A Gap-Filling Theory of Corporate Debt Maturity Choice*

Robin Greenwood
Harvard University

Samuel Hanson
Harvard University

Jeremy C. Stein
Harvard University and NBER

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Abstract

We argue that time-series variation in the maturity of aggregate corporate debt issues arises because firms behave as macro liquidity providers, absorbing the large supply shocks associated with changes in the maturity structure of government debt. We document that when the government funds itself with relatively more short-term debt, firms fill the resulting gap by issuing more long-term debt, and vice-versa. This type of liquidity provision is undertaken more aggressively: i) in periods when the ratio of government debt to total debt is higher; and ii) by firms with stronger balance sheets. Our theory provides a new perspective on the apparent ability of firms to exploit bond-market return predictability with their financing choices.

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I. Introduction

There is substantial year-to-year variation in the average maturity of corporate debt issues. For example, using *Flow of Funds* data, which covers all forms of borrowing, both public and private, we estimate that in 1999, 24.7% of nonfinancial corporate debt issues were "long-term"—defined as having a maturity of one year or more. This long-term share fell sharply to 19.9% in 2000, and then bounced back to a new peak of 30.1% in 2001.

What accounts for these movements? There are a number of prominent theories of debt maturity choice, but the majority of these focus on firm-level determinants, and hence do not have clear-cut implications for aggregate time-series behavior. One familiar idea is that firms should attempt to match the maturities of their assets and liabilities (e.g., Myers (1977), Hart and Moore (1995)). Indeed, in Graham and Harvey's (2001) survey of financial managers, this emerges as the most highly cited factor in the debt maturity decision. However, unless there are sharp changes over time in economy-wide asset composition, maturity matching has little to say about the patterns described above. Relatedly, Diamond (1991) argues that firms decide on debt maturity by trading off the favorable signaling properties of short-term debt against an increased risk of inefficient liquidation (see also Flannery (1986)). But again, this kind of model is more naturally suited to making cross-sectional, as opposed to time-series predictions.

There is a smaller and almost entirely empirical literature that seeks to explain the time series of corporate debt maturity by appealing to "market conditions", including the general level of interest rates, the slope of the yield curve, etc. (e.g., Taggart (1977), Bosworth (1971), Marsh (1982)).[1] While this may seem like a more natural avenue to pursue, there is not a fully-developed theory for *why* such market conditions should matter. One possibility is that

[1] Several firm-level studies also control for market conditions. See Guedes and Opler (1996), Barclay and Smith (1995), and Stohs and Mauer (1996).

managers are eager to pump up short-term earnings, perhaps at the expense of long-run value (Stein (1989)). If so, they will tend to borrow at short maturities when the yield curve is steeply upwards-sloping, and vice-versa, simply to keep their current interest expenses low (Faulkender (2005), Chernenko and Faulkender (2007)). This may be why survey respondents tell Graham and Harvey (2001) that they prefer to borrow at shorter maturities "when short-term interest rates are low compared to long-term rates." Note that this story can be told in a classical asset-pricing setting where the expectations hypothesis of the term structure holds—there is no need to introduce predictability in the relative returns on bonds of different maturities.[2]

An alternative market-conditions story, and one that does rely on a violation of the expectations hypothesis, is put forward by Baker, Greenwood and Wurgler (2003), hereafter BGW. They argue that managers time the maturity of their debt issues to exploit the predictability of bond-market returns. That is, they issue short-term debt when the expected return on short-term debt is below the expected return on long-term debt, and vice-versa.

BGW (2003) offer several pieces of evidence in support of their timing hypothesis. However, they do not explicitly spell out either: i) the root sources of bond-market predictability; or ii) why corporate issuers might be expected to have a comparative advantage—relative to other market participants—in recognizing or responding to temporary mispricings. Some critics have interpreted BGW as claiming that corporate issuers have a *forecasting advantage* over other players, a premise which these critics see as implausible. As Butler, Grullon and Weston (2006) put it: "While it is provocative to think that corporate managers may be better able to predict interest rate movements than other market participants….most purchasers of corporate debt are

[2] Graham and Harvey (2001) also report that managers borrow short when they are "waiting for long-term interest rates to decline." Thus, if managers believe that the level of rates is slowly mean reverting, we might expect firms to borrow short when the level of interest rates is high. Evidence in Baker, Greenwood and Wurgler (2003), replicated below, is consistent with this idea.

sophisticated investors (for example, banks, insurance companies, and pension funds) who are unlikely to make naïve investment decisions."

