Long-Term Bond Supply, Term Premium, and the Duration of Corporate Investment

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Using large and plausibly exogenous shocks to the maturity structure of U.S. government debt, I find that a higher supply of long-term government bonds, increases firms' discount rates at long horizons leading to a crowding-out of long-duration investment. I show that this crowding out occurs through reallocations of capital away from long-duration investment towards short-duration investment, not only *across industries* but also *within industries across firms* and *within firms across divisions*. I show that these changes to the average duration of investment explain a significant share of changes to the average maturity of corporate debt. These results identify important real effects of policies which affect the net supply of long-term bonds, such as quantitative easing by central banks.

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I Introduction

In the aftermath of the great financial crisis, central banks have resorted to unprecedented bond purchase programs (quantitative easing) to stimulate investment at times when conventional monetary policy tools were constrained. A standard feature of these programs has been to reduce the supply of long-term bonds available to investors so as to lower long-term yields and the financing costs of firms. More recently, many central banks in advanced economies are unwinding the positions resulting from their purchases (quantitative tightening). While the literature has highlighted that large shocks to the supply of long-term bonds affect the term structure of interest rates[1], the real effects on corporate investment are not well understood and empirical evidence is scarce.

As shocks to the supply of long-term bonds affect long-term interest rates *relative* to short-term interest rates, in this paper I investigate whether they also affect the duration of corporate investment. Textbook capital budgeting tells us that the value of investment opportunities with distant cash-flows is more sensitive to changes in long-term rates and less to changes in short-term rates compared to the value of investment opportunities with less distant cash-flows. There is substantial variation in the cash-flow duration of corporate real investments: in the Duke CFO Survey of 2018 the average expected 'productive life' of new projects was above 8 years in the transportation, utilities and energy sectors, about 5 years in the tech sector, and below 3 years in the finance and communications sectors. Hence, government interventions in bond markets[2] may have consequences for the relative profitability of long-duration investments and therefore for the duration of aggregate corporate investment.

Uncovering and quantifying such mechanisms is useful in providing policy guidance on alternatives for governments to spur long-duration investments. Long-term investments are typically considered critical for productivity gains, economic growth, and social objectives that may be unattainable with short-term investments. Jones and Summers (2020) assesses the literature on the social value of innovation and shows that even under very conservative assumptions, both

[1]See for instance Vayanos and Vila (2021) for a theoretical framework and Greenwood and Vayanos (2014) and Krishnamurthy and Vissing-Jorgensen (2011) for empirical evidence.

[2]Beyond bond purchase programs by central banks, government debt management and financial regulation also impact supply and demand for long-term bonds.

average and marginal social returns of innovation are very large. In addition, long-term investments in tangible capital, such as structures contribute to output growth.[3,4]

In this paper, I provide the first causal evidence that plausibly exogenous shocks to the relative supply of long-term bonds affect the duration of corporate investment. Using financial data on public US corporates over the period 1970-2010 and plausibly exogenous variation to the supply of long-term government bonds, I find that a higher supply of long-term bonds increases discount rates at long horizons leading to a crowding-out of long-duration investment. I show that this crowding out occurs through a reallocation of capital on the basis of cash-flow duration, both *across firms* and *within firms across divisions*.

My empirical analysis relies on the framework of limited arbitrage across bond markets (see e.g. Vayanos and Vila (2021): shocks to the net supply of long-term bonds which are large relative to the limited risk capacity of the marginal investor affect the interest rate risk borne by the marginal investor and therefore the return on long-term bonds relative to the return on short-term bonds. I introduce heterogeneous investment technologies, or projects, that differ in cash-flow duration and are accessible to that same investor who was marginal in bond markets. As long-term (short-term) cash-flows should be discounted with long-term (short-term) interest rates, the profitability of new projects with a long cash-flow duration drops relative to the profitability of new projects with a short cash-flow duration. The relative drop in the profitability of long-duration projects results in a reallocation of investment towards shorter-duration projects. I refer to this mechanism as the *investment reallocation channel*.

The causal identification of the *investment reallocation channel* is challenging due to endogeneity concerns. Long-term bond supply may be endogenous to long-duration investment opportunities. For instance, better long-duration real investment opportunities may increase long-term debt supply by firms. Similarly, central bank asset purchases are typically implemented during bad times, when

[3] See e.g. Aghion, Angeletos, Banerjee, and Manova (2010) or the literature estimating the economic effects of large infrastructure projects. Such papers include, for instance, Röller and Waverman (2001), Donaldson (2018), Asher and Novosad (2020)

[4] Consistent with this evidence, governments actively support long-term investments through, for instance, providing tax incentives for R&D, promoting investment in infrastructure through Public-Private Partnerships (PPPs) and climate change transition investments.

credit constraints are likely to deter long-duration real investments that are hard to liquidate (Aghion et al., 2010).

To address these issues, I exploit variation in the supply of long-term debt by the US government over the period 1965-2007 and show it is plausibly exogenous to long-duration corporate investment. Specifically, I show that variation in government debt maturity is not driven by changes to the U.S. government's borrowing costs or refinancing risk. Instead, a narrative examination of Treasury debt management actions from 1961 to 2007 shows that the bulk of the variation in the average maturity of Treasury debt can be traced back to 6 specific policy shocks. These specific policy decisions are either exogenous to economic activity or come in response to the mechanical effects from the previous exogenous policy decisions in order to maintain the implicit objective to keep maturity of Treasury debt within some "bounds" (Garbade, 2020). I also show that variation in government debt maturity is a relevant instrument for the net supply of long-term bonds. For instance, a one standard deviation in government debt maturity is roughly equal in magnitude to one of the most prominent long-term bond supply shock originated by the Federal Reserve: The Maturity Extension Program.

An additional challenge to identification lies in the measurement of duration of real investments. I measure investment duration using firm-level depreciation rates on fixed assets inferred from firm-level annual regulatory reports and averaged over time. I proxy investment duration as the inverse of depreciation rate on a firm's fixed-assets, scaled by the importance of fixed-assets for a firm's investments.[5] I show that this measure is (i) well-aligned with a general intuition about which firms (or industries) are characterised by long-duration investments, (ii) correlates strongly with the horizon of business plans measured using regulatory filings textual information (Dessaint, Foucault, & Frésard, 2023), and (iii) is one of the strongest predictor of the maturity of corporate debt issuances.

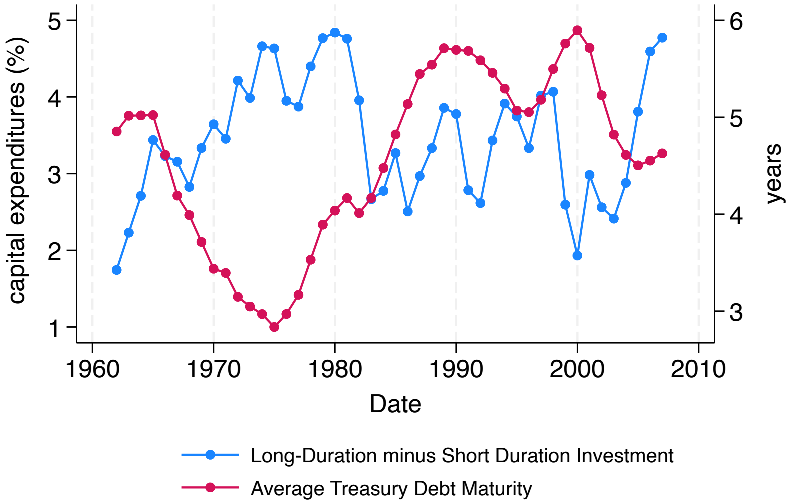
Figure 1 provides suggestive evidence of the investment reallocation channel *across firms*. The difference in investment rates between firms with above-median investment duration and firms with below-median investment duration exhibits a strong negative correlation with the maturity of Treasury debt. In other words,

[5] Following Stohs and Mauer (1996), the empirical corporate finance literature has shown that measures of the the duration of assets based on depreciation rates are empirically consistent with many corporate finance predictions. See e.g. Livdan and Nezlobin (2021),Geelen, Hajda, Morellec, and Winegar (2023), or Kermani and Ma (2022).

when the supply of long-term bonds is high, long-duration investment drops.

Figure 1: Treasury debt maturity and long-duration investment rate

The figure presents the yearly time series of average Treasury debt maturity value-weighted by outstanding principal (blue line with values on the right-hand side axis). The red bars correspond to the difference in investment rates (capital expenditures as a % of lagged total assets) between firms with above median investment duration (measured by accounting asset maturity) and firms with below median investment duration.



I further test the investment reallocation channel *across-firms* by estimating differences-in-differences empirical investment equations including an interaction term between a firm's average investment duration and the average maturity of U.S. Treasury debt. A 1-year higher average maturity of Treasury debt (1.1 sd) causes a 0.9pp drop in the investment rate of long investment-duration firms. I show that the drop in capital expenditures is explained by a drop in investment in machinery and equipment and a drop in real estate investments. I also show that long-duration firms also experience drops in R&D expenses and acquisitions and experience a lower employment growth.

I find that the investment reallocation channel *across-firms* is taking place across industries and within industry across firms and show the elasticities are not significantly different within and across industries.

My results hold after controlling for the differential response to long-term bond supply of firms along the cross-section of plausible measures of investment opportunities, and for the differential response of firms in the cross-section of investment duration to other macroeconomic shocks (interactions of *asset maturity* with e.g. credit spreads, unemployment, GDP growth, inflation and short-term interest rates). I also rule out alternative explanations for the baseline results. For instance, I am able to rule out that my result arises as long-duration firms respond differently to business cycle shocks or experience a relaxation of financial constraints via an increase in their collateral value (Chaney, Sraer, & Thesmar, 2012).

To quantify the aggregate relevance of the investment reallocation channel, across firms, I construct a time series of the average duration of investment across firms. A 1-year increase in government debt maturity is associated with a 0.16-year in aggregate investment duration of U.S public firms.

To shed light on the reallocation channel for investments in intangible capital, I rely on the horizons of business plan collected by Dessaint et al. (2023). Consistent with the measure capturing duration of all types of investments, I find a higher relative response in R&D expenses compared to elasticities obtained using the measure of the duration of tangible investments. More generally, using horizon of firms' investment plans also confirms the baseline results for capital expenditures.

I also find evidence for the investment reallocation channel *within firm* by studying division-level investment response to the supply of long-term government bonds. A higher supply of long-term government bonds is associated with a decrease in investment in divisions specialised in long-duration investments. The within-firm result also rules out that the reallocation results confound a collateral channel, whereby investment duration on tangible capital may be capturing pledge-ability or collateral value rather than duration of cash flows and whereby firms may be responding to an aggregate unobserved negative shock.

My empirical findings support a mechanism where an increase to the supply of long-term government bonds raises discount rates on long-duration projects. I first show that the supply of long-term government bonds is positively associated with the slope of the term structure for government and corporate bonds. Using predicted data on firms' discount rates from Gormsen and Huber (2023), I also show evidence that changes in the slope of the term structure for corporate bonds are incorporated in the slope of the duration structure of discount rates across firms, defined as the average over firm-level discount rates for a given firm-level investment duration. Finally, I also show that, consistent with maturity matching in debt financing, one reflection of this discount rate mechanism in my sample is the increase in the cost of debt of long-duration firms.

Due to the prevalence of debt financing and maturity-matching by firms, an increase in the supply of long-term bonds also maps into a drop in the supply of long-term corporate debt, the debt reallocation channel. Decomposing the aggregate covariance between government and corporate debt maturity into within- and across-firm variation, I find that the debt reallocation channel explains at least half of the aggregate covariance between the maturity of Treasury debt and the aggregate maturity of corporate debt highlighted in Greenwood, Hanson, and Stein (2010).

I confirm my results in a different setting. Using the 2004 reform to the UK's Pensions Act that generates a plausibly exogenous positive shock to the demand for long-term bonds in the UK and a significant drop in the term spread, I find a relative semi-elasticity of investment to the term spread (in the cross-section of investment duration) that is quantitatively comparable to the baseline relative semi-elasticity obtained using the US policy shocks. This shows that the paper's main findings hold with a different instrument, and that they are also externally valid.

Overall, this paper makes three main contributions. First, I identify, to the best of my knowledge, the first causal evidence that changes to the supply of long-term debt affect the duration of corporate investment. I find that this effect goes through a reallocation of capital across investments with different cash-flow duration. Second, my results establish a link between the observed reallocation of investment and time-series variation in the maturity of corporate debt. Third, I present a new potential cost of long-term government financing: when the government issues long-term debt (rather than short-term debt) it crowds out long-duration corporate investment. Conversely, my findings suggest that policies that aim at reducing the supply of outstanding long-term debt, such as quantitative easing, can stimulate long-term corporate investment.

Related Literature. This paper is linked with four strands of the literature. First, it builds on the literature related to segmentation in bond markets arising from imperfect substitutability following Tobin (1958) or the presence of preferred-habitat clienteles as formalised by Vayanos and Vila (2021). Drawing from the asset prices implications highlighted by the literature, I extend them to corporate decisions. Relatedly, a strand of this literature has linked variation in long-term government bond supply to corporate financing choices. Baker, Greenwood, and Wurgler (2003) provides evidence that the time series variation in the maturity of corporate debt strongly correlates with the term premium. Greenwood et al. (2010) argues that this correlation arises because firms absorb large shocks to the term structure that break the expectations hypothesis. Greenwood et al. (2010) and Badoer and James (2016) provide evidence consistent with this mechanism.[6] Instead of firms arbitraging bond markets, I propose a *real* mechanism linking changes in effective discount rates to capital budgeting decisions and highlight real effects. I also show that this *real* mechanism explains a significant share of the covariance between the maturity of corporate debt and the maturity of government debt.

I also contribute to the literature studying the composition of aggregate investment and in particular the determinants of long-term corporate investment. An important strand of this literature identifies the relevance of credit constraints for the composition of aggregate investment following Aghion et al. (2010), which shows that illiquid long-term investment may be rationed in the presence of financial constraints.[7] Another strand, following Stein (1988), stresses that agency problems have an impact on the horizon of investments.[8] In contrast to the streams of work that follow from these two papers, my results do not rely on financial frictions at the level of the firm but instead on supply and demand shocks in segmented markets that change the relative valuation of long-duration investments.

To the best of my knowledge, the only paper that is related to my envisioned channel is Dew-Becker (2012). In the latter, the author shows that the term spread correlates with one-year ahead average duration of investment using the Bureau of Economic Analysis (BEA)'s fixed-assets tables and the BEA depreciation rates for each of the 36 fixed-assets classes. My contribution is to provide causal evidence for a mechanism that has the potential to explain the correlation observed by Dew-Becker (2012): a higher supply of long-term government debt increases the term premium (and the term spread holding the expectations of future short rates constant) and lowers the average duration of investment by redistributing investment *across firms and industries* and *within firm across divisions.*

[6] Relatedly, Foley-Fisher, Ramcharan, and Yu (2016) finds that the Federal Reserve's maturity extension program (MEP) may have helped reducing financial constraints of firms more dependent on long-term debt.

[7] See, for instance, Garicano and Steinwender (2016) and Mendes (2020) for empirical evidence.

[8] See, for instance Terry (2015) and Dessaint et al. (2023).

This paper also contributes to two important strands of the macroeconomic literature. The first of these, following Friedman (1978), focuses on the implications of government borrowing for corporate investment. My paper is about changes to the supply of government debt *across maturities*, as opposed to changes in government borrowing quantities (see, e.g., Graham, Leary, & Roberts, 2014; Demirci, Huang, & Sialm, 2019; Akkoyun, Ersahin, & James, 2020; Pinardon-Touati, 2021). In contrast with this first strand, I argue that focusing on the supply of government debt *across maturities* allows to tackle the critical challenge of endogeneity: (i) by looking into the difference in investment response between long- and short-duration firms, I control for aggregate investment opportunities; (ii) I document that the time series variation in government debt maturity is plausibly exogenous to investment opportunities for long-duration investments. The second strand in macroeconomics looks at the optimal maturity of government debt. Several properties of short-term and long-term financing have been proposed: for instance, long-term financing favours tax-smoothing (e.g. Bohn, 1990, Angeletos, 2002), or provides a hedge against the risk of refinancing outstanding debt at variable rates (e.g. Angeletos, 2002) at the expense of an historically positive term premium and excessive short-term debt issuance by the financial sector (Greenwood, Hanson, & Stein, 2015). In contrast, I highlight a new potential cost of long-term financing: when the government issues more long-term debt it may crowd-out long-duration corporate investment.

The rest of the paper proceeds as follows. Section II presents the conceptual framework and theoretical predictions. Section III explains the main identification choices for the analysis. Section IV presents the data and measurement choices. Section V outlines the empirical strategy and reviews the results for investment. Section VI uncovers the mechanism and highlights the consequences for corporate debt maturity. Section VII outlines the external validity of the baseline results by studying a plausibly exogenous shock to the demand for long-term bonds in the UK. Section VIII concludes and elaborates on policy implications of the main findings.

II Conceptual Framework

In this section, I provide a simple framework to explain the idea that long-term debt (net) supply shocks crowd out long-term investment and long-term debt. I rationalise this idea more formally in a three-period representative agent model with complete markets and no default risk (Appendix G).

Investment reallocation channel A positive supply shock to the (net) supply of long-term bonds increase long-term interest rates relative to short-term inerest rates (Tobin, 1958, Vayanos and Vila (2021)). As long-term (short-term) cash-flows should be discounted with long-term (short-term) interest rates, the profitability of marginal projects with a long cash-flow duration drops relative to profitability of marginal projects with a short cash-flow duration. The relative drop in the profitability of long-duration marginal projects results in a relative drop in investment into these long-duration marginal projects, and a reallocation of investment towards shorter-duration projects. I call this mechanism the *investment reallocation channel*.

This idea can be rationalised in an economy with limited arbitrage between short- and long-term bonds - arising because of both interest rate risk and risk aversion - and two projects with different technologies - one with long cash-flow duration and one with short cash-flow duration (hereafter, a long-term project and a short-term project). In this economy, a representative agent is exposed to interest rate risk when trading short and long-term bonds such that they require a drop in long-term bond price to absorb a positive shock to the long-term bond net supply.

The heterogeneity in cash-flow duration of projects implies that the value of the long-term (short-term) project is more exposed to long-term interest rates (to short-term interest rates) if more of the cash flows from production accrue at longer (shorter) horizons. A Modigliani-Miller-type financing irrelevance holds as the mechanism hinges on aggregate discount rates which are reflected in the price of short- and long-term bonds (the risk-free Arrow Debreu securities), rather than depending on firm borrowing in debt markets.

In a setting in which firms may specialise in projects of different duration, the investment reallocation channel may hold both within- and across-firms. To the extent that a firm may have several projects or operate across different businesses, the reallocation might happen within firm. In addition, we may expect the reallocation to take place across firms if the heterogeneity in investment duration arises from (exogenous) technological constraints and specialisation of firms into certain businesses. Lastly, if the same technological constraints apply to all firms within an industry, we expect most of the reallocation investment to occur across-industries, rather than within-industries across-firms.

Debt reallocation channel While Modigliani-Miller-type financing irrelevance does not undermine the prevalence of the above investment reallocation, the financing irrelevance is unlikely to hold in the presence of agency costs, differential tax treatment under different financing choices, and bankruptcy costs. Instead, theoretical predictions in such environment are (i) the existence of an optimal capital structure and (ii) firms matching the duration of cash flows from investment and the duration of cash outflows to creditors in order to reduce interest rate and liquidation risks (Myers, 1977).[9]

If firms finance projects with debt and pursue maturity-matching, the changes in the economy-wide asset composition over time arising from the above investment reallocation are associated with time series variation in aggregate corporate debt maturity. A positive supply shock to the (net) supply of long-term bonds results in a relative drop in investment into long-duration marginal projects and therefore in a relative drop in the amount of debt financing long-duration marginal projects if the optimal capital structure is unchanged. If firms pursue maturity-matching, this results in a relative drop in issuance of long-term debt. I call this mechanism the *debt reallocation channel.*

[9] In the field, debt financing is important: from 1965 through 2007 in Compustat annual files, median book leverage is equal to 21%. Evidence for maturity matching by firms is also widespread: see e.g. Stohs and Mauer (1996), Guedes and Opler (1996), Graham and Harvey (2001), Badoer and James (2016), Geelen et al. (2023).

