings suffer much more when the value of the firm does not follow a sufficiently optimistic growth path from the point of view of the investors, and therefore warrant additional consideration (Forte & Peña, 2011).

[8] Naturally, national indicators that decrease the confidence of the creditors, such as a poor public credit rating and volatile economic activity, serve as aggravating factors (Jonasson & Papaioannou, 2018).

the communication of debt management agencies (as we will see in a subsequent chapter) and could seemingly be important enough to influence the maturity of debt issuance.

Another aspect of refinancing risk is the potential variation in the market value of outstanding debt. In an environment with rapidly falling interest rates, a heavily indebted government may be vulnerable to having this value rise to levels which would make potential investors concerned, in turn increasing the rates on its new issuances of debt even more.

Liquidity risk refers to the danger that “the government cannot meet its financial obligations, for example as a result of a lack of access to capital markets”, and is often hard to isolate from other types of risk (Jonasson & Papaioannou, 2018), as it can frequently by definition be a particular subtype of refinancing risk. Nevertheless, it can also originate from an abrupt increase in government spending, which would therefore not qualify as “refinancing”. Addressing this risk is achieved by keeping liquid cash reserves and developing lasting outreach programs to diverse groups of potential creditors (Danmarks Nationalbank).

Finally, contingent risk relates to contingent liabilities, which may become real liabilities for the government in specific circumstances. These liabilities can be either explicit or implicit in their contingency, meaning they can either be contractually stipulated (which is frequently the case for obligations towards state-owned enterprises facing default or insolvency), or imply some form of significant cost for the government if it chooses not to make the payments, an example of which could be the incentive to bail out important financial institutions. Despite their informal nature, implicit liabilities often represent the biggest risk for a government’s finances. Broadly speaking, contingent risk can be considered as a category of fiscal risk, as the latter is sometimes defined to include foreseen liabilities whose future materialization is certain, albeit frequently with uncertainty margins around the amount associated with them (Jonasson & Papaioannou, 2018).

Among other risks that can be cited is the credit risk, which relates to the government’s debtors honoring their financial obligations towards the government. The legal and operational risks describe in turn the uncertainties arising from potential legal obstacles to the expected trajectory of asset and cash transfers, and from purely practical difficulties that can arise in financial transfers (such as errors or security breaches). We will not study the direct impact of credit risk on the maturity of government debt, nor that of the legal risk. We could perhaps simply consider them, in our framework, as stochastic sources of liabilities.

3. Fiscal hedging theory

a. Fiscal hedging motivations

An optimal portfolio hedges fluctuations in interest rates, primary surpluses, liquidities and inequalities. (Aparisi de Lannoy et al., 2022)

One of the major roles of debt management is to better prepare the state for stochastic shocks affecting its income and spending flows. In addition to maximizing the expected value of net revenues, businesses and governments use fiscal hedging (or "fiscal risk management") in order to avoid registering exceptionally high deficits during financially challenging times. Hedging can help firms reduce overall borrowing costs and capabilities (Alexandridis et al., 2021), or even significantly reduce bankruptcy risk (Spanò, 2004).

Governments face slightly different challenges. As government revenue is in large part derived from various forms of taxation,[9] a thorough management of the public debt should allow for a more stable taxation regime. In the absence of explicit hedging instruments, changes in government revenues, expenses, or in the value of its outstanding debt implies the necessity to resort to increased taxation in the future. The postponing of debt repayment is therefore not a permanent solution to this issue, but it can have effects delayed by decades.[10]

The government has a few options when it comes to taxation: an increase in public debt may be addressed either directly through an increase in distortionary taxes (in practice, it is the main channel of government income), or indirectly by sponsoring inflationary policies that will devalue the government's outstanding debt. Nevertheless, both of these approaches carry potentially undesired economic consequences. We will address inflation in a later section; as for variations in tax distortions, they are thought (at least in a neoclassical framework) to hinder the formation of smooth intertemporal production and consumption profiles, which reduces overall utility (Bohn, 1990 and Missale, 2002).

While choosing the appropriate form of taxation is the main action the policymaker can undertake *ex post* to a shock to public spending deficit, it is also possible to construct in advance a debt profile that can serve as a hedging tool against fiscal shocks, as will be demonstrated in the next chapters.

[9] Today, taxation represents almost 90% of total government revenues in the EU. See: « Tax revenue statistics », *Eurostat*, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Tax_revenue_statistics .

[10] For instance, looking at Canadian data, Lloyd-Ellis & Zhu (2001) find that the increase in sovereign debt/GDP ratio at the turn of the century is likely due to a slow adjustment to negative shocks to public deficit in the 1970s and 1980s.

b. *Hedging with state-contingent and non-state-contingent debt*

To illustrate what "fiscal hedging" means in sovereign debt management, we first examine the foundational principles of state-contingent bonds: securities whose returns co-vary negatively with the government's net expenditures, which are assumed to be higher during financially challenging periods. Intuitively, the most basic way to hedge against shocks that increase fiscal spending (or decrease revenues) would be to issue bonds whose returns depend directly on the future fiscal performance of the state (Angeletos, 2002).

However, state-contingent bonds have only been issued on very rare occasions in the history of public fiscal management. They have sometimes been linked to the annual extraction of a resource that plays an important role in government revenues, such as oil or a specific metal; Mexico and Grenada have also experimented with "catastrophe" bonds, whose repayment may be delayed in case of a specified natural disaster occurrence. Nevertheless, most state-contingent debt issuances have simply relied on (real) GDP or GDP growth as an indicator of state performance, both of which have been susceptible to statistical manipulation. The recurrent difficulty in establishing unambiguous contractual terms for these bonds makes them mostly unappealing for lenders; therefore, even when they are issued, it is generally in relatively small quantities due to a stark lack of demand (Barro, 1998 & Pina, 2022).

