With Age Comes Immaturity: Do Countries with Older Populations Issue Shorter Maturity Debt?

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March 4, 2021

Abstract

Are markets for different maturities of public debt segmented? Recent work suggests so: Countries with older populations face steeper yield curves and issue shorter maturity debt than do younger countries (Guibaud et al. (2013)). Using a new database of public debt maturity and yields for OECD countries, we provide further evidence for these stylized facts and show the change in the degree of segmentation in the public debt markets throughout the years. We find that the eurozone countries are the primary driver of the results: As public debt markets became less segmented following the adoption of the euro, the strong relationship between population age, maturity and yield curve slope disappeared, only to reemerge as the European debt crisis led markets to re-segment.

Keywords: Public Debt, Debt Maturity, Aging, Sovereign Default, Eurozone
JEL Codes: E43, G11, H63

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1. Introduction

Are markets for different maturities of public debt segmented? Modern central banking practice assumes so. During the global financial crisis, the US Federal Reserve (the "Fed") engaged in large-scale asset purchases (LSAP) of long-dated Treasuries aimed at reducing long-term bond yields. Shortly afterwards, a number of advanced economy central banks, including the Bank of England and the European Central Bank (ECB), the Bank of Japan made similar purchases for similar reasons.

Despite the widespread use of these central bank programs, more evidence for segmentation of public debt markets is needed to assess their effectiveness. Some of the most intriguing evidence for the segmentation of public debt markets comes from Guibaud et al. (2013), who document that the governments of countries with older populations issue shorter maturity debt and have steeper yield curves. These findings are consistent with a naive preferred habitat theory and provide suggestive evidence, although not proof of market segmentation by itself.

In this paper, we revisit these stylized facts using a newly constructed database of public debt maturity and yields covering 20 advanced economy countries from 1960 to 2019. We provide further evidence for the finding that countries with older populations face steeper yield curves and issue shorter maturity debt. We also find that the results are mainly driven by the eurozone countries. In the early years of eurozone, with the help of our extended data, we show that the relationship between population age, yield curve slopes, and public debt maturity is particularly strong as the markets for public debt were not well integrated. When the euro was adopted, our findings show that the relationship between population age, yield curve slopes, and the maturity of public debt disappeared, only to reemerge after the eurozone debt crisis as public debt markets disintegrate. Based on this evidence, we argue that recent resegmentation of the public debt markets has allowed central banks to target different clienteles on the yield curve, which improved the effectiveness of the most recent bond-buying programs.

2. Data

We briefly review those sources in this section and provide a detailed discussion of data sources and methods in the Appendix A. Data on the median age of the population from 1960 to 2019 is taken from the 2019 edition of the United Nation's *World Population Prospects*. Data on long-term bond spreads—specifically, the difference between the 10-year bond and 3-month treasury bill rates—is primarily taken from the OECD website.[1] Data on the average maturity of countries' debt stock is combined from several sources including Missale (1999), OECD's *Central Government Debt Statistics*, *Bloomberg*, European Central Bank, the Bank for International Settlements, and the International Monetary Fund, as described in the data appendix.

Following Guibaud et al. (2013), we exclude any country-year observation after 2007 when that country is rated below AA- by Standard and Poors (S&P), which results in the exclusion of all data for Greece and Mexico, together with some observations of Iceland (2007-2019), Ireland (2010-2019), Italy (2006-2019), Portugal (2009-2019), Spain (2012-2019), and Japan (2012-2019).

As shown in Table 1, our database of debt maturity and spread is larger than that used by Guibaud et al. (2013), due to the inclusion of data for earlier years derived from country-specific sources as well as data on years after 2009. This dataset may be of independent interest to researchers.

[1] Guibaud et al. (2013) uses the spread between 30-year and 10-year bonds, but due to lack of 30-year bond returns before 1998, we use the spread between the 10-year bond and 3-month treasury bill.

Table 1: Summary Statistics

Summary Statistics for Median Age, Maturity and Spread										
Country Name	Country Code	Median Age (mean)	Median Age (std.dev.)	Obs	Maturity (mean)	Maturity (std.dev.)	Obs	Spread (mean)	Spread (std.dev.)	Obs
Australia	AUS	32.36	3.66	60	6.39	1.89	46	0.34	1.45	51
Austria	AUT	37.32	3.19	60	6.73	1.42	39	1.07	1.09	30
Belgium	BEL	37.24	2.72	60	6.07	1.87	44	1.00	1.42	60
Canada	CAN	32.89	5.43	60	5.96	1.21	60	0.61	1.35	60
Switzerland	CHE	36.68	3.70	60				0.50	1.45	46
Germany	DEU	38.76	3.94	60	5.47	1.13	53	0.89	1.39	60
Denmark	DNK	36.70	3.24	60	5.18	1.92	42	0.62	1.65	33
Spain	ESP	34.60	4.78	60	5.83	2.83	58	0.95	1.77	40
Finland	FIN	35.83	5.06	60	4.68	0.88	35	0.98	1.46	32
France	FRA	35.70	3.40	60	6.63	0.59	30	1.06	1.30	50
United Kingdom	GBR	36.55	2.13	60	11.93	1.71	57	0.20	1.63	34
Greece	GRC	35.85	4.52	60	7.11	1.02	21	3.71	5.93	23
Ireland	IRL	30.03	3.69	60	8.38	2.36	58	0.96	3.15	36
Iceland	ISL	29.93	4.29	60	4.62	0.94	27			
Italy	ITA	37.69	4.76	60	4.53	1.85	60	1.71	1.50	29
Japan	JPN	36.69	6.91	60	6.42	1.42	30	0.59	0.50	18
Luxembourg	MEX	36.71	1.60	60	5.66	2.52	23			
Mexico	NLD	20.88	4.07	60				1.02	1.10	18
Netherlands	LUX	34.61	4.93	60	8.19	2.62	60	1.06	1.04	38
Norway	NOR	35.68	2.29	60	4.51	1.36	42			
New Zealand	NZL	31.19	4.29	60	4.94	1.17	28			
Portugal	PRT	34.93	5.43	60	5.02	0.99	25	2.25	2.65	27
Sweden	SWE	38.08	2.02	60	3.86	0.96	44	1.01	1.25	33
United States	USA	32.77	3.37	60	4.86	0.85	60	0.77	1.56	56
Total	TOTAL	34.57	5.51	1440	6.19	2.55	942	0.97	1.95	774

This table illustrates the summary statistics of the median age, average maturity, and the spread between 10-year and 3-month bonds of the OECD countries. In the sample, there are 22 countries with maturity data and 20 countries with spread data.

3. Results

In this section, we focus entirely on two dimensions of the relationship between median age and public debt markets: the average maturity of the outstanding stock of public debt and the slope of the long-run part of the yield curve given by the spread between 10-year bond and 3-month Treasury bills.