III Identification: Treasury long-term bond supply

In this section, I present my preferred strategy to identify the investment and debt reallocation channels. Specifically, I show that time series variation in the supply of long-term bond by the U.S. Treasury in the period between 1965 and 2007 is a plausibly exogenous source of variation for the net supply of long-term debt.

I proxy the relative supply of U.S. government long-term debt using the quarterly time series of the average maturity of Treasury debt value-weighted by the outstanding principal.[10,11]

Relevance To convince the reader of the relevance of variation in government debt maturity as an instrument for the net supply of long-term bonds, I highlight three facts. First, the government sector is one of the largest suppliers: over 1965-2007 Federal debt represented on average 23% of the stock of outstanding domestic nonfinancial debt securities and loans in the U.S. .[12] This understates the fact that this debt is typically fixed-rate, has long-maturity and is therefore associated with more duration risk.

Second, the standard deviation of government debt maturity (year-to-year) variation the sample is high (0.9 years around a mean of 4.6 years). Based on average debt payments to GDP in the sample, the marginal buyer of Treasury bonds would have to absorb an additional exposure to aggregate interest rate risk worth 36% of maturity-weighted debt to GDP (roughly the magnitudes of the maturity extension program by the Federal Reserve).

Third, (year-to-year) variation in Treasury debt is very persistent : the AR(1) coefficient is 0.96. This feature is key to capture firm-level real effects as firms are sluggish in updating their discount rate (Gormsen et al. (2023)).

[10] Appendix A presents the descriptive statistics.

[11] Note that the measure is in face-value terms, rather than market-value terms, to rule out endogeneity concerns that government debt maturity is affected mechanically by variation in the term structure (following Greenwood & Vayanos, 2014). Appendix B shows that all my results obtained using the average maturity of Treasury debt are unchanged when using alternative proxies for long-term bond supply such as maturity-weighted-debt-to-GDP, or the shares of Treasury debt with residual maturity above 5 or 10 years.

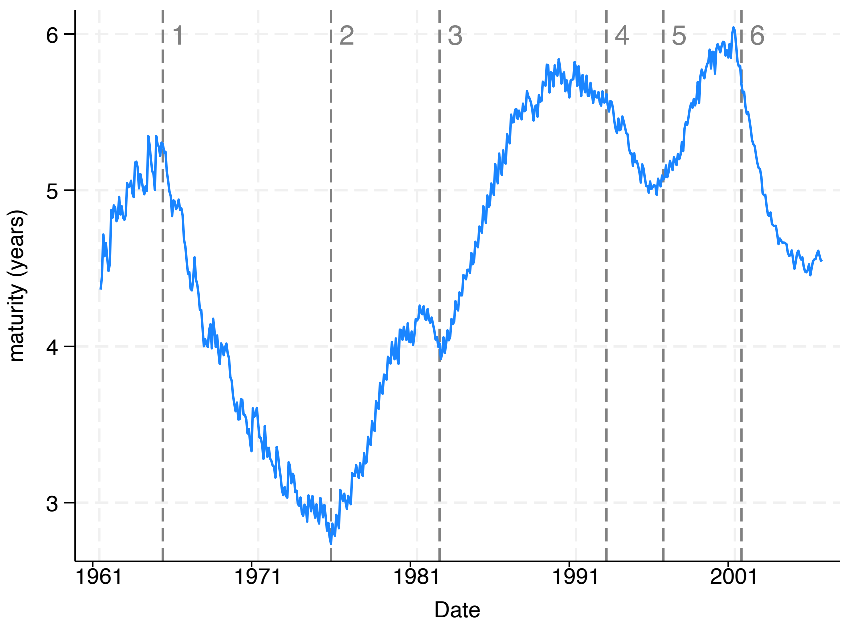
[12] The figure is computed from the Financial Accounts of the United States data available at www.federalreserve.gov/releases/z1/

Narrative identification of exogenous policy shocks driving variation Figure 2 presents the quarterly time series of the average maturity of Treasury debt value-weighted by outstanding principal over the period 1961-2007. It is visually clear that the time series variation in U.S. Treasury debt maturity is not occuring at high frequency. The latter is at odds with the idea of government debt maturity choices driven by the Treasury issuing opportunistically, for instance timing the term premium which varies at even higher frequency than business cycles.

Indeed, the U.S. Treasury has been systematically “reluctant to embrace opportunistic debt management programs” (Garbade, 2015) and effectively adopted a "regular and predictable offering" framework in the 1970s.[13] The U.S. Treasury has consistently emphasised the role of predictability in reducing financing costs by improving the liquidity of Treasury debt instruments and minimising surprises to investors demanding these instruments.[14]

Figure 2: Average maturity of U.S. Treasury debt and policy shocks

The figure presents the quarterly time series of the average maturity of Treasury debt value-weighted by outstanding principal. The vertical dotted lines indicate the 6 policy decisions detailed in the body of the text and in Appendix B. Data comes from the CRSP's daily Treasury bond database. The CRSP U.S. Treasury and Inflation Series include end-of-day price observations for nearly 7,000 U.S. Treasury bills, notes, and bonds from 1961. I replace issue-level missing outstanding amounts by the earliest available issue-level information.



[13]See (Garbade, 2015) and Appendix B for careful examinations of Treasury debt management actions and communications.

[14]Other motives include the Treasury being a very large issuer: the price impact due to the scale of its issuances limit the gain from seizing market opportunities. For instance, in 2019, U.S. Treasury debt issuances represented 60% of total U.S. debt securities issuances.

The careful examination of Treasury debt management actions from 1961 to 2007 shows that the bulk of the variation in the average maturity of Treasury debt can be traced back to 6 specific policy shocks.[15] These specific policy decisions, described in Appendix B, are either exogenous to economic activity or come in response to the mechanical effects from the previous exogenous policy decisions in order to maintain the implicit objective to keep maturity of Treasury debt within some "bounds" (Garbade, 2020).

Below, I provide a short summary of the extended description of the shocks available in Appendix B:

1. 1965 shock: The 1919 Second Liberty Bond amendment prescribed Treasury debt issues with an initial maturity above 5 years to be priced at an interest rate higher than a 4.25pp ceiling. The ceiling only become a permanent binding constraint as the general level of interest rates rose in the 1960s leading to a drop in the average maturity of Treasury debt.

2. 1976 shock: Major first steps in the staggered removal of 1917 prescription are undertaken. In March 1976 Congress extended the maximum exempted maturity to ten years and increased the exemption from the ceiling to USD 12bn, followed by a series of increasing exemptions.

3. 1982 shock: Large increase to the exemption in September 1982 after Congress failed to increase the exemptions in April and July. This marks the second phase of the staggered repeal associated with larger exemptions and a full repeal of the ceiling in 1988.

4. 1993 shock: Announcement by newly installed Clinton Administration of reduction of 30-year bond offerings against the advice of the advisory committee to the Treasury. As a result of the policy, the average maturity of Treasury debt is predicted to be one year lower five years ahead.

5. 1996 shock: Policy reversal by increasing the Treasury's offering of 10-year notes and 30-year bonds justified by the pace of decline in Treasury debt maturity that could become a subject of worry in the long-run and by the "noticeable adverse impact on liquidity" of long-term Treasury instruments.

[15] I focus on policy shocks before the Great Financial Crisis of 2007-2008 as following 2007, due to the endogeneity to the state of the economy of the Fed's quantitative easing programmes and the Treasury's dramatic increase in the maturity of Treasury debt issuances following the crisis.

6. 2001 shock: U.S. Treasury Secretary Fisher announces a suspension of debt issues of 30-year U.S. Treasury bond on the basis of preserving liquidity for the 10-year segment in the long run that surprises market participants.

Consistent with the "regular and predictable offering" framework adopted by the U.S. Treasury since the 1970s, these policy decisions to swap long-term bonds for short-term bonds (and vice versa) generate steady trends in government debt maturity for as long as the policy is not reversed (Figure 2). These trends characterise persistent and economically significant variation (over three to ten years). The fact that the level of U.S. Treasury debt maturity is itself a long-term consequence of the specific (plausibly exogenous) policy decisions sharpens identification.

Note that this narrative description of variation in government debt maturity may substitute or complement an alternative view that government debt maturity changes are driven by changes in the government debt burden (Greenwood and Vayanos (2014), Badoer and James (2016), and Krishnamurthy and Vissing-Jorgensen (2012)).[16] Two facts go in favour of my preferred narrative.

First, while debt-to-GDP is positively associated with government debt maturity between 1965 and 1985, the correlation becomes negative after 1985 (see Figure B.2). This reversion in the correlation undermines the importance of debt size variation for debt maturity variation in my sample.

Second, prior to 1985 when the correlation is indeed positive, explicit communication by U.S. policymakers goes against the argument that the drop in the government debt maturity and its subsequent recovery have been driven by contemporaneous choices. Instead, policymakers repeatedly recognise the relevance of the binding statutory constraint in explaining the drop in the average maturity of Treasury debt and (1965-1975) and the “countervailing commitment” to Treasury debt maturity lengthening associated to regain flexibility after its repeal (1975-1985). One of many examples[17] is the report from the Committee on Finance of March 9 1971 agreeing that “the Treasury Department may well be

[16] Greenwood and Vayanos (2014), Badoer and James (2016), and Krishnamurthy and Vissing-Jorgensen (2012) instrument government debt maturity with government debt size to GDP with the intuition that a higher debt burden raises roll-over risk that can be hedged with longer-term debt issuance. Debt to GDP is arguably a good instrument because it is driven mainly by the cumulation of past deficits rather than by changes in investor demand.

[17] For more detailed overview, see Garbade (2020) and Garbade (2015).

correct in assuming that the 4.25pp interest rate limit has interfered with good debt management practices".[18] Garbade (2015) collects anecdotal evidence in the form of communication (notably by the Treasury Borrowing Advisory Committee) and shows that the long period of binding constraints, in turn, generated a "countervailing commitment" to debt management flexibility achieved through Treasury debt maturity lengthening that persisted into the early 1990s.

Importantly, I also show that all of my results are quantitatively robust sample restrictions pre- and post-1985.

Omitted business cycle variable in small sample I address the possibility that the path of government debt maturity driven by plausibly exogenous shocks may be spuriously correlated with the business cycle in relatively small samples (time series of 50 years). Failing to incorporate this fact may bias the estimates of the reallocation channel if firms with different investment duration are differentially exposed to the economic cycles.

A visual inspection (see Figure B.1) suggests that there does not seem to be any robust time series correlation between government debt maturity and other macroeconomic time series of interest such as the real GDP growth, the unemployment rate, credit spreads, the level of interest rates, or inflation. Furthermore, controlling for differences in cyclical sensitivities of firms with different investment duration does not affect quantitatively the results.

IV Data and Measurement

IV.A Data

To test the investment and debt reallocation channels across firms, I construct a panel of financial and accounting variables for U.S. (non-financial) corporations with publicly traded securities at the yearly level using Compustat Fundamentals

[18]Another example is the 1975 statement of U.S. Treasury Secretary Simon before the U.S. Senate's Committee on Finance as he states that "the extension of the maximum note maturity [...] could be a powerful tool to arrest the decline in the average maturity" and highlights the "urgency of the need for greater debt management flexibility".

database. In addition, to study within-firm reallocation, I construct a yearly panel at the firm-division level, using division-level Compustat Segment data.

I exclude financial firms (SIC 6000 to 6999) and public utilities (SIC 4900 to 4999). I also exclude firm-year observations with incorrect ZIP codes, missing state information, missing capital expenditures, and missing or zero assets. I exclude firms with less than three consecutive years in the sample, and drop firms that disappear and reappear in the panel. For the within-firm analysis, I furthermore drop firms with divisions active in the financial or utility sectors and focus on firms with at least two divisions in a given year. I define divisions by aggregating firms' segments financials at the two-digit SIC level.

I also collect the fiscal year-end bond or stock market conditions, such as debt-to-GDP, real GDP growth, unemployment rate, inflation, credit risk premia and short-term yields from the CRSP's daily Treasury bond database, the interpolated yield curve data for U.S. Treasury bonds from the Federal Reserve website, and the FRED database of the Federal Reserve Bank of St. Louis.

Appendix A presents the definitions and summary statistics for the different variables in the sample.

IV.B Measurement of marginal investment duration

One important challenge related to testing the reallocation channels presented in Section II lies in the measurement of duration of the cash flow of a firm's marginal project.[19]

I measure investment duration using depreciation rates inferred from depreciation expenses in Compustat annual files. Measures of asset maturity (equivalently the useful life of assets) based on reported depreciation by firms have been shown to correlate with debt maturity (Stohs & Mauer, 1996)[20], to be

[19] Note that the relevant source of heterogeneity underlying the capital budgeting predictions in the theoretical framework is the cash-flow duration of a firm's marginal investment rather than the cash-flow duration of a firm's equity. The equity duration reflects both the cash-flow duration of new investments and the residual cash-flow duration resulting from the sequence of investments made in the past and expected to be made in the future.

[20] I run linear debt maturity choice regressions based on a dataset of corporate debt issues extracted from the Thomson Reuters LPC Dealscan and Thomson Reuters SDC Platinum New Issues databases and confirms the result for the firms in my sample (Appendix E). The dataset construction is detailed in Appendix E.

consistent with replacement investment rates in the data and have comparable economic significance to that of Tobin's Qs (Livdan & Nezlobin, 2021), and to fit well the maturity matching debt dynamics and duration of financing cycle at the firm level and in the aggregate (Geelen et al., 2023). Kermani and Ma (2022) shows that the implied depreciation rates derived from depreciation expense of firms are very similar to those used by the BEA (correlation is about 0.6 and median difference is about 0.9 percentage points).

Using a formula inspired by the value-weighted average asset maturity measure of Stohs and Mauer (1996), I calculate the (book) value-weighted average maturity (*Asset Maturity*) of current assets (*CA*) and of net property, plant and equipment (*Net PPE*) as:

$$\textit{Asset Maturity} := \frac{\text{CA}}{\text{CA} + \text{Net PPE}} \cdot 1 + \frac{\text{Net PPE}}{\text{CA} + \text{Net PPE}} \cdot \frac{\text{Net PPE}}{\text{Depreciation}}.$$

I assume that current assets have a maturity of one year. Intuitively, it follows that all current assets are assumed to be at most used for production in a given fiscal year.[21]

The maturity of fixed assets is measured as *Net PPE* divided by depreciation expense net of amortisation (*Depreciation*), which can be interpreted as the inverse of a firm's depreciation rate on its stock of fixed-assets.[22] Intuitively, assuming straight-line depreciation for each asset, a higher depreciation rate would translate into a lower weighted-average remaining life for the concerned asset stock.[23]

The measure combines two different margins of the cash-flow duration of a firm's investments. The first one is the extensive margin of long-term investments, defined as the ratio of net PPE to the sum of net PPE and current assets. It measures the importance of long-term assets in the firm's current investment mix:

[21] In Stohs and Mauer (1996), the maturity of current assets is measured as current assets, divided by costs of goods sold. Stohs and Mauer (1996) argues that "current assets support production, where production is measured by the costs of goods sold". I do not use the measure of the maturity of current assets because it is very volatile within firm across time.

[22] Table IB.2 shows that other construction choices, such as including amortisation or focussing only on firms using straight-line depreciation rules do not change the results of my analysis.

[23] Livdan and Nezlobin (2021) notes that "firms overwhelmingly use the straight-line depreciation rule to account for their fixed assets, and under this rule, the ratio of gross PPE to the depreciation expense should be roughly equal to the useful life assumed by the accountants". This would validate the use of the ratio of net PPE to the depreciation expense as the measure of the remaining life.

the average fixed-asset is more likely to be associated with longer-duration cash flows than the asset used for production in the current year. The second one is the intensive margin of long-term investments, defined as the inverse of the depreciation rate on fixed-assets. For a given dollar invested in a fixed-asset, the motivations for pinning down a higher depreciation rate for that asset are likely to correlate negatively with the duration of cash-flows tied to this asset, in other words how close is the bulk of the asset's cash-flows.

I aggregate the firm-year measure at the firm- or industry-level by averaging over time by firm or industry to capture the duration of the average marginal investment. In addition, averaging over time can mitigate measurement error: the time series variation might be polluted by deviations from simple accounting policies following, for instance, changes in tax incentives, potentially reducing the correlation between accounting depreciation and economic depreciation on which the identification hinges.

To illustrate the aggregation choice, Figure 3 reports the time series of *Asset Maturity* averaged at the industry-level (SIC-2digits) over 5-year periods from 1976 to 2010 for industries with most extreme average values for the measure over 2001-2005. It suggests that the measure is persistent when aggregated at the industry level at low frequency. The measure is well-aligned with the intuition about the identity of industries characterised by large and long-duration investments: these are industries, such as transportation or mining, with very large upfront costs as opposed to industries offering trading or business services.

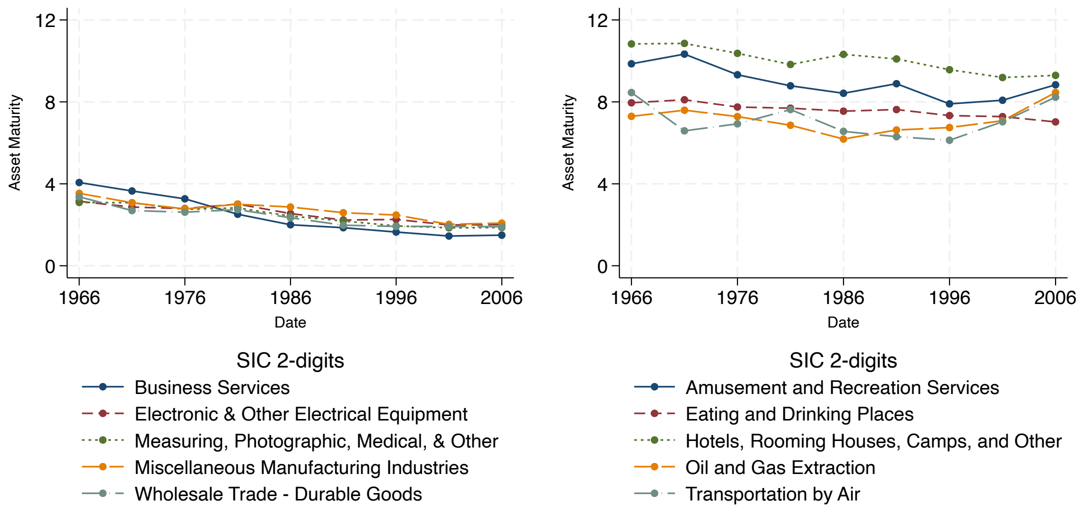
Table IA.1 shows that the bulk of the firm-level variation is explained at the industry-level: 50% percent of the firm-level variation in *Asset-Maturity* is explained at the NAICS-3 digit level and 58% at the NAICS-6 digit level. This confirms that the measure captures the degree of technology specialisation that firms share within an industry.

I further try to explain the within-industry across-firms variation by regressing the measure on firm characteristics. I show that the main source of variation within industry across firms is the rate of capital depreciation (the intensive margin) rather than the share of fixed-assets (the extensive margin). Table IA.2 also shows that thus variation is economically explained by differences in investment into different asset classes (e.g. more land, buildings and construction, less leases). These residual differences in investment across asset classes within industry may

Figure 3: Variation in Asset Maturity by industry and time

The figure reports the time series by industry (SIC-2digits) of *Asset Maturity* averaged at the industry-level by 5-year periods from 1966 to 2010 for the universe of firms in Compustat. Only the industries with the most extreme average values for 2001-2005 and with at least 100 underlying firms are represented.