In this paper, we develop a new theory to explain time-variation in corporate maturity choice. Like BGW (2003), our theory allows for predictability in bond-market returns, and has the feature that corporate issuers tend to benefit from this predictability—i.e., they use short-term debt more heavily when its expected returns are lower than the expected returns on long-term debt. Crucially, however, we do not assume any forecasting advantage for corporate issuers: they have no special ability to predict future returns, or to recognize sentiment shocks. Instead, the key comparative advantage that corporate issuers have relative to other players in our model is an advantage in *macro liquidity provision*.

More specifically, our theory has the following ingredients. First, the bond market is partially segmented, in that there are some important classes of investors who have a preference for investing at given maturities. These investors might include, e.g., pension funds, who, based on the structure of their liabilities, have a natural demand for long-term assets. Second, there are shocks to the supplies of long and short-term bonds that are large relative to the stock of available arbitrage capital. In our empirical work, we associate these supply shocks with changes in the maturity structure of U.S. government debt. And third, there are arbitrageurs (e.g., broker-dealers and, more recently, hedge funds) who attempt to enforce the expectations hypothesis, but, who—given limited capital and the undiversifiable nature of the required trade—do so incompletely, leaving behind some residual predictability in bond returns.

Taken together, these three ingredients imply that bond-market predictability takes a particular form: when the supply of long-term Treasuries goes up relative to the supply of short-term Treasuries, long-term Treasuries must offer a greater expected return. This idea goes back to Modigliani and Sutch (1966a, 1966b) and is developed formally in recent work by Vayanos and Vila (2007), as well as by Greenwood and Vayanos (2008), who provide supporting evidence.[3] Building on these papers, we add one further ingredient to the story: corporate issuers, who have to raise a fixed amount of total debt financing, and who must choose whether to issue at short or long maturities. These corporate issuers have no forecasting edge over the arbitrageurs, since the government-induced supply shocks are perfectly observable to both types of agents. Rather, what distinguishes the corporate issuers from the arbitrageurs is that they have a potentially greater capacity to absorb the supply shocks. In other words, corporate issuers have a comparative advantage in the provision of this particular kind of liquidity.

The source of this comparative advantage flows from the logic of the Modigliani-Miller (1958) theorem. To see why, imagine a world in which there are no taxes or costs of financial distress, so that firms are indifferent as to the maturity structure of their debt. If we now introduce into this world even tiny differences in the expected returns to short and long-term debt, firms will respond very elastically, by varying the maturity of what they issue. Indeed, in the limit, they will do so until the point where any expected-return differentials are eliminated.

In a more realistic setting, firms are likely to have well-defined preferences over their maturity structures, for the reasons alluded to above, and will view it as costly to deviate from their maturity targets. Nevertheless, to the extent that these costs are modest—i.e., to the extent that, in the spirit of M-M, the objective function is flat in the neighborhood of the target—patterns of corporate debt issuance will still respond elastically to differences in expected returns, though no longer to the point of completely eliminating these return differences.[4]

[3] In related work, Krishnamurthy and Vissing-Jorgensen (2008) show that when the overall supply of Treasury securities goes up, Treasuries offer a greater expected return relative to corporate bonds.

[4] As argued in Stein (2005), the closed-end nature of operating firms gives them an added advantage relative to open-end arbitrage funds in terms of their ability to take on long-horizon, undiversified "macro" positions.

In what follows, we develop this theory with a simple model that embeds the limited-arbitrage logic of Vayanos and Vila (2007) and Greenwood and Vayanos (2008), and adds a rudimentary corporate sector. We then go on to test four broad implications of the theory:

1. *Gap filling by corporate issuers*: First and foremost, our theory predicts that corporate issuance will fill in the supply gaps created by changes in government financing patterns. When the government issues more long-term debt, firms should respond by issuing more short-term debt, and vice-versa. Consistent with this prediction, we document a strong negative correlation between the maturities of government and corporate debt. A rough estimate is that the corporate sector fills 30% to 40% of the gap created by a shock to government debt maturity. This result holds in a battery of specifications that: i) use different measures of corporate debt issuance; ii) control for contemporaneous interest-rate conditions, credit spreads, and macroeconomic variables; and iii) take into account the dynamics of corporate and government issuance.