3.1. Panel Regressions

We begin our analysis by estimating the relationship between the median age and average maturity of the outstanding stock of public debt for different periods. Table 2 and Table 3 present the regression results for the OECD and eurozone countries, respectively. We start our analysis pre-crisis period in Panel B. The results in Panel B of Table 2 and Table 3 imply that there is a strong negative relationship between median age and average maturity. Higher significance and the larger absolute value of the regression coefficient in the eurozone sample implies that the results are mainly driven by the eurozone countries. It may seem surprising at first due to the long convergence efforts culminated in the introduction of the euro. However, the Chinn-Ito financial liberalization index in Figure 1 shows that eurozone financial markets were more segmented than other OECD countries before the 1990s, justifying a stronger relationship between median age and average maturity. Lastly, between effects is significant at the 1% level in the eurozone sample, which also suggests that our results are not driven by a time trend in the median age data but rather by cross-country differences. Comparing these results with Guibaud et al. (2013), we find that the coefficients and their significance are very similar regarding both magnitude and significance.[2]

In Panel A of Table 2 and Table 3, we conduct our analysis with years spanning from 1960 to 1998. In this case, the absolute value of coefficients is larger, especially for the eurozone countries, implying more segmented public debt markets.[3]

[2]See Appendix B.1 for further analysis.

[3]This would have been of potential concern; for all but one country in the sample (Ireland); the median age increases gradually and monotonically over time, indicating that the age variable might be acting as a proxy time trend for secular changes in debt issuance. However, this concern is alleviated as the coefficient of the between effects regression is still significant and larger in absolute terms for the 1960-1998 eurozone sample.

We finalize our regression analysis of median age and maturity using the overall sample between the years 1960-2019. Panel C of Table 2 and Table 3 reports the regression results for the OECD countries and eurozone countries, respectively. These tables illustrate that when we extend the data till 2019, even though the median age coefficient has the same sign as before, it is insignificant. In line with this finding, when we only consider the post-1998 sample in Panel D, the sign of the median age coefficient reverts to positive. These findings show that the clientele effect has disappeared during the 2000s following the integration of sovereign debt markets.

We continue our analysis by estimating the relationship between the median age and spread between 10-year and 3-month government bonds. Table 4 and Table 5 present the regression results for the OECD and eurozone countries, respectively. The results in Panel B of Table 4 and Table 5 show that our findings are in line with the previous analysis: there is a strong positive relationship between median age and spread. Higher significance and the larger value of the regression coefficient in the eurozone sample implies that the results are mainly driven by the eurozone countries. Moreover, between effects is significant at the 1% level in the eurozone sample, which also suggests that our results are not driven by a time trend in the median age data but rather by cross-country differences.[4]

Lastly, the results in Panel A, Panel C and Panel D of Table 4 and Table 5 are in line with the maturity analysis: the value of coefficients is still significant and positive, suggesting segmented public debt markets before the 2000s specifically for the eurozone countries, and when we extend the data till 2019, the median age coefficient becomes smaller implying that public debt markets become more integrated after 2000.

[4]In Appendix B.2 we compare these results with those of Guibaud et al. (2013), using the spread between 30-year and 10-year government bond yields. In these analyses, we find that the magnitude and the significance of coefficients are similar.

Table 2: Regression Results for Maturity and Median Age
OECD Countries

Panel A: Regression Results: OECD Countries (1960-1998)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.283**	-0.197	-0.367***	-0.356***
	(-2.52)	(-1.39)	(-9.53)	(-9.58)
Constant	15.43***	12.37**	18.21***	17.81***
	(4.08)	(2.54)	(14.17)	(13.31)
Number of observations	480	480	480	480
R^2	0.136	0.092	0.166	

Panel B: Regression Results: OECD Countries (1960-2007) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.185**	-0.206	-0.130***	-0.133***
	(-2.18)	(-1.58)	(-5.36)	(-5.56)
Constant	12.30***	12.84**	10.40***	10.26***
	(4.05)	(2.77)	(12.30)	(11.04)
Number of observations	666	666	666	666
R^2	0.081	0.116	0.043	

Panel C: Regression Results : OECD Countries (1960-2019) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.0512	-0.106	0.0157	0.0133
	(-0.70)	(-0.80)	(0.85)	(0.73)
Constant	7.955***	9.716*	5.552***	5.383***
	(2.94)	(2.00)	(8.33)	(6.91)
Number of observations	857	857	857	857
R^2	0.007	0.032	0.001	

Panel D: Regression Results : OECD Countries (1999-2019) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.223***	0.147	0.520***	0.499***
	(2.93)	(0.89)	(12.72)	(12.50)
Constant	-2.468	0.387	-14.16***	-13.35***
	(-0.84)	(0.06)	(-8.80)	(-8.23)
Number of observations	377	377	377	377
R^2	0.064	0.040	0.313	

This table shows the relationship between median age and average maturity in the OECD countries. In all panels, Greece is excluded, together with some observations of Iceland (2007-2019), Ireland (2010-2019), Italy (2006-2019), Portugal (2009-2019), Spain (2012-2019), and Japan (2012-2019). The t- and z-statistics are reported in parentheses. Errors are clustered by country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Regression Results for Maturity and Median Age
Eurozone Countries

Panel A: Regression Results: Eurozone Countries (1960-1998)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.489***	-0.388**	-0.514***	-0.501***
	(-5.33)	(-2.39)	(-8.51)	(-8.91)
Constant	22.30***	19.18***	23.14***	22.98***
	(6.65)	(3.41)	(11.46)	(11.56)
Number of observations	254	254	254	254
R^2	0.395	0.389	0.230	

Panel B: Regression Results: Eurozone Countries (1960-2007) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.301***	-0.379***	-0.183***	-0.206***
	(-3.45)	(-3.51)	(-4.73)	(-5.64)
Constant	16.39***	19.18***	12.29***	13.00***
	(4.89)	(4.95)	(9.09)	(9.73)
Number of observations	351	351	351	351
R^2	0.238	0.577	0.062	

Panel C: Regression Results : Eurozone Countries (1960-2019) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.121	-0.213	-0.0224	-0.0331
	(-1.32)	(-1.79)	(-0.78)	(-1.18)
Constant	10.53**	13.80**	6.966***	7.198***
	(2.93)	(3.14)	(6.63)	(6.55)
Number of observations	442	442	442	442
R^2	0.055	0.263	0.001	

Panel D: Regression Results : Eurozone Countries (1999-2019) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.187*	0.0624	0.479***	0.393***
	(1.86)	(0.56)	(8.42)	(7.56)
Constant	-1.121	3.785	-12.83***	-9.367***
	(-0.28)	(0.86)	(-5.62)	(-4.48)
Number of observations	188	188	188	188
R^2	0.106	0.034	0.287	

This table shows the relationship between median age and average maturity in the eurozone countries. In all panels, Greece is excluded, together with some observations of Iceland (2007-2019), Ireland (2010-2019), Italy (2006-2019), Portugal (2009-2019), Spain (2012-2019), and Japan (2012-2019). The t- and z-statistics are reported in parentheses. Errors are clustered by country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Regression Results for Spread and Median Age
OECD Countries

Panel A: Regression Results: OECD Countries (1960-1998)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0621**	0.0485	0.102*	0.0621**
	(2.90)	(1.29)	(1.96)	(2.24)
Constant	-1.617**	-1.252	-2.956*	-1.617*
	(-2.27)	(-0.96)	(-1.68)	(-1.71)
Number of observations	358	358	358	358
R^2	0.014	0.100	0.011	

Panel B: Regression Results: OECD Countries (1960-2007) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0702***	0.0640**	0.0884***	0.0713***
	(5.67)	(2.43)	(3.15)	(3.76)
Constant	-1.840***	-1.650	-2.480**	-1.882***
	(-4.14)	(-1.73)	(-2.50)	(-2.79)
Number of observations	515	515	515	515
R^2	0.028	0.270	0.020	