(a) Bottom 5 industries (b) Top 5 industries



reflect regional characteristics and constraints or, alternatively, differences in technologies across businesses that standard industry classifications fail to capture.[24]

IV.C Alternative measurement and intangibles

My preferred measure of marginal investment duration, which is based on depreciation rates on tangible capital, may fail to capture the duration of marginal intangible investment if the duration of marginal intangible investments does not correlate positively with the duration of marginal tangible investments across firms or across industries.

If this is the case, I would still identify a proof of concept of the reallocation mechanism within tangible investments. However, if the duration of marginal investments of both categories are negatively correlated (e.g. research in the mining sector has a lower duration than research in the business advisory sector), I may be underestimating the level of investment reallocation.

[24] I also show that, while measures of firm size have explanatory power (10pp in incremental R^2), other firm characteristics are not statistically important. In particular, the remaining source of variation does not appear to be explained by age or the life cycle of firms.

To tackle the lack of information on the depreciation of intangible capital, I use an alternative measure of the duration of investment that may capture the marginal duration of investment for both types of investments: the horizon of business plans that firms publicly disclose in their 10Ks, as measured by (Dessaint et al., 2023). Specifically, the authors retrieve information about 13,908 SEC filings for 3,925 distinct firms between 1994 and 2015 by "systematically searching for the terms "year business plan", "year strategic plan", "year growth plan", "year investment plan", etc. (for more details, see Dessaint et al., 2023) through the content of all SEC filings and manually collecting the information about the horizon in number of years when it is explicitly mentioned (e.g., "3-year"). The authors show the measure is highly persistent across time within firm, and highly correlated within industry. This finding is consistent with the characteristics of my preferred measure.

The correlation between my measure of investment duration and the measure derived from business plans at the SIC-2 level is 0.26. I will exploit the variation in the horizon of business plans (and in particular the variation orthogonal to the proxy based on depreciation rates) as an alternative measure in the tests of the investment reallocation channel with a specific focus on the context of intangible investments. While my main results are qualitatively unchanged when using this measure, I use the proxy based on depreciation rates as my preferred measure to ease interpretation and for the rich variation it entails.[25]

V The investment reallocation channel

V.A Across firms

Empirical strategy To test and quantify the reallocation of investment across firms, I study their investment response to the net supply of long-term government bonds in the cross-section of firms using variation across firms in the average cash flow duration of firms' marginal projects (measured with my asset maturity measure averaged at the firm level, AssetMaturity) in my panel of U.S. public firms. I measure firm investment as its capital expenditures scaled by

[25]The distribution of business plan horizon is quasi bi-modal with close to 80% of firms either associated with a 3 or 5-years business plan horizon.

lagged firm assets. The net supply of long-term government bonds is measured by the average maturity of government debt, TSYMAT.

Specifically, for firm f in industry s, measured at fiscal year end t, I run panel regressions with the following general form:

$$\begin{aligned}\frac{\mathrm{Capex}_{f,s,t}}{\mathrm{Assets}_{f,s,t-1}} =& \beta \cdot \mathrm{TSYMAT}_t \cdot \mathrm{AssetMaturity}_f + \alpha_f + \gamma_t \\ &+ \delta \cdot \mathrm{TSYMAT}_t \cdot X_{f,t} + \theta \cdot Z_t \cdot \mathrm{AssetMaturity}_f + \epsilon_{f,s,t}\end{aligned} \tag{1}$$

The vector $X_{f,t}$ includes firm- and industry-level controls for investment opportunities, and the vector Z_t includes measures of the business cycle. Standard errors are double clustered at firm and time-levels.

The coefficient of interest is β measures the effect on the investment rate of a higher supply of long-term government debt for firms with long-duration of investment relative to firms with short-duration of investment.

The main assumption to identify the so-called investment reallocation channel is that the variation in the maturity of outstanding Treasury debt should have explanatory power for the relative level of investment rates for firms specialised in long-duration investment only through its effect on discount rates. In other words, the maturity of outstanding Treasury debt should not systematically correlate with better or worse investment opportunities for firms with long-duration investments. For instance, firms cut more long-term investments in recessions (Garicano & Steinwender, 2016), such that a significant correlation between variation in the maturity of outstanding Treasury debt and the business cycle may violate the identifying assumption.

As discussed in Section III, the variation between 1965 and 2007 is driven by policy shocks which are either plausibly exogenous to economic activity or come in response to the mechanical effects from the previous exogenous policy decisions to maintain the implicit objective to keep maturity of Treasury debt within some “bounds”. Nevertheless, I also control for investment opportunities at the time of the shock and for the differential response of firms in industries with different duration to macroeconomic fluctuations by interacting the measure of investment duration with various contemporaneous macroeconomic controls such as the level of interest rates, credit spreads, unemployment rates or inflation.

Baseline results Table 1 presents the estimates from the panel regressions identifying an across-firm investment reallocation channel, gradually adding fixed effects and control variables. Column (1) includes the interaction and base terms as well as firm fixed effects; column (2) adds time fixed effects to control for the composition of industries and firms across time; column (3) includes the interaction of proxies for firm-level investment opportunities (the firm' sales growth rate, market-to-book ratio, profitbalility, a dummy equal to one for investment-grade firms, and firm size, allows to control for the cross-sectional response to long-term bond supply along other firm-level dimensions); and column (4) includes the interaction of the duration measure with business cycle proxies.

Table 1: The investment reallocation channel: across firms

The table presents the reduced-form estimates based on Equation Equation 1 where the dependent variable is capital expenditures normalised by lagged total assets based on the yearly panel of Compustat firms for 1965-2007. The investment duration measure is the firm-level average asset maturity. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	Capital Expenditures			
	(1)	(2)	(3)	(4)
TSYMAT × AssetMat	-0.162***	-0.154***	-0.172***	-0.179***
	(0.032)	(0.027)	(0.027)	(0.029)
TSYMAT × Sales Growth			-0.012***	-0.012***
			(0.003)	(0.003)
TSYMAT × M/B Ratio			0.012	0.016
			(0.049)	(0.049)
TSYMAT × Profitability			-0.261	-0.272
			(0.276)	(0.280)
TSYMAT × IG Rating			0.121	0.137
			(0.170)	(0.170)
TSYMAT × Size			0.107***	0.107***
			(0.040)	(0.040)
Firm FE	✓	✓	✓	✓
Time FE	–	✓	✓	✓
AssetMat x Macro Controls	–	–	–	✓
Observations	126522	126522	126522	126522
Adjusted R^2	0.369	0.422	0.453	0.454

Overall, a higher supply of long-term government bonds is associated with a decrease in investment for firms specialised in long-duration investments. The baseline results are robust to the additional controls in both statistical significance and size. Table C.1 shows that controlling for the differential response of firms to individual measures of macroeconomic fluctuations does not affect the conclusions.

I take the specification in column (3) as my preferred specification. The results indicate that a 1-year higher average maturity of Treasury debt (1.1 sd) is associated with a 0.5pp drop in the investment rate of firms with long-duration investments relative to firms with short-duration investments (firms at the 75th percentile of the *Asset Maturity* distribution relative to firms at the 25th percentile of the distribution).

Economic significance In Appendix C, to assess the economic significance of the results, I re-run the regressions of Table 1 , replacing the continuous measure of investment duration by a dummy which equals one for firms with *Asset Maturity* above the (total assets-weighted) median across firms. The analogue to my preferred specification indicates that a 1-year higher average maturity of Treasury debt (1.1 sd) is associated with a 0.9pp drop in the investment rate of high *Asset Maturity* firms. This result implies a yearly reallocation of about 0.4% of total public assets from long- to short-duration firms (approximately 10% of the median capital expenditures in my sample).

Other outcomes In Appendix C, I show that long-duration firms also experience significant drops in R&D expenses and acquisitions. The drop in capital expenditures is 4 times larger than the drop in R&D expenses.

I also show that firms experience a significantly lower employment growth. A 1-year higher average maturity of Treasury debt (1.1 sd) is associated with a 0.2pp drop in employment growth of firms with long-duration investments relative to firms with short-duration investments (firms at the 75th percentile of the *Asset Maturity* distribution relative to firms at the 25th percentile of the distribution).

Finally, I breakdown the drop in investment associated with more long-term bond supply into investment rates in major categories of property, plant, and equipment: Buildings, Land and Improvement, Construction in Progress, and Machinery and Equipment using the variation in the stock of these assets valued at historical cost. I find that about 60% of the capital expenditures drop is explained by a drop in investment in machinery and equipment and 40% is explained by a drop in real estate investments.[26]

Robustness I confirm the robustness of the results using alternative empirical specifications and samples found in Appendix C.

In particular, the coefficients for capital expenditures are similar in magnitude and significance to the baseline results when splitting the sample in two halves (1965-1985 and 1986-2007), and when extending the sample to 2019.

I also show the results are robust to alternative definitions of long-term bond supply - the weighted-average duration of Treasury debt payments (coupons and principal), maturity-weighted debt to GDP, and government bond supply measured in 10-year duration equivalents.

Moreover, consistent with the mechanism highlighting the importance of the duration of cash flows, I show that the results are quantitatively robust to controlling for measures of irreversibility of investments in tangible capital such as capital re-deployability at the firm-level (Kim & Kung, 2017) or other industry-level measures of asset specificity and recovery rates (Kermani & Ma, 2022).

I measure pro-cyclicality of investment and show that my results are robust to controlling for quintiles of pro-cyclicality × time fixed effects.[27]

I also rule out the possibility that my results are driven by a "collateral channel" (Chaney et al., 2012), or the idea that changes in interest rates driven by long-term bond supply may translate into changes in real estate prices which, in turn, may affect differentially long-duration firms. Specifically, I control for the cross-sectional covariance of investment with real estate prices at the state- and MSA-level. and show that the baseline results are robust.

Finally, I show that the baseline results are robust to alternative measures of the duration of investment. In particular, the results are qualitatively unchanged when I use distinctly the measures identifying the intensive and extensive margins of specialisation into long-duration investments (Fixed-Asset Maturity and

[26] This data is available in the second part of my sample: 1985-2007.

[27] I measure the distribution of cyclicality across NAICS-3 digits industries as the distribution of the point estimates specific to each industry in the OLS regressions of firm-level capital expenditures (scaled by lagged assets) on real GDP growth.

Fixed-Asset Share). I also show that despite both margins being correlated, they both matter in isolation.

Across and within industries To decompose the across-firms reallocation into across industries and within-industry reallocations, I contrast my preferred specification using the firm-level measure of investment duration with specifications either using the industry-level measure or using within-industry across-firms variation in the firm-level measure.

Table 2: The investment reallocation channel: across and within industries

The table presents the reduced-form estimates based on Equation Equation 1 where the dependent variable is capital expenditures normalised by lagged total assets based on the yearly panel of Compustat firms for 1965-2007. The investment duration measure is either firm-level average asset maturity or the industry-level average asset maturity. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms or alternatively time and industries for specifications using industry-level measures.

	Capital Expenditures				
	(1)	(2)	(3)	(4)	(5)
TSYMAT × AssetMat (firm)	-0.172***		-0.168***		-0.175***
	(0.027)		(0.040)		(0.057)
TSYMAT × AssetMat (NAICS3)		-0.158***			
		(0.056)			
TSYMAT × AssetMat (NAICS6)				-0.150***	
				(0.048)	
Firm Controls x TSYMAT	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓
Time FE	✓	✓	–	✓	–
NAICS3 x Time FE	–	–	✓	–	–
NAICS6 x Time FE	–	–	–	–	✓
Observations	126522	126522	119167	126522	85374
Adjusted R^2	0.453	0.452	0.493	0.453	0.513

The elasticities are not significantly different within and across industries. Nevertheless, owing to more variation across industries, a 1-year increase in government debt maturity is associated with a 0.4% drop in investment rate for firms in long-duration industries (75th relative to 25th percentile across NAICS-3 digits industries) and a 0.3% drop in investment rate for long-duration firms within industries (75th relative to 25th percentile across firms within NAICS-3 digits industries).

Intangible investments To shed light on the reallocation channel for investments in intangible capital, which are key in modern economies[28], I rely on the horizons of business plan collected by Dessaint et al. (2023).

Consistent with the measure capturing duration of all types of investments, I find a ratio of R&D response to capital expenditures response about 2 times larger relative to the ratio obtained when using the measure of the duration of tangible investments. This results is robust to using the variation in the business plan horizon measure that is uncorrelated with the asset maturity measure.

Table 3: Horizon of business plans and R&D

The table presents the reduced-form estimates based on Equation Equation 1 where the dependent variable is capital expenditures normalised by lagged total assets based on the yearly panel of Compustat firms for 1965-2007. The investment duration measure is the firm-level average asset maturity. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	Capital Expenditures			R&D Expense		
	(1)	(2)	(3)	(4)	(5)	(6)
TSYMAT × AssetMat	-0.179***			-0.042*		
	(0.029)			(0.023)		
TSYMAT × BusPlanHorizon		-0.323**			-0.141***	
		(0.128)			(0.050)	
TSYMAT × BusPlanHorizon (res.)			-0.228*			-0.121**
			(0.125)			(0.056)
Time FE	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓
Firm Controls x TSYMAT	✓	✓	✓	✓	✓	✓
Horizon x Macro Controls	✓	✓	✓	✓	✓	✓
Observations	126522	125732	125732	126522	125732	125732
Adjusted R^2	0.454	0.453	0.453	0.799	0.799	0.799

V.B Within firm

Empirical strategy To test and quantify the reallocation of investment within firm, I study the division-level investment response (measured with division-level capital expenditures scaled by lagged firm assets) to the net supply of long-term government bonds in the cross-section of divisions of a firm. I rely on variation across divisions in the average cash flow duration of the divisions' marginal projects in my panel of multi-divisional U.S. public firms.

[28]see e.g. Eisfeldt and Papanikolaou 2013; Crouzet and Eberly 2019

I run panel regressions to explain the investment rate of division d, of firm f, with division-level industry s(d), measured at fiscal year-end t, with the following general form:

$$\begin{aligned}\frac{\text{Capex}_{f,d,s,t}}{\text{Assets}_{f,s,t-1}} =& \beta \cdot \text{TSYMAT}_t \cdot \text{AssetMaturity}_{s(d)} + \alpha_{f,t} + \gamma_{f,d} \\ &+ \delta \cdot \text{TSYMAT}_t \cdot X_{f,d,t} + \epsilon_{f,d,s,t}\end{aligned} \tag{2}$$

The vector $X_{f,d,t}$ includes a division-level measure of the profitability of divisions to control for investment opportunities. Standard errors are double-clustered at firm-division and time-levels.

The division-level investment duration measure ($\text{AssetMaturity}_{s(d)}$) is computed as the average firm-level investment duration in the firm-year panel for the industry the division belongs to.

The coefficient of interest β measures the effect on the division-level investment rate of a higher supply of long-term government debt for divisions with a long duration of investment relative to divisions with a short duration of investment.

The main identifying assumption is that the variation in the maturity of outstanding Treasury debt should not reflect otherwise better or worse investment opportunities for divisions belonging to industries with long-duration investments.

Results Table 4 presents the estimates from the panel regressions identifying a within-firm investment reallocation channel, gradually adding fixed effects. Column (1) the interaction and base terms as well as firm-divison and time fixed effects; column (2) adds firm-time fixed effects to control for the average investment rate of a firm at each point in time; and column (3) includes the interaction of proxies for firm-level investment opportunities.

Overall, a higher supply of long-term government bonds is associated with a decrease in investment within-firm for divisions specialised in long-duration investments. The results are robust to different fixed effects and the inclusion of the division-level measure of profitability in column (3).

I take the specification in column (3) as my preferred specification. The results indicate that a 1-year higher average maturity of Treasury debt is associated with a

Table 4: The investment reallocation channel: within-firm

The table presents the reduced-form estimates based on Equation Equation 2 where the dependent variable is division-level capital expenditures normalised by firm-level lagged total assets based on the yearly panel of Compustat Segment firm-divisions for 1976-2007. The investment duration measure is varying at the division-level. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	Capital Expenditures		
	(1)	(2)	(3)
TSYMAT × AssetMat (segment)	-0.0857***	-0.0960***	-0.0971***
	(0.0239)	(0.0208)	(0.0208)
TSYMAT × Profitability			0.469***
			(0.118)
Time FE	✓	–	–
Firm x Segment FE	✓	✓	✓
Firm x Time FE	–	✓	✓
Observations	52483	52308	52308
Adjusted R^2	0.620	0.648	0.649

0.2pp drop in the investment rate of divisions with long-duration investments relative to divisions with short-duration investments (divisions at the 75th percentile of the *Asset Maturity* distribution relative to divisions at the 25th percentile of the distribution).

The reallocation of investment within firm is smaller in magnitude compared to the reallocation found across firms. This owes to both smaller variation in the asset maturity across divisions within-firm in the sample, and smaller semi-elasticities. In particular, the semi-elasticity is twice as low as the across-firms semi-elasticity in the panel of firms. This result may identify another "discount rate fallacy" (following the "WACC fallacy" result in Krüger, Landier, and Thesmar (2015)): firms may improperly adjust their discount rate across projects (here divisions) and overinvest (underinvest) in relatively long (short) divisions following a shock to long-term bond supply.

The within-firm result also rules out that the reallocation results confound a collateral channel, whereby asset maturity may be capturing pledgeability or collateral value rather than duration of cash flows and whereby firms may be responding to an aggregate unobserved negative shock. The inclusion of firm×time fixed effects controls for such channel at the level of the firm. The stability of the coefficients confirms the relevance of the investment reallocation channel.[29]

[29] An implicit assumption is that of efficient internal capital markets.

V.C Mechanism: discount rates

In this section, I provide evidence consistent with the idea that the variation in the supply of long-term government bonds affects the composition of investment through the cross-section of discount rates used by firms. I first show that the supply of long-term government bonds is positively associated with the slope of the term structure for government and corporate bonds. I then show that, consistent with maturity matching in debt financing, this directly impacts the cost of capital of long-duration firms. Finally, I show broader evidence that changes in the slope of the term structure for corporate bonds are incorporated in the slope of the term structure of firms' discount rates.

Slope of the term structure I run monthly time series regressions of the slope of the term structure on the average maturity of Treasury debt.[30] I include macroeconomic controls which are known to have explanatory power for the term spread and report Newey and West (1987) standard errors allowing for 36 months of lags.

Table 5 presents the estimates for different measures of the slope of the term structure on Treasury and corporate bonds on the maximum sample where the yield data is available.

A higher maturity of Treasury debt is associated with an increase in the slope of the term structure, which is broad across definitions and robust to sub-samples. A lengthening of the maturity of the stock of Treasury debt by 1 year is associated with an increase in the term spread by 0.4 pp. In Table IC.1, I also show that the effect is increasing with maturity. In Table IC.2, I show robustness to using alternative measure of long-term bond supply. This allows to show my results are comparable in size with those obtained in Greenwood and Vayanos (2014).

In the last column of Table 5, I confirm the relation transmits to the term structure for high quality corporate bonds by a ratio of 4:5. I obtain this result computing term spreads on bonds using estimated yield curve data for high quality U.S. corporate bonds.[31]

[30] I use yield curve data U.S. Treasury bonds available on the Federal Reserve website.

[31] The data is from the U.S. Treasury's High Quality Market (HQM) Corporate Bond Yield Curve database available on the U.S. Treasury's website. The sample starts in 1985 due to data availability.