One of the few alternatives to securities directly linked to state performance are simple long-term bonds, as their market value generally covaries negatively with budget deficits and therefore implies fiscal hedging potential. Periods with particularly high public deficits are often linked to higher interest rates for public borrowing (Angeletos, 2002); while this does not affect the book value of outstanding debt, the evolution of its market value is crucial in determining the creditworthiness of a government. The simplified intertemporal budget constraint for a creditworthy government is (adapted from Equiza-Goñi et al., 2023):

$$Market\ value\ of\ debt = Present\ discounted\ value\ of\ fiscal\ surpluses$$

Mathematically, the condition can be expressed as:

$$\sum_{j\geq 1}^{N} q_t^{j-1} \frac{B_{t-1}^{j}}{\pi_t} = E_t \sum_{k=0}^{\infty} \frac{S_{t+k}}{r_{t,t+k}} \qquad (3.1)$$

where the left-hand side represents the current (t) price (q) of each of the N emitted zero coupon bonds (B) of maturities j = 0,1,…,N , adjusted for inflation (π_t) between now and the previous period, and the right-hand side is the current expected (E_t) sum of future surpluses (S) in all (k) periods ahead, adjusted by their respective stochastic discount factor (r) for each period ahead. The negative covariance between market value and spending that fiscal hedging aspires to exploit results from variations in q_t, which may differ depending on the maturity j of the bond.[11]

More formally, bond returns (for maturity j) between t − 1 and t in this context can be defined as:

$$R^{j}_{t-1,t} = \frac{q_t^{j-1}}{\pi_t q^{j}_{t-1}} \qquad (3.2)$$

where π is inflation, q is the market price of a bond, and j is the maturity of the bond. With this expression, the (3.1) budget constraint can be rewritten as:

$$\sum_{j\geq 1}^{N} R^{j}_{t-1,t} w^{j}_{t-1} = \frac{E_t \sum_{k=0}^{\infty} \frac{S_{t+k}}{r_{t,t+k}}}{\sum_{j\geq 1}^{N} q^{j}_{t-1} B^{j}_{t-1}} \qquad (3.3)$$

where w^{j}_{t-1} is the share of j-maturity bonds with respect to the entire debt portfolio, and $\sum_{j\geq 1}^{N} q^{j}_{t-1} B^{j}_{t-1}$ is the total current market value of bonds emitted in the previous period. Therefore, a negative covariance of returns with government deficit shocks ($\epsilon_{t,G}$) would imply fiscal hedging properties of j-maturity bonds by compensating for an expected decrease in future surpluses:

$$cov_t(R^{j}_{t-1,t}\, ,\, \epsilon_{t,G}) < 0 \qquad (3.4)$$

In the case of innovations to the public deficit without matching positive innovations to the public revenue expectations, reducing the market value of outstanding debt can help governments achieve better borrowing opportunities by reassuring creditors with regards to the sustainability of their borrowing position.

Long-term debt is a potential tool to achieve this based on the premise that interest rates increase contemporaneously with positive budget deficit shocks, and thus that the market prices of outstanding long-term bonds (which will have lower nominal returns than newly emitted bonds of equal remaining maturity) should decrease as a result (Angeletos, 2002). It is therefore the sensitivity of long-term bond valuation to variations in the real discount rate that makes them prone to being utilized for hedging purposes (Barro, 1998). Following this line of reasoning, shorter-term debt, which needs regular rollovers and whose prices necessarily react much less to changes in interest rates, does not allow such a reduction in the market value. This theoretical development has been supported by empirical analysis: for instance, with the help of a VAR and looking specifically at shocks

[11] The government budget expressed in (3.1) has been studied empirically by Cochrane (2020), in order to better understand the innovations in government debt valuation from the equation's right-hand side perspective. By analysing time series of the post-war US public finances through a VAR model, he finds that an estimated 55% of the variation of the (market value) debt-to-GDP ratio corresponds to forecasts of future primary surpluses, while the remaining half is explained by discount rate (expected real returns) variation.

in defense spending, Berndt et al. (2010) found that the absorbed fiscal risk goes from 8% for 1-year bonds to 18% for 20-year bonds in a sample from 1946 to 2008 of US fiscal and macroeconomic data.

On the side of theoretical modeling, multiple articles have expressed their support for long-term debt use in fiscal hedging. Lustig et al. (2008), with a model that restricts debt issuances to being nominal and non-contingent (on paper) on state performance, arrive at the conclusion that the longest possible maturity[12] should be preferred in most cases; it provides hedging properties ten times stronger than those of the shortest maturity. In fact, it appears that virtually the only mechanism through which the shortest-term bonds were providing hedging benefits was through contemporaneous shocks to inflation ("inflation surprises"), while the longest-term bonds could hedge by the variation of bond prices. Their model treats inflation and yields as endogenous variables, and derives that long-term yields are more volatile than short-term ones: this is exactly what allows for better hedging properties to emerge on long-term bonds. The authors also argue that the rationale according to which long-term debt should be avoided for cost minimization purposes misses the point, as the higher price on this debt is analogous to a direct premium paid on insurance and is therefore part of the deal when the state decides to opt for fiscal hedging.

More recently, Equiza-Goñi et al. (2023) have proposed a model that specifically examines the optimal hedging portfolio in a monetary union, therefore offering a different outlook than articles basing their framework on the US economy. They found that indexed long-term debt appears to be the best tool in a framework similar to the Euro Area. The reasoning behind the need for inflation indexing is based on the fact that real returns on bonds, and not nominal ones, can differ between member states, and the logic for the use of long-term bonds is akin to what has been described previously. This conclusion echoes the analysis of Barro (1998), whose simple model already suggested that a high share of indexed perpetuities is the best tool for tax smoothing. However, indexed securities (let alone indexed perpetuities) are rarely supplied by European governments. In EURO10 countries, the De Graeve paper informs us that France and Italy have the highest average indexed debt holdings for the 1995-2020 sample, with respectively 7.80% and 5.32% of their outstanding debt; the share is lower than 2% for Germany and Spain and is zero for the remaining 6 countries. The database doesn't provide detailed accounts of indexed debt issuances and holdings, only sample averages by country; we will therefore not be able to study its hedging effects in isolation despite the intriguing nature of the theoretical developments around it, yet this broad context will prove interesting to keep in mind for the SVAR analysis.

[12] The model is infinite horizon, but the maximum maturity of government bonds was fixed at 7 periods.

c. *Is fiscal hedging welfare improving?*

Fiscal hedging has the potential to have an overall positive effect on utility for agents in the economy if its benefits[13] outweigh its costs. This question has been studied through various models of welfare and utility. In extreme cases, such as for countries running a significant risk of being heavily affected by natural disasters, fiscal hedging may greatly increase the amount of available external borrowing, and therefore substantially increase immediate welfare (Lopez-Martin et al., 2017).[14] This section examines whether this holds under different circumstances and fiscal risk profiles.

A model proposed by Lloyd-Ellis & Zhu (2001) suggests that even under fairly conservative assumptions,[15] fiscal hedging increases welfare. In their paradigm, this is achieved for two main reasons: overall less high-tax regimes that would lead to harmful distortions, and more specifically a reduced frequency of occurrences of increased taxation taking place in economic conditions where they would be most harmful for economic activity; the authors call this second channel of welfare improvement "*diversification*".