Panel C: Regression Results : OECD Countries (1960-2019) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0652***	0.0517**	0.0775***	0.0652***
	(5.66)	(2.77)	(4.36)	(4.93)
Constant	-1.637***	-1.164	-2.087***	-1.637***
	(-3.78)	(-1.67)	(-3.19)	(-3.35)
Number of observations	682	682	682	682
R^2	0.034	0.325	0.028	

Panel D: Regression Results : OECD Countries (1999-2019) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.0154	-0.00318	-0.0773*	-0.0284
	(-0.52)	(-0.10)	(-1.90)	(-1.14)
Constant	1.666	1.212	4.130**	2.192**
	(1.36)	(1.00)	(2.55)	(2.20)
Number of observations	324	324	324	324
R^2	0.002	0.001	0.012	

This table shows the relationship between median age and spread in the OECD countries. In all panels, Greece and Mexico are excluded, together with some observations of Ireland (2010-2019), Italy (2006-2019), Portugal (2009-2019), Spain (2012-2019), and Japan (2012-2019). The t- and z-statistics are reported in parentheses. Errors are clustered by country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Regression Results for Spread and Median Age
Eurozone Countries

Panel A: Regression Results: Eurozone Countries (1960-1998)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.128**	0.124**	0.0919	0.128**
	(2.77)	(2.55)	(0.98)	(2.51)
Constant	-3.786*	-3.777*	-2.540	-3.786**
	(-2.24)	(-2.21)	(-0.78)	(-2.13)
Number of observations	192	192	192	192
R^2	0.032	0.448	0.005	

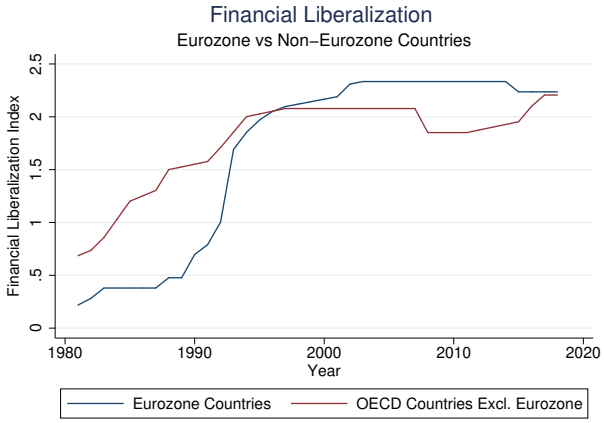
Panel B: Regression Results: Eurozone Countries (1960-2007) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0918**	0.0961***	0.0860**	0.0918***
	(2.90)	(3.47)	(1.97)	(3.01)
Constant	-2.508*	-2.691**	-2.299	-2.508**
	(-2.08)	(-2.67)	(-1.46)	(-2.27)
Number of observations	280	280	280	280
R^2	0.032	0.602	0.014	

Panel C: Regression Results : Eurozone Countries (1960-2019) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0691**	0.0789***	0.0663**	0.0691***
	(2.29)	(4.56)	(2.48)	(3.31)
Constant	-1.679	-2.071**	-1.575	-1.679**
	(-1.47)	(-3.20)	(-1.57)	(-2.14)
Number of observations	359	359	359	359
R^2	0.030	0.722	0.017	

Panel D: Regression Results : Eurozone Countries (1999-2019) (Excluding High-Risk Country-Year Observations)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.0473*	-0.0275	-0.0677	-0.0473*
	(-2.18)	(-1.02)	(-1.38)	(-1.84)
Constant	3.087***	2.315*	3.907*	3.087***
	(3.55)	(2.15)	(1.97)	(2.97)
Number of observations	167	167	167	167
R^2	0.020	0.115	0.012	

This table shows the relationship between median age and spread in the eurozone countries. In all panels, Greece and Mexico are excluded, together with some observations of Ireland (2010-2019), Italy (2006-2019), Portugal (2009-2019), Spain (2012-2019), and Japan (2012-2019). The t- and z-statistics are reported in parentheses. Errors are clustered by country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figure 1: Financial Liberalizaton



This graph shows the unweighted average Chinn-Ito Index for eurozone countries and non-eurozone OECD countries.

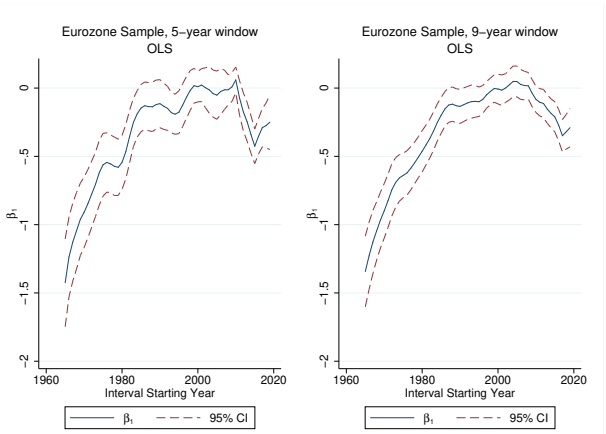
3.2. Rolling Window Regressions

We continue our analysis with rolling-window regressions to understand the evolution of market segmentation. Figure 2 plots the coefficients from a series of regressions of average maturity on median age for rolling 5- and 9-year windows, along with the 5% confidence interval. Figure 2a is constructed using the whole eurozone sample, while in Figure 2b, we exclude the high-risk country-year observations. In both figures, at the beginning of the sample, the negative relationship between age and maturity is clear, as is the fact that this relationship weakens as we approach the year 2000 and the formation of the eurozone. Interestingly, the point estimate for the relationship turns negative again in the years after the eurozone debt crisis. Moreover, comparing the results in Figure 2a and Figure 2b after 2013 indicates that the high-risk countries drive the reemergence of the negative relationship as these countries become more isolated from the financial markets.

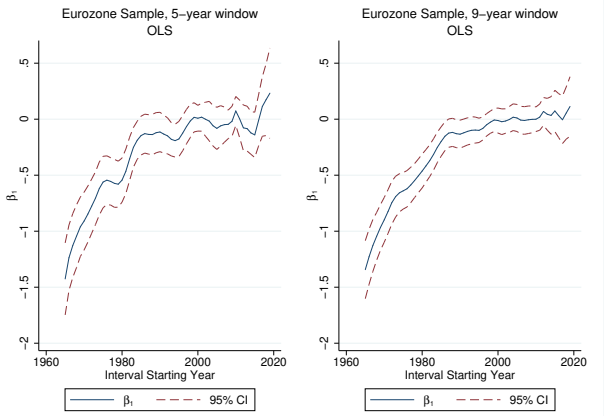
We continue our rolling-window analysis with the spreads illustrated in Figure 3. In line with our findings in Figure 2, in Figure 3, at the beginning of our time series, the positive relationship between age and spread is significant in the 5-year-window regressions, as is the fact that this relationship weakens significantly before the 1980s, reemerges during the early 1990s, and becomes insignificant as we approach the year 2000 amid the formation of the eurozone. Interestingly, in the 5-year-window regressions, the point estimate for the median age turns positive again in the years after the eurozone debt crisis. Moreover, in Figure 3a,

as compared to Figure 3b, the point estimate for the median age becomes significant after the eurozone debt crisis confirming our previous findings that the high-risk countries drive the reemergence of the positive relationship as these countries become more isolated from the financial markets.