Table 5: Average maturity of U.S. Treasury debt and the term spread

The table presents the estimates from time series of different yield spread measures (column heads) for government and corporate bonds on government long-term bond supply (measured with the weighted-average maturity of Treasury debt) where the sample starts in the year indicated in the last row of each column and the sample ends in 2007. Details for variable definition in Appendix A. Standard errors reported in parentheses are Newey and West (1987) standard errors allowing for 36 months of lags.

	y10−y1				y5−y1	y15−y1	c10−c1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
TSYMAT	0.34*	0.38***	0.59***	0.55***	0.31***	0.68***	0.46**
	(0.19)	(0.12)	(0.05)	(0.13)	(0.09)	(0.06)	(0.22)
y1		-0.34***	-0.37***	-0.29***	-0.26***	-0.46***	
		(0.03)	(0.03)	(0.10)	(0.03)	(0.04)	
Unemp.		0.58***	0.60***	0.78***	0.43***	0.65***	0.37*
		(0.06)	(0.06)	(0.15)	(0.05)	(0.06)	(0.20)
Credit Spread		0.31*	0.29*	0.48**	0.24*	0.34	1.16***
		(0.16)	(0.16)	(0.20)	(0.13)	(0.22)	(0.18)
GDP Growth		0.07*	0.11***	0.12**	0.06*	0.11***	0.10*
		(0.04)	(0.03)	(0.05)	(0.03)	(0.04)	(0.06)
Linear trend		-0.01	-0.03***	0.00	-0.01	-0.03***	-0.04
		(0.01)	(0.01)	(0.04)	(0.01)	(0.01)	(0.04)
c1							-0.49***
							(0.11)
constant	-0.70	10.58	52.44***	-11.55	25.82	46.22***	84.71
	(0.89)	(23.87)	(11.98)	(74.63)	(18.47)	(14.76)	(83.89)
Observations	516	516	432	276	516	432	276
Sample Start	1965	1965	1972	1985	1965	1972	1985
R-squared	0.07	0.80	0.85	0.84	0.76	0.87	0.80

This result allows us to compare the semi-elasticities of investment from the across-firms reallocation obtained using instrumented variation in the term spread with those obtained using endogenous variation in the term spread. The 2SLS regression indicates that using variation in the maturity of government debt, a 1pp increase in the term spread is associated with a 1pp drop in the investment rate of firms with long-duration investments relative to firms with short-duration investments (firms at the 75th percentile of the *Asset Maturity* distribution relative to firms at the 25th percentile of the distribution).

This compares to a 0.4pp drop in the investment rate of firms with long-duration investments obtained from an endogenous least square regressions (Table D.1). This aligns with strong concerns of reverse causality underlying the endogenous relationship. Higher investment by long-duration firms financed with debt is essentially a positive supply shock to long-term debt.

Net debt issuance and the cost of debt If firms finance their investment with maturity-matched debt, the discount rate channel would be reflected in their cost of debt. Table E.2 provides suggestive evidence of strong maturity matching in the sample both for at the level of stocks (outstanding debt) and flows (new issuances).

In line with debt financing and maturity-matching, Table 6 reports the estimates from my baseline specifications, with respectively capital expenditures scaled by lagged assets, net debt issuance scaled by lagged assets and interest expenses scaled by debt as dependent variables. The drop in investment by long-duration firms is closely matched by an increase in their cost of debt servicing and a drop in debt issuance. This suggests that a significant chunk of the debt serviced by public firms in my sample is fixed-rate debt.

Table 6: The investment reallocation channel: investment, issuance, and debt cost

The table presents the reduced-form estimates based on Equation Equation 1 where the dependent variable is capital expenditures normalised by lagged total assets based on the yearly panel of Compustat firms for 1965-2007. The investment duration measure is either firm-level average asset maturity or the industry-level average asset maturity. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms or alternatively time and industries for specifications using industry-level measures.

	Capital Expenditures		Net Debt Issuance		Interest Expense	
	(1)	(2)	(3)	(4)	(5)	(6)
TSYMAT × AssetMat	-0.168***	-0.160***	-0.143***	-0.100***	0.069***	0.105***
	(0.028)	(0.029)	(0.027)	(0.029)	(0.017)	(0.023)
Time FE	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓
Firm Controls x TSYMAT	✓	✓	✓	✓	✓	✓
AssetMat x Macro Controls	–	✓	–	✓	–	✓
Observations	110560	110560	110560	110560	110560	110560
Adjusted R^2	0.468	0.469	0.092	0.092	0.319	0.319

Discount rates I provide final suggestive evidence in favour of the proposed mechanism proposed by studying whether changes in the slope of the term structure for corporate bonds are incorporated in the slope of the term structure of firms' discount rates.

To do so, I use predicted data on firms' discount rates from Gormsen and Huber (2023)[32] to compare the evolution of discount rates used by firms with different

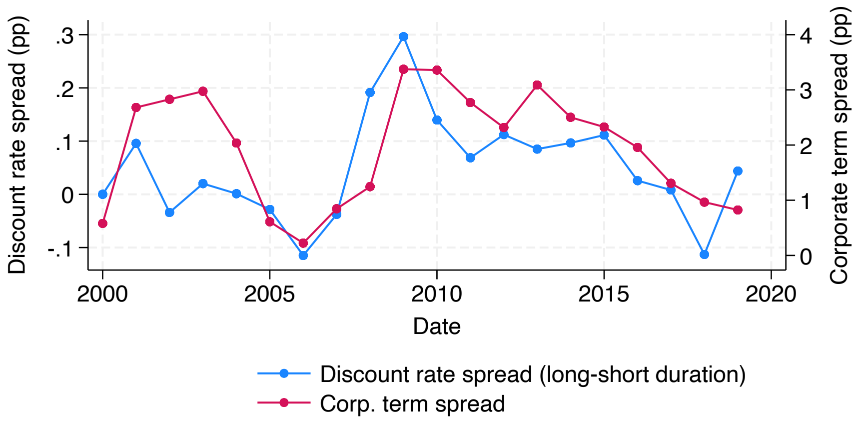
[32]The authors use information from corporate conference calls over the period 2002-2021, relying on explicit manager statements about the minimum required IRR that they want to earn on

investment duration with the evolution in the slope of the corporate bond yield curve.

Figure 4 provides suggestive evidence that a higher corporate term spread is associated with a higher difference in discount rates for firms in industries with long investment duration relative to firms in industries with short investment duration. In other words, when long risk-free interest rates increase relative to short risk-free interest rates, discount rates in long-duration industries increase relative to discount rates in short-duration industries.

Figure 4: The term spread and the cross-section of discount rates

The figure presents the yearly average of the monthly time series for the corporate term spread (yield spread between 10-year and 1-year constant maturity bonds) for bonds issued by high quality corporate issuers and the (yearly) rolling estimate in the regression of discount rates on industry-level (NAICS-3 digits) asset maturity.



More formally, in Table D.2, I estimate the covariance between the term structure of risk-free interest rates and the duration structure of firms' discount rates by running, in a yearly panel of industries, regressions of discount rates on an interaction term between the corporate term spread and measures of industries' duration of investment. Overall, I find a strong, positive, and robust relationship between the term structure of risk-free interest rates and the duration structure of discount rates.[33] I show that this relationship is robust to using the firm-level

new investment projects. They create out-of-sample predicted values of firms' discount rates from the dataset of communicated discount rates following a Lasso procedure in which they feed in a large list of firm-level risk factors and macroeconomic variables, such as the factor zoo, country fixed effects, and discount rate predictors - a year trend, option-implied volatility, a financial frictions index, and a market power index. The authors demonstrate the relevance of the predicted data: regressing the values of the discount rate from the Duke CFO data on their new predicted values they find a coefficient that is not statistically different from 1.

[33]The statistical significance of the relationship is robust to sample selection once one outlier industries is removed: SIC2-digits industries 40 (Railroad Transportation). Including the industry (untabulated results) does not affect the economic significance.

investment duration measure.

V.D Aggregate reallocation

To quantify the aggregate relevance of the investment reallocation channel, I construct a time series of the average duration of investment in the Compustat sample of public firms, defined as the average asset maturity weighted by capital expenditures of each firm. As the time series variation only come from variation in weights, it only captures the investment reallocation channel across-firms.

Figure 5: Aggregate investment duration and Treasury debt maturity

The figure presents the yearly average maturity of Treasury debt and the average duration of investment computed in the Compustat sample of public firms

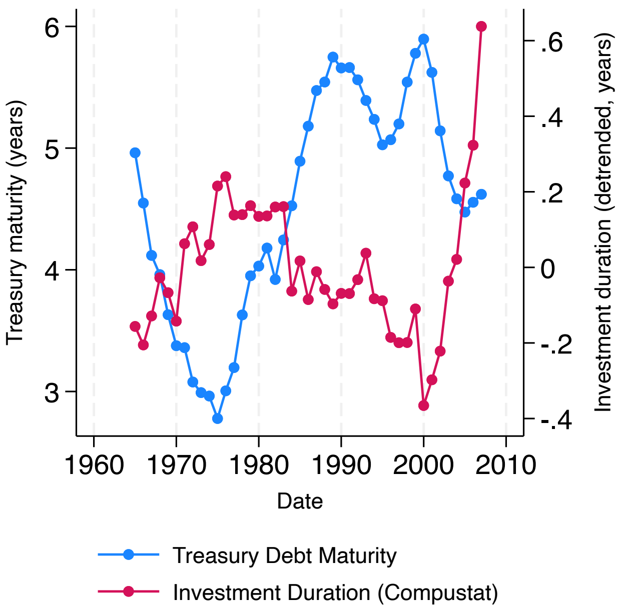


Figure 5 plots the series (linearly detrended) against the average maturity of Treasury debt. The strong correlation is confirmed in time series regressions (Table C.5). A higher maturity of Treasury debt is associated with a lower maturity of investments for the representative public firm. This correlation is robust to controlling for measures of business cycles. A 1-year increase in government debt maturity is associated with a 0.16-year in aggregate investment duration. This result is large compared to time series variation: its unconditional standard deviation in the sample is 0.21-year, and the standard deviation in the linearly de-trended series is 0.18-year.

VI The debt reallocation channel

As discussed in Section II, if the reallocation of investment is matched by a reallocation of net debt issuance and firms pursue maturity-matching, a positive shock to the supply of long-term bonds would result in a drop in the issuance of long-term corporate debt (the debt reallocation channel). Because the investment reallocation channel can propagate both within and across firms, so does the debt reallocation channel.

In section subsection V.C, I show that a higher supply of long-term Treasury bonds is indeed associated, for long-duration firms, with a drop in net debt issuance comparable in magnitude to the drop in investment. In addition, Figure E.1 confirms that firms in my sample do indeed pursue assets-liabilities maturity matching.

It follows that in the aggregate, one should expect a negative correlation between government debt maturity and corporate debt maturity. This has indeed been shown in the literature following Greenwood et al. (2010), but has thusfar been attributed exclusively to a financial arbitrage channel - the idea that firms change the maturity of their outstanding debt to minimise financing costs.

In this section, I quantify the importance of the debt reallocation channel for explaining this aggregate negative correlation instead. The aggregate maturity of corporate debt at time t is defined as the weighted average maturity of corporate debt over the panel of firms, each indexed i:

$$\mathrm{m_t} = \sum_{\mathrm{i}} \frac{\mathrm{Debt_{i,t}}}{\sum_{\mathrm{i}} \mathrm{Debt_{i,t}}} \cdot \mathrm{m_{i,t}} = \sum_{\mathrm{i}} \mathrm{w_{i,t}} \cdot \mathrm{m_{i,t}}$$

where $\mathrm{Debt_{i,t}}$ is the stock of debt of firm i at time t, and $\mathrm{m_{i,t}}$ is the average maturity of the debt of firm i at time t.

In this setting, the covariance between government debt maturity and corporate debt maturity may be driven by changes to either the distribution of firms' contributions to total debt (the weights, $\mathrm{w_{i,t}}$), or the distribution of firms' debt maturity (the individual maturities, $\mathrm{m_{i,t}}$). Based on this observation, I propose to decompose the aggregate covariance into two parts - one based on variation in weights across-firm and one based on the within-firm variation in debt maturity.

To do so, I define an *across-firm term* as the weighted average corporate debt maturity, keeping the debt maturity of each firm constant at the firm's average:

$$m_t^{ACROSS} = \sum_i \frac{Debt_{i,t}}{\sum_i Debt_{i,t}} \cdot \overline{m_i}$$

Note that variation in firm weights may come from both changes to the composition of the panel of firms and from changes to the debt size of each firm present in the panel over time.

I also define a *within-firm term* as the the weighted average corporate debt maturity, keeping the weight of each firm constant at a value based on the firm's average debt and a constant composition of the panel.

$$m_t^{WITHIN} = \sum_i \frac{\overline{Debt_i}}{\sum_i \overline{Debt_i}} \cdot m_{i,t}$$

The covariance between m_t^{WITHIN} and government debt maturity can reflect both the within-firm debt reallocation channel due to maturity matching and the corporate arbitrage channel. Both mechanisms are associated with a within-firm drop in corporate debt maturity following an increase in government debt maturity. Hence, the covariance between the maturity of Treasury debt and within-firm variation in corporate debt maturity is an upper bound (in absolute terms) to the corporate arbitrage channel.

On the other hand, covariance between m_t^{ACROSS} and the government debt maturity cannot be explained by the financial arbitrage channel. Assuming that there are no other mechanisms that explain the covariance, it is solely explained by the debt reallocation channel.

Taking a conservative view and assuming that the full covariance between m_t^{WITHIN} and government debt maturity is explained by the corporate arbitrage channel, and focussing on the covariance between m_t^{ACROSS} and government debt maturity instead allows to quantify a lower bound (in absolute terms) to the debt reallocation channel.

To quantify the relative importance of the debt reallocation channel in explaining the covariance between the aggregate maturity of corporate debt and the maturity of Treasury debt, I first replicate the results of Greenwood et al. (2010). Table 7 presents the estimates corrresponding to regressions of firm-level debt maturity on the average maturity of Treasury debt in the panel of U.S. public firms over 1975-2007. To capture the covariance between the aggregate corporate debt maturity and the average maturity of Treasury debt, these regressions are weighted.

Table 7: Maturity of U.S. Treasury debt and maturity of aggregate corporate debt

The table presents the estimates from weighted regressions of firm-level debt maturity on the average maturity of Treasury debt in the panel of U.S. public firms over 1975-2007. In columns (1) to (3), the dependent variable is the firm-year share of debt maturing in more than five years and the weight is equal to the firm-year outstanding debt scaled by total outstanding debt. In columns (4) to (6), the dependent variable is the firm-year average maturity of new issuances and the weight is equal to the firm-year total issuance amount scaled by total issuance amounts. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Standard errors reported in parentheses are clustered by firms.

	LT Debt Share (>5y)			Years-to-Maturity (New Issuances)		
	(1)	(2)	(3)	(4)	(5)	(6)
	share(f,t)	share(f,t)	$\overline{\text{share}}$(f)	issmat(f,t)	issmat(f,t)	$\overline{\text{issmat}}$(f)
TSYMAT	-7.3***	-3.7***	-3.2***	-4.6***	-2.9***	-1.9***
	(2.1)	(0.7)	(1.2)	(0.5)	(0.4)	(0.3)
constant	48.3***	46.4***	48.0***	10.3***	10.7***	10.0***
	(2.4)	(0.1)	(2.0)	(0.2)	(0.2)	(0.2)
No FE	✓	–	✓	✓	–	✓
Firm FE	–	✓	–	–	✓	–
Observations	80634	80083	80634	8164	7899	8164
Adjusted R^2	0.069	0.416	0.029	0.271	0.350	0.156
weights	debt(f,t)	debt(f)	debt(f,t)	issuance(f,t)	issuance(f)	issuance(f,t)

In columns (1) to (3), the dependent variable is the firm-year share of debt maturing in more than five years and the weight is equal to the firm-year outstanding debt scaled by total outstanding debt. In columns (4) to (6), the dependent variable is the firm-year average maturity of new issuances and the weight is equal to the firm-year total issuance amount scaled by total issuance amounts.[34]

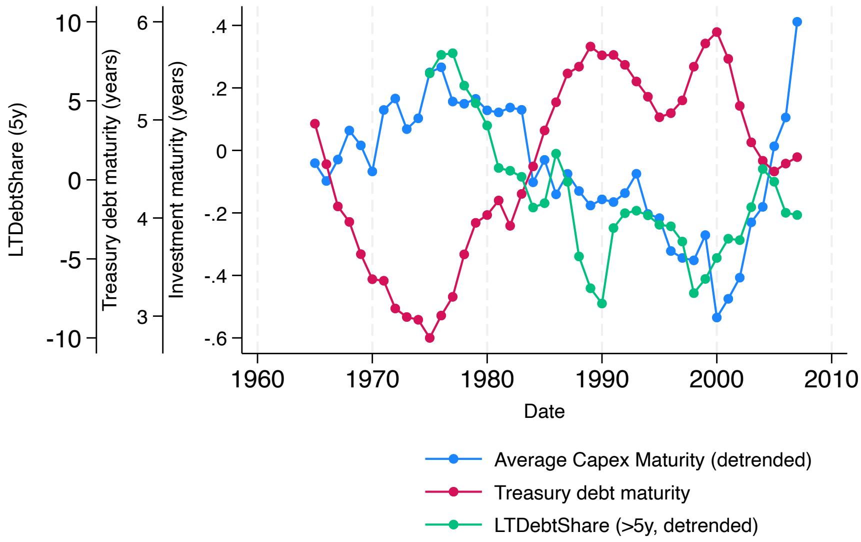
Column (1) shows that a 1-year increase in government debt maturity is associated with a 7.3pp drop in the aggregate share of corporate debt with residual maturity above 5-years. Figure 6 allows to visually grasp this time series correlation. Column (4) also shows that an increase in government debt maturity is associated with a drop in the maturity of new issuances.

In column (2) and (5), I re-estimate the aggregate covariance by (i) fixing the firm-year weights to the average firm-level weight and (ii) controlling for

[34] Following Badoer and James (2016), I construct a panel of bond and syndicated loan issuances by non-financial firms over 1975-2007 aggregated at the firm-year level from debt issue-level observations extracted from the Thomson Reuters LPC Dealscan and SDC Platinum New Issues databases. More details can be found in Appendix E.

Figure 6: Maturity of U.S. Treasury debt and maturity of aggregate corporate debt

The figure presents the yearly average maturity of Treasury debt, the average duration of investment computed from the Compustat sample of public firms and the aggregate share of debt with residual maturity above five years in the Compustat sample of public firms.



composition in the panel with firm fixed effects. This quantifies the covariance between government debt maturity and the within-firm term.

In column (3) and (6), I re-estimate the aggregate covariance by fixing the dependent variable to the firm-level average. This quantifies the covariance between government debt maturity with the across-firms term.

The covariances with the within-firm and across-firms terms have similar magnitude for both empirical strategies, highlighting the economic importance of the debt reallocation channel which explains about half of the aggregate covariance between the maturity of Treasury debt and the aggregate maturity of corporate debt. [35]

More broadly, these results suggest that the investment reallocation channel may be a general mechanism underlying the correlation highlighted in the aggregate between the time series variation in the maturity of corporate debt and the term premium.[36]

[35] In Table ID.1, I show the results are robust to proxying the maturity of corporate debt with the share of corporate debt with residual maturity above one year or above three years.

[36] Baker et al. (2003) provides evidence that the time series variation in the maturity of corporate debt strongly correlates with the predictability of bond market returns. That is, the long-term debt share (measured as the ratio of long-term debt to total debt) is high when the term premium is low.

VII External validity: The UK demand shock

In this section, I exploit another plausibly exogenous demand shock to the net supply for long-term bonds in the UK.

Demand shock: Pensions Fund Act (2004) The Pensions Act of 2004 established a government fund to protect the benefits of pension scheme members from the risk of a pension fund bankruptcy. One of the introduced criteria for the newly created pension fund regulator to take over the funds perceived to be at risk is a pension plan's "accouting deficit" - the difference between the market values of a plan's assets and its liabilities.