The Lustig et al. (2008) model that we referenced earlier derives a small but positive increase in welfare with the usage of long-term debt, which increases in the initial total value of debt (akin to the debt/GDP ratio for countries); for practical purposes, the welfare benefit this model shows is nevertheless all but negligible, as it is equivalent at most to an increase by 0.12% of the consumption allocation. Higher maturity is also shown to be associated with higher, persistent, and volatile inflation, but the consequences of this are integrated in the model; we will come back to the problematic of inflation in a subsequent section with real-world data, as purely theoretical models may simplify its wide-ranging effects.

Lopez-Martin et al. (2017) point out that the small (or negligible) increase in utility for the representative household that hedging seems to bring in models (such as that of Lustig et al. mentioned above) is in fact likely underestimated. This is because a single homogenous representative household cannot represent the idiosyncratic shocks suffered by individuals due to fluctuations in the business cycle, as the welfare damage to many of them can be ignored without agent differentiation; for this reason, the authors suggest that the utility improvement numbers brought by those models should not be regarded in absolute terms. Their own model suggests that in a range of different scenarios (with various measures of welfare, indexed bonds, etc.) hedging is welfare improving. Their analysis showcases some of the other difficulties associated with models of debt management, namely the fact that it could be necessary to take into account the cost

[13] Mostly avoiding hikes to distortionary taxes and, in some forms of hedging, also avoiding hikes to inflation.
[14] This is conditional on the presence of a discount factor.
[15] Notably the absence of endogenous growth, so that tax changes do not carry a permanent effect on growth in the model.

associated with setting up a new bond market when implementing the decision of switching the type of sovereign bond issuances; this element alone could tip the welfare tradeoff balance between different types of debt products.

d. Long-term debt and inflation expectations

The issuance of longer-term debt may come with drawbacks. For instance, Missale (2002) points out a significant potential problem with long-term bonds: the rise in inflationary expectations. Economists have noticed for at least half a century that expectations about inflation have various important effects on the real economy, from impacting the actual short-term inflation to affecting the transmission efficiency of the central monetary policy (Adrian, 2023). In the case of government debt, a longer maturity allows even a low but persistent unexpected inflation increase to reduce the real value of outstanding debt substantially more than would be the case with only short-term debt that requires constant roll-overs.

There exists an academic debate around the use of inflation to operate this type of indirect taxation. The "conventional wisdom" on the subject (as it is characterized by Leeper & Zhou, 2021) is that marginal taxation in response to fiscal shocks should only come from taxation spread through time (and not its alternatives, namely surprise changes in inflation or bond prices). Among the proponents of this approach are Schmitt-Grohé & Uríbe (2004), who argue that any level of price stickiness (even much lower than actually observed) implies too big of a cost in aggregate social welfare due to market distortions to justify the benefits of inflating away government obligations.[16] They additionally suggest that this may be a "metaphor" for the real reasons that make inflation control the first priority of monetary policy for most countries.

Nevertheless, in their literature review, Leeper & Zhou (2021) expose the practical importance of inflation innovations in marginal deficit financing. For the US, it appears that up to 25% of government spending shocks have historically been financed in this way, depending on the specific period studied. The tendency to resort to this tool has been observed well into the 21st century, albeit on a reduced scale compared to the first few post Second World War decades of American debt management. The particularity of this line of action lies in that it heavily depends on the expectations of financial actors in the economy regarding the state's commitment to its inflation targeting policy. If its monetary policy is perceived as unreliable, actors will anticipate a higher probability for the implementation of inflationary measures and demand higher yields for new bond issuances; yet only surprises to inflation lead to a decrease in the market value of the

[16] Citing other theoretical explorations of this problematic, Schmitt-Grohé & Uríbe also propose that the utility of state-contingent debt (in real terms) is not that high to begin with, which plays a role in it being heavily outweighed by its costs to welfare through the distortionary effect of inflation on markets.

sovereign debt. As such, states need to give the impression that their inflation targeting is credible in order to emit longer-term nominal debt and use its hedging properties.

For this reason, governments that do not boast a great reputation for their monetary policy credibility (or do not have a stringent inflation targeting framework) may cause an immediate and undesired increase in expected inflation by shifting towards the issuance of longer-term debt, while also being unable to fully harness its hedging benefits. This is therefore an important potential limitation of the hedging properties of long-term debt.

The inflationary effect provoked by an increase in the issuance of long-term bonds should theoretically be more pronounced the higher the public debt-to-GDP ratio is, as it would further increase the incentives for the government to reduce the debt through inflation despite its negative economic effects.

This problematic has also been studied empirically. From a sample of 41 countries between 2000 and 2020, Brandao-Marques et al. (2023) find that while emerging economies (and especially those with a relatively high debt/GDP ratio) do increase inflation expectations with "debt surprises", this has not been the case for developed countries with inflation targeting frameworks like the one in the Euro Area.[17] This is only a partial answer to our question, as the authors do not separate debt surprises by their maturity, but it does suggest that a credible monetary policy plays an important role in keeping inflation expectations low regardless of debt management policies.

The question of debt maturity and inflation expectations has also been investigated by theoretical research. Corhay et al. (2021) construct a Neo-Keynesian model which leads them to conclude that maturity reshufflings can affect macroeconomic variables in vastly different ways depending on whether the state champions a "monetary regime" focused on firmly controlling inflation and debt, or a so called "fiscal regime" in which central responses to inflation variations and deficit increases are weak.[18] Indeed, their model supports the fact that in the case of a classical monetary regime, changes in government portfolio risk by way of maturity operations do not lead to inflationary pressures, and are rather "absorbed" by increases in the expectations for real future surpluses. This analysis again corroborates the idea that a credible monetary policy is a necessary prerequisite for countries desiring to make use of debt maturity for hedging purposes.

e. Long-term debt opportunity cost: short-term debt

The drawbacks of long-term debt issuance are also related to its opportunity cost, as short-term debt carries its own particular benefits. For instance, as demonstrated with the help

[17] However, the authors specifically point out that a VAR would theoretically be better suited for their analysis, but they were unable to conduct it; therefore, despite introducing several controls in their regressions, the authors admit the presence of some limitations to their study.
[18] On a more practical note, the authors suggest that for the United States, we could claim that a transition from the "monetary regime" to the "fiscal regime" happened in 2008-2009.

of SVARs and local projections by Mankart et al. (2024), short-term debt boasts a significantly larger fiscal multiplier than long-term debt, and may therefore be a useful tool to stimulate economic activity. A likely explanation for this multiplier effect is the liquid nature of short-term bonds, which showcase "money-like" properties: they help banks to back deposits and collateralize transactions, whereas long-term bonds are often held in portfolios with withdrawal costs (like retirement accounts). Although the consensus in the economic literature has not favored short-term debt issuances even in the case of governments facing crises related to expenditure and general productivity, an article by Bouakez et al. (2016) suggests that with increasingly important spending shocks, short-term debt can help to avoid liquidity traps.