Figure 2: Evolution of Regression Coefficient β_1
OLS Regression Results for Average Maturity (Eurozone Countries)



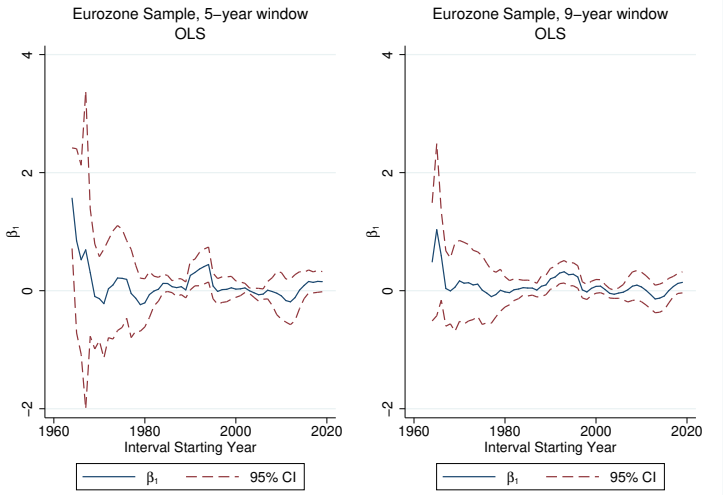
(a) Eurozone Countries



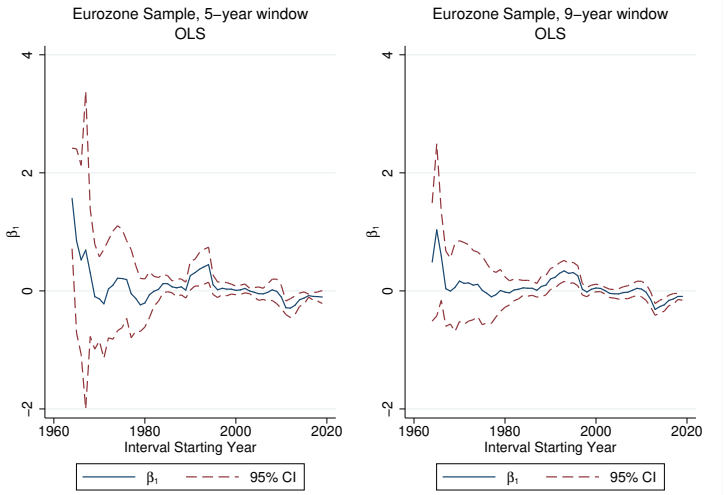
Eurozone Countries
(b) (Excluding High-Risk Country-Year Observations)

Notes: This graph shows the evolution of the coefficient β_1 for rolling-window regressions of maturity on median age for the eurozone countries. The blue line displays the point estimate of the coefficient while the red lines illustrate the 5% coefficient interval. The left panel is with respect to the regressions on a 5-year rolling window while the right panel is with respect to a 9-year rolling window.

Figure 3: Evolution of Regression Coefficient β_1
OLS Regression Results for Spread (Eurozone Countries)



(a) Eurozone Countries



Eurozone Countries
(b) (Excluding High-Risk Country-Year Observations)

Notes: This graph shows the evolution of the coefficient β_1 for rolling-window regressions of spread on median age for the eurozone countries. The blue line displays the point estimate of the coefficient while the red lines illustrate the 5% coefficient interval. The left panel is with respect to the regressions on a 5-year rolling window while the right panel is with respect to a 9-year rolling window.

4. Conclusion

Following Guibaud et al. (2013), we document an overall negative relationship between median age and average maturity and an overall positive relationship between median age and spreads of government debt with the help of more comprehensive data. Moreover, we show that this relationship is mainly driven by eurozone countries and is not monotone: for average maturity, it is negative before the 2000s due to more segregated eurozone debt

markets, insignificant between 2000 and 2010 after eurozone integration, becoming negative again after 2010 due to European debt crisis. For spread, it follows a similar pattern: it is positive before the 2000s due to strong clientele effect, insignificant between 2000 and 2010 as the share of nonresident investors increases, becoming positive again after 2010 due to resegmentation of the markets. This behavior is particularly evident for the countries with high credit risk, which is in line with the degree of these countries' financial openness.

Acknowledgements

We would like to thank Stéphane Guibaud for sharing the yield spread data and Alessandro Missale for sharing the maturity data.

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Online Appendix (Not for Publication)

A. Data Sources

A.1. Sovereign Debt Maturity

Numerous sources of data on the maturity of government debt are in existence. These sources differ in significant ways with respect to issuer coverage (central government versus general government debt), debt type coverage (government bonds and/or government bills and/or other nonmarketable debts), and measurement (residual versus initial maturity versus duration). Based on data availability, we have attempted to assemble data series on the weighted-average residual maturity of total marketable central government debt. In some cases, we have had to interpolate gaps in the data using other data sources (for example, weighted-average residual maturity of government bond debt, or of total debt), although our analysis of periods where there is overlapping data suggests that this is not a significant concern. Our data is annual and corresponds to the stock of debt at the end of a calendar year whenever possible.

Bearing these issues in mind, there are six main sources of cross-country data on the maturity of a government's debt. The first source is Bloomberg, which measures the weighted-average residual maturity of debts in their database issued by the central government of a country. The debts include both bonds and bills and thus would seem to best approximate the marketable stock of debt. These data have only been available since 2010.

A second source is the International Monetary Fund's *Fiscal Monitor* publication, which contains data on the residual maturity of a country's debt since 2010. The IMF list their source as Bloomberg "for most countries". A comparison with data downloaded from Bloomberg reveals small but significant differences in the data, with Bloomberg data tending to show a slightly lower maturity. Corsetti et al. (2013) suggest that this may be due to the inclusion of bank loans and other nonmarketable debts in the IMF data that are not counted by Bloomberg, a broader coverage of the government sector in the IMF's data, and different accounting treatments. As a result, we treat this data source as separate from Bloomberg.

The third source is the OECD's now discontinued *Central Government Debt Database*

which contains data from 1990 to 2010 on the weighted-average residual term to maturity for domestic, foreign and total debt owed by a country's central government. Data is also available for the central government's marketable debt, which is defined by excluding savings bonds, loans from some international institutions, other direct loans, and private bond placements. In many cases, the total and marketable debt data series are identically or approximately equal and are available for the same time periods. For some countries and some time periods, the online database is missing data or contains data that is rounded to zero decimal places. Where available, we have used data from the printed version of the OECD's *Central Government Debt Statistics* yearbook instead.

The fourth source is the ECB's *Debt Securities Issuance and Service by EU Governments* report which contains data on average residual maturity for total central government debt and for debt subject to the Maastricht treaty for European countries. The database is restricted to government debt securities issued with an International Securities Identification Number (ISIN) which may exclude some domestic and short term debt. We collect data on total central government debt and take the figures for the month of December each year (using the annual option in the database gives an average for the entire year). Some of the ECB data is rounded to integer numbers; we use these data only when all other options have been exhausted.

The fifth source is the BIS's *Debt Securities Statistics* which presents data on the average residual term to maturity for marketable central government debt. These data start for some countries as early as 1995 and are annual.

The sixth source of cross-country data is Missale (1999) , who assembled data from a range of country-specific sources for the period 1960 to 1995. Although there are some differences across countries resulting from differences in data availability, the series of Missale (1999) on average maturity are typically constructed for debt in the hands of the public (excluding central bank holdings) owed by the central government. Different measures are available for different countries. We typically focus on measures of conventional maturity, filling gaps with series on the maturity of fixed-rate debt when available. We typically do not use data on effective maturity (in which Missale (1999) sets the maturity of indexed and foreign currency debts to zero).

