Barcelona School of Economics

Master in Specialized Economic Analysis
Specialization in Macroeconomic Policy and Financial Markets

"Fiscal Insurance During Financial Distress. The Case of Belgian Sovereign Debt in the 21st Century"

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June 12th, 2023

ABSTRACT IN ENGLISH (100 words)**:**

We empirically test the theoretical hypothesis that long term bonds offer governments fiscal insurance in times of crisis, analyzing Belgian sovereign debt dynamics during the 21st century. We use a novel data set of monthly prices and quantities for bonds in circulation between 2000 and 2022. We calculate total market value of debt and one-period holding returns, capturing the funding cost in the government's inter-temporal budget constraint. The main findings of the study indicate a positive co-movement between bond prices and government net funding requirement during periods of financial distress, suggesting a limited role of long bonds in fiscal insurance.

ABSTRACT IN CATALAN/ SPANISH (100 words)

Examinamos empíricamente la hipótesis teórica que bonos de larga duración ofrecen seguro fiscal a gobiernos en tiempos de crisis, analizando la deuda soberana Belga durante el siglo XXI. Utilizamos una novedosa base de datos de precios y cantidades de bonos en circulación entre 2000 y 2022. Calculamos valor de mercado total de la deuda y rendimientos de tenencia de un período, capturando costos de financiamiento en la limitación presupuestaria inter-temporal del gobierno. Encontramos co-movimiento positivo entre precios de bonos y requerimientos de financiamiento gubernamentales netos durante períodos de crisis, sugiriendo un papel limitado de bonos largos en el seguro fiscal.

KEYWORDS IN ENGLISH (3)**:** Maturity structure, financial crises, debt management

KEYWORDS IN CATALAN/ SPANISH (3)**:** manejo de deuda, estructura vencimiento, crisis financiera

Fiscal Insurance During Financial Distress

The Case of Belgian Sovereign Debt in the 21^{st} Century

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Abstract

This study aims to empirically test whether the theoretical hypothesis that long term bonds offer governments fiscal insurance in times of crisis holds, analyzing Belgian sovereign debt dynamics during the 21st century. The study uses a novel data set of monthly prices and quantities for bonds in circulation between 2000 and 2022. We calculate total market value of debt and one-period holding returns, capturing the funding cost in the government's inter-temporal budget constraint. The main findings of the study indicate a positive co-movement between bond prices and the net funding requirement of the government during periods of financial distress, suggesting a limited role of long bonds in fiscal insurance.

JEL Classification: E30, E62, C54, C82
Keywords: Public debt, debt dynamics, maturity structure, financial crises, debt management

1 Introduction

Belgian national debt, like that of many European countries, has been on a rising trajectory, partially influenced by the Global Financial Crisis of 2008 and the Eurozone debt crisis that followed. These events led to increased borrowing to finance economic recovery and bailout initiatives. More recently, the COVID-19 pandemic further exacerbated this situation since early 2020, as the government borrowed heavily to fund healthcare initiatives and economic relief measures, leading to a significant increase in public debt (OECD, 2023). Thus, debt sustainability and adequate levels of debt have been the main subject regarding debt management discussions. However, only few have considered the composition of debt, and empirical lessons from the analysis of debt maturity.

Belgium is of particular interest for several reasons. Firstly, as outlined, the debt-GDP ratio has been persistently high throughout the last two decades. It was approximately 87% in 2000, peaked at around 107% in 2014, and hovered above 100% in the years leading up to 2020, when it reached a new peak of 119.4% (World Bank, 2023). This is far above the EU-wide average of 85.1% in 2022 (Eurostat, 2023). Secondly, Belgium has only ran a primary surplus in three of the last 23 years, all of which were before 2008 (World Data, 2023). Thirdly, Belgian's weighted average maturity of debt has risen from 6 years in 2009 to 16.5 years in 2023 (World Bank, 2023). The Belgian Debt Agency pursues a balanced and sustainable budget, minimising the "financial costs related to the federal debt". The increase in debt-GDP, far above EU average, together with a significant rise in weighted average maturity - implying higher issuance of long-term bonds - raise concerns about whether the Belgian Debt Agency has fulfilled its responsibility effectively over the past two decades.

These factors motivate an analysis of debt maturity, using a novel data set which captures Belgian debt dynamics since 2000. We follow the approach introduced by Ellison and Scott (2020) in retrieving monthly prices and quantities on each bond available and in circulation, which allows for calculating one-period holding returns. These returns capture the funding cost in the government's intertemporal budget constraint, as argued by Hall and Sargent (2011).

We find that the common academic argument – issuing long-term bonds is beneficial as it exploits low interest rates and offers fiscal insurance – only holds for one of the three financial crises since 2000. For each of the other periods, we show that bond prices have a positive co-movement with the net funding requirement in periods of financial distress, which indicates a lack of fiscal insurance. Hence, our analysis demonstrates that the decision to increasingly issue long bonds following the Global Financial Crisis in 2008 may have resulted in escalated Belgian debt levels compared to an alternate strategy of shorter-term bond issuance.

This paper is structured as follows. Section 2 summarizes the theoretical argument for long-term bonds and fiscal insurance during financial distress, as well as other empirical work. Section 3 explains our empirical strategy, while section 4 outlines the novel database we construct. Following this description, we report our results for the decomposition exercise in section 5, before discussing the main findings. We outline key limitations, such as data availability and structural issues in section 6, providing suggestions for future extensions in section 7. Section 8 concludes our investigation.