A pension fund can reduce the volatility of its "accouting deficit" by investing in long-term government bonds. Indeed, the assets providing the best hedge for variation in the present value of pension liabilities are the same assets whose price is used to discount these liabilities.[37] As the Pensions Act of 2004 also instituted fines for underfunded pension plans, it provided strong incentives to pension funds to buy more long-term UK government bonds.

Greenwood and Vayanos (2010) shows that as a consequence of the 2004 reform, pension funds increased their exposure to long-term government bonds and reduced that to equities. They provide evidence that between 2005 and 2006, pension funds bought approximately GBP 11 billion of inflation-linked bonds as well as bonds with maturities longer than 15 years, and swapped as much as GBP 50 billion of interest rate exposure so as to increase the duration of their assets. The authors highlight that the increase is substantial in comparison with the GBP 73 billion of net government issuance of inflation linked and long-term bonds between April 2005 and March 2007.

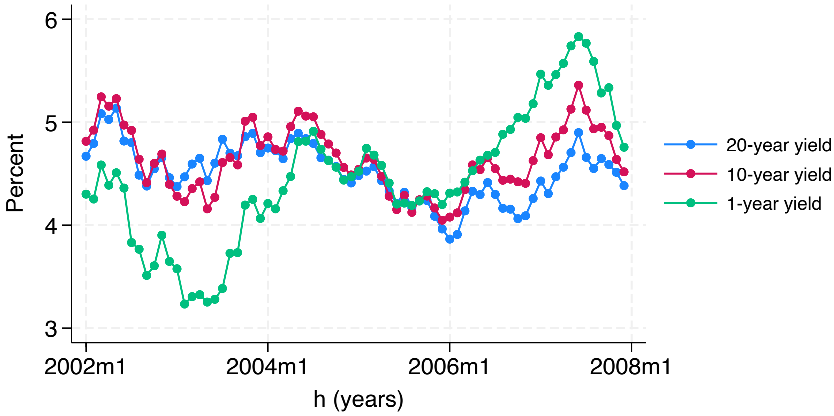
The drop in long-term term rates This increase in demand is matched by a dramatic drop in the yields on both inflation-linked and nominal long-term government bonds. Figure 7 documents the dramatic inversion of the UK nominal yield curve. Greenwood and Vayanos (2010) concludes that this yield curve inversion cannot be rationalised based on the expectations hypothesis as it

[37] Pension funds' liabilities have a long-duration and are mostly comprised of inflation linked pension benefits.

would rely on unrealistic expectations of significant drops in short-term interest rates in the very distant future.[38]

Figure 7: Term spread on UK government bonds (2002-2008)

The figure plots the yields on long-term bonds (resp. 10-year and 20-year maturities) and the yield on the 1-year maturity bond. The estimated yield curves data can be found on the Bank of England website.



Increase in investment by long-duration firms The reform allows me to test, in a different setting, the effect of the net supply of long-term bonds for the duration of corporate investment. I focus on a panel of UK firms with publicly traded securities from 2001 to 2008 obtained from Compustat Global. Table A.6 presents the summary statistics.

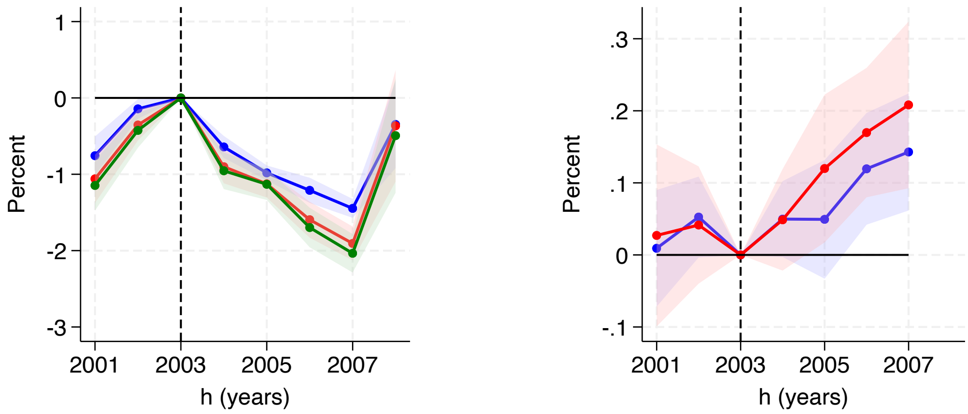
I run event-study difference-in-differences (DiD) regressions that compare the investment of firms after the policy shock to before, for long-duration firms relative to short-duration firms. I regress investment (measured as capital expenditures scaled by lagged total assets, as before) on event-study dummies interacted with the treatment variable: firm-level *Asset Maturity*. Standard errors are clustered at the level of the firm.

Figure 8 presents the DiD estimates for investment from the specification that includes firm and time fixed effects. After the shock, long-duration firms invest relatively more.The dynamics of the effect are consistent with the cumulative net purchases of long-term bonds by UK pension fund reported in Greenwood and Vayanos (2010) (i.e. growing steadily until at least end of 2006) and the price

[38]Consistent with a “demand shock” interpretation, the authors report that pension-fund managers and the UK Debt Management Office have agreed with the the attribution of these changes in price to the policy-driven changes in demand for long-term bonds.

Figure 8: UK event study for investment by long-duration firms

The figure plots the event-study coefficients on the interactions of year dummies and firm-level *Asset Maturity* in the regression where the dependent variable is capital expenditures normalised by lagged total assets based on the yearly panel of Compustat Global UK firms for 2001-2008. The specification in blue corresponds to the specification in the second third column of Table F.1 which includes firm and time fixed-effects. The year 2003 acts as the baseline period. Confidence intervals are built at the 95 percent confidence level based on standard errors clustered by firm. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A.



pressures highlighted in Figure 7 to persist until 2008. Importantly, the parallel trends assumption holds prior to the shock.

Table F.1 presents the related DiD estimates. After the shock, firms at the 75th percentile of the *Asset Maturity* distribution on average increase yearly capital expenditures by 0.4% of assets relative to firms at the 75th percentile of the *Asset Maturity* distribution over 2006-2008 where the yield curve inversion is the most severe.

Table F.2 quantifies the changes in term spreads for the UK yield curve (long-term yields over 1-year yield) over the same periods. Relative to 2003 averages, term spreads for resp. 10-year, 20-year, and 25-year yields have dropped by 1, 1.29, and 1.41pp on average for 2006-2008.

Comparison of semi elasticities It follows that the shock predicts a difference in the semi-elasticity of investment across investment duration[39] to the term spread ranging from –0.7% to –1% of assets. This compares to the difference in the semi-elasticity of investment across investment duration of –1.2% of assets obtained from the U.S. policy shocks (cf. the 2SLS results in Table D.1). Overall, I

[39] Semi-elasticity of investment to a 1pp level increase in the term spread (10-year minus 1-yield yield) for a firm with a one standard-deviation higher *Asset Maturity*.

find that a plausibly exogenous shock to the demand for long-term bonds in the UK depressed long-term yields and in turn increased the investment of UK public firms in long-duration industries. The exercise confirms the external validity of my baseline results in another plausibly exogenous setting.

VIII Conclusion and discusssion

In this paper, I show that large shocks to the supply of long-term bonds crowd out long-term investment through a discount rate channel and long-term debt through maturity-matching.

Using plausibly exogenous variation in the maturity structure of U.S. government debt, I find that a higher supply of long-term bonds increases firms' financing costs and discount rates for long duration assets leading to a crowding-out of long-duration investment. The reallocation of investment towards assets with shorter cash-flow duration, occur both *across firms* and *within firm across divisions*. Because firms pursue maturity matching, I also show that the aggregate changes to the duration of investment map into aggregate changes to the maturity of corporate debt.

Overall, these results are important because they highlight new real effects of government interventions in bond markets on corporate investment. In particular, the evidence presented in this paper can be a relevant input to the trade-offs faced by policy makers for decisions over the maturity of government debt issues. Furthermore, it contributes to the understanding of the implications of central bank purchases of long-term obligations for corporate investment.

One obvious takeaway is the optimal timing of quantitative easing. If financial constraints and costly liquidation of long-duration investments leads to their under-provision in bad times (Aghion et al., 2010, Garicano & Steinwender, 2016) and if long-term investments, such as structures or R&D, contribute more to productivity growth, the social planner may want to mitigate the effect of financial constraints on long-term investment in recessions. My investment reallocation channel therefore suggests a rationale for pursuing quantitative easing and incentivise long-term investments *in recessions* precisely because recessions are characterised by a lower than socially optimal provision of long-term investments.

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A Variables

Variables Description

Firms' financials	**Variable description**
Total Assets	Total assets measured with Compustat variable *at* in USD mn.
PP&E	Net fixed assets measured with Compustat variable *ppent* in USD mn.
Employment	Total employment measured with Compustat variable *emp* in thousands of employees.
Sales	Total net sales measured with Compustat variable *sale* in USD mn.
Market Value of Equity	Market value of equity measured with Compustat variables as the product of *prcc* and *csho* in USD mn.
Market-Debt Ratio	Market-Debt ratio measured with Compustat variables as $\frac{\text{dltt}+\text{dlc}}{\text{dltt}+\text{dlc}+\text{prcc}*\text{csho}}$.
Market to Book Ratio	Market-to-book ratio measured with Compustat variables as $\frac{\text{at}+\text{prcc\_c}*\text{csho}-\text{ceq}-\text{txdb}}{\text{at}}$.
EBIT to Assets	Earnings before interest and taxes, scaled by total assets measured with Compustat variables as $\frac{\text{in}+\text{xint}+\text{txt}}{\text{at}}$
Capex (% of lagged assets)	Capital expenditures (Compustat variable capx) scaled by lagged total assets.
R&D (% of lagged assets)	R&D expenses (Compustat variable xrd) scaled by lagged total assets. Missing values are replaced by zeros.
Acquisitions (% of lagged assets)	Acquisitions (Compustat variable acq) scaled by lagged total assets.
Debt	Debt measured with Compustat variables as dltt + dlc.
Book leverage	Book leverage measured as *Debt* to *Assets*.
LT debt share (1y)	Share of debt with residual maturity above one year measured with Compustat variables as $(1-(\text{dlc})/(\text{dlc}+\text{dltt}))$.
LT debt share (2y)	Share of debt with residual maturity above one year measured with Compustat variables as $(1-(\text{dlc}+\text{dd2})/(\text{dlc}+\text{dltt}))$.
LT debt share (3y)	Share of debt with residual maturity above one year measured with Compustat variables as $(1-(\text{dlc}+\text{dd2}+\text{dd3})/(\text{dlc}+\text{dltt}))$.
LT debt share (4y)	Share of debt with residual maturity above one year measured with Compustat variables as $(1-(\text{dlc}+\text{dd2}+\text{dd3}+\text{dd4})/(\text{dlc}+\text{dltt}))$.
LT debt share (5y)	Share of debt with residual maturity above one year measured with Compustat variables as $(1-(\text{dlc}+\text{dd2}+\text{dd3}+\text{dd4}+\text{dd5})/(\text{dlc}+\text{dltt}))$.
Sales Growth	Change of a firm's sales in percentage points of previous year's sales.
Sales Growth (2digits SIC)	Yearly average of yearly firm observations for *Sales Growth* aggregated at two-digits SIC industry
Dividend Dummy	Dummy variable taking a value of one if the firm declared dividends on common stock (Compustat variable *dvc*).
IG Rating Dummy	Dummy variable taking a value of one if the firm has a S&P long-term credit rating of BBB- or higher or if it has a S&P short-term credit rating of A-3 or higher. Measured with the S&P ratings database variables *splticrm* and *spsticrm*
Asset Maturity (firm-year)	Book-value-weighted average maturity of assets measured with Compustat Annual variables as $\frac{\text{act}}{\text{act}+\text{ppent}}\cdot 1+\frac{\text{ppent}}{\text{act}+\text{ppent}}\cdot\frac{\text{ppent}}{\text{dp}-\text{am}}$. Missing amortisation observations (*am*) are replaced by zeros.
Asset Maturity	*Asset Maturity* averaged over the sample by firm.
Asset Maturity (NAICS-3)	*Asset Maturity* averaged over the sample by 3-digits NAICS industry .
Asset Maturity (NAICS-6)	*Asset Maturity* averaged over the sample by 6-digits NAICS industry .
Asset Maturity (w/in NAICS-3)	*Asset Maturity* residualised against NAICS-3 digits fixed-effects.
Fixed-Asset Maturity	maturity of fixed assets measured with Compustat variables as $\frac{\text{ppent}}{\text{dp}-\text{am}}$ and averaged over the sample by firm. Missing amortisation observations (*am*) are replaced by zeros.
Fixed-Asset Share	The ratio of *PP&E* to the sum of *PP&E* and *Current Assets* averaged over the sample by firm.
Business Plan Horizon	Two-digits SIC industry's average of the horizon of the business plan that managers disclose from SEC filings obtained from Dessaint et al. (2023).

Business Plan Horizon (res.)	*Business Plan Horizon* residualised against *Asset Maturity*.
Redeployability	Firm-level measure of asset redeployability from Kim and Kung (2017).
Redeployability (equal-weighted)	Firm-level measure (equal-weighted) of asset redeployability from Kim and Kung (2017).
Mobility	Industry-level (SIC2-digits) measure of the mobility of fixed assets from Kermani and Ma (2022).
Customization	Industry-level (SIC2-digits) measure of the customisation of fixed assets from Kermani and Ma (2022).
Recovery Rate	Industry-level (SIC2-digits) average recovery rate for fixed assets from Kermani and Ma (2022).
Age	Time in years since founding date of the company from Jay Ritter's website.
Time from IPO	Time in years since IPO date of the company from Jay Ritter's website.
Num of obs	Firm-level number of observations in the panel.
RE price (State)	Residential house prices at state level from replication package for Chaney et al. (2012).
RE price (MSA)	Residential house prices at MSA level from replication package for Chaney et al. (2012).
Change in FA (Total)	Yearly change in total Fixed-Assets at historical cost (measured with Compustat variables as fatb+fatl+fate+fatc+fato+fatp+fatn) scaled by lagged total Fixed-Assets at historical cost.
Change in FA (Machinery and Equipment)	Yearly change in Fixed-Assets (Machinery and Equipment) at historical cost (Compustat variable fate) scaled by lagged total Fixed-Assets at historical cost.
Change in FA (Real Estate)	Yearly change in Fixed-Assets (Real Estate) at historical cost (measured with Compustat variables as fatb + fatl + fatc + fatn) scaled by lagged total Fixed-Assets at historical cost.

Macroeconomic and asset prices series	**Variable description**
TreasuryDebtMaturity	Dollar-weighted average maturity of Treasury debt at monthly frequency and expressed in years.
TreasuryDebtMaturity (5-year demeaned)	The residual on the regression of *TreasuryDebtMaturity* on 5-year period indicators
Moody's LT BAA-AAA Spread	Spread in percentage points between yields on the Moody's Seasoned BBB- and AAA-rated corporate bond indices (based on bonds with maturities 20 years and above). The data is retrieved at the monthly frequency from FRED, Federal Reserve Bank of St. Louis.
Total GDP 4Q Growth	Real GDP growth over the past four quarters measured quarterly and expressed in percentage points.
Treasury Debt to GDP	Sum of principals of outstanding Treasury debt from CRSP Treasury scaled by nominal GDP from FRED and expressed in percentage points.
N-y TSY Yield	The yield-to-maturity on the *N*-year maturity Treasury bond using the U.S. Treasury constant maturity zero-coupon bond yield curve from the Federal Reserve (in percentage points).
H-y Excess Return on N-y TSY	The *H*-year horizon excess return on the *N*-year Treasury bond calculated as the holding-period return from buying a *N*-year bond and selling it *H*-year later in excess of the return on the *H*-year bond, computed with the monthly data on U.S. Treasury constant maturity zero-coupon bond yield curve from the Federal Reserve (in percentage points).
y10-y1	The spread between the yield-to-maturity on the 10-year maturity Treasury bond and the yield-to-maturity on the 1-year maturity Treasury bond using the U.S. Treasury constant maturity zero-coupon bond yield curve from the Federal Reserve (in percentage points).

Issuance characteristics	**Variable description**
Years to Maturity	Maturity of the issue at issuance date in years.
Deal Amount	Loan principal amount (*facilityamt*) for issues in Dealscan and Total principal amount of the issue (*totdolamt*) in USD mn.
Dealscan Flag	Dummy for deal observations that come from the Dealscan dataset (mostly bank loans) as opposed to the SDC dataset (public bonds).

Table A.4: Summary statistics: firm-year panel of U.S. public firms (1965-2007)

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Total Assets*	736.61	2,687.00	0.05	5.70	17.69	66.63	306.44	1,376.75	39,042.00	126,522
Capital Expenditures*	48.18	169.80	0.00	0.14	0.67	3.46	18.40	89.69	2,430.00	126,522
Sales*	731.98	2,404.99	0.00	4.50	18.70	77.78	351.99	1,476.97	35,214.00	126,522
Employment*	6.05	15.77	0.00	0.05	0.18	0.86	3.70	14.40	197.60	122,263
AssetMat (firm)**	3.86	2.72	0.99	1.29	1.85	3.00	4.93	7.85	14.85	126,522
AssetMat (NAICS 3)**	3.86	1.97	1.08	2.14	2.17	3.38	4.84	7.29	13.03	126,522
AssetMat (NAICS 6)**	3.86	2.22	1.04	1.76	2.28	3.04	4.73	7.38	14.63	126,522
AssetMat (firm w/in NAICS 3)**	0.03	1.87	-9.27	-1.85	-0.98	-0.26	0.81	2.33	11.94	126,522
FixedAssetMat**	7.57	3.59	0.65	3.20	4.88	7.24	9.63	12.30	22.05	126,522
FixedAssetShare**	0.35	0.21	0.01	0.11	0.18	0.31	0.49	0.70	0.88	126,522
BusPlanHorizon	4.31	0.48	1.00	3.70	3.99	4.32	4.58	4.78	8.00	125,732
BusPlanHorizon (res.)	-0.01	0.48	-3.44	-0.60	-0.31	0.03	0.31	0.44	3.73	125,732
LT debt sh. (1y)	68.93	31.28	0.00	10.95	51.83	80.99	93.89	98.98	100.00	111,373
LT debt sh. (3y)	43.59	34.00	0.00	0.00	5.88	45.62	73.83	89.40	100.00	82,408
LT debt sh. (5y)	27.98	29.85	0.00	0.00	0.00	18.21	51.36	73.36	100.00	80,955
Capex (% of lagged assets)**	8.31	8.34	0.17	1.17	2.61	5.52	10.70	19.99	55.48	126,522
R&D (% of lagged assets)**	4.17	8.38	0.00	0.00	0.00	0.00	4.27	13.97	56.84	126,522
Acquisitions (% of lagged assets)**	1.53	4.73	0.00	0.00	0.00	0.00	0.00	4.45	37.14	126,522
Emp. Growth**	6.14	23.37	-47.67	-19.49	-6.00	2.45	14.44	36.92	100.00	108,018
Profitability*	-0.02	0.61	-16.53	-0.26	-0.01	0.08	0.14	0.21	0.53	126,522
M/B Ratio*	2.13	3.88	0.41	0.81	1.00	1.34	2.09	3.63	112.99	126,522
Sales Growth*	5.16	49.38	-744.50	-20.35	-0.91	9.64	21.20	38.66	100.00	126,522
IG Rating	0.13	0.34	0.00	0.00	0.00	0.00	0.00	1.00	1.00	126,522
log(Assets)	4.35	2.14	-6.91	1.74	2.87	4.20	5.73	7.23	13.08	126,522
log(MCap)	4.11	2.24	-1.84	1.35	2.49	3.95	5.63	7.13	10.95	126,494
log(PPE)	2.83	2.49	-6.91	-0.25	1.17	2.75	4.47	6.13	9.56	126,220
log(Emp)	-0.19	2.19	-6.91	-3.02	-1.69	-0.14	1.31	2.67	5.29	121,861
Book Leverage*	0.24	0.20	0.00	0.00	0.07	0.22	0.37	0.52	0.98	124,454
Redeployability	0.40	0.11	0.03	0.26	0.36	0.42	0.46	0.53	0.91	82,914
Redeployability (eq. wght)	0.33	0.08	0.03	0.19	0.30	0.35	0.38	0.43	0.70	82,914
Mobility	0.03	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.07	122,629
Customization	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.09	122,629
Recovery Rate	0.34	0.09	0.04	0.24	0.28	0.35	0.38	0.49	0.62	122,629
Age	21.66	20.84	-10.00	5.00	9.00	15.00	26.00	45.00	167.00	46,518
Time from IPO	6.83	6.45	-23.00	1.00	2.00	5.00	10.00	16.00	31.00	48,574
Num of obs	22.10	14.33	2.00	6.00	11.00	19.00	31.00	46.00	56.00	126,522
RE price (State)	209.37	122.05	41.95	97.10	122.71	185.54	254.42	355.76	727.86	112,316
RE price (MSA)	113.78	55.76	18.77	54.15	78.60	103.58	132.32	188.08	357.29	100,121
Change in Total FA**	11.72	17.85	-29.48	-6.14	1.49	8.06	19.25	37.56	86.81	55,751
Change in FA (Mach. and Eq.)**	8.83	15.03	-17.15	-6.72	0.86	5.66	14.12	31.53	46.30	51,655
Change in FA (Real Estate)**	3.55	6.51	-11.67	-3.12	-0.02	1.50	5.79	13.22	37.97	49,718
Buildings to Total FA**	0.15	0.16	0.00	0.00	0.00	0.11	0.27	0.40	0.56	45,161
Equipment to Total FA**	0.68	0.21	0.23	0.35	0.53	0.70	0.85	0.95	1.00	45,161
Leases to Total FA**	0.10	0.13	0.00	0.00	0.00	0.03	0.14	0.32	0.48	45,161
Construction to Total FA**	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.05	0.10	45,161
NatResources to Total FA**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45,161
Land to Total FA**	0.03	0.04	0.00	0.00	0.00	0.01	0.04	0.09	0.15	45,161
Other FA to Total FA**	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.02	0.34	45,161

Note: This table reports summary statistics for the main variables in the yearly panel of Compustat firms from 1965 to 2007. All variables are defined in Appendix A.