Another potential problem associated with long-term debt is linked to the interest rate risk. Indeed, issuing debt in a high interest rate environment may prove tricky, as an unexpectedly quick drop in interest rates can significantly increase the value of the government's outstanding long-term debt. "Locking-in" high interest debt while the rates continue to decrease is of course less likely when the treasury opts for shorter-term debt issuance. This is therefore another issue to keep in mind when considering elongating the maturity of the sovereign debt.

Finally, on the front of theoretical research, Alfaro & Kanczuk (2009) notably present a model in which longer-term debt leads to an overall decrease in welfare compared to shorter-term debt, although their study rests upon some rather restrictive assumptions.[19] Their conclusions may therefore not be generalizable to the EURO10 countries.

f. Alternatives to long-term debt for decreasing refinancing risk

When it is desirable to exploit the benefits of short-term debt while also mitigating the increase in refinancing risk it might imply, other tools besides the issuance of long-term debt can be mobilized. For instance, debt buybacks can be used to alter the maturity structure of the sovereign debt, and thus emulate the hedging benefits of long-term bonds.

The practice of debt buybacks has largely risen in popularity at the beginning of the 21st century (Medeiros et al., 2007). In 2012, 19 out of 33 surveyed OECD countries claimed resorting to buybacks to smooth the redemption profile of their debt (Blommestein et al., 2012), which therefore represents a significant alternative in refinancing risk management.[20] The idea behind this strategy still seems to hold to this day; French public

[19] "We assumed that debt levels were constant, that preferences were linear on consumption, that the government expenditure process was exogenous, and that long-term debt duration was only two years." (Alfaro & Kanczuk, 2009).
[20] As Blommenstein et al. (2012) point out, buybacks also have the advantage of implying the issuance of on-the-run securities; these securities are more liquid and can therefore participate in mitigating the potential negative effects of a longer-term debt profile with regards to liquidity.

debt managers mention buybacks (which were equal to about 11% of yearly debt issuances) as a major redemption smoothing tool for securities maturing in 2024 and 2025 (Agence France Trésor, 2023).

Debt buybacks can nevertheless have secondary effects, some of which may be considered undesirable by the policy makers. Because they increase the liquidity in the asset market,[21] they can lead to inflated prices of domestic assets. This effect is most pronounced for countries with less sophisticated markets for debt: because of naturally low levels of asset liquidity, buybacks affect liquidity the most in those cases. Of course, increasing the liquidity in the bond market may in fact be beneficial for the government, depending notably on the deviation of the aggregate output from its trend. For instance, an increase in buybacks would likely imply the same kind of crowding-in effect observed with short-term debt issuances (by extension of the conclusion in Mankart et al., 2024), hence they could represent a way to alleviate the amplitude of business cycle fluctuations. In general, increasing the price on newly issued bonds also implies lower interest rates on the new government bonds due to their liquidity, but the increased supply pushes on the other hand towards lower borrowing fees. This is an optimization problem that requires country-specific calculations (Garbade & Rutherford, 2007).

Conducting bond-trading operations such as swaps and buybacks can also help with broadening the base of creditors and therefore, for countries with less developed financial structures, stimulating demand, but this is less of an issue in the Euro Area (Medeiros et al., 2007).

[21] By operating buybacks, the government is essentially taking off-the-run securities of the market, which have repeatedly been observed as having a significantly lower liquidity than on-the-run securities in various countries (Pasquariello & Vega, 2009).

4. Empirical analysis

To investigate whether the theoretical considerations we mentioned so far are taken into account in debt maturity structure in the Euro Area, we look at various macroeconomic indicators in EURO10 economies, notably through a SVAR analysis. We then contrast those observations with the communication strategies undertaken by debt management agencies.

a. Debt structures in the EU

In the following graph, we can observe the evolution of the weighted average maturity (WAM) among the studied countries.[22] On average, the tendency has been very close to a clear linear increase of maturity with time.

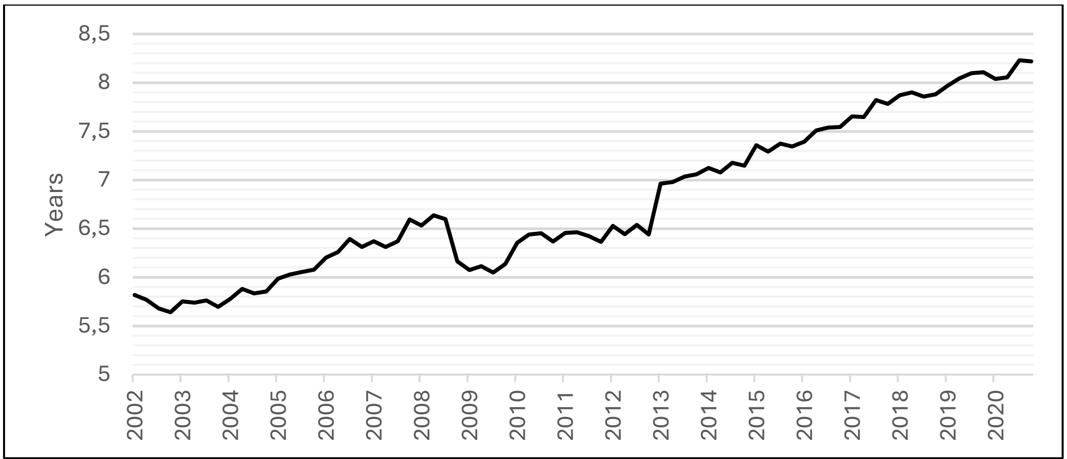

Figure 1: Mean of weighted average maturities (WAM) among EURO10 countries, 2002-2022

A simple linear regression gives us the following relationship ($R^2 = 0.93$):

$WAM = 5.455 + \mathbf{0.034} * n_{quarters}$,

Which implies an average annual WAM increase of 0.136 years.

Outside of minor fluctuations, the period between 2008 and 2013 is the only one characterized by a significant distinctness from the trend. The first sign of this perturbation is a rapid drop in the WAM by 0.52 years between Q3 2008 and Q1 2009; the rates for government short-term debt decreased considerably at the time as a result of the reallocation of capital towards assets deemed as being safer than equity, such as the sovereign bonds of developed economies (especially the short-term ones, which also bore the advantage of being more liquid), while longer-term yields for bonds were not

[22] This data is an average that gives the WAM of each country from the sample the same weight, even though the total volumes of debt are of course very different between them; it is therefore a better representation of the average debt maturity policy evolution than of the sovereign debt aggregate market in the Euro Area.

dramatically affected. As an adaptation to those market conditions, many governments reduced the WAM of their newly issued debt by a consequential margin; for instance, while this value had oscillated between 5 and 11 years in the previous quarters, Austria emitted debt with a WAM of 2.16 years in Q4 2008. As seen previously, short-term debt can also have a multiplier effect that could typically be exploited by governments in the context of a recession, but whether this was a major motivation in short-term debt issuance during this period is a much more complex question to answer.