2 Literature Review

A considerable body of research has examined the impact of managing the maturity structure of government debt in supporting fiscal policy. The prevailing viewpoint supports the issuance of long bonds, as they offer fiscal insurance due to the variation in their prices that hedges the government's budget constraint against the need to raise taxes to cover expenditure shocks. The need for insurance stems from the fact that governments do not issue state-contingent bonds, and just as proven by Faraglia et al. (2008), bond markets are incomplete. This necessitates finding alternatives to offer insurance to governments, as smoothing distortions across time and states of the world enhances welfare. The role of the maturity structure of debt has been proposed to be a key instrument for this purpose.

Advocates of long debt, such as Barro (1997), Angeletos (2002), and Buera and Nicolini (2004) argue a government is required to satisfy its inter-temporal budget constraint such that the present value of expenditures plus the debt burden are covered by the present value of taxes. If the government relies mostly on short-term debt, then any variation in expenditures must be covered with an adjustment in the tax rate, or by borrowing ex-post in response to the shock. Conversely, long-term debt depends on interest rates which are endogenous to the state of the economy. Hence, any variation in interest rates, and thus prices of long bonds, allows the government to raise taxes by less to meet the budget constraint - provided prices move in the opposite direction of expenditures. In other words, long-term debt can lead to capital gains for the government during shocks and reduces the total tax burden. These arguments all rely on Lucas and Stokey (1983), who initially showed that variation in the return of assets held by governments can smooth distortions by taxes across states.

These claims have been formalized in frameworks of a Ramsey planner under full commitment, stochastic government expenditures, and distortionary taxes. Angeletos (2002) formalizes the argument with a general equilibrium model and proves that with heterogeneous debt maturities structures, governments can implement every Arrow-Debreu allocation, thus completing the markets and hedging themselves against any uncertainty. Buera and Nicolini (2004) also complete markets by constructing state-contingent debt with the use of non-contingent debt of different maturities, exploiting shifts in the term structure of interest rates. Nosbusch (2008) strengthens the argument by employing an incomplete markets model to find that long bonds yield capital gains in periods of high government spending, that is, in bad states of the world, because bond prices fall after bad shocks. In these states, marginal utility of consumption is high, implying low expected marginal utility growth and high equilibrium interest rates, which reduce the value of long-term debt. As such, all of these models prescribe the issuance of long debt to exploit co-movements between expenditures and prices of debt to hedge against uncertainty, and advocate against the use of shorter maturity bonds (Barro, 1997).

The downsides of long-term debt - higher overall cost and higher volatility - are minimized in these models. Proponents of long bonds claim that the welfare gain of completing the markets is greater than the cost. Lustig et al. (2008) argue that cost and volatility should be seen as an insurance premium paid by the government.

Despite the extensive theoretical framework, empirical studies on this subject are relatively limited. Faraglia et al. (2008) calculate market value of debt for a panel of OECD countries and find that market value and face value are strongly correlated. Therefore, variations in bond prices offer limited fiscal insurance. However, their analysis utilizes an approximation of market value of debt, using outstanding debt, coupons, and yields, but does not allow for the analysis of individual bonds. Their use of an approximation highlights the main practical challenge in testing the fiscal insurance hypothesis empirically: official published data on government bonds only documents outstanding face value debt.

Ellison and Scott (2020) have thus far been the sole researchers to solve this problem, constructing a comprehensive database with monthly quantities and prices of every single bond issued by the UK government from 1694 to 2018. The database allows them to calculate the exact market value of debt. Their analysis decomposes changes in the debt-GDP ratio, examining the contribution of bond price revaluations during wars, financial crises, and normal periods. Their findings provide no evidence of fiscal insurance and instead indicate a cost advantage favoring short-maturity bonds.

3 Methodology

In order to analyse the empirical evidence for fiscal insurance in times of financial distress between 2000 and 2022, we follow the definition of evolution of government debt-GDP by Hall and Sargent (2011) (1). This equation describes the effect of previous debt-GDP, the current deficit-to-GDP - which is the net funding requirement of the government in each period - and interest rate $r_{t-1,t}$, inflation $\pi_{t-1,t}$ and GDP growth $g_{t-1,t}$ on current debt-GDP. Further, we model change in debt-GDP between t and $t-1$

as the RHS of equation (2). This is our initial equation for the decomposition of change in debt-GDP.

$$\frac{B_t}{Y_t} = (r_{t-1,t} - \pi_{t-1,t} - g_{t-1,t}) \frac{B_{t-1}}{Y_{t-1}} + \frac{def_t}{Y_t} + \frac{B_{t-1}}{Y_{t-1}} \tag{1}$$

$$\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} = (r_{t-1,t} - \pi_{t-1,t} - g_{t-1,t}) \frac{B_{t-1}}{Y_{t-1}} + \frac{def_t}{Y_t} \tag{2}$$

3.1 Holding Period Returns

Crucially, we analyse the debt-GDP development in *market value of marketable debt*. Thus, the nominal interest rate $r_{t-1,t}$ is equivalent to holding period returns between t and $t-1$. Intuitively, higher returns, driven by positive price movements, result in higher market value of debt-GDP, whereas both inflation and GDP growth reduce debt-GDP. Lastly, a positive net funding requirement (deficit) also drives up debt-GDP. The calculation of holding period returns serves as the basis for our analysis, as it allows us to assess the expense incurred by the government in raising capital. The one-period holding return encompasses semi-annual interest payments and a revaluation component which accounts for capital gains or losses due to prive movements. This enables us to analyse the co-movement between revaluation and the net funding requirement, investigating whether the Belgian government debt maturity structure displays fiscal insurance during the analysed period.