One possible objection to our interpretation of these results is that—counter to the spirit of our model—government debt maturity is endogenous, and may be influenced by some of the same forces as corporate debt maturity, albeit with the opposite sign. To address this concern, we instrument for government debt maturity with the ratio of government debt to GDP. These two variables are strongly positively correlated: when the government's financing needs are greater, it tends to extend its offerings out to longer maturities. Moreover, it seems plausible that the ratio of government debt to GDP—essentially, a measure of the stance of long-term fiscal policy—is not itself correlated with the sort of omitted factors that might govern corporate maturity choice, and hence is likely to be a valid instrument. Reassuringly, the results from this instrumental-variables approach are nearly identical to our baseline results.

2. *Time-series variation in gap filling:* If we allow for time-series variation in the relative sizes of the government and corporate debt markets, our theory makes an additional

prediction. When the government share of total debt is larger, gap-filling behavior by firms will be more pronounced, because larger supply shocks imply a larger reward for liquidity provision. This prediction is also borne out in the data.

3. *The cross section of gap filling*: At a micro level, our theory further implies that those firms with the smallest costs of deviating from their maturity targets will be the most aggressive gap fillers. To operationalize this hypothesis, we observe that a firm with a strong balance sheet (a firm that is relatively unconstrained in its investment behavior) is less likely to pay a price if it deviates from its maturity target—thereby taking on, e.g., more interest-rate or refinancing risk—than a firm with a weak balance sheet. Thus we would expect firms with stronger balance sheets to have maturity choices that respond more elastically to changes in the structure of government debt.[5] Using a variety of measures of balance-sheet strength, we confirm this prediction.

4. *The origin of corporate market timing ability*: As noted above, BGW (2003) document that corporate maturity choices have forecasting power for bond returns, but they do not specify the mechanism that drives this relationship. Our theory suggests that corporate actions can be informative because they are a mirror of government supply shocks, which in turn are the primitive drivers of expected returns. Consistent with this, we find that the ability of corporate issuance to forecast bond returns is attenuated if government debt maturity is included in the forecasting regression.[6]

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[5] This prediction is similar to that of Hong, Wang and Yu (2008), who argue that firms with strong balance sheets can act as liquidity providers in their own stocks, by repurchasing shares when prices drop below fundamental value.

[6] In spite of these results, we should stress that our model's implications for expected bond returns are neither as fundamental nor as robust as its implications for quantities. In the M-M limit where firms are indifferent as to the maturity mix of their debt, there will be strong quantitative gap-filling behavior, but all predictability in returns will be arbitraged away. Moving away from the limit, this suggests that any predictability we do find may be modest in nature, even when the mechanism in our model is key to understanding observed corporate debt maturity. Thus while the predictions for expected returns are of some interest, we do not view them as central for our purposes.

The remainder of the paper is organized as follows. Section II outlines our model of gap filling. Section III describes our measures of corporate and government debt maturity. Sections IV through VII test the four sets of hypotheses described above. Section VIII concludes.

II. The Model

We consider a simple model with three dates labeled 0, 1 and 2. Short-term interest rates follow an exogenous process; one can think of them being determined by either monetary policy, or by a stochastic short-term storage technology that is in perfectly elastic supply. In particular, the short-term rate from 0 to 1, denoted r_1, is known at time 0. The short-term rate from 1 to 2, denoted r_2, is random as of time 0, with mean $E[r_2]$ and variance $Var[r_2]$. There is also a default-free long-term bond that pays one unit of wealth at time 2, and that trades at a price of P at time 0. P will be determined endogenously, as described below.

There are four types of actors in our model: preferred-habitat investors, the government, arbitrageurs, and corporations. The preferred-habitat investors can be taken to represent pension funds, life insurance companies, endowments or others who have a natural demand for long-duration assets. These investors inelastically demand a dollar quantity L of long-term bonds at time 0. At the same time, the government issues a dollar quantity G of long-term bonds. In what follows, we only need to keep track of $g = G - L$, which measures the time-0 excess supply of long-term government bonds relative to preferred-habitat investor demand. The quantity g, which is exogenous in our model, can be either positive or negative.