In addition to the cross country sources, there are numerous country-specific sources available, especially for later periods.

As a general rule, given that many data series are restricted to marketable securities, we started with OECD data on the weighted-average residual maturity of marketable government debt, and extrapolated forward in time using a mixture of ECB, BIS, IMF, and Bloomberg data. We always chose the data series closest in conception to the OECD series. We use data in Missale (1999) to extrapolate backwards in time. There were many exceptions to this general rule. Each of these exceptions, along with uses of country-specific data, is detailed in the country notes below.

As a general rule, we use data in the following order of priority (although there are numerous exceptions):

1. OECD data on marketable central government debt
2. OECD data on total central government debt
3. ECB total central government debt
4. ECB Maastricht debt
5. BIS data
6. Bloomberg
7. IMF Fiscal Monitor
8. Missale CON.MAT, then CON.TOT, CON.BOND, CON.GP, FIX.MAT, FIX.BOND in order
9. Country-specific sources on maturity
10. Missale (1999) EF.MAT
11. Country-specific sources on duration
12. Missale (1999) TOT.DUR, then FIX.DUR

Australia

OECD data on marketable central government debt was used for 1980 to 2010. This was extended back to 1974 using the conventional maturity series from Missale (1999) and extended forward to 2019 using data from Bloomberg.

Austria

OECD data on marketable central government debt is rounded to zero decimal places prior to 2003. Hence, OECD marketable debt series was used for 2003 to 2010. Data from the printed publication is not rounded and so is used from 1981 to 1998 (the entry for 1980 was zero maturity and was discarded). The years between come from the OECD series for total debt from 1998 to 2003. Lastly, the data were extended forward to 2019 using the end-of-year data provided by the ECB.

Data from the Austrian Fiskal Advisory Council (FiskalRat) on the residual maturity of federal debt from 1998 to 2015 from their *Statistical Annex of the Austrian Report on Public Finances 2015-2017* coincided with the other sources and was not directly used (https://www.fiskalrat.at/dam/Annex-2018).

Belgium

OECD data on marketable debt is not available, and so the series for total debt was used from 1999 to 2010. This was extrapolated forward to 2019 using ECB data on total marketable debt. The data were extrapolated backward to 1995 using the ECB series on Maastricht debt and then further to 1990 using the ECB series on total debt calculated as a year average (these data are missing between 1995 and 1997). Lastly, the data were extrapolated backward to 1977 using the series on conventional maturity of total debt from Missale (1999).

The National Bank of Belgium also produces a series on the average maturity of the consolidated gross debt of the general government from 1995 to the present (https://stat.nbb.be/Index.aspx?DataSetCode=CGDHCM#). As this does not line up with the rest of our data which refers to the central government, these data were not incorporated.

Canada

The OECD data on marketable debt before 1993 for Canada is rounded to zero decimal places. The Bank of Canada reports data on the average residual term to maturity of government of Canada direct securities in its *Banking and Financial Statistics* publication Table G.6 (see http://www.bankofcanada.ca/publications/bfs/) from 1994 to the

present online. These data appear to line up exactly with the OECD data but are less rounded. As a result, we use the Bank of Canada data from 1994 to the present, extrapolating back to 1981 using the OECD series on marketable debt from the printed publication, and then back to 1960 using data on conventional maturity from Missale (1999).

Denmark

OECD data on marketable debt was used from 1990 to 2010. This was extrapolated forward to 2019 using data from the ECB on using end-of-the-year data from the ECB. The data were then extrapolated back to 1978 using data on conventional maturity from Missale (1999).

Finland

OECD data on marketable debt was only available from 2002 to 2010. This was extended back to 1990 using data on total debt, and then further extended back to 1985 using the maturity of fixed rate debt series from Missale (1999). These data were then extrapolated forward to the present using the ECB's year-end series.

France

OECD data on marketable debt before 1995 is rounded to zero decimal places. Hence we use the marketable debt series for 1995 to 2010, and extrapolate back to 1992 using the OECD series on total debt and to 1990 using the conventional maturity data from Missale (1999). This was extrapolated forward to 2019 using the ECB end-of-year series

Germany

OECD data on marketable debt is rounded to zero decimal places prior to 2002, and so we use the marketable debt series only from 2002 to 2010. This is extrapolated back to 1990 using the OECD series on total debt, and then further back to 1967 using the Missale (1999) data on conventional maturity of long-term debt. These data were then extrapolated forward to 2019 using the ECB end-of-year series.

Greece

OECD data on marketable debt is missing, and so we use the OECD series on total debt from 2003 to 2010. This is extrapolated back to 1999 using data from the Greek Public Debt Management Agency (http://www.pdma.gr/en/public-debt-strategy/public-debt/historical-characteristics/weighted-average-maturity). These data are then extrapolated forward to 2019 using the ECB end-of-year series. Note that the Bloomberg series, the PDMA series, and the ECB Maastricht series, all show much larger increases in maturity in recent years because they include offical debt restructurings in which maturities were lengthened significantly. We exclude these debts as many are not marketable. The fact that the different series disagree wildly, and the fact that the maturity extensions were the result of a restructuring and not the result of issuance into the market lead us to drop Greek data in most cases after 2011.

Iceland

We use the OECD data on marketable debt from 1993 to 2010, noting that data prior to 2002 are rounded to zero decimal places. For the period 1993 to 1999, unrounded data is available from the printed publication and is used instead. In extrapolating forward to 2019, there are extremely large differences between the IMF data (which shows a dramatic rise in maturities in the most recent 3 years) and data from Bloomberg (which shows no such increase). We use the Bloomberg data since it appears more closely aligned with overall data on marketable debt, but typically omit data for Iceland for this period from the analysis as the maturity extensions are not associated with issuance in normal market conditions.

Ireland

We use OECD data on marketable debt from 1998 to 2010 and extrapolate forward to 2019 using end-of-year data from the ECB. No data is available for 1996 and 1997. Data from 1960 to 1995 is taken from Missale (1999) conventional maturity series. In 1974 Missale (1999) data switches from being a start-of-year series (up to and including 1974) to an end-of-year series (starting with and including 1974). Prior to 1974, we treat the start of 1974

as representing the end of 1973 and so on, giving us a data series that begins in 1959.[5]

To fill the gap for 1996 and 1997, we computed estimates of the maturity structure of Irish domestic debt (roughly 60 percent of outstanding debt) using data on the maturity profile of debts depicted in various issues of the *Annual Report of the National Treasury Management Agency* (http://www.ntma.ie/).

Italy

We use OECD data on marketable debt from 1980 to 2010. This is extrapolated back to 1960 using the conventional maturity series from Missale (1999). The data were then extended forward to 2019 using the end-of-year series from the ECB.

Japan

We use OECD data on marketable debt from 1998 to 2009 and extrapolate back to 1990 using OECD data on total debt. Note that the data on total debt in the OECD database appear to have been mistakenly lagged one period, and we correct for this in our calculations (that is, the data reported for 1989 should be for 1990). These data are then extrpolated forward to 2019 using data from Bloomberg.