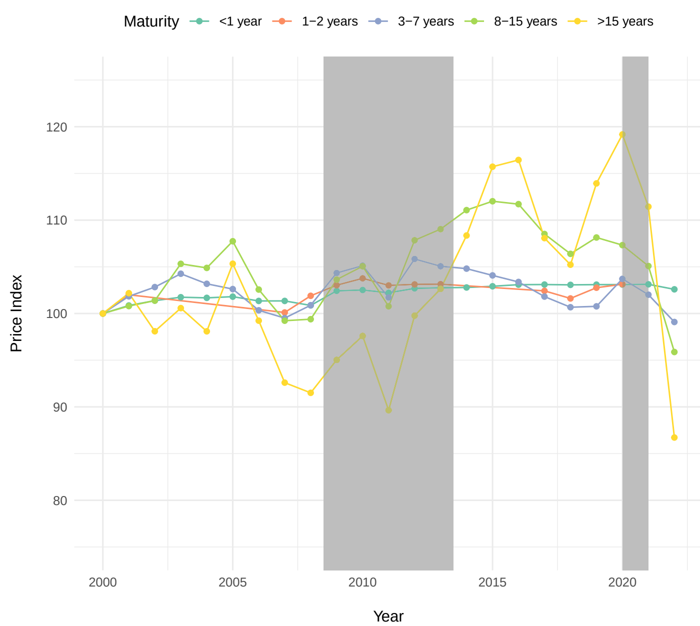

Figure 1: Price Indices by Maturity

The one-period holding return is taken to be an average across maturities in equations (1) and (2). This is a restricting assumption which does not hold empirically, as shown in Figure 1. Thus, to allow for variation in holding period returns across bonds of different maturities, we redefine equation (2). Specifically, we let $B_{t-1} = \sum_{j=1}^{n} B_{t-1}^{j}$ be the total market value of nominal debt, where B_{t-1}^{j} is the market value of debt of maturity j at time $t-1$. Further, $r^j_{t-1,t}$ represents nominal holding period returns for maturity j. This leads change in debt-GDP to be defined as follows:

$$\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} = \sum_{j=1}^{n} r^j_{t-1,t} \frac{B^j_{t-1}}{Y_{t-1}} - (\pi_{t-1,t} + g_{t-1,t}) \frac{B_{t-1}}{Y_{t-1}} + \frac{def_t}{Y_t}$$

In this modified equation, we can differentiate between those contributions to change in debt-GDP which influence the total value of debt, and those which are maturity-dependent, specifically holding period returns. We calculate said holding period returns by retrieving end-of-month prices for each bond from our database. Prices are then multiplied by the bonds' respective quantity, which yields the total market value of marketable debt. This is subsequently subtracted from the the one-year ahead market value to retrieve yearly returns, which we report for every month of the year. Thus, we construct monthly series of one-year holding returns for every bond in circulation at each month between January 2000 and December 2022.

4 Data

Our analysis of Belgian debt begins in the year 2000, following the adoption of the Euro as the country's official currency. We set about constructing a comprehensive database of all government bonds issued, matured, and in circulation during the studied period. The database contains, for each year and for each month, the end-of-month price, original issuance amount (denoted as "quantity" throughout this paper), and coupon rate for each bond. Bonds are identified by their unique International Securities Identification Number (ISIN).

We obtain the list of full marketable bonds issued by the Kingdom of Belgium from Refinitv Eikon, with their corresponding issued amount and ISIN. Daily prices are obtained from the Bloomberg terminal and we proceed to keep only the end of month prices. This procedure yields a database of 414 bonds and 16,558 observations. The database confers several advantages. Firstly, it allows us to identify each type of bond issued every month and every year. Secondly, We are also able to calculate total face value and total market value of debt outstanding at every month and, consequently, we can calculate yearly returns on a monthly basis. Appendix A shows a sample of a portion of the constructed data set.

4.1 Types of Bonds

Our database contains 217 short-term bonds, with maturity of one year or less, and 197 long-term bonds, with maturity greater than one year. Figure 2 shows the evolution of the maturity structure over the 22 year sample period by plotting the percentage of debt issued by maturity. After 2005, we observe that the issued maturity becomes longer, and following 2010, the amount of long bonds (> 8 years) rises substantially, accounting for more than half of the issuance in 2022.