Next we add risk-averse arbitrageurs who have zero initial wealth. In equilibrium, they buy a dollar amount h of long bonds at time 0, and finance this by borrowing short term. Note that h can also be negative, in which case the arbitrageurs buy short-term bonds financed with long-term borrowing. Terminal arbitrageur wealth is simply $w = h\left[P^{-1} - (1+r_1)(1+r_2)\right]$. We assume that arbitrageurs have mean-variance preferences with risk tolerance γ, choosing h to maximize $E[w] - (2\gamma)^{-1} Var[w]$. Given these assumptions it is easy to show that arbitrageurs' time-0 demand for long-term bonds is given by:

$$h^*(P) = \gamma \frac{\left[P^{-1} - (1+r_1)(1+E[r_2])\right]}{(1+r_1)^2 Var[r_2]} \tag{1}$$

As in Vayanos and Vila (2007), arbitrageurs borrow short and invest long when long-term bonds offer an expected return premium over short-term bonds. Conversely, when the return premium is negative, they borrow long and invest at the short rate.

Suppose for the moment that we leave out corporate issuers. The market clearing condition is $h^*(P) = g$, which implies:

$$P^{*-1} - (1+r_1)(1+E[r_2]) = \frac{(1+r_1)^2 Var[r_2]}{\gamma} g \tag{2}$$

Thus, the expectations hypothesis holds, i.e. $P^{*-1} = (1+r_1)(1+E[r_2])$, if either: i) $g = 0$, so that government supply matches preferred-habitat investor demand for long term bonds, ii) $Var[r_2] = 0$, so that arbitrageurs face no interest rate risk; or iii) γ is infinite, so that arbitrageurs are risk-neutral. Otherwise, an increase in the supply of long-term government bonds raises their expected-return premium.

As a quantitative matter, equation (2) implies that supply shocks have the potential to generate economically interesting effects to the extent that g is large relative to γ, in other words, to the extent that the shocks are large compared to the risk tolerance of the arbitrageurs. To get a sense of the magnitudes involved, note that in our sample, a one-standard-deviation annual shock to the long-term share of government debt is 9%. The total amount of outstanding government debt at the end of 2005 was $4.7 trillion.[7] These numbers imply that, in order to absorb a one-standard-deviation increase in the maturity of government debt, the arbitrage sector would have to go long $423 billion of long-term bonds, funding this position at the short-term rate. The annualized standard deviation of excess bond returns is 10%, which implies that this trade carries a one-percent value-at-risk (VaR) of approximately $98 billion, assuming normally distributed returns. This $98 billion VaR figure can be compared to the total assets of macro and fixed-income-arbitrage hedge funds, which were $118 billion and $28 billion respectively in 2005.[8] Thus it seems likely that the limits of arbitrage identified by Shleifer and Vishny (1997) would loom large in this context, especially given that the risk in question is a macro one that cannot easily be diversified away.

The last set of players in our model is a group of operating firms. We assume that these firms collectively need to borrow a total dollar amount C; as will become clear, the parameter C effectively indexes the size of the corporate sector relative to the government sector. Firms raise a fraction f (and hence a dollar amount fC) of their needs from long-term debt, and the remaining $(1 - f)$ from short-term debt. Timing considerations aside, their target optimal capital structure involves having a fraction z of long-term debt. If they stray from this target in either direction, they incur quadratic costs (in total dollar terms) of $\theta C(f - z)^2/2$. These costs might reflect interest-rate exposure or refinancing risk, either of which could lead to a tightening of financial constraints, and ultimately, to a reduction in value-creating investment. In this context, the parameter θ can be thought of as a measure of balance-sheet strength. In the limit where $\theta = 0$,

[7] This figure refers to the portion of the national debt held by the public, and excludes intragovernmental holdings.

[8] The source for these hedge-fund numbers is Hedge Fund Research, Inc. (HFR).

the firm in question has a balance sheet that is so strong that it is financially unconstrained in all states of the world, and it is therefore indifferent as to the maturity structure of its debt. At the other extreme where θ is large, the firm has tightly binding financial constraints, so that any increase in, say, interest-rate risk has the potential to be very costly.