Luxembourg

The OECD data on marketable and total debt coincide from 1997 to 2005 and differ significantly in 2006-2007, with the marketable debt series stopping in 2007. As a result, we focus on the larger category of total debt which is also available the longest from 1997 to 2010, even though it is rounded to zero decimal places prior to 2002. From 2009 to 2019 we use data from the ECB end-of-year series.

OECD data from the printed publication that is less rounded is available for 1997 and 1998, although it seems to disagree with the rounded data in the database. As a result, it is not incorporated.

[5] We use the observations starting from 1960.

Netherlands

The OECD data on marketable debt between 1991 and 2003 is rounded to zero decimal places. Hence, we use it for 2004 to 2010 and use the series for total debt to extrapolate back to 1992. These data are then extrapolated back to 1960 using the conventional maturity series from Missale (1999). The data are extrapolated forward to 2019 using data from the ECB. We first use year-average data to 2013, as this lines up exactly with the OECD data and then use end-of-year data until 2019.

New Zealand

OECD data on marketable central government debt was used for 1992 to 2010. This was extended forward to 2019 using data from Bloomberg.

A series on the residual maturity of government bonds (but excluding bills) from the New Zealand Debt Management Office was also available from 2000 to the present but was not used.

Norway

We use OECD data on marketable debt from 1982 to 1992 and again from 1997 to 2010. Data between 1993 and 1996 inclusive are missing from the online database and are replaced with data from the printed publication. These data are extrapolated forward to 2019 using data from Bloomberg. The data are then extrapolated back to 1978 using data on the average residual maturity of government bonds (but not bills) provided by the Debt Management Office of the Norges Bank.

Portugal

OECD data on marketable debt is not available, and so we use the OECD series on total debt from 1996 to 2010. This is extrapolated forward to 2019 using the end-of-year series from the ECB. The ECB series for Maastricht debt goes back to 1995, and so we use it to extrapolate the data back to 1995. The Bloomberg data for Portugal differs significantly from the ECB and IMF series, and so we experiment with dropping Portuguese data in some cases.

Spain

OECD data on marketable debt are used from 1980 to 2010. These are extrapolated forward to 2019 using the end-of-year data from the ECB, and are extrapolated back to 1962 using the maturity of fixed rate series from Missale (1999).

Sweden

OECD data on the maturity of marketable debt is missing, while data on total debt is missing between 2000 and 2005 inclusive. As a result, we use the OECD series on total debt for 1990 to 1999 and from 2006 to 2010. The data are extrapolated backwards to 1976 using the Missale (1999) series on conventional maturity. The data are extrapolated forward to 2019 using the ECB end of year series.

The Riksgalds Kontornet (Swedish National Debt Office) makes available data on the maturity of subcomponents of Swedish debt on a monthly basis from 2001 to the present (see https://www.riksgalden.se/fi/For-investors/Borrowing-and-the-government-debt/Central-government-debt-details/Maturity-measures/). The series for government bonds suggests a consistency higher maturity than the sources from OECD, ECB, IMF and Bloomberg (although closer in magnitude to the data from Missale (1999)). As a result, we de-emphasize these data using them only to extrapolate between 2001 and 2006. There is no data available for 2000.

To fill in data for 2000, we use movements in the duration of cental government debt from the 2003 Annual Report of the Swedish National Debt Office (see page 7 at https://www.riksgalden.se/Dokument_eng/press/reports/annual-reports/).

United Kingdom

OECD data on marketable central government debt was used for 1998 to 2010. This was extended forward to 2019 using the end-of-year data from ECB. Data on conventional maturity from Missale (1999) was used for 1963 to 1996. Data for 1997 came from the UK Debt Management Office Gilt Review for 1997-98 (http://www.dmo.gov.uk/documentview.aspx?docname=publications/annualreviews/gar9798.pdf&page=Gilt_Review) where we used the geometric average of the growth between 1996 and 1997, and between

1997 and 1998, to interpolate the value for 1997.

United States

OECD data on marketable central government debt was used for 1980 to 2010. This was extended back to 1960 using the maturity of fixed rate debt series (the only series available) from Missale (1999) and extended forward to 2019 using data from Bloomberg.

A.2. Spread Data

We use two sets of data in our analysis. The first set of data consists of spread between the 10-year and 3-month government bonds using the OECD website. This dataset is more extensive prior to 1998 so that we can use it for our main panel and rolling-window regressions.

The second dataset is created by calculating the spread between 30-year and 10-year government bonds and is used to replicate Guibaud et al. (2013). Following Guibaud et al. (2013), we use Global Financial Data (GFD) to obtain the spreads between 30-year and 10-year bonds. We extend the data forward to 2019. Even though we use the same sources, there are still some discrepancies between our data and Guibaud et al. (2013). Table A1 summarizes the data availability and the comparison of 30-year and 10-year bond yields with those of Guibaud et al. (2013). Based on this data, we obtain spreads for the countries listed in Table A1. Summary statistics are shown in Table A2

Table A1: Availability of 30-year and 10-year Bond Yield Data

Country Code	30-year Bond Data Availability	30-year Bond Comparison w/ Guibaud et al. (2013)	30-year Bond Data Source	10-year Bond Data Availability	10-year Bond Comparison w/ Guibaud et al. (2013)	10-year Bond Data Source
AUS	2016-2019	Missing in Guibaud et al. (2013)	Bloomberg	1999-2019	Matches with Guibaud et al. (2013)	Bloomberg
AUT	1999-2019	Missing in Guibaud et al. (2013)	Bloomberg	1999-2019	Matches with Guibaud et al. (2013)	Bloomberg
BEL	1998-2019	Matches with Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD
CAN	1976-2019	Matches with Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD
DNK	2008-2019	Missing in Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD
FIN	2013-2019	Missing in Guibaud et al. (2013)	Bloomberg	1993-2019	Matches with Guibaud et al. (2013)	Bloomberg
FRA	1990-2019	Matches with Guibaud et al. (2013)	Bloomberg	1990-2019	Matches with Guibaud et al. (2013)	Bloomberg
DEU	1988-2019	Matches with Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD
GRC	2005-2012, 2015-2016	Missing in Guibaud et al. (2013)	GFD	1981-2019	Matches with Guibaud et al. (2013)	GFD
IRL	2015-2019	Missing in Guibaud et al. (2013)	Bloomberg	1960-2019	Matches with Guibaud et al. (2013)	Bloomberg
ITA	1993-2019	Matches with Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD
JPN	1999-2019	Matches with Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD
MEX	2006-2019	Matches with Guibaud et al. (2013)	GFD	2001-2019	Matches with Guibaud et al. (2013)	GFD
NLD	1999-2019	Missing in Guibaud et al. (2013)	Bloomberg	1999-2019	Matches with Guibaud et al. (2013)	Bloomberg
PRT	2006-2019	Missing in Guibaud et al. (2013)	Bloomberg	1999-2019	Matches with Guibaud et al. (2013)	Bloomberg
ESP	1998-2019	Matches with Guibaud et al. (2013)	Bloomberg	1998-2019	Matches with Guibaud et al. (2013)	Bloomberg
SWE	2009-2016	Missing in Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD
CHE	1998-2019	Matches with Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD
GBR	1960-2016	Matches with Guibaud et al. (2013)	GFD	1960-2016	Matches with Guibaud et al. (2013)	GFD
USA	1960-2019	Matches with Guibaud et al. (2013)	GFD	1960-2019	Matches with Guibaud et al. (2013)	GFD

This table summarizes the data availability of 30-year and 10-year bond yields in our sample obtained from the Global Financial Data and Bloomberg. The second and the fifth columns report the time interval for which yield data is available for each country. The third and the sixth columns compare our dataset with Guibaud et. al (2013).