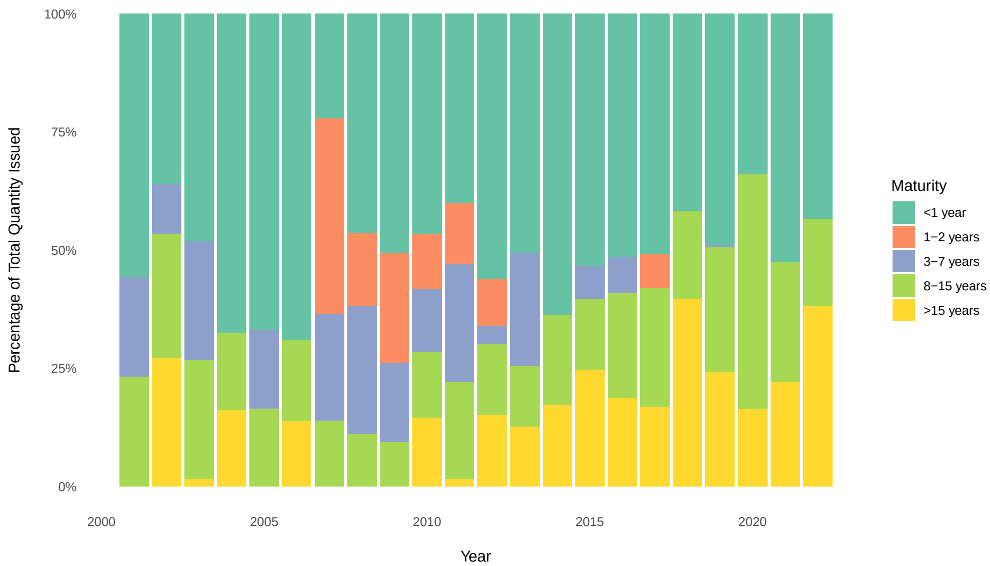

Figure 2: Composition of Debt Issuance by Maturity

In fact, to better capture the dynamics of increasing maturity, we consider the weighted average maturity (WAM) of debt as reflected in Figure 3. We observe the WAM of debt to have risen over the past 22 years from 5.5 in 2000, to 13.25 years in 2022. Further, it seems that there is a significant decrease in WAM between 2007 and 2010, and a steep rise after, suggesting that the maturity structure has significantly changed over the analysed period.

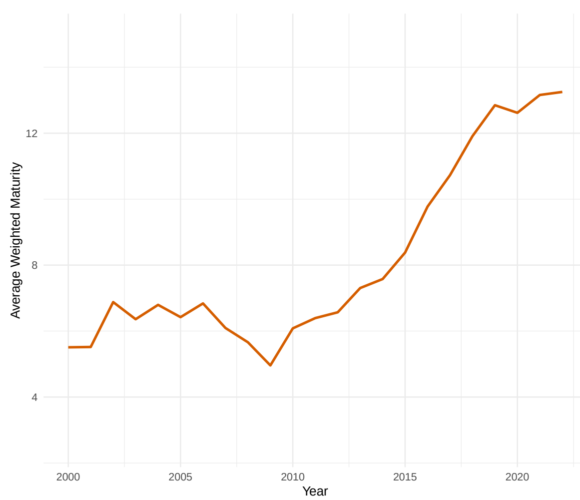

Figure 3: Weighted Average Maturity

4.2 Quantity of Debt

We calculate total face value by summing the face value of all individual bonds outstanding at the end of each year. Figure 4 shows total debt rises in nominal terms across the sample period.

Besides the bonds issued in the local market, the government has issued a number of Eurobonds in foreign currencies, mainly the US Dollar, British Pound and Norwegian Krone. We have 36 foreign-currency Eurobonds in our sample and we convert the issued amount to Euro using the exchange rate between the Euro and the corresponding currency recorded by the European Central Bank on the issue date. For all the bonds issued before the adoption of the Euro [1], we take the exchange rate at the introduction of the Euro.

4.3 Prices of Bonds

We use end of month bid prices to calculate market value by multiplying this price by the quantity of the issuance. In general, prices reflect future coupons and repayment probabilities (Ellison and Scott, 2020). Figure 5 plots the evolution of total market value of debt in euro terms. We observe a similar trend as nominal debt.

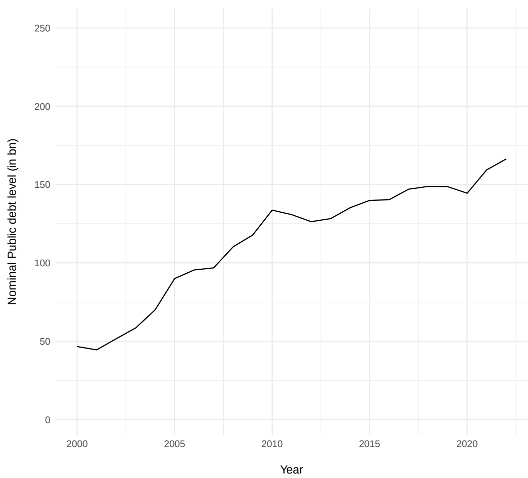

Figure 4: Evolution of Nominal Debt

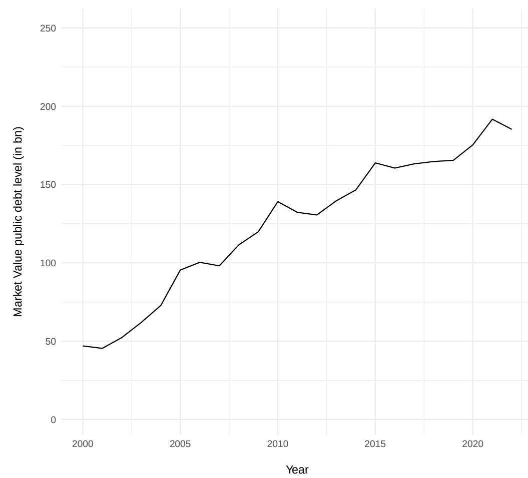

Figure 5: Evolution of Market Value of Debt

To better assess price movements in our sample, we construct a price index for different maturity groups using weighted average prices of each group during the sample period. Appendix B contains the index construction and figure 1 plots their historical movements. We first confirm the typical assumption about bond prices: short term debt is less volatile than long term. But in general, Belgian government bonds are not highly volatile assets and tend to trade between 97 and 109. The outlier seems to be in the longest maturity group (> 15 years) for which the price index reached a low level of 86 in 2022 as interest rates have been rising. This is expected of longer maturity bonds which are more sensitive to interest rate fluctuations.