In the spirit of Stein (1996), the firm's objective function is to minimize the sum of expected interest costs plus the costs associated with financial constraints. That is, firms solve:

$$\min_f \left[C\left((1 - f)(1+ r_1)(1+ E(r_2)) + \frac{f}{P} + \theta \frac{(f - z)^2}{2} \right) \right] \tag{3}$$

which has solution:

$$f^*(P) = z - \frac{P^{-1} - (1+ r_1)(1+ E\left[r_2\right])}{\theta}. \tag{4}$$

The partial equilibrium intuition is that when long-term debt is expensive, i.e., when $P^{-1} - (1+ r_1)(1+ E\left[r_2\right])$ is higher, firms deviate from their target debt mix and issue less long-term debt ($f < z$).

Once we add the corporate sector to the model, the market clearing condition for long-term bonds becomes $h^*\left(P\right) = g + Cf^*\left(P\right)$, which implies:

$$P^{*-1} - \left(1+r_1\right)\left(1+E\left[r_2\right]\right) = \left[\frac{\theta\left(1+r_1\right)^2 Var\left[r_2\right]}{\gamma\theta + C\left(1+r_1\right)^2 Var\left[r_2\right]} \right]\left(g+Cz\right) \tag{5}$$

We can solve for the equilibrium fraction of long-term corporate debt by substituting (5) into (4), which yields:

$$f^* = z - \left[\frac{\left(1+r_1\right)^2 Var\left[r_2\right]}{\gamma\theta + C\left(1+r_1\right)^2 Var\left[r_2\right]} \right]\left(g+Cz\right) \tag{6}$$

As above, the expectation hypothesis holds as γ tends to infinity or as $Var[r_2]$ goes to zero, since in either case arbitrageurs take arbitrarily large long (short) positions in long-term bonds if they deliver higher (lower) expected returns than short-term bonds. In addition, as θ tends to zero, so that there are no costs of deviating from the target maturity z, firms completely absorb any changes in government supply ($Cf^* = -g$), and the expectations hypothesis holds irrespective of arbitrageur risk tolerance. In such a world, firms respond aggressively to government supply shocks, even though these shocks have no effect on equilibrium prices.

In the limiting case where $\gamma = 0$, so that there are no arbitrageurs, the expected-return premium on long-term bonds is given by $(\theta / C)(g + zC)$. This is because there is a net excess supply of long-term bonds of $(g + Cz)$ if firms stick to their target debt mix, while θ / C measures the (lack of) willingness of the corporate sector to absorb this excess supply.

The following four propositions, which follow immediately from equations (4) through (6), provide the basis for our empirical work below.

Proposition 1: Gap filling. It is apparent from equation (6) that $\partial f^* / \partial g < 0$. Thus when the government issues more long-term debt, firms respond by tilting their debt issuance *away* from long-term debt.

Proposition 2: Time-variation in gap filling. Equation (6) also implies that $\partial^2 f^* / \partial g \partial C > 0$. This means that gap-filling behavior is more pronounced when the stock of government debt is large relative to the stock of corporate debt. One simple intuition for this result is that gap filling is fundamentally a dollars-for-dollars phenomenon. When C is small (i.e., there is relatively more government debt) it takes a larger change in the fractional composition f of corporate debt to absorb a given dollar shock to supply.

Although the dollars-for-dollars nature of Proposition 2 makes it sound mundane, it is actually a sharply differentiating prediction of our theory. To see why, consider an alternative explanation for gap filling. One might argue, for example, that government debt maturity is itself endogenous, and responds to the same unobserved factors that drive corporate maturity decisions, albeit with the opposite sign. Perhaps the government tends to shorten the duration of its debt when it perceives future economic conditions to be deteriorating, while the corporate sector does just the reverse. This could generate $\partial f^* / \partial g < 0$, as in Proposition 1. But it would *not* generate $\partial^2 f^* / \partial g \partial C > 0$, as in Proposition 2, since in this alternative story, all that is relevant about government financing choices is their informational content, not their raw scale.

Proposition 3: The cross section of gap filling. Another implication which follows from equation (6) is that $\partial^2 f^* / \partial g \partial \theta > 0$. With a little bit of liberty, this comparative static can be interpreted as a cross-sectional statement: firms with stronger balance sheets (those for whom θ is closer to zero) will exhibit more aggressive gap-filling behavior.