Table A2: Summary Statistics

Summary Statistics for Spread				
Country Name	Country Code	Spread (mean)	Spread (std.dev.)	Obs
Australia	AUS	0.71	0.23	4
Austria	AUT	0.57	0.27	21
Belgium	BEL	0.63	0.30	22
Canada	CAN	0.37	0.24	44
Switzerland	CHE	0.63	0.58	22
Germany	DEU	0.50	0.37	32
Denmark	DNK	0.49	0.41	12
Spain	ESP	0.71	0.36	22
Finland	FIN	0.67	0.09	8
France	FRA	0.60	0.31	30
United Kingdom	GBR	-0.10	0.83	57
Greece	GRC	-1.06	7.14	10
Ireland	IRL	0.95	0.12	5
Italy	ISL	0.53	0.54	27
Japan	ITA	0.69	0.77	21
Mexico	JPN	0.67	0.41	14
Netherlands	MEX	0.51	0.21	21
Portugal	NLD	0.49	1.35	14
Sweden	LUX	0.66	0.22	8
United States	NOR	0.25	0.47	60
Total	NZL	0.40	1.18	454

This table illustrates the summary statistics of the spread between 30-year and 10-year bonds of the OECD countries. In the sample, there are 20 countries with spread data.

A.3. Sovereign Debt Holdings Share for the Nonresidents

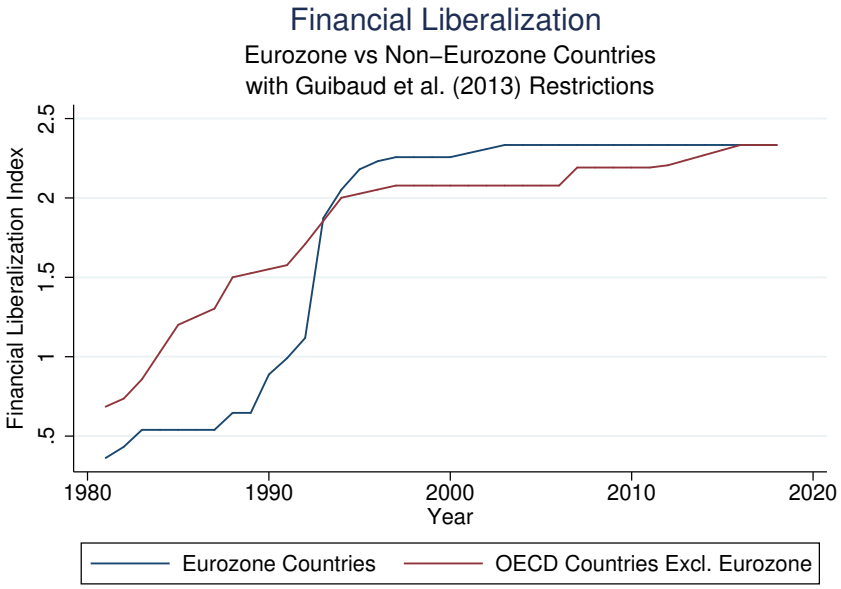
We use Bruegel database of sovereign bond holdings developed in Merler and Pisani-Ferry (2012) in order to create a measure for financial integration. Specifically, we calculate the share of nonresidents' holdings in the sovereign bond market. The data is available for Belgium, Finland, France, Germany, Greece, Ireland, Italy, Spain, Portugal, Netherlands, UK, and US. Moreover, the nonresident debt holdings data starts in late 1990s and is available till 2019 for all countries except Belgium where the most recent data for Belgium is 2017. In order to calculate the share of nonresident debt holdings we divide the nonresident debt investment by the total sovereign debt debt and calculate the percentage of nonresident investment in the sovereign bond market.

A.4. Financial Liberalization

We use unweighted average of Chinn-Ito Index for eurozone countries and non-eurozone OECD countries for which the index data is available. Figure 1 illustrates that the financial liberalization was more rapid in the eurozone countries between years 1990-2000 and the disparity stayed constant till the 2008 financial crisis. After 2008, non-eurozone OECD countries experienced a decline in financial openness which is followed by a rebound after 2015. However, in the eurozone, financial openness declined after the eurozone debt crisis and stayed at the lower levels in the years following 2015.[6]

[6]Note that in Figure A1, the financial openness does not change after the 2008 financial crisis and eurozone debt crisis, which is due to the exclusion of Ireland, Italy, Portugal, Spain and Japn.

Figure A1: Financial Liberalization
with Guibaud et al. (2013) Restrictions



This graph shows the unweighted average Chinn-Ito Index for eurozone countries and other OECD countries using Guibaud et al. (2013) restrictions. In this case Greece is excluded, together with some observations of Ireland (2010-2019), Italy (2006-2019), Portugal (2009-2019), Spain (2012-2019), and Japan (2012-2019).

B. Comparison with Guibaud et al. (2013)

In order to compare our results with those of Guibaud et al. (2013), we first create maturity and spread datasets to use as benchmarks that replicate the descriptive statistics and number of observations of Guibaud et al. (2013) as closely as possible and call it "Guibaud et al. (2013) Data". Moreover, we also apply the restrictions used in Guibaud et al. (2013).[7] Since Guibaud et al. (2013) includes observations between the years 1960 and 2009, we rerun our regressions within this time frame.

B.1. Maturity

Panel A of Table A3 shows the results using "Guibaud et al. (2013) Data", while Panel B shows the results using our extended dataset.

Comparing Panel A of Table A3 with Panel B of Table 3 in Guibaud et al. (2013),

[7]Specifically, they exclude any country-year observation after 2007 when that country is rated below AA- by Standard and Poors (S&P).

it can be seen that the results are very close to each other, implying that the "Guibaud et al. (2013) Data" does a good job in replicating the original dataset. Next, comparing Panel B of Table A3, with Panel A of Table A3, we see that with the extended data, the coefficient of the OLS regression becomes less significant but has the same sign. In contrast, the significance of other regression results does not change.

We continue our analysis with the eurozone subsample. Guibaud et al. (2013) does not consider the eurozone subsample; however, to understand the underlying sources of segmentation, it is essential to examine how regression coefficient change when we restrict the sample to the eurozone countries. Panel A and Panel B of Table A4 show that the coefficient of median age is larger in absolute value and more significant for both the 'Guibaud et al. (2013) Data" and our data with Guibaud et al. (2013) restrictions. This implies that the regression results in Table A3 are mainly driven by the eurozone countries.