* To mitigate the influence of outliers, the variables have been winsorised at the latest stage with tail cuts at the 1st and 99th percentiles of the yearly distributions of the variables.

** To mitigate the influence of outliers, the variables have been winsorised at the latest stage with tail cuts at the 5th and 95th percentiles of the yearly distributions of the variables.

Table A.5: Summary statistics: firm-division-year panel of U.S. public firms (1977-2007)

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Total Assets (firm)*	1,910.32	4,383.92	0.29	15.72	55.52	276.93	1,440.53	5,231.10	39,042.00	52,483
Capital Expenditures (firm)*	128.40	326.76	0.00	0.56	2.59	14.20	81.04	352.00	5,326.00	52,483
Employment (firm)*	13.60	23.42	0.00	0.22	0.78	3.29	13.55	44.00	137.70	51,430
AssetMat (firm)**	4.45	2.61	1.02	1.94	2.63	3.61	5.54	8.37	14.23	52,483
Capex (% of assets) (segment)**	2.64	3.07	0.00	0.13	0.48	1.42	3.64	7.34	14.46	52,483
AssetMat (segment)**	4.04	1.88	1.39	2.31	2.62	3.55	4.95	7.02	13.06	52,483
Profitability (segment)**	0.11	0.28	-5.77	-0.06	0.03	0.12	0.20	0.32	1.40	52,483

Note: This table reports summary statistics for the main variables in the yearly panel of Compustat Segment firm-divisions from 1977 to 2007. All variables are defined in Appendix A.
* To mitigate the influence of outliers, the variables have been winsorised at the latest stage with tail cuts at the 1st and 99th percentiles of the yearly distributions of the variables.
** To mitigate the influence of outliers, the variables have been winsorised at the latest stage with tail cuts at the 5th and 95th percentiles of the yearly distributions of the variables.

Table A.6: Summary statistics: firm-year panel of UK public firms (2001-2008)

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Total Assets*	881.34	3,778.65	0.02	4.05	12.62	52.10	231.25	1,363.00	52,959.00	7,017
Capital Expenditures*	43.88	206.30	0.00	0.06	0.24	1.46	10.82	57.00	3,442.00	7,017
Sales*	760.40	3,047.00	0.00	1.81	9.32	48.98	273.45	1,355.20	51,514.00	7,017
Employment*	7.33	25.20	0.00	0.05	0.16	0.62	3.67	15.61	440.00	5,120
AssetMat (firm)**	4.61	5.82	1.01	1.09	1.31	2.30	4.72	11.45	31.90	7,017
AssetMat (SIC 2)**	5.09	4.73	1.69	1.94	2.15	3.21	4.92	11.21	27.85	7,017
Capex (% of assets)**	5.71	6.61	0.02	0.61	1.44	3.28	6.90	14.86	29.70	7,017

Note: This table reports summary statistics for the main variables in the yearly panel of Compustat Global firm from 2001 to 2008. All variables are defined in Appendix A.
* To mitigate the influence of outliers, the variables have been winsorised at the latest stage with tail cuts at the 1st and 99th percentiles of the yearly distributions of the variables.
** To mitigate the influence of outliers, the variables have been winsorised at the latest stage with tail cuts at the 5th and 95th percentiles of the yearly distributions of the variables.

Table A.7: Summary statistics: macroeconomics monthly series (1965-2007)

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
TSYMAT	4.58	0.93	2.74	3.16	3.93	4.66	5.44	5.70	6.04	504
TSY DUR	5.95	1.14	3.83	4.10	5.04	6.02	6.99	7.30	7.47	504
TSY MWD	250.93	118.06	78.58	101.84	136.84	233.21	371.77	412.22	451.28	504
TSY D/GDP	40.01	13.06	20.12	24.83	26.74	39.08	52.33	59.66	62.27	504
Baa-Aaa Spread	1.02	0.42	0.32	0.62	0.73	0.90	1.22	1.63	2.69	504
Unemployment rate	5.89	1.51	3.40	3.90	4.80	5.70	7.00	7.70	10.80	504
Real GDP Gwth	3.33	2.21	-2.56	0.15	2.34	3.48	4.49	6.04	8.58	504
Inflation	0.00	0.00	-0.01	0.00	0.00	0.00	0.01	0.01	0.02	504
y20	7.82	2.40	4.44	5.25	5.92	7.35	8.85	11.68	14.51	306
y15	7.83	2.25	4.35	5.26	6.20	7.56	8.75	11.55	14.42	422
y10	7.31	2.47	3.33	4.53	5.55	6.90	8.40	11.10	15.32	504
y5	7.00	2.45	2.29	4.23	5.35	6.65	8.10	10.71	14.82	504
y1	6.46	2.90	1.01	3.36	4.80	5.90	7.81	10.12	16.72	504
c15	8.14	1.85	5.24	5.91	6.76	7.77	9.43	10.33	13.07	276
c10	7.89	2.05	4.52	5.40	6.43	7.48	9.25	10.25	13.66	276
c5	7.35	2.22	3.17	4.55	5.80	7.04	8.93	9.90	14.16	276
c1	6.31	2.55	1.39	2.72	4.65	6.03	8.14	9.31	13.29	276
y20-y1	1.74	1.37	-2.27	-0.00	0.78	1.59	2.70	3.80	4.53	306
y15-y1	1.26	1.42	-2.89	-0.53	0.34	1.24	2.10	3.46	4.38	422
y10-y1	0.86	1.15	-3.07	-0.52	0.07	0.79	1.69	2.39	3.29	504
y5-y1	0.62	0.86	-2.75	-0.42	0.06	0.58	1.26	1.74	2.44	504
c15-c1	1.84	1.23	-0.65	0.42	0.95	1.58	2.67	3.89	4.61	276
c10-c1	1.58	1.07	-0.59	0.35	0.76	1.32	2.31	3.39	3.97	276
c5-c1	1.04	0.76	-1.44	0.19	0.46	0.89	1.62	2.25	2.87	276

Note: This table reports summary statistics of monthly average values for the main macroeconomic variables in the firm panel over 1965-2007. All variables are defined in A.

Table A.8: Summary statistics: macroeconomics yearly series (1965-2007)

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
TSYMAT	4.53	0.94	2.78	3.08	3.92	4.57	5.39	5.66	5.90	42
TSY DUR	5.90	1.15	3.91	4.09	4.98	6.00	6.98	7.22	7.40	42
TSY MWD	251.24	119.15	83.03	108.76	144.12	234.48	371.75	411.06	443.75	42
TSY D/GDP	40.38	13.15	20.91	25.38	26.73	39.25	52.63	59.99	61.91	42
Baa-Aaa Spread	1.08	0.44	0.34	0.67	0.78	0.95	1.28	1.74	2.32	42
Unemployment rate	5.89	1.56	3.40	3.90	4.90	5.70	7.00	7.80	10.80	42
Real GDP Gwth	3.32	2.26	-1.95	0.15	2.09	3.54	4.49	5.58	8.46	42
Inflation	0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00	0.01	0.01	42
y20	7.65	2.36	4.76	5.14	5.65	7.20	8.85	11.60	13.32	26
y15	7.65	2.21	4.73	5.14	6.02	7.35	8.76	11.52	13.25	36
y10	7.20	2.40	4.03	4.56	5.70	6.75	8.08	10.54	13.72	42
y5	6.88	2.39	3.12	4.44	5.17	6.18	7.73	10.42	13.11	42
y1	6.41	2.85	1.31	3.61	4.72	5.78	7.67	10.11	14.88	42
c15	7.94	1.80	5.67	5.74	6.33	7.59	9.23	10.37	12.32	23
c10	7.66	1.97	5.17	5.40	5.95	7.27	8.93	10.25	12.48	23
c5	7.11	2.10	4.02	4.42	5.61	6.88	8.84	9.81	12.05	23
c1	6.21	2.43	1.65	2.94	4.84	6.06	8.21	8.87	10.89	23
y20-y1	1.73	1.37	-0.08	-0.00	0.72	1.54	2.44	3.80	4.18	26
y15-y1	1.20	1.49	-2.16	-0.53	0.23	0.97	2.17	3.60	3.91	36
y10-y1	0.80	1.23	-2.04	-0.52	-0.01	0.78	1.63	2.58	3.06	42
y5-y1	0.55	0.95	-1.71	-0.48	-0.01	0.55	1.22	1.74	2.38	42
c15-c1	1.73	1.26	0.26	0.46	0.82	1.17	2.69	4.04	4.31	23
c10-c1	1.46	1.15	0.05	0.29	0.55	1.08	2.14	3.43	3.77	23
c5-c1	0.91	0.89	-0.79	0.18	0.25	0.75	1.26	2.25	2.87	23

Note: This table reports summary statistics of end of year of monthly average values for the main macroeconomic variables in the firm panel over 1965-2007. All variables are defined in A.

B Identification

In this section, I provide details about the management over the maturity of debt issues by the U.S. Treasury and about the 6 policy shocks driving variation in the average maturity of outstanding Treasury debt over 1965-2007.

Objective function of the U.S. Treasury's office of Debt Management

The long-standing goal of the U.S. Treasury's office of Debt Management is to "maintain the lowest cost of borrowing over time"[40] and the stated strategies to pursue this goal are:

(1) Offer high quality products through regular and predictable issuance
(2) Promote a robust, broad, and diverse investor base
(3) Support market liquidity and market functioning
(4) Keep a prudent cash balance
(5) Maintain manageable rollovers and changes in interest expense

In this context, both the objective and strategy (5) may highlight a trade-off between issuing short-term debt to save an historically positive term premium and issuing long-term debt to maintain rollover risk sufficiently low.[41]

However, in support of strategies (1) and (2), the Overview of Treasury's Office of Debt Management makes clear that the Treasury is not "a market timer" and "doesn't react to current rate levels or short-term fluctuations in demand". This owes notably to one central characteristic of the Treasury as an issuer: it is "too large an issuer to behave opportunistically in debt markets".

An examination of Treasury debt management from the 1960s confirms the historical salience of such message in the practice and alleviate the concerns that variation in Treasury debt maturity is exogenous to corporate investment opportunities.

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[40] See the Overview of Treasury's Office of Debt Management.

[41] Roll-over risk is the risk of unexpected changes in rates coming from two main sources: one the one hand unanticipated and persistent strengthening of the economy, and on the other hand the exposure to short-term market disruptions.

U.S. Treasury debt maturity: Policy shocks

In this section, I provide a summary of the main decisions by the U.S. Treasury affecting the average maturity of marketable government debt and in particular the 6 policy shocks driving most variation in Treasury debt maturity. This summary draws heavily on Garbade (2015) and Garbade (2020).

1965 shock: Binding WWI Interest rate ceiling constrains debt maturity in the 60s and 70s. Before 1917 the Congress was the main debt management authority for the Federal government and the U.S. Treasury had little discretion. The large amounts of borrowing during World War I brought a change in this situation and the Treasury became the main debt management authority. Importantly, from 1918 following the Second Liberty Bond amendment, U.S. law prescribed marketable Treasury debt to have an interest rate above 4.25pp. The extra need for government financing in 1919 led to an exclusion of medium-term notes from the prescription, therefore allowing debt issues with an initial maturity lower than 5 years to be priced at an interest rate higher than the ceiling. As noted in Garbade (2015), with only two brief exceptions, the ceiling was not a binding constraint on Treasury debt management actions before the middle of 1965.

But as the general level of interest rates rose in the 1960s, the interest ceiling on new bonds became binding. The statutory constraints effectively lowered the maturity of new issuances and de facto the maturity of outstanding Treasury debt. Despite any reference to changes in expectations about future economic outcomes the congress recognised several times the need for flexibility[42] and subsequently increasing in 1967 the maximum maturity on exempted Treasury notes from 5 years to 7 years, authorising in 1971 to issue up to USD 10 billion of bonds without ceiling, and allowing several increases in the former limit.

These policies were not sufficient to halt the fall in the average maturity of marketable Treasury debt to a (post-WWII) low of about three years by the end of 1975 (see Figure 2).

1976 policy shock: Repeal of the statutory constraints and regular predictable

[42] See, for instance, the 1967 statement of U.S. Treasury Secretary Simon before the U.S. Senate's Committee on Finance as he calls for additional measures to "arrest the decline in the average maturity" that spur the "need for frequent refinancings". The Committee on Finance of March 9 1971 agreed that âĂIJthe Treasury Department may well be correct in assuming that the 4Âij percent interest rate limit has interfered with good debtmanagement practices.âĂİ

openings. The situation began to change in 1976 following new interventions by the Congress. Two major changes were undertaken.

First, in March 1976 Congress extended the maximum maturity of a note from seven years to ten years and increased the exemption from the ceiling to USD 12bn. This increase in the exemption precedes repeated liftings of ceiling exemptions. The Congress increased the exemption several times from USD 17bn in 1976 to USD 70bn in 1980.

Second is the regularisation of long-term debt offerings over 1975-1977 which paved the way for predictable offerings and suppressed the ability of Treasury debt managers to pursue "tactical issuance decisions". By 1983, the U.S. Treasury was regularly issuing 4-, 5-, and 7-year notes and 20-year bonds quarterly, and 3-year and 10-year notes and 30-year bonds in mid-quarter refundings.

These changes effectively halted the drop in Treasury debt maturity and helped it predictably recover until the late 1980s. Garbade (2015) collects anecdotal evidence in the form of discussions and communication (notably by the Treasury Borrowing Advisory Committee) showing that the rate ceiling, in turn, generated a "countervailing commitment" to Treasury debt maturity lengthening that persisted into the early 1990s. Thus, in the first part of the sample and until 1992, the steady increase in debt maturity is therefore effectively driven by (1) the "countervailing commitment" to regain flexibility that was lost as the results of the statutory constraint, and the (2) the policy change towards regular and predictable offerings that restrict opportunistic issuances.

1982 policy shock: Large changes to the size of exemptions after Congress's failure to increase the 1982 April and July exemptions. In early 1982 Congress failed to increase the exemption from the ceiling in time to allow the issuance of 20 and 30-year bonds in April and July. The effect is evident is visually evident (see Figure 2). A large increase (USD 110bn) in September 1982 allowed the Treasury to restart issuance.

This marks the second phase of the staggered repeal with much larger exemptions being granted in the subsequent years (up to $270bn in 1987) before finally removing the ceiling in 1988.

1993 policy shock: Reduction of 30-year bond offerings. In the second part of the sample, the mechanical increase leads Treasury debt maturity to reach historical highs in the early 1990s. The flexibility regained, the first discussions about the potential costs implications of the latter maturity extension program emerge. They coincide with an historical long maturity leaving the Treasury and other government officials believe there was room to take advantage of the historical discount on short-term debt.

The Treasury takes a few decisions that slow down and stop the increase in debt maturity by increasing the issuance of 3-year notes more rapidly than 10-year notes and 30-year bonds 30s in 1990 and 1991, and marginally reducing longer-term offerings in February 1992. the Treasury justifies the latter with the following statement: “taxpayer financing costs can be lowered at the margin by a modest reduction in the maturity structure of the debt” (Garbade, 2015).

However it is only in 1993 that events triggered the subsequent drift to a downward trajectory for the maturity of Treasury debt. In mid-February 1993: the White House released *A Vision of Change for America*, setting the political agenda of the newly installed Clinton Administration and including a statement about potential savings over 1994-1998 from shortening issuance maturities. The lack of details over the assumptions underlying the statement left market participants confused. In early March, the advisory committee to the Treasury recommended continued issuance of 30-year bonds in light of the “near perpetual nature of existing Treasury debt,” and the importance of 30-year bonds serving “as a vital benchmark for state and local governments" as well as corporate issuers. In particular, lowering 30-year bonds issuance would lower outstanding long-term bonds liquidity and "impair such markets". Consistent with regular and predictable issuances implying persistent changes rather than short-term opportunism, the committee did not identify any advantages from shortening permanently the maturity structure of Treasury debt highlighted the higher roll-over risks induced by changing the rules.

Nevertheless on May 5, the Treasury announced that it would reduce the offering of 30-year bonds in May 1993, and would no longer offer 30-year bonds in subsequent May and November refundings. Statements highlighted that the change in offerings was not dependent on current interest rates but on the existence over time of something variously called [...] the risk premium in longer-term rates.” and officials insisted that they would not reverse course looking ahead. A Treasury official stated that, as a result of the new policy, the average maturity of Treasury debt would be one year lower in five years.

Hence the decision to reduce 30-year bond offerings leads to a predictable and mechanical decrease in the average maturity of Treasury debt up until late 1995 as highlighted in Figure 2.

1996 Policy shock: Reversing the 1993 decision. The following decrease in the average maturity of Treasury debt is halted by the decision to increase the Treasury's offering of 10-year notes and 30-year bonds in May 1996. As documented by Garbade (2015), advices over the course of 1995 from the Treasury Borrowing Advisory Committee point at two reasons underlying the policy decision. First, the pace of decline in Treasury debt maturity if not halted over the course of 1996 and beyond could become a subject of worry to investors and be costly for the government in the long-run. Garbade (2015) notes: "the decision may instead have reflected an assessment by Treasury officials that five years was the lower limit of their comfort zone with respect to average maturity." Second, the committee highlights that the 1993 decision to issue 30-year bonds semiannually had had "a noticeable adverse impact on liquidity" and again recommended the reintroduction of quarterly 30-year bond offerings to restore liquidity.