5 Results

We set about testing the fiscal insurance hypothesis by following the Hall and Sargent (2011) decomposition of changes in debt-GDP, as outlined in our methodology. There is evidence in support of fiscal insurance during the periods of financial distress if holding period returns co-move negatively with the

[1]These are a total of seven bonds showing up in the sample because they matured after 2000

net funding requirement.

We follow Hobelsberger et al. (2022) to define the years of three periods of crisis and adverse government expenditure shocks in Europe, starting with the 2008-2010 Global Financial Crisis, continuing with the 2010-2013 European sovereign debt crisis, and ending with the 2020 COVID-19 crisis. The results of the decomposition are outlined in table 1 for both crisis and normal years.

Table 1: Decomposition of changes in debt-GDP

	Start MV debt to GDP[1]	End MV debt to GDP[1]	Change in debt to GDP	Contribution of nominal returns	- of which coupons	- of which revaluation	Contribution of inflation[2]	Contribution of GDP growth	Contribution of new debt
Crisis Times									
2008-2010	30.67	36.04	5.37	1.11	0.95	0.16	−1.49	−0.57	6.32
2010-2013	38.52	35.21	−3.30	2.74	1.29	1.45	−2.51	−2.13	−1.41
2020-2020	33.93	40.24	6.30	0.58	0.34	0.24	−0.51	1.82	4.42
Normal Times									
2001-2007	15.45	30.67	15.22	1.86	1.60	0.27	−3.32	−4.09	20.77
2014-2019	35.21	33.93	−1.28	5.86	1.92	3.94	−3.38	−3.81	0.05
2021-2022	40.24	26.95	−13.29	−2.10	0.35	−2.45	−3.26	−3.70	−4.23

[1] Nominal quarterly GDP Data in euros obtained from Federal Reserve Bank of St. Louis
[2] Inflation calculated using growth rate of the GDP deflator, also obtained from Federal Reserve Bank of St. Louis

We first notice the differences between crisis and normal times. For the majority of periods, changes in debt-to-GDP are positive during crises and negative during normal times. This finding confirms the first assumption that the debt ratio increases during negative shocks as the government is increasing its expenditures. Fiscal policy, as measured by the net funding requirement, is a positive driver of this change, suggesting the Belgian government ran deficits in these periods, as reported by other sources (World Data, 2023). More importantly, by focusing on the Great Financial Crisis and the COVID-19 crisis, we observe that a positive revaluation of government bonds accompanies an increase in the net funding requirement. This is our main result - a rise in prices negates the ability of the bonds to offer fiscal insurance. Furthermore, the effect of inflation in containing a rise in the debt-GDP ratio is much higher, suggesting that the holding period returns effect is dominated by another factor.

The same argument does not seem to hold for the European sovereign debt crisis. According to our data set, the change in debt was negative and the revaluation term positive, suggesting in fact the potential for fiscal insurance. However, this period immediately follows the Great Financial Crisis, and the effects of the latter on the former might be hard to disentangle. We therefore proceed to take the entire five-year period from 2008 to 2013 encompassing both crises and repeat the analysis, as shown in table 2.

Once again, the role that prices of long bonds play for fiscal insurance is non-existent and in fact, the revaluation of bonds is increasing the debt-GDP ratio. For the entire 2008-2013 period, we see the government running a deficit and the revaluation term accounting for more than half of the change in the debt-GDP ratio: 2.5 percentage points of the 4.54% change. Inflation is the largest driver of the change.

Table 2: Decomposition of changes in debt-GDP

Adjusting for crisis periods

	Start MV debt to GDP	End MV debt to GDP	Change in debt to GDP	Contribution of nominal returns	- of which coupons	- of which revaluation	Contribution of inflation	Contribution of GDP growth	Contribution of new debt
Crisis Times									
2008-2013	30.67	35.21	4.54	4.40	1.91	2.50	−3.27	−1.60	5.01
2020-2020	33.93	40.24	6.30	0.58	0.34	0.24	−0.51	1.82	4.42
Normal Times									
2001-2007	15.45	30.67	15.22	1.86	1.60	0.27	−3.32	−4.09	20.77
2014-2019	35.21	33.93	−1.28	5.86	1.92	3.94	−3.38	−3.81	0.05
2021-2022	40.24	26.95	−13.29	−2.10	0.35	−2.45	−3.26	−3.70	−4.23

5.1 Discussion

Standard debt management literature advocates for the use of almost exclusively long bonds which allow governments to hedge their budget constraints against negative expenditure shocks. The argument exploits the expected negative co-movement of prices and deficits. Our empirical analysis of Belgian Government Debt suggests the opposite – prices of long bonds actually rise during crises, and other economic factors, mainly inflation, play a much bigger role in containing any worsening of debt ratios. These results are in line with those of Ellison and Scott (2020) study of UK debt management, and with those of Faraglia et al. (2008) for a panel of OECD countries. It seems the empirical evidence for the role of long debt in fiscal insurance is limited.