Table A3: Regression Results for Maturity and Median Age
OECD Countries (1960-2009)

Panel A: Regression Results: OECD Countries (1960-2009) (Guibaud et al. (2013) Data)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.175**	-0.180	-0.153***	-0.154***
	(-2.27)	(-1.38)	(-6.44)	(-6.59)
Constant	12.02***	11.87**	11.27***	10.95***
	(4.56)	(2.54)	(13.64)	(11.90)
Number of observations	649	649	649	649
R^2	0.074	0.091	0.062	

Panel B: Regression Results : OECD Countries (1960-2009) (Our Data with Guibaud et al. (2013) Restrictions)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.161*	-0.181	-0.108***	-0.110***
	(-1.97)	(-1.37)	(-4.74)	(-4.91)
Constant	11.50***	12.01**	9.662***	9.504***
	(3.93)	(2.56)	(12.12)	(10.71)
Number of observations	703	703	703	703
R^2	0.064	0.090	0.032	

This table shows the relationship between median age and average maturity in the OECD countries. In Panel A, we create a new dataset that has the same summary statistics with those of Guibaud et al. In Panel B, we use our data with the data restrictions of Guibaud et al. (2013). In this case, Greece is excluded, together with some observations of Iceland (2007-2009), Italy (2006-2009), and Portugal (2009). The t- and z-statistics are reported in parentheses. Errors are clustered by country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: Regression Results for Maturity and Median Age
Eurozone Countries (1960-2009)

Panel A: Regression Results: Eurozone Countries (1960-2009) (Guibaud et al. (2013) Data)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.285***	-0.376**	-0.192***	-0.206***
	(-4.34)	(-3.03)	(-5.25)	(-5.90)
Constant	15.76***	18.78***	12.51***	12.77***
	(6.84)	(4.21)	(9.82)	(9.83)
Number of observations	347	347	347	347
R^2	0.241	0.504	0.076	

Panel B: Regression Results : Eurozone Countries (1960-2009) (Our Data with Guibaud et al. (2013) Restrictions)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	-0.270**	-0.352**	-0.159***	-0.178***
	(-3.11)	(-3.20)	(-4.49)	(-5.26)
Constant	15.40***	18.33***	11.52***	12.08***
	(4.59)	(4.62)	(9.20)	(9.62)
Number of observations	370	370	370	370
R^2	0.209	0.532	0.053	

This table shows the relationship between median age and average maturity in the eurozone countries. In Panel A, we create a new dataset that has the same summary statistics with those of Guibaud et al. In Panel B, we use our data with the data restrictions of Guibaud et al. (2013). In this case, Greece is excluded, together with some observations of Italy (2006-2009), and Portugal (2009). The t- and z-statistics are reported in parentheses. Errors are clustered by country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

B.2. Spread

Panel A of Table A5 shows the results using "Guibaud et al. (2013) Data" with 30-year and 10-year spreads, Panel B shows the results using our extended dataset with 30-year and 10-year spreads, and Panel C includes the results using our dataset with 10-year and 3-month spreads.

Comparing Panel A of Table A3 with Panel A of Table 3 in Guibaud et al. (2013), it can be seen that the results are very close to each other, implying that the "Guibaud et al. (2013) Data" does a good job in replicating the original dataset. Next, Panel B of Table A5 illustrates that the coefficient of all the regression has the same significance and sign with

Panel A.

In Panel C of Table A5, we use the spread between 10-year and 3-month bonds. In this case, the coefficient for median age is larger than Panel B and Panel A, and has the same significance. However, the coefficient of determination is lower implying that the explanatory power of the median age is smaller.

We continue our analysis with the eurozone subsample. In Panel A and Panel B of Table A6, when we use the spread between 30-year and 10-year bonds, the coefficient of median age is insignificant and smaller. However, in Panel C, when we use the spread between 10-year and 3-month bonds, the coefficient is larger and becomes significant at the 5%. This implies that in Panel A and Panel B, the lack of spread data in the eurozone prior to 1998 creates insignificant results. Moreover, this finding justifies the use of spread between 10-year and 3-month bonds in our analysis.

Table A5: Regression Results for Spread and Median Age - OECD Countries

Panel A: Regression Results : OECD Countries (1960 - 2009) (Guibaud et al. (2013) Data)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0507***	0.0654**	0.0452***	0.0488***
	(3.41)	(2.45)	(3.59)	(4.30)
Constant	-1.588**	-2.063*	-1.389***	-1.443***
	(-2.56)	(-2.03)	(-3.03)	(-3.31)
Number of observations	236	236	236	236
R^2	0.132	0.428	0.054	

Panel B: Regression Results : OECD Countries (1960 - 2009) (Our Data (30-year and 10-year spread) with Guibaud et al. (2013) Restrictions)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0497***	0.0575**	0.0429***	0.0481***
	(3.33)	(2.64)	(3.56)	(4.83)
Constant	-1.553**	-1.798*	-1.304***	-1.442***
	(-2.47)	(-2.13)	(-2.95)	(-3.78)
Number of observations	264	264	264	264
R^2	0.134	0.348	0.049	

Panel C: Regression Results : OECD Countries (1960 - 2009) (Our Data (10-year and 3-month spread) with Guibaud et al. (2013) Restrictions)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0718***	0.0530**	0.0984***	0.0721***
	(6.37)	(2.18)	(3.82)	(4.12)
Constant	-1.877***	-1.237	-2.824***	-1.889***
	(-4.57)	(-1.39)	(-3.07)	(-3.01)
Number of observations	548	548	548	548
R^2	0.030	0.229	0.027	

This table shows the relationship between median age and spread in the OECD countries. In the first panel, we use Guibaud et al. (2013) data between years 1960 and 2009. In this case, we only include Belgium, Canada, France, Germany, Italy, Japan, Spain, Switzerland, United Kingdom and USA. In the second panel, we use our data (30-year and 10-year spread) with Guibaud et al. (2013) restrictions between years 1960 and 2009. In the third panel, we use our data (10-year and 3-month spread) with Guibaud et al. (2013) restrictions between 1960 and 2009. The t- and z-statistics are reported in parentheses. Errors are clustered by country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A6: Regression Results for Spread and Median Age
eurozone Countries

Panel A: Regression Results: Eurozone Countries (1960-2009) (Guibaud et al (2013) Data)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0224	-0.0156	0.0435*	0.0224
	(1.19)	(-0.92)	(1.93)	(1.23)
Constant	-0.421	1.070	-1.247	-0.421
	(-0.55)	(1.61)	(-1.41)	(-0.59)
Number of observations	79	79	79	79
R^2	0.019	0.219	0.048	

Panel B: Regression Results: Eurozone Countries (1960-2009) (Our Data (30-year and 10-year spread) with Guibaud et al. (2013) Restrictions)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0116	-0.0497	0.0301	0.0116
	(0.57)	(-1.48)	(1.49)	(0.71)
Constant	-0.0153	2.374	-0.738	-0.0153
	(-0.02)	(1.79)	(-0.93)	(-0.02)
Number of observations	104	104	104	104
R^2	0.005	0.267	0.023	

Panel B: Regression Results: Eurozone Countries (1960-2009) (Our Data (10-year and 3-month spread) with Guibaud et al. (2013) Restrictions)				
	OLS	Between Effects	Fixed Effects	Random Effects
Median Age	0.0883**	0.0809**	0.0938**	0.0883***
	(2.95)	(3.17)	(2.38)	(3.08)
Constant	-2.370*	-2.127*	-2.573*	-2.370**
	(-2.09)	(-2.27)	(-1.79)	(-2.27)
Number of observations	297	297	297	297
R^2	0.031	0.556	0.019	

This table shows the relationship between median age and spread in the eurozone countries. In the first panel, we use Guibaud et al. (2013) data between years 1960 and 2009. In this case, we only include Belgium, France, Germany, Italy, and Spain. In the second panel, we use our data (30-year and 10-year spread) with Guibaud et al. (2013) restrictions between years 1960 and 2009. In the third panel, we use our data (10-year and 3-month spread) with Guibaud et al. (2013) restrictions between 1960 and 2009. The t- and z-statistics are reported in parentheses. Errors are clustered by country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.