Thus, the policy change appears to only be dictated by the need to reverse the past policy decision, rather than being driven by changes in market conditions or macroeconomic outcomes. The following resurgence of long-term debt issuances contributes to a mechanical increase in the maturity of Treasury debt highlighted in Figure 2.

The improvements in the U.S. fiscal position in the late 90s mechanically decreased the offerings along the maturity curve and raised liquidity concerns for the main debt instruments (e.g. 10-year), despite the reintroduction of long-term issuances. The Treasury reacted by halting the offer of 30-year bonds of November 1999 and concentrate offerings on the 10-year maturity segments before announcing long-term debt buybacks in January 2000. This series of action only contributed to lowering the growth in the maturity of U.S. government debt and did not generate any shift in the maturity of Treasury debt.

2001 Policy shock: Suspension of 30-year debt issues. In October 2001, U.S. Treasury Secretary Fisher announces a suspension of debt issues of 30-year U.S.

Treasury bond on the basis of preserving liquidity for the 10-year segment in the long run that surprises market participants, as the fiscal position was deteriorating and the U.S. had returned to a net borrower position (Badoer & James, 2016). The latter unanticipated decision is the main driver of the subsequent decrease in the average maturity of Treasury debt.

Once again, the policy change seems to be driven by policymakers expectations over potential long-term costs (in this case liquidity for the 10-year instrument) rather than market timing considerations.

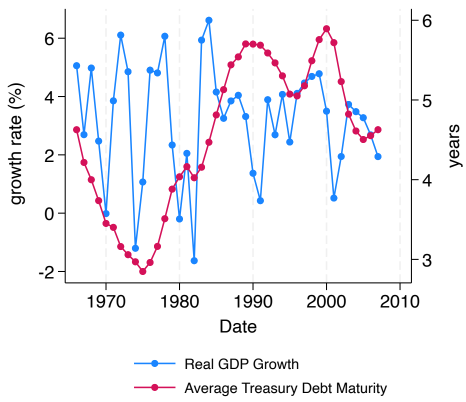
Post-sample: Roll-over risk resurgence and post-financial crisis consensus on roll-over risk. As the average maturity of publicly held debt dropped well below five years, the trade-off focus shifted again towards an emphasis on rollover risk in the mid 2000s leading to the announcement of reintroduction of the 30-year bonds debt issues in August 2005. Discussions point again against any reference to an observed changed in neither the relative cost of long-term issuances, or materialisations of roll-over risk but the need to reverse the 2001 policy decision. The extension in the average maturity of Treasury debt is comforted in the aftermath of the financial crisis amid consensus in Treasury committees over growing concerns of roll-over risk.

Treasury debt maturity and macroeconomic series

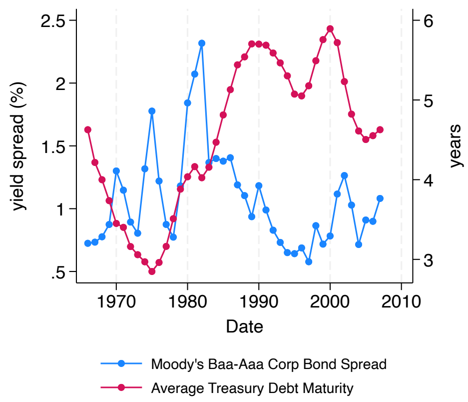
Figure B.1: Treasury debt maturity and business cycles

The subfigures present the yearly time series of the average maturity of Treasury debt value-weighted by outstanding principal (in red) in perspective with other macroeconomic time series (in blue).

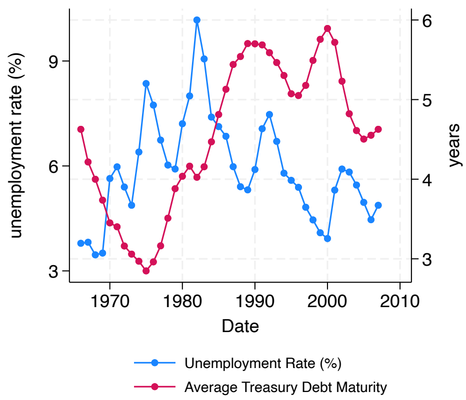
(a) 4-quarters real GDP growth



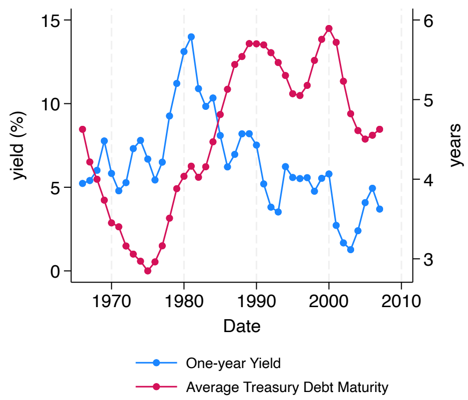
(b) Moody's LT corporate bond credit spread



(c) Unemployment Rate



(d) 1-year yield



(e) Inflation

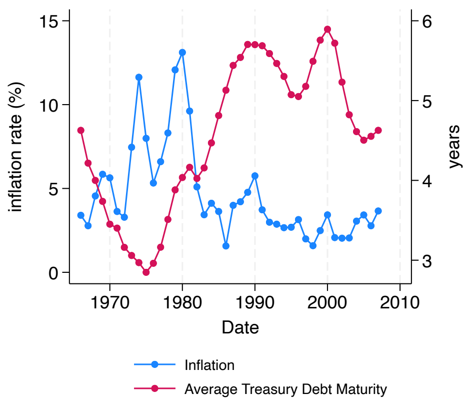
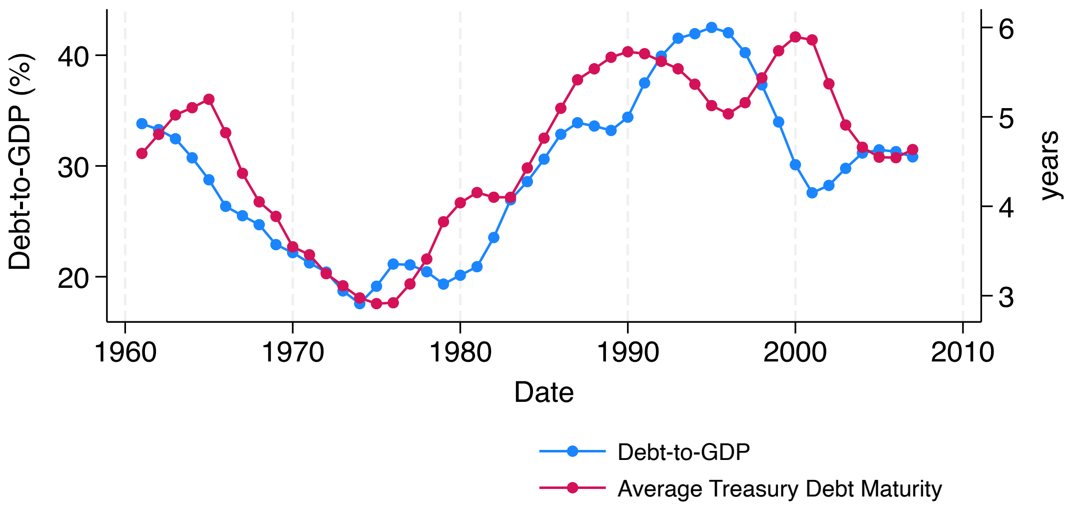


Figure B.2: Treasury debt maturity and Treasury debt size

The figure present the yearly time series of the average maturity of Treasury debt value-weighted by outstanding principal in perspective with the time series of total outstanding Treasury debt to nominal U.S. GDP.



C The investment reallocation channel

Table C.1: Across-firms reallocation: robustness to cyclical sensitivities

The table presents the reduced-form estimates based on Equation Equation 1 where the dependent variable is capital expenditures normalised by lagged total assets based on the yearly panel of Compustat firms for 1965-2007. The investment duration measure is the firm-level average asset maturity. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	Capital Expenditures					
	(1)	(2)	(3)	(4)	(5)	(6)
TSYMAT × AssetMat	-0.165***	-0.183***	-0.162***	-0.172***	-0.141***	-0.179***
	(0.027)	(0.027)	(0.026)	(0.027)	(0.029)	(0.029)
Baa-Aaa Spread × AssetMat	0.072					-0.012
	(0.067)					(0.092)
U-rate × AssetMat		-0.022				-0.047**
		(0.015)				(0.018)
1y yield × AssetMat			0.040***			0.042***
			(0.008)			(0.008)
Real GDP Gwth × AssetMat				-0.021**		-0.029***
				(0.009)		(0.010)
Linear trend × AssetMat					-0.006**	-0.001
					(0.003)	(0.003)
Firm FE	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓
Observations	126522	126522	126522	126522	126522	126522
Adjusted R^2	0.453	0.453	0.454	0.453	0.453	0.454

Table C.2: Across-firms reallocation: discrete measure

The table presents the reduced-form estimates based on Equation Equation 1 where the dependent variable is capital expenditures normalised by lagged total assets based on the yearly panel of Compustat firms for 1965-2007. The investment duration measure is a dummy for firm-level average asset maturity above its (asset-weighted) median in the distribution across firms. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	Capital Expenditures			
	(1)	(2)	(3)	(4)
TSYMAT × High AssetMat	-0.762***	-0.822***	-0.872***	-0.892***
	(0.153)	(0.141)	(0.141)	(0.153)
Time FE	–	✓	✓	✓
Firm FE	✓	✓	✓	✓
Firm Controls x TSYMAT	–	–	✓	✓
High AssetMat x Macro Controls	–	–	–	✓
Observations	126522	126522	126522	126522
Adjusted R^2	0.369	0.421	0.453	0.454

Table C.3: Across-firms reallocation of investment: other outcomes

The table presents the reduced-form estimates based on Equation Equation 1 where the dependent variables are respectively capital expenditures normalised by lagged total assets based, employment growth, R&D expenses normalised by lagged total assets based and acquisitions normalised by lagged total assets based on the yearly panel of Compustat firms for 1965-2007. The investment duration measure is the firm-level average asset maturity. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	Capex	Emp Gwth	R&D	Acq
	(1)	(2)	(3)	(4)
TSYMAT × AssetMat	-0.172***	-0.054***	-0.033***	-0.076
	(0.027)	(0.019)	(0.011)	(0.052)
Time FE	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Firm Controls x TSYMAT	✓	✓	✓	✓
Observations	126522	126522	126522	106726
Adjusted R^2	0.453	0.799	0.241	0.254

Table C.4: Across-firms reallocation: breakdown by investments

The table presents the reduced-form estimates based on Equation Equation 1 where the dependent variables are respectively capital expenditures normalised by lagged total assets, the year-to-year change in the total stock of fixed assets valued at historical cost normalised by the lagged total stock, the year-to-year change in Machinery and Equipment valued at historical cost normalised by the lagged total stock, and the year-to-year change in Real Estate valued at historical cost normalised by the lagged total stock based on the yearly panel of Compustat firms for 1985-2007. The investment duration measure is the firm-level average asset maturity. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	Capex	FA (Total)	FA (Machinery and Equip.)	FA (Real Estate)
	(1)	(2)	(3)	(4)
TSYMAT × AssetMat	-0.248***	-0.289***	-0.160**	-0.118***
	(0.064)	(0.094)	(0.075)	(0.043)
Time FE	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Firm Controls x TSYMAT	✓	✓	✓	✓
AssetMat x linear trend	✓	✓	✓	✓
Observations	44388	44388	44388	44388
Adjusted R^2	0.462	0.335	0.318	0.257

Table C.5: The investment reallocation channel: aggregate investment duration

The table presents the time series regression estimates of the measure of the aggregate duration of investment as defined in Section V on the average maturity of Treasury debt and other macroeconomic time series. Details for variable definition in Appendix A. Standard errors reported in parentheses are Newey and West (1987) standard errors allowing for 2 years of lags.

	Investment Duration (Compustat)	
	(1)	(2)
TSYMAT	-0.17***	-0.16***
	(0.04)	(0.04)
Linear trend	-0.01***	-0.01**
	(0.00)	(0.00)
Credit Spread		0.03
		(0.11)
Unemployment		0.01
		(0.03)
y1		0.01
		(0.01)
GDP Growth		0.01
		(0.01)
R-squared	0.816	0.844
Observations	43	43

D Mechanism

Table D.1: Term structure and the cross-section of investment: OLS vs 2SLS

The table presents the 2SLS estimates based on Equation Equation 1 where the dependent variable is capital expenditures normalised by lagged total assets based on the yearly panel of Compustat firms for 1965-2007. The investment duration measure is the firm-level average asset maturity. Government long-term bond supply is measured with the weighted-average maturity of Treasury debt and instruments the yield spread between 10-year constant maturity Treasury debt and 1-year constant maturity Treasury debt. Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	OLS		2SLS	
	(1)	(2)	(3)	(4)
y10-y1 × AssetMat	-0.131***	-0.147***	-0.323***	-0.374***
	(0.027)	(0.026)	(0.062)	(0.066)
Time FE	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
AssetMat x Macro Controls	✓	✓	✓	✓
Firm Controls x TermSpread	–	✓	–	–
Firm Controls x TSYMAT	–	–	–	✓
Observations	126522	126522	126522	126522
Adjusted R^2	0.423	0.427	0.001	0.025

Table D.2: Term structure and the cross-section of discount rates

The table presents the 2SLS estimates based on Equation Equation 1 where the dependent variable is the average discount rate over firms in an industry(NAICS-3 digits)-year panel (2000-2019). The discount rate data comes from the first version of data released with Gormsen et al. (2023). The investment duration measure is the firm-level average asset maturity. Yield spreads between 10-year constant maturity bonds and 1-year constant maturity bonds are for corporate bonds (column 1 to 4) and Treasury bonds (column 5 to 8). Details for variable definition in Appendix A. Lower-level interactions are not reported for ease of presentation. Standard errors reported in parentheses are double clustered by time (fiscal year-end) and firms.

	k (NAICS3)					
	(1)	(2)	(3)	(4)	(5)	(6)
$c10-c1$ × AssetMat	0.044***	0.036***	0.035***			
	(0.012)	(0.012)	(0.012)			
$y10-y1$ × AssetMat				0.051***	0.040***	0.038***
				(0.013)	(0.013)	(0.013)
No FE	✓	–	–	✓	–	–
Industry FE	–	✓	✓	–	✓	✓
Time FE	–	–	✓	–	–	✓
Observations	1331	1328	1328	1331	1328	1328
Adjusted R^2	0.022	0.508	0.536	0.021	0.508	0.536

E The debt reallocation channel

Issuance data

I construct a dataset of debt issues by non-financial firms over 1975-2007 aggregated at the firm-year level from debt issue-level observations extracted from the Thomson Reuters LPC Dealscan and SDC Platinum New Issues databases. The debt issue-level observations are extracted from the Thomson Reuters LPC Dealscan and Thomson Reuters SDC Platinum New Issues databases.

Table E.1: Summary statistics: firm-year panel of issuances by U.S. public firms (1975-2007)

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Issuance maturity	8.38	7.20	0.02	2.51	4.83	6.84	10.01	15.65	100.07	9,967
Issuance amount	517.69	1,809.80	0.09	10.00	34.50	125.00	360.00	1,000.00	44,400.00	9,967
Dealscan Dummy	0.55	0.47	0.00	0.00	0.00	0.67	1.00	1.00	1.00	9,967
Total Assets*	3,565.06	6,162.14	1.43	73.84	237.29	926.44	3,605.08	10,982.00	39,042.00	9,967
Capital Expenditures*	225.32	385.43	0.00	2.68	11.00	50.17	236.00	757.10	2,430.00	9,967
Sales*	3,199.73	5,323.86	0.02	67.25	221.90	851.72	3,523.22	9,919.00	35,214.00	9,967
Employment*	18.69	28.22	0.00	0.40	1.33	5.40	22.50	64.00	137.70	9,847
AssetMat (firm)**	4.97	3.01	1.03	1.72	2.60	4.19	6.70	9.78	13.96	9,967
LT debt sh. (1y)	83.24	21.20	0.00	54.34	77.65	91.39	97.71	99.80	100.00	9,721
LT debt sh. (3y)	64.09	28.44	0.00	18.18	47.10	70.61	86.65	96.65	100.00	8,321
LT debt sh. (5y)	44.32	30.18	0.00	0.00	17.65	46.69	67.72	84.99	100.00	8,164
Profitability*	0.07	0.15	-3.95	-0.03	0.04	0.09	0.13	0.18	0.53	9,967
M/B Ratio*	1.64	1.25	0.50	0.96	1.10	1.37	1.82	2.53	72.10	9,967
Sales Growth*	10.53	27.30	-658.33	-8.41	1.54	9.39	20.57	36.76	100.00	9,967
IG Rating*	0.36	0.48	0.00	0.00	0.00	0.00	1.00	1.00	1.00	9,967
logat	6.80	1.87	0.36	4.30	5.47	6.83	8.19	9.30	10.57	9,967
log(Assets)	6.84	1.95	0.36	4.30	5.47	6.83	8.19	9.40	13.08	9,967
log(MCap)	6.36	2.15	-1.84	3.57	4.89	6.46	7.92	9.16	10.95	9,960
log(PPE)	5.54	2.12	-2.90	2.71	4.03	5.63	7.18	8.36	9.56	9,965
log(Emp)	1.62	1.90	-6.91	-0.86	0.31	1.70	3.12	4.17	4.93	9,793
Book Leverage*	0.36	0.19	0.00	0.14	0.23	0.34	0.47	0.62	0.98	9,809

Note: This table reports summary statistics for the main variables in the yearly panel of issuances by Compustat firms from 1975 to 2007. All variables are defined in Appendix A.
* To mitigate the influence of outliers, the variables have been winsorised at the latest stage with tail cuts at the 1st and 99th percentiles of the yearly distributions of the variables.
** To mitigate the influence of outliers, the variables have been winsorised at the latest stage with tail cuts at the 5th and 95th percentiles of the yearly distributions of the variables.

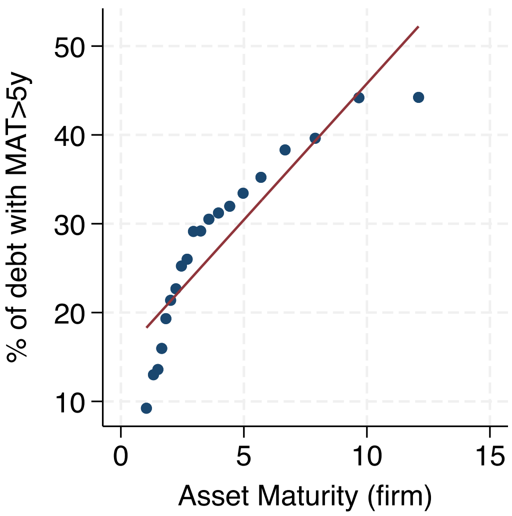
I extract detailed terms and conditions for individual corporate loans from Dealscan and for individual debt securities including non-convertible debt securities, debt shelf registrations, U.S. Rule 144A non-convertible debt, and medium-term note programs from SDC (Thomson). Following Badoer and James (2016), I exclude asset- and mortgage-backed debt, secured debt, pass-through securities, equipment trust certificates, lease obligations, convertible debt, preferred stock that has been misclassified as debt, equity-linked certificates, and perpetual debt. I only keep USD denominated deals with non-missing positive deal amounts. I discard duplicates entry within and across both databases - identified as observations with the same issuer, issuance and maturity dates, deal amount and maturity. I exclude credit lines as they are less likely to isolate the timing of large investments as opposed to term loans.

I merge the issue-level information with fiscal year-end financial information data of public U.S. firms using the CRSP/Compustat Merged - Fundamentals Annual database obtained from WRDS. The merge is completed for the Dealscan dataset using the 2017 version of the link file from Chava and Roberts (2008) which matches individual loan facilities to the corresponding borrowing firm's unique company identifier (variable *gvkey*) on Compustat. For the SDC dataset, I use the DSENAMES database from WRDS to merge unique historical identifiers specific to each issuer in SDC (first 6 digits of variable *cusip*) to unique identifiers in Compustat (variable *gvkey*).