Two subsequent adjustments back towards the trend can be observed, the first one between Q4 2009 and Q2 2010, and then a much more rapid increase of WAM in Q1 2013. Those are not necessarily representative of a common synchronized policy, especially for the Q1 2013 jump in WAM. Indeed, a few countries contribute for most of the change, such as Finland which emitted debt with a WAM of more than 15 years during this quarter. In other countries, for instance Italy or Portugal, the WAM of newly emitted debt stayed relatively constant in this period, and only started growing a few quarters later.

To visualize the broad tendencies in bond issuances that led to this evolution of debt maturity composition between 2002 and 2020, we represent the state of market value by residual maturity at the beginning, in the middle, and at the end of our sample.[23]

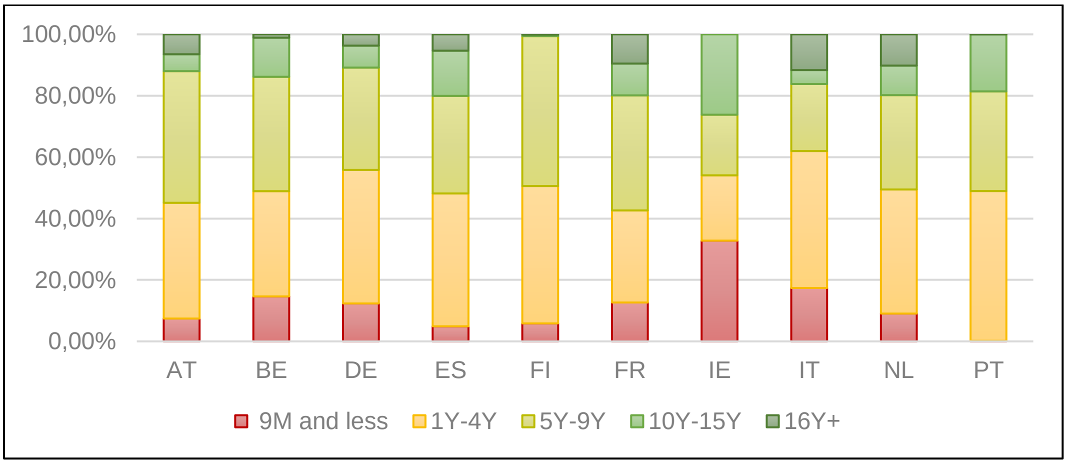

Figure 2: Sovereign debt market value distribution by residual maturity in EURO10 countries, Q1 2002

[23] Q3 2020 is considered instead of Q4, as our database did not include detailed market value maturity structures for the very last period.

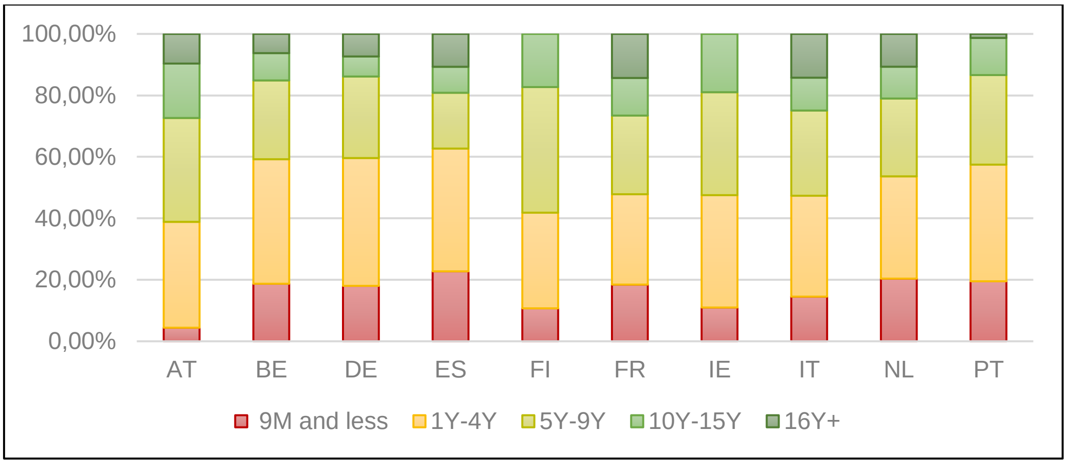

Figure 3: Sovereign debt market value distribution by residual maturity in EURO10 countries, Q1 2011

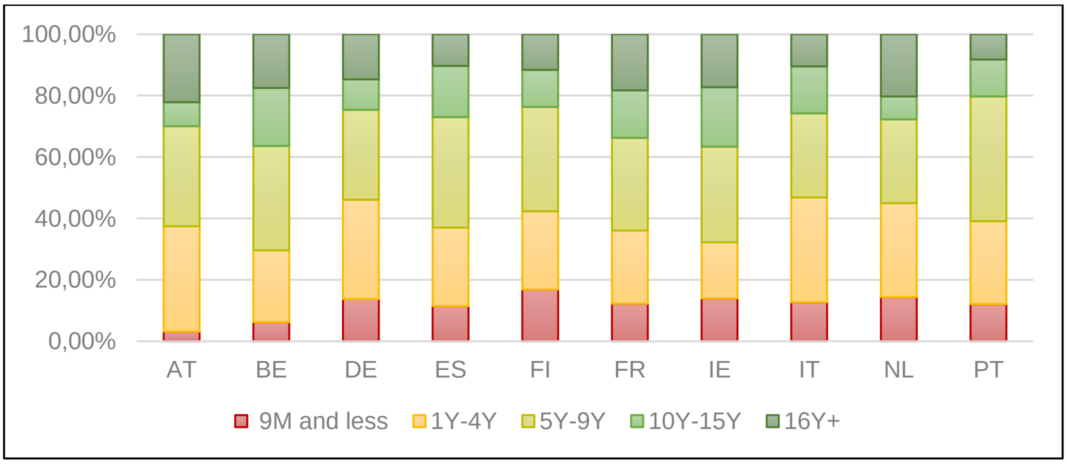

Figure 4: Sovereign debt market value distribution by residual maturity in EURO10 countries, Q3 2020

A first observation that can be made from our data relates to the very short-term debt; while there is no obvious reduction (the average reduction in the share of this type of debt between 2002 and 2020 is 1.1% in absolute terms), its distribution amongst countries became much more harmonized, hinting at a relative alignment of debt management practices in this regard.