The fact that prices of bonds have been rising, causing the market value of debt to rise at a faster rate than nominal debt, as seen in figure 6, is the main reason the argument for fiscal insurance fails. This automatically begs the question as to why prices of bonds are rising, rather than falling, during periods of financial distress. Although the aim of this paper is not to derive a theory of asset pricing, we can attempt to discuss possible reasons that can help to rationalise our empirical results.

Observing that the trend of faster growth rate of market value accelerates after the Great Financial Crisis, the first plausible explanation is the introduction of quantitative easing and negative real interest rates. The European Central began lowering nominal interest rates on October 2008 with a 50 bps cut from 3.25% to 2.75%.[2] The trend continued well into 2020 with the deposit facility rate reaching a low of -0.50% in 2019[3]. It is a well-known fact there exists an inverse relationship between prices of debt instruments and interest rates. As such, prices of bonds rose after the European Central Bank set interest rates at unprecedented low levels as a response to the crisis. The theoretical models arguing for fiscal insurance assume that interest rates are determined endogenously in the economy as a consequence of individuals´ consumption and demand. But they completely ignore the role of monetary policy and the fact that this element is guiding interest rate movements, and thus, bond prices. Our analysis suggests that the interactions between monetary and fiscal policy may break down

[2]For a detailed description of the ECB´s initial response to the crisis see ECB Monthly Bulletin October 2010 (European Central Bank, 2010)

[3]ECB Key Rates - European Central Bank

the fiscal insurance theory.

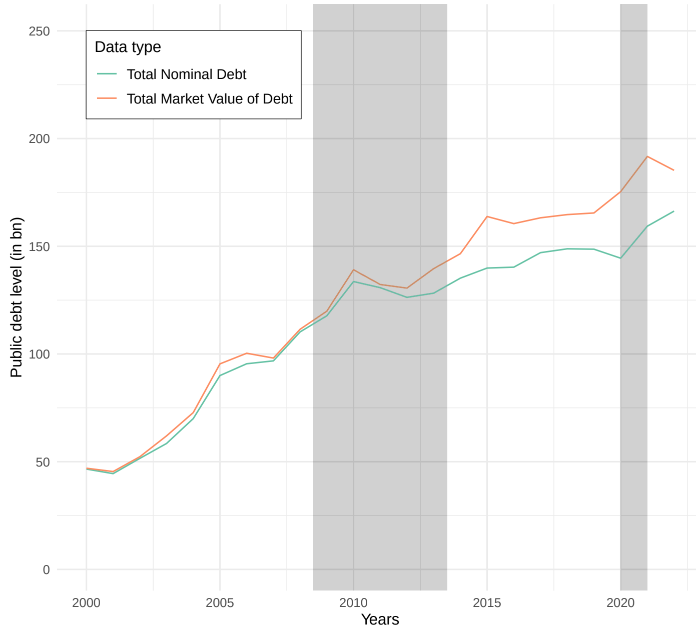

Figure 6: Total Outstanding Debt

Another relevant aspect to point out from our results in table 1 is the positive revaluation term during the European Sovereign Debt Crisis which might at first glance seem like an anomaly. Financial distress periods result in volatile market values for government debt (Bernoth et al., 2012). The nature of sovereign debt crises is different than typical financial crisis because the assets in distress are government bonds, and as such, bond prices fall, representing the increased probability of default. The Eurozone crisis led to a precipitous decline in bond values, propelled by the dual forces of rating downgrades and heightened investor uncertainty, which consequently drove up borrowing costs (Afonso et al., 2012). The crisis may exhibit particularly heterogeneous effects, depending on whether investors believed specific member states to be more significantly exposed to the crisis than others. This, together with the possible spillovers from the financial crisis which motivated our second decomposition, lead us to interpret the results for the Eurozone crisis' effects on Belgian government bond prices with caution.

Yet, if we consider the role of monetary policy again, we can rationalise the result. Beyond the interest rate cuts following the Great Financial Crisis, in the midst of the sovereign debt crisis, the ECB undertook an extensive asset-purchase program famously coined in Mario Draghi´s July 26th 2012 speech when he stated 'Within our mandate, the ECB is ready to do whatever it takes to preserve the euro' (Draghi, 2012). Two months later, in September, the Governing Council of the ECB announced the bank would engage in transactions in the secondary sovereign bond markets. The announcement was key in the development of the Sovereign Debt crisis as it signaled to investors that the ECB would stand behind its member countries, and thus significantly impacted prices of the most distressed debt instruments. Altavilla et al. (2014) find decreases of up to 200 basis points in bond rates of Italy and Spain. In their same study, they find that the impact on bond prices was not homogeneous across Europe, with yields of German and French bonds having remained largely unchanged. We deem a similar dynamic occurred to Belgian bonds. As seen in Figure 7, yields of Belgian debt instruments had been falling long before the announcement, probably responding more to the low rate environment than to the bond-buying program, and do not show major variation following the announcement. However, it is evident from the same figure that the support of the ECB was crucial in maintaining high prices.