Appendix A presents the sample's descriptive statistics for debt issues' properties and financial characteristics of issuing firms, as well as macroeconomic conditions at issuance.

Maturity-matching on stocks and flows of debt

Figure E.1: Asset-Liability maturity matching



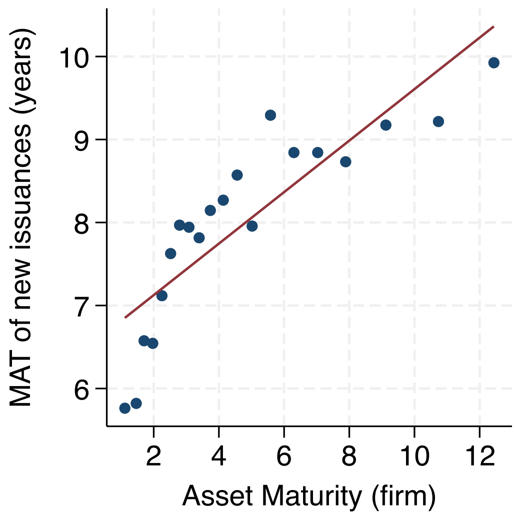


Table E.2: Corporate debt maturity and investment duration

The table presents the reduced-form estimates based on linear models of outstanding and new debt maturity where the dependent variable is the share of debt with residual maturity above five years and the maturity of the firm-year average issuance. The issuance dataset is detailed in Appendix E. Covariates are measured at first preceding year-end. Details for variable definition in Appendix A. Standard errors reported in parentheses are clustered by firm.

(a) Outstanding debt maturity

	LT debt share (5y)					
	(1)	(2)	(3)	(4)	(5)	(6)
AssetMat (firm)	3.240***	2.961***	2.961***	2.367***	1.405***	1.547***
	(0.088)	(0.087)	(0.087)	(0.090)	(0.078)	(0.105)
Profitability				9.168***	1.371***	1.384***
				(0.675)	(0.323)	(0.318)
M/B Ratio				-0.179**	0.161***	0.161***
				(0.088)	(0.061)	(0.060)
Sales Growth				0.014***	0.002	0.003
				(0.002)	(0.002)	(0.002)
Book Leverage				22.987***	22.551***	22.249***
				(1.037)	(0.901)	(0.892)
log(Assets)					5.616***	5.458***
					(0.117)	(0.118)
constant	14.995***	16.115***	16.115***	12.455***	-9.774***	-9.542***
	(0.413)	(0.403)	(0.403)	(0.473)	(0.537)	(0.600)
No FE	✓	–	–	–	–	–
Time FE	–	✓	✓	✓	✓	✓
Industry FE	–	–	–	–	–	✓
Observations	80955	80955	80955	80955	80955	80955
Adjusted R^2	0.090	0.128	0.128	0.163	0.288	0.302

(b) Issuance debt maturity

	Issuance Maturity					
	(1)	(2)	(3)	(4)	(5)	(6)
AssetMat (firm)	0.336***	0.250***	0.239***	0.238***	0.147***	0.173***
	(0.028)	(0.023)	(0.023)	(0.023)	(0.021)	(0.030)
Issuance amount			0.000***	0.000***	0.000	0.000
			(0.000)	(0.000)	(0.000)	(0.000)
Profitability				3.492***	1.989***	2.115***
				(0.345)	(0.299)	(0.308)
M/B Ratio				0.006	0.008	0.004
				(0.040)	(0.039)	(0.041)
Sales Growth				0.001	0.005***	0.005***
				(0.001)	(0.001)	(0.001)
Book Leverage				-0.509*	0.203	0.014
				(0.287)	(0.255)	(0.257)
log(Assets)					0.757***	0.718***
					(0.040)	(0.039)
constant	6.134***	6.535***	6.451***	6.388***	1.585***	1.791***
	(0.146)	(0.122)	(0.120)	(0.173)	(0.256)	(0.271)
No FE	✓	–	–	–	–	–
Time FE	–	✓	✓	✓	✓	✓
Industry FE	–	–	–	–	–	✓
Observations	9967	9929	9929	9771	9771	9771
Adjusted R^2	0.038	0.276	0.284	0.292	0.351	0.359

F UK demand shock

Table F.1: UK demand shock: DiD estimates for investment

The panel presents the event-study coefficients on the interactions of period dummies and firm-level *Asset Maturity* in the regression where the dependent variable is capital expenditures normalised by lagged total assets based for the yearly panel of Compustat Global UK firms for 2001-2008. The year 2003 acts as the baseline period. Standard errors clustered by firm. Lower-level interactions not reported for ease of presentation. Details for variable definition in Appendix A.

	(1) Capex	(2) Capex	(3) Capex	(4) Capex	(5) Capex	(6) Capex
[2001; 2002] × AssetMat	0.00845	0.0249	0.0321	0.00277	0.0215	0.0283
	(0.0322)	(0.0308)	(0.0277)	(0.0446)	(0.0437)	(0.0423)
[2004; 2008] × AssetMat	0.0678*	0.0714*	0.0494	0.138**	0.130**	0.101*
	(0.0300)	(0.0301)	(0.0298)	(0.0450)	(0.0453)	(0.0427)
[2006; 2008] × AssetMat	0.171***	0.165***	0.122***	0.199***	0.188***	0.155***
	(0.0367)	(0.0352)	(0.0341)	(0.0505)	(0.0478)	(0.0455)
AssetMat	0.199***	0.126**		0.208***		
	(0.0376)	(0.0437)		(0.0481)		
constant	4.331***	4.674***	5.382***	4.044***	5.118***	5.221***
	(0.173)	(0.218)	(0.106)	(0.215)	(0.210)	(0.163)
Year FE	✓	✓	✓	✓	✓	✓
Industry FE	–	✓	–	–	✓	–
gvkey	–	–	✓	–	–	✓
Observations	7019	7019	7017	7019	7019	7017
Adjusted R^2	0.087	0.187	0.539	0.067	0.164	0.539

Table F.2: UK demand shock: DiD estimates for the term spread

The panel presents the event-study coefficients on the period dummies in the regression where the dependent variables are different definitions for the term spread on the UK yield curve for 2001-2008. The year 2003 acts as the baseline period. Robust standard errors. Details for variable definition in Appendix A.

	(1) TS (10y-1y)	(2) TS (20y-1y)	(3) TS (25y-1y)
[2001; 2002]	-0.450***	-0.707***	-0.786***
	(0.100)	(0.133)	(0.142)
[2004; 2005]	-0.812***	-1.013***	-1.043***
	(0.0642)	(0.0951)	(0.106)
[2006; 2008]	-1.002***	-1.289***	-1.409***
	(0.134)	(0.188)	(0.195)
constant	0.922***	1.038***	0.998***
	(0.0444)	(0.0843)	(0.0965)
Observations	96	96	96
Adjusted R^2	0.275	0.253	0.280

G Three-period model

In this section, I lay out a simple theoretical framework to guide my empirical strategy. The model builds on the bond market framework in Greenwood et al. (2010) to which I add a continuum of firms making real investment decisions.

This model has three dates labeled 0, 1, and 2. There are two types of assets. There are one-period bonds with exogenous one-period returns (determined for instance by monetary policy). The return on such bond from time 0 to 1, denoted $R_{0,1}$, is known at time 0. Instead the return on one-period bonds from time 1 to 2, denoted $R_{1,1}$ is random as of time 0, with mean $E[R_{1,1}]$ and variance $Var[R_{1,1}]$, and will be known as of time 1. There are also default-free long-term bonds that trade at an endogenously determined price at time 0 and offer a deterministic payoff at time 2 with return from time 0 to time 2 denoted $R_{0,2}$. It is useful to write: $R_{R_{0,2}} = R_{0,1} \cdot E[R_{1,1}] + \pi$. That is, one can decompose the return on the long-term bond into an (exogenous) component $R_{0,1}E[R_{1,1}]$, equal to the expected return from investing in short-term bonds over two periods, and an endogenously determined term premium, denoted π.

There are three types of actors in the model: preferred-habitat investors, the government, and risk-averse households. The preferred-habitat investors inelastically demand a dollar quantity L of long-term bonds at time 0.[43] The government inelastically issues a dollar quantity G of long-term bonds. I denote g $(= G - L)$ the exogenous net supply of long-term bonds as of time 0 .

Risk-averse households invest in both types of bonds. They have zero initial wealth such that they borrow a dollar amount $X_{0,2}$ of long bonds at time 0 to invest it in short-term bonds. Conversely, when $X_{0,2}$ is negative, households finance the purchase of long-term bonds by selling short-term bonds. Households have mean-variance preferences with risk tolerance γ such that in the model without corporations, households' optimal time 0 borrowing in long-term bonds

[43] The natural preference of some investors for bonds with specific characteristics, e.g. pension funds and life insurers with a preference for long-duration assets, can be the result of both underlying aggregate households' life cycle decisions and agency frictions in financial intermediation.

would be given by

$$X^*_{0,2} = \gamma \frac{R_{0,1} \cdot E\left[R_{1,1}\right] - R_{0,2}}{(R_{0,1})^2 \mathrm{Var}\left[R_{1,1}\right]} = \gamma \frac{-\pi}{(R_{0,1})^2 \mathrm{Var}\left[R_{1,1}\right]}. \tag{3}$$

Intuitively, households borrow using long-term bonds to invest in short-term bonds when the term premium, π, is negative and vice-versa.

Households also own a mass one continuum of firms $i \in [0,1]$ that are heterogeneous with respect to their cash-flow duration of investment $d_i \in [0,1]$. The cash flows from investing I_i in the technology of firm i at time 0 are $(1-d_i) \cdot f(I_i)$ at time 1 and $d_i \cdot f(I_i)$ at time 2 with $f(I) = I^\alpha$ and $\alpha \in (0,1)$. The duration d_i of the investment opportunity that each firm is endowed with is fixed and reflects business specificities, such as the useful life and mix of assets exploited for production.[44] As households have no cash in hand, they finance corporate investments by issuing short- and long-term bonds.[45]

Equilibrium. Households maximise final period consumption C_2 by investing in bonds and firms. They choose the scale of investment I_i for each firm i at time 0, the dollar quantity of long-term borrowing ($X_{0,2}$) and of short-term borrowing for first and second periods ($X_{0,1}$ and $X_{1,1}$) to maximise expected utility under resource constraints at each period. That is, households solve:

$$\begin{aligned}
&\mathrm{argmax}_{\{I_i\}_{i\in[0,1]}, X_{0,2}, X_{0,1}, X_{1,1}} \quad E\left[\tilde{C_2}\right] - (2\gamma)^{-1} \mathrm{Var}\left[\tilde{C_2}\right] \\
&\text{s.t.} \quad (BC_1): \quad \int_0^1 I_i \, di = X_{0,1} + X_{0,2} \\
&(BC_2): \quad X_{0,1} \cdot R_{0,1} = X_{1,1} + \int_0^1 \left[(1-d_i) \cdot f(I_i)\right] di \\
&(BC_3): \quad \tilde{C_2} + X_{1,1} \tilde{R_{1,1}} + X_{0,2} \cdot R_{0,2} = \int_0^1 \left[d_i \cdot f(I_i)\right] di
\end{aligned}$$

Substituting first for $X_{0,1}$ into (BC_2) using (BC_1), and then $X_{1,1}$ into (BC_3) using

[44] Dessaint et al. (2023) shows that most of the variation in the horizon of firms' investment plans is found in the cross-section of firms. This is consistent with the fact that firms' investment duration is a rather fixed economic attribute that arises from the firm's business model.

[45] In the version of their model with corporations, Greenwood et al. (2010) introduce firms, with an exogenous financing need, acting as arbitrageurs. In my model households are arbitraging the market possibly through trades outside of firms or through firms financing. The key contribution is to introduce real investment decisions to study real effects.

(BC_2), we get the following first-order conditions for the investment scale ($\mathrm{I_i}$) of each firm i :

$$1=\frac{\mathrm{d_i}\cdot \mathrm{f}'(\mathrm{I_i})}{\mathrm{R_{0,2}}}+\frac{(1-\mathrm{d_i})\cdot \mathrm{f}'(\mathrm{I_i})}{\mathrm{R_{0,1}}} \tag{4}$$

and for the amount of borrowing in long-term bonds:

$$\mathrm{X_{0,2}}=\gamma\frac{\mathrm{R_{0,1}}\cdot \mathrm{E}\left[\tilde{\mathrm{R}}_{1,1}\right]-\mathrm{R_{0,2}}}{(\mathrm{R_{0,1}})^2\mathrm{Var}\left[\tilde{\mathrm{R}}_{1,1}\right]}+\int_0^1 \mathrm{I_i}\,\mathrm{di}-\frac{\int_0^1\left[(1-\mathrm{d_i})\cdot \mathrm{f}(\mathrm{I_i})\right]\mathrm{di}}{\mathrm{R_{0,1}}} \tag{5}$$

Equation Equation 4 states that the optimal investment schedule on firm i's investment satisfies that the marginal cost of investment incurred at time 0 is equal to the marginal revenue from investment technology at time 1 and time 2, respectively discounted by the interest rates on the one-year and two-year bonds.

Equation Equation 5 states that households take the same level of interest rate risk as in the case without corporations. The additional terms in the long-term borrowing equation (relative to the case without corporations in Eq. Equation 3) correspond to the quantity of long-term borrowing that exactly offsets firms' total refinancing risk at time 1. More precisely, households borrow $(\int_0^1\left[(1-\mathrm{d_i})\cdot \mathrm{f}(\mathrm{I_i})\right]\mathrm{di})/\mathrm{R_{0,1}}$ dollar amount of short-term bonds such that time 1 cash-flows from corporations cover repayments for short-term bonds and raise the remaining financing need, $\int_0^1 \mathrm{I_i}\mathrm{di}$ – $(\int_0^1\left[(1-\mathrm{d_i})\cdot \mathrm{f}(\mathrm{I_i})\right]\mathrm{di})/\mathrm{R_{0,1}}$, by issuing long-term bonds.

Equation Equation 4 yields the optimal investment scale for firm i:

$$\mathrm{I_i^*}=\left[\frac{\alpha \mathrm{d_i}}{\mathrm{R_{0,2}}}+\frac{\alpha\left(1-\mathrm{d_i}\right)}{\mathrm{R_{0,1}}}\right]^{\frac{1}{1-\alpha}}=\left[\frac{\alpha \mathrm{d_i}}{\left(\mathrm{R_{0,1}}\mathrm{E}[\mathrm{R_{1,1}}]+\pi\right)}+\frac{\alpha\left(1-\mathrm{d_i}\right)}{\mathrm{R_{0,1}}}\right]^{\frac{1}{1-\alpha}} \tag{6}$$

Differentiating optimal investment with respect to the term premium and investment duration gives $\frac{\partial \log(\mathrm{I_i^*})}{\partial \pi}<0$ and $\frac{\partial^2 \log(\mathrm{I_i^*})}{\partial \pi \partial \mathrm{d_i}}<0$: a higher term premium is associated with lower corporate investment and, in the cross-section of firms, this effect is stronger for the long-duration firms.

By analogy, one can show that $\frac{\partial \log(\mathrm{I_i^*})}{\partial \mathrm{E}[\mathrm{R_{1,1}}]}<0$ and $\frac{\partial^2 \log(\mathrm{I_i^*})}{\partial \mathrm{E}[\mathrm{R_{1,1}}]\partial \mathrm{d_i}}<0$: long investment-duration firms invest more when the interest rate on the long-term bond is low either because the expected future short rate ($E[R_{1,1}]$) is low or the term premium (π) is low. In the empirical analysis I test the latter comparative statics, as supply and demand shocks in segmented bond markets affect the term premium rather than future short rates.

The market for the long-term bond market clears by equating households demand for long-term bonds (Equation Equation 5) to government bond (net) supply: $-X^*_{0,2} = g$. Assuming without loss of generality that $R_{0,1} = E[R_{1,1}] = 1$ and differentiating the terms of the market clearing conditions with respect to g, I obtain:

Proposition 1 (Identical to Greenwood et al., 2010)**:** *A higher net supply of long-term government bonds raises the term premium:*

$$\frac{d\pi}{dg} = \left[\frac{\gamma}{Var[R_{1,1}]} - \int_0^1 \frac{\partial I^*_i}{\partial \pi} \left(1 - (1 - d_i) \cdot \alpha I^{\alpha - 1}\right) \, di \right]^{-1} > 0$$

This proposition replicates the result in Greenwood et al. (2010) and Greenwood and Vayanos (2014): supply shocks in the long-term bond market have stronger effects when the risk-tolerance of the marginal investor is lower (lower γ), or when the marginal investor faces more interest rate risk (higher $Var[R_{1,1}]$).[46] Proposition Theorem 1 implies the following prediction for corporate investment:

Proposition 2 (Average effect)**:** *A higher net supply of long-term government bonds lowers corporate investment:*

$$\frac{d\log(I^*_i)}{dg} = \frac{\partial \log(I^*_i)}{\partial \pi} \cdot \frac{d\pi}{dg} < 0.^{47}$$

A higher net supply of long-term debt raises the term premium ($\frac{d\pi}{dg} > 0$) and lowers corporate investment ($\frac{\partial \log(I_i)}{d\pi} > 0$) provided that the cash-flow duration is not fully short-term.

Most relevant for distributional effects is the cross-sectional proposition:

Proposition 3 (Across-firms channel)**:** *A higher net supply of long-term government*

46 $\frac{d\pi}{dg} > 0$ in the case of positive long-term financing need, $I^*_i - (1 - d_i) \cdot f(I^*_i) > 0$, and as $\frac{\partial I^*_i}{\partial \pi} = \frac{d_i}{\alpha(\alpha-1)\left(d_i+(1+\pi)(1-d_i)\right)^2} \left[\frac{1}{\alpha} \frac{(1+\pi)}{d_i+(1+\pi)(1-d_i)} \right]^{\frac{2-\alpha}{\alpha-1}} < 0$

47 $\frac{d\log(I^*_i)}{dg} < 0$ as $\frac{\partial \log(I^*_i)}{\partial \pi} = \frac{1}{\alpha-1} \left[\frac{d_i}{d_i(1+\pi)+(1+\pi)^2(1-d_i)} \right] < 0$ and $\frac{d\pi}{dg} < 0$.

bonds lowers corporate investment more for firms with a longer investment duration:

$$\frac{\partial^2 \log(\mathrm{I}_\mathrm{i}^*)}{\partial \mathrm{g} \partial \mathrm{d}_\mathrm{i}} = \frac{\partial^2 \log(\mathrm{I}_\mathrm{i}^*)}{\partial \pi \partial \mathrm{d}_\mathrm{i}} \cdot \frac{\mathrm{d}\pi}{\mathrm{dg}} < 0.^{48}$$

Proposition Theorem 3 highlights an *across-firms channel*: in response to an increase in the term premium, firms with a higher duration of investment decrease investment relative to firms with a short-duration of investment, as the former experience a relatively higher cost of capital.

48 $\frac{\partial^2 \log(\mathrm{I}_\mathrm{i}^*)}{\partial \mathrm{g} \partial \mathrm{d}_\mathrm{i}} < 0$ as $\frac{\partial^2 \log(\mathrm{I}_\mathrm{i}^*)}{\partial \pi \partial \mathrm{d}_\mathrm{i}} = \frac{1}{\alpha - 1} \frac{(1+\pi)^2}{(\mathrm{d}_\mathrm{i}(1+\pi)+(1+\pi)^2(1-\mathrm{d}_\mathrm{i}))^2} < 0$ and $\frac{\mathrm{d}\pi}{\mathrm{dg}} < 0$.

Internet Appendix

The Internet Appendix is available at this link.