A much more significant drop can be observed in the total debt with under 5 years of residual maturity, which is used (as we will see later) by many debt management agencies as one of the prime superficial indicators of refinancing risk. It was on average reduced from 53.2% to 41.0%, and none of the 10 countries had a share of short-term debt above 50% in 2020.

Finally, long term debt (10Y-15Y) and very long-term (16Y+) have been subject to the most dramatic changes, the first rising from 8.2% to 14.1%, and the second from an average of 8.1% to 14.4% in 2020. Such an increase may have significant implications for fiscal policy and debt management if hedging properties are observed in Euro Area countries.

b. SVAR setup

Our SVAR model is constructed to study the impact of government spending shocks on contemporaneous government debt returns.[24] We aim to determine whether the structure of government debt in EURO10 countries displays hedging properties in the impulse response functions (IRFs) of the debt returns in reaction to government spending shocks. If this is the case, it could suggest the existence of a conscious desire to exploit those properties, for instance by the issuance of long-term debt which is theoretically associated with the hedging potential. Where we notice hedging potential, we decompose the debt structure by maturity in order to see whether it is the long-term debt that is responsible for it.

We work with quarterly time series from Q1 2002 until Q4 2020. Four variables are considered, and ordered[25] as follows by decreasing exogeneity:

- Real government spending (inflation-adjusted with the GDP deflator, cycle, detrended with HP filter). Source: Eurostat.
- Real GDP (inflation-adjusted with the GDP deflator, cycle, detrended with HP filter). Source: De Graeve (2023).
- Inflation (GDP deflator, cycle, detrended with HP filter). Source: ECB.
- Debt returns. Calculated as the total market value of debt divided by the total nominal value. Source: De Graeve (2023).

All variables are normalized before computation. The potential seasonal component of our quarterly data is taken into account. The lag has been established at 2, analogously to Equiza-Goñi et al. (2023), as this has repeatedly been advised for quarterly data in previous similar analyses. For our series detrended with a Hodrick-Prescott filter we use $\lambda = 1600$, as is common practice for quarterly data.

For our identification framework, we follow the principles of a Cholesky decomposition. In our AB-model, the matrix for contemporaneous coefficients is:

$$A = \begin{pmatrix} NA & 0 & 0 & 0 \\ NA & NA & 0 & 0 \\ NA & NA & NA & 0 \\ NA & NA & NA & NA \end{pmatrix}$$

The matrix for the identification of individual shocks is:

[24] The general template and guidelines for our SVAR are in great part drawn from Prof. Kevin Kotzé's publicly available tutorial, which we cite in our sources.
[25] The ordering follows the logic laid out by Equiza-Goñi et al. (2023) for the direction of instantaneous impacts between the variables.

$$B = \begin{pmatrix} NA & 0 & 0 & 0 \\ 0 & NA & 0 & 0 \\ 0 & 0 & NA & 0 \\ 0 & 0 & 0 & NA \end{pmatrix},$$

implying no covariance for residuals (Kotzé).

c. *IRFs and interpretation*

This SVAR configuration allows us to study the IRFs of debt returns following a shock to government spending for each country in our sample:

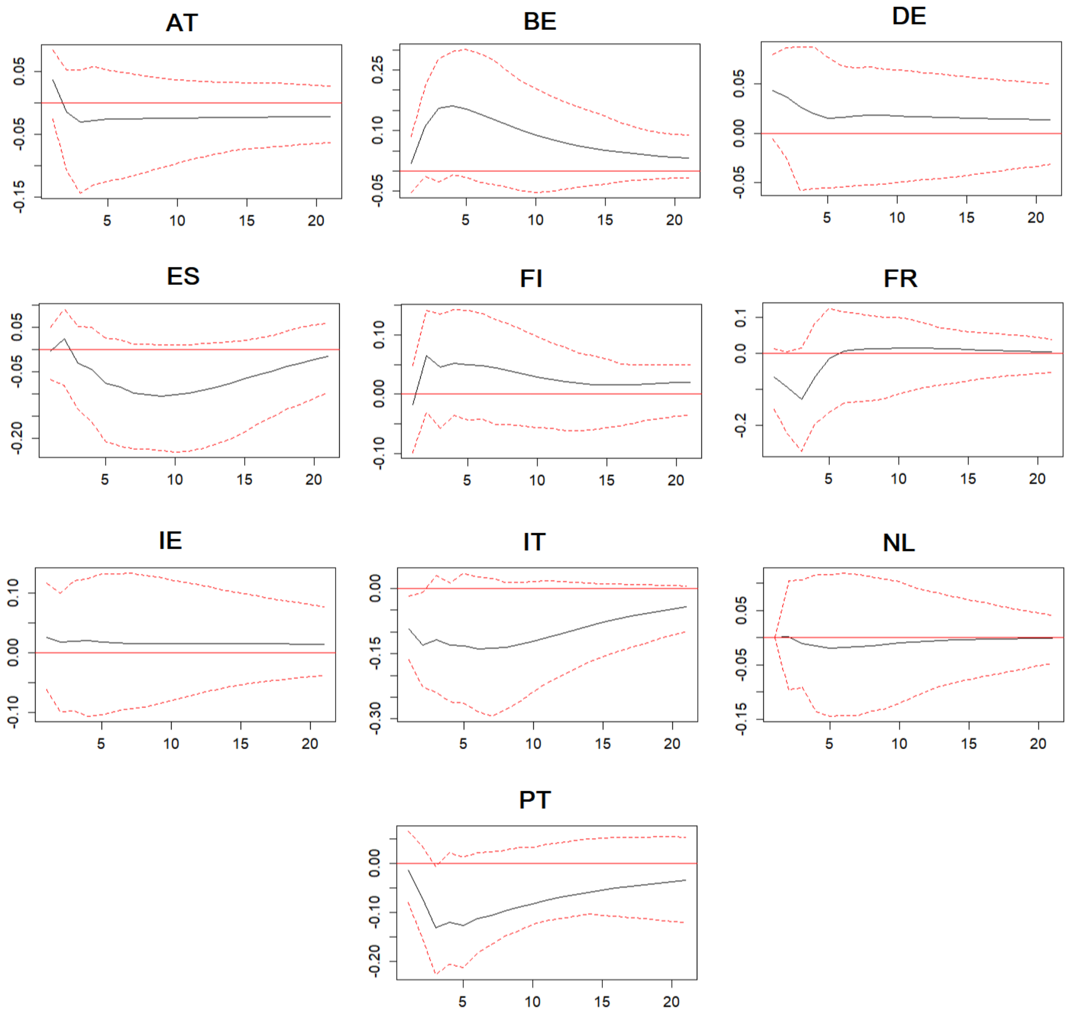

Figure 5: EURO10 IRFs of total debt returns to government spending shocks, 2002-2020 (X-axis: quarters, Y-axis: standard deviation)

As the IRFs with our set of assumptions suggest, most countries do not benefit from fiscal hedging in their debt returns. Nevertheless, two notable exceptions are France and Italy, although the French hedging effect is just short of being significant at the 95% confidence level, while the Italian hedging is just barely significant.