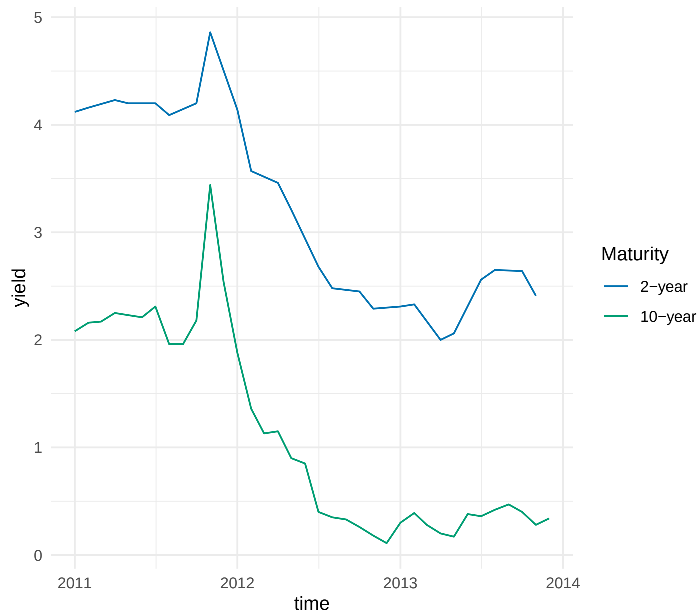

Figure 7: Belgian Government Yields

This more muted response of Belgian government bond prices to the asset purchase program leads us to another, not mutually exclusive, plausible explanation as to why prices of bonds are rising during crisis periods. It could be the case that Belgian government bonds are actually a safe haven compared to other European riskier bonds (Portugal, Italy, Ireland, Greece, and Spain), and to other riskier assets like corporate bonds and stocks. This becomes even more relevant for Belgium for which debt has consistently been rated above A. So, it may be the case that during a crisis investors have moved away from riskier assets to safer government bonds.

6 Limitations

6.1 Database

There are several caveats to the analysis which we shall address in this section. Chiefly, the available data on Belgian bond prices is incomplete. As shown in Figure 8, actual face value of debt, retrieved from the World Bank database, is different from the face value of debt calculated from our database.

An Augmented Dickey-Fuller test on the difference between actual face value and that of our database reveals we cannot reject that the time series of the difference is non-stationary. Thus, the

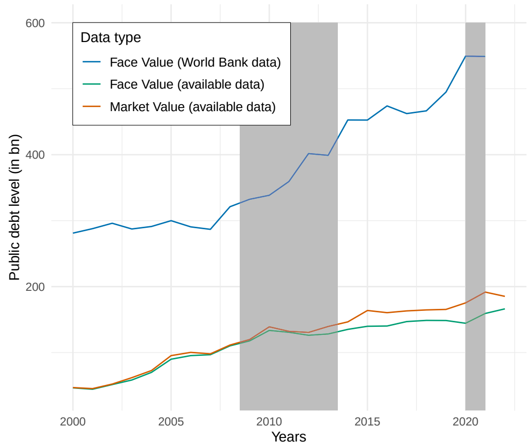

Figure 8: Public Debt Level of database and external source

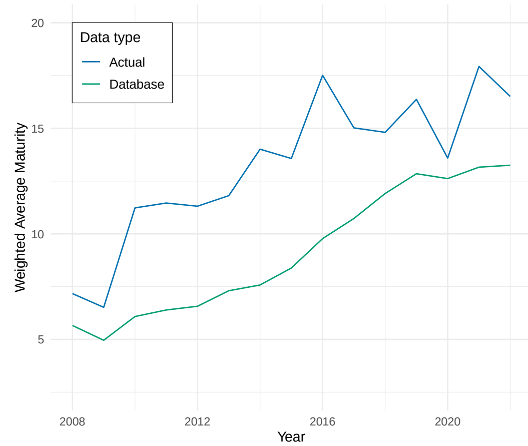

Figure 9: Weighted Average Maturity of database and external source

two series are likely not co-integrated. This is a potential threat to the internal validity of our results. If the series are not co-integrated, results for debt dynamics in periods of financial distress – the focus of our analysis – may differ. The graph shows that there are different public debt developments during crises (shaded areas), which need further analysis.

There are 751 additional bonds reported in Refinitiv Eikon between 2000 and 2022, which could complete the database and raise face value to the World Bank level, thus alleviating some of the structural problems that could cause non-representative results. However, for these ISINs, either price histories are missing partially, or entirely, or there are no reported quantities, all of which impede our calculation. Upon preliminary investigation of potential structural misrepresentation in our data, we find that WAM displays different developments across the analyzed period between our database and data from the Belgian Debt Agency, as shown in figure 9. The corresponding Augmented Dickey-Fuller test, reported in table 3, verifies this deviation, showing no significant evidence for stationarity of the difference between database and actual WAM. Thus, the composition of our database's maturity structure may influence the representativeness of our results due to potential disparities in the outstanding amount and issuance of long and short bonds. Considering that these bonds may exhibit unique price behaviors, it could lead to distinct revaluation terms during periods of financial distress.

Table 3: Results of ADF tests on stationarity

	ADF Statistic	**p-value**	**Alternative Hypothesis**
Difference in Face Value	2.092	0.537	Stationary
Difference in WAM	-1.897	0.611	Stationary

Further, as stated in section 4, we homogenize the database to report EUR as the sole currency, using exchange rates most appropriate to the specific bonds. This step is required for our calculation, but may overlook currency risks. If debt is issued in a foreign currency, this model does not account for the effects of exchange rate movements across the period within which a bond is in circulation.

6.2 Structural Considerations

Given that the database has the potential to be completed, the analysis also assumes that all government debt is marketable, whereas a share of government debt may not be easily traded or marketable. Due to these limitations, we may not have been able to capture debt dynamics entirely.