Even with a more specific study at different maturity brackets in the case of France, no broad maturity category seems to have a particularly remarkable effect in terms of fiscal hedging. All three point towards some light hedging properties on impact, although not significant at our confidence level:

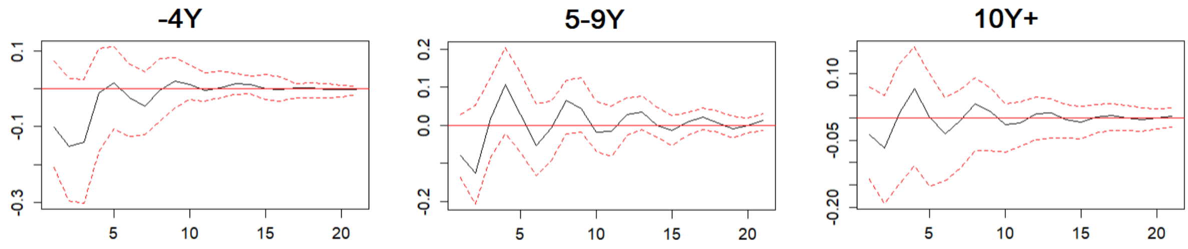

Figure 6: French IRFs of debt returns to government spending shocks, segmented by outstanding maturity, 2002-2020 (X-axis: quarters, Y-axis: standard deviation)

The results for Italian IRFs with maturity breakdown are similar to the French ones, with no clear hedging benefits regardless of maturity:

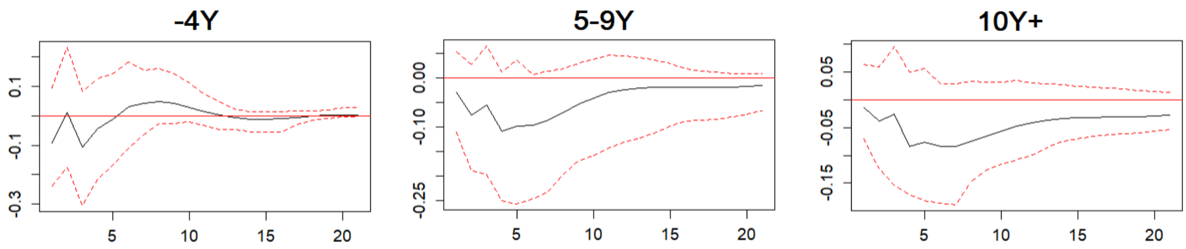

Figure 7: Italian IRFs of debt returns to government spending shocks, segmented by outstanding maturity, 2002-2020 (X-axis: quarters, Y-axis: standard deviation)

Comparing the evolution of WAM in Italy to the average EURO10 we notice that it is somewhat of an outlier, as it hasn't followed the general increasing trend in the last 15 years of the sample:

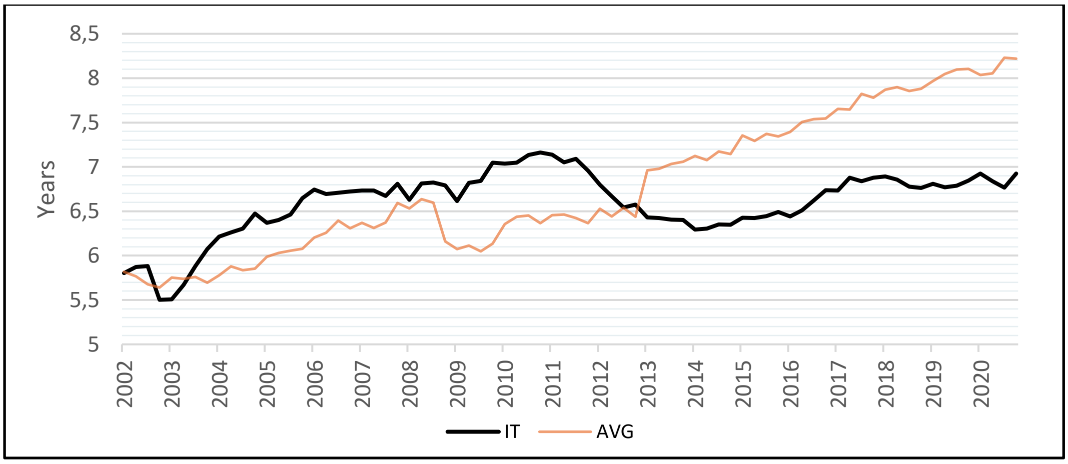

Figure 8: Mean of weighted average maturities (WAM) among EURO10 countries compared to the WAM of Italian debt, 2002-2022

Given the low significance of IRF data and the trend of Italian WAM, we cannot conclude that Italy orients its debt maturity evolution in hope of exploiting its potential or observed hedging properties.

The fact that our analysis does not highlight hedging effects of the sovereign debt in Euro Area countries may be due to the simplified nature of its outlook. For instance, Equiza-Goñi et al. (2023) only found hedging effects when looking at how European sovereign portfolios reacted to aggregate shocks in the monetary union (shocks to the average government spending), while no such effect was empirically observed for idiosyncratic shocks (shocks to the difference between the government spending in the country and the union's average). This is a distinction that was not implemented in our simple SVAR, and yet may be useful to reflect the heterogeneity of fiscal situations in Euro Area countries, especially in the early 2010s.

Another approach that may be interesting to explore would be to apply the SVAR to a database of inflation-indexed debt. We saw earlier that France and Italy are the two countries that have by far the highest average share of indexed debt among the EURO10 countries, and they are also both the closest to exhibiting hedging properties through their debt structure in our analysis. The evolution of this indexed debt share and the maturity of their indexed bonds may perhaps tell a different story than the aggregate market value of government debt, which is largely determined by nominal bonds.

d. Debt management communication strategies

In this section, we briefly review the communication choices of some of the EURO10 countries with regards to their debt. We aim to understand if some clear differences are noticeable, and whether the focus of their communication reflects realities about the evolution of their debt maturity profile and our empirical observations.

As it stands, maturity is a common talking point in debt management briefs. Governments establish requirements for the minimal average maturity, as well as for the "maximum refinancing risk" at different maturity levels (meaning the amount of debt with a maturity lower than a certain benchmark). As an illustration, the required average is fixed at 9.25 years since 2021 in Belgium, while the debt under 1 and under 5 years maturity is limited to 17.50% and 42.50% of the total outstanding amount.[26] In the Belgian Debt Agency's presentation to investors, short-term debt is directly addressed as "refinancing risk". This approach not only explicitly associates maturity with refinancing risk, but the evolution of the benchmarks in the direction of decreasing short-term debt ratios also showcases a deliberate desire to use long-term debt as a tool against refinancing risk (Belgian Debt Agency, 2024).

[26] These limits are respected in practice; the actual numbers have in fact been significantly better than the benchmark.

A country like Belgium, whose debt/GDP ratio exceeds 100%, needs to pay particular attention to refinancing risk considerations, as investors could require significantly higher rates for a sharp peak of rollover debt. It is also possible that not all necessary funding is obtained. The establishment of these maturity benchmarks and an efficient communication on their subject is therefore essential (Deboutte & Debergh, 2006), and it shows in the Belgian communication strategy.

In the Netherlands (Dutch State Treasury Agency, 2024), the benchmark is 8 years for the average maturity, and it is reviewed each year by the DSTA. The refixing ratio is also a bit higher than in Belgium, as the 1-year cutoff is fixed at a maximum of 25%. This time, it is the prevention of "interest risk" that is mentioned as a positive byproduct of a longer-maturity debt:

The average maturity of the debt portfolio limits the cumulative interest rate risk over all future years, contributing to multi-annual stability of interest rate costs. Additionally, the cap on the 12-month refixing amount prevents too much concentration of interest rate risk in a single year.

The rationale for the revision of the average maturity benchmark is also linked to interest rates:

Following the previous external framework review in 2019, the DSTA raised the target for the average maturity. This extension of the maturity mitigates the costs of rising interest rates. Since 2021 interest rates have risen significantly. At the same time, the difference between short and long term interest rates (i.e. the term premium) has remained at low levels. Under these conditions the DSTA has decided to maintain the current target.

The most recent activity report of the French debt management agency (Agence France Trésor, 2023) claims that the average maturity of its debt continues to increase thanks to the sustained demand for long-term *obligations assimilables du Trésor*. Whatever the core reason behind the increase of the average maturity may be, the *Trésor* does consider that it reduces refinancing risk, as it only allows a "gradual effect" of the increase of the interest rates after 2022.

Other countries have a more minimalistic approach to debt management communication. For instance, the annual review of the Finnish treasury (2023) makes little specific remarks about risk management, their presentation being rather general and theoretical. This is despite the fact that Finland has the highest share of very short-term debt among the EURO10 countries. It does nevertheless put a relative emphasis on interest rate risk, which the treasury claimed to tackle with interest rate swaps. Similarly, the Austrian debt management strategy and annual funding outlook are very brief, but mostly contain information about the general philosophy of refinancing risk management: diversification of refinancing sources with a larger investor base, no redemption concentrations, and of course open communication. The increasing WAM is also exposed.

Finally, the Portuguese communication for investors is quite classic and emphasizes a smooth redemption plan, and a downward trend of the debt/GDP ratio following the 2020 pandemic. They boast the lowest share of debt to be repaid in both less than 1 year and less than 5 years amongst the 10 major Euro Area economies, which they advertise as indication of the lowest refinancing risk "compared with peers"; this slightly competitive presentation is rather unique, but understandable given the high substitutability between European sovereign bonds. The Portuguese WAM has stayed relatively stable for the last 10 years (although slightly downward orientated), a fact employed to demonstrate that the Portuguese debt management is on a safe and predictable trajectory.

In essence, we notice that refinancing risk is in most cases a primordial element of communication provided by national debt management agencies; at the very least, it is advertised as being of prime importance in the list of priorities of the treasury. If the public communication of EURO10 countries is deemed to be credible, refinancing risk indubitably impacts the maturity structure evolution. The various reports we presented generally promote very similar strategies, reflecting the harmonization of debt maturity structures we observed from data.

The dominance of refinancing risk considerations in public communications of national treasuries is of course expected. Managing expectations about the safe nature of government bonds as investment instruments is tantamount to keeping the interests on their debt low. On the contrary, advertising potential fiscal hedging properties of national debt instruments is avoided. This can be explained by the fact that open communication about hedging with nominal government debt may lead to higher expectations of inflation, and in general to a lower valuation of new issuances of government bonds, leading in turn to increased interest rates for new debt issuance. Those elements would therefore have a detrimental effect on the confidence of investors.

On the other hand, fiscal hedging is helpful to maintain debt sustainability, and the advertisement of this property could paradoxically lead to a higher confidence in the government's ability to avoid defaults. The debt/GDP ratio, in particular its stability or even its decrease (such as in the case of Portugal) are ubiquitous elements of treasuries' communication aimed at investors, and fiscal hedging could in some cases be an important tool to control this ratio. However, as we did not find clear indications of hedging through debt instruments in our sample, this communication avenue may not be a priority for EURO10 countries.

5. Conclusion

Our study investigated the potential effect that fiscal hedging and refinancing risk management may be playing in the increasing average maturity of public debt in the Euro Area. Despite numerous theoretical indications that long-term debt can provide fiscal hedging benefits, and that hedging can be welfare improving, our SVAR model did not find significant indications of hedging properties of public debt in EURO10 countries. The trend of increasing WAM may more easily be explained, outside of factors such as cost minimization addressed in other papers, by the preoccupation to keep a low apparent refinancing risk, which transpires both from theory and from the communication of European public debt management agencies. Further research would likely benefit from implementing a more sophisticated SVAR configuration. A different computation of government spending and of debt returns is also worth exploring. Finally, incorporating a specific study of indexed debt maturity and its potential hedging attributes could prove interesting, but would likely not explain the observed increase in WAM given the relatively small share of this type of security in European public debt issuances.

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Annex: simplified R code for IRF plotting

```r
library(readxl)
library(vars)
library(svars)

data <- read_excel("...")

data_scaled <- scale(data)

var.est <- VAR(data_scaled, p = 2, type = "const", season = 4)

a.mat <- diag(4)
diag(a.mat) <- NA
a.mat[2, 1] <- NA
a.mat[3, 1] <- NA
a.mat[3, 2] <- NA
a.mat[4, 1] <- NA
a.mat[4, 2] <- NA
a.mat[4, 3] <- NA

b.mat <- diag(4)
diag(b.mat) <- NA

svar.one <- SVAR(var.est, Amat = a.mat, Bmat = b.mat, max.iter = 10000,
    hessian = TRUE)

one.inf <- irf(svar.one, response = "Debt_returns", impulse = "Gov_spending",
    n.ahead = 20, ortho = TRUE, boot = TRUE)

plot(one.inf)
```