Moreover, we check for possible sensitivity of our results to changes in the analysed time periods. For the main anaylsis, we decompose the change in debt-GDP from January of the first crisis year to January of the first year after the crisis ended. When we vary the time period - for example by setting the start months of each crisis according to Hobelsberger et al. (2022) - we notice changes in magnitude and, for some specifications, even in sign of the revaluation term and net funding requirement. Under the assumption that our database captures the main dynamics in crises correctly, this poses the question which exact months drive the changes in results. A more comprehensive study of those months may provide further insight into Belgian debt dynamics in periods of financial distress. We conclude that following Ellison and Scott (2020)'s definition of periods of financial distress is most adequate, as it allows for continuity across periods, as well as capturing any irregular market movements before and after the actual crises by extending the analysed periods.

7 Extensions

Whatever the true underlying cause of the rise in prices during crises in the last twenty two years, further work is required to test for fiscal insurance. A starting point would be to extend the study to cover a longer time period, which would allow us to assess if there is indeed a structural break in the data after Quantitative Easing was introduced – it may be that before such time prices of bonds moved differently. New models that incorporate the interactions between fiscal and monetary policy would be a welcomed addition to the existing literature.

Another extension would be to attempt to identify other exogenous shocks on the deficit and study the responses of prices using a Vector Auto-regression approach with a Cholesky-type identification scheme. This would allow us to test for the potential of fiscal insurance beyond the three crises outlined in this paper.

8 Conclusion

Determining the appropriate structure of government debt a country should issue is a challenging task, considering the great uncertainty and unique nature of economic crises. The increase in weighted average maturity of Belgian debt in the past 22 years, particularly after the 2008 Global Financial crisis, motivates empirical testing of fiscal insurance during episodes of financial distress through issuance of long-term bonds. We follow Ellison and Scott's (2018) analysis to decompose changes in debt-GDP ratios and analyze the co-movement of prices and net funding requirement to test the fiscal insurance hypothesis. We construct a novel database of 414 bonds which yields 16,558 observations of monthly prices and quantities. We employ this database to calculate total market value of debt and one-period holding returns of bonds across all maturities. Against the theoretical argument in favour of long-term bonds, our analysis indicates positive co-movement between bond prices and the net funding requirement of the government. We consider monetary policy to be a key driver of interest rates, which in turn affects bond prices. This dynamic seems to be inadequately examined in the existing theoretical models. It could explain why empirical tests, including ours, have indicated a limited role of long bonds for fiscal insurance. We hope that our study sparks a more nuanced analysis of historical debt dynamics in the Eurozone and beyond. In times of extraordinary levels of public debt and debt-GDP, it is vital to consider the debt structure of governments, in order to derive key takeaways for debt managers and enable a sustainable future for government debt.

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A Sample from Constructed Data Base

	ISIN	Year	Month	Coupon	Price	Q
4013	0000316258	2014	2	3.500	103.550	5000000000
4014	0000316258	2014	3	3.500	103.235	5000000000
4015	0000316258	2014	4	3.500	102.950	5000000000
4016	0000316258	2014	5	3.500	102.750	5000000000
4017	0000316258	2014	6	3.500	102.540	5000000000
4018	0000316258	2014	7	3.500	102.240	5000000000
4019	0000316258	2014	8	3.500	101.970	5000000000
4020	0000316258	2014	9	3.500	101.710	5000000000
4106	0000318270	2014	1	3.750	114.470	5000000000
4107	0000318270	2014	10	3.750	119.550	5000000000
4108	0000318270	2014	11	3.750	119.740	5000000000
4109	0000318270	2014	12	3.750	119.845	5000000000
4110	0000318270	2014	2	3.750	114.290	5000000000
4111	0000318270	2014	3	3.750	114.890	5000000000
4112	0000318270	2014	4	3.750	115.550	5000000000
4113	0000318270	2014	5	3.750	116.580	5000000000
4114	0000318270	2014	6	3.750	117.570	5000000000
4115	0000318270	2014	7	3.750	118.405	5000000000
4116	0000318270	2014	8	3.750	119.390	5000000000
4117	0000318270	2014	9	3.750	119.455	5000000000
4233	0000319286	2014	1	2.750	105.285	4000000000
4234	0000319286	2014	10	2.750	103.840	4000000000
4235	0000319286	2014	11	2.750	103.630	4000000000
4236	0000319286	2014	12	2.750	103.405	4000000000
4237	0000319286	2014	2	2.750	105.100	4000000000
4238	0000319286	2014	3	2.750	104.885	4000000000
4239	0000319286	2014	4	2.750	104.715	4000000000
4240	0000319286	2014	5	2.750	104.690	4000000000
4241	0000319286	2014	6	2.750	104.610	4000000000
4242	0000319286	2014	7	2.750	104.440	4000000000

Figure 10: Database sample, showing ISIN, month and year of corresponding price and quantity

B Price Index

To construct the price index, we first divided the bonds into five groups of different maturities:

- < 1 year
- 1-2 years
- 3-7 years
- 8-15 years
- > 15 years

We then proceed to take the weighted average price (weighed by issued amount i.e. quantity) of each month per maturity group. We then keep only observations at the month 12 (December), and calculate yearly returns by taking $\left(\frac{\text{Price}_t}{\text{Price}_{t-1}}\right) \times 100$. The index is set to start at 100 and reflects these returns.