Proposition 4: The origin of corporate market timing ability. In our model, corporate maturity choices forecast bond returns, so long as we are not in the limiting M-M case where $\theta =$ 0. This can be seen in equation (4). In particular, when f^* is high, so that firms are tilting towards long-term debt, expected returns on long-term bonds are lower, and vice-versa. However, the ability of f^* to forecast returns in this way arises because f^* endogenously responds to changes in the supply g of long-term government bonds, with g being the exogenous factor that drives variation in expected returns.

One implication of Proposition 4 is that we would expect the forecasting power of corporate maturity choices for bond returns to be diminished if we also include a measure of government debt maturity in the forecasting regression. Indeed, if changes in g are the *only* source of variation in expected returns, the two variables f^* and g are completely colinear. More generally, if there are other sources of variation (e.g., shocks to target corporate maturity z, or to arbitrageur risk tolerance γ), then f^* may retain some incremental predictive power for bond returns, even controlling for g. This is what we find in the data.[9]

III. The Maturity of Corporate and Government Debt

In this section we describe our proxies for corporate and government debt maturity. For government debt, we use the CRSP bond database. For corporate debt, we rely on two sources: the Federal Reserve *Flow of Funds* and Compustat. Because Compustat is available starting in 1963 and since many bond market studies (e.g., Fama and Bliss (1987), Cochrane and Piazzesi (2005)), start their forecasting in 1963 or 1964, we use 1963-2005 as our main period of study. However, the *Flow of Funds* data is available earlier, and thus many of our tests can be replicated on a longer sample; where applicable we mention these results.[10]

A. Flow of Funds data on corporate debt maturity

The Federal Reserve *Flow of Funds* tracks financial flows throughout the U.S. economy. As mentioned above, we follow recent research and start in 1963. We use annual data from the

[9] In a multivariate forecasting regression for bond returns, the coefficient on f^* is negative, while that on g is positive. To fully rationalize this pattern within our model, we would require shocks to at least three exogenous quantities: government supply g, target corporate maturity z, and some other variable which affects required returns (e.g. arbitrageur risk tolerance γ). Furthermore, the shocks to z must be only weakly correlated with variation in expected returns; this would be the case if, for instance, the corporate sector is small relative to the government sector (C is small). Intuitively, if shocks to z were themselves a major driver of variation in expected returns, this would imply a positive coefficient on f^* in a multivariate regression, as opposed to the negative coefficient we observe in the data. The details of this analysis are available on request.

[10] The *Flow of Funds* data is available as early as 1945. However, reliable estimates of government debt maturity based on CRSP cannot be constructed until the early 1950s. Furthermore, most studies focus on the period following the 1951 Fed-Treasury accord, prior to which interest rates were partially pegged. When we work with this longer sample, we follow BGW (2003) and begin in 1953.

credit market liabilities of the nonfarm, nonfinancial corporate business sector (Table L. 102). This sector comprises all private domestic corporations except corporate farms, S-corporations, and real estate management corporations. We focus on the debt maturity choices of nonfinancials since we expect the choices of financial institutions to be driven more by duration-matching asset and liability management considerations. In the words of our model, financials are likely to have a high value of θ, making it costly for them to deviate from their target maturity structure. Another reason to focus on nonfinancials is to preserve comparability with other studies.[11]

We follow BGW (2003) and define short-term corporate debt as the sum of "commercial paper," "bank loans not elsewhere classified," and "other loans and advances." By definition, short-term debt retires at the end of each year. Thus short-term debt issues ($d_{S,t}^{C}$) are the same thing as short-term debt outstanding ($D_{S,t}^{C}$). Throughout the paper, we follow the convention of level variables being denoted in upper case, and issue variables being denoted in lower case.

Long-term corporate debt ($D_{L,t}^{C}$) is the sum of "industrial revenue bonds," "corporate bonds," and "mortgages." BGW (2003) provide a detailed description of each of these items, as well as their shares in total long-term debt. Our first corporate debt maturity measure, the *long-term corporate level share*, is simply long-term corporate debt over total debt ($D_{L,t}^{C} / D_{t}^{C}$). As can be seen in the summary statistics in Table 1, the level share based on *Flow of Funds* data is quite persistent, with a first-order autocorrelation of 0.85.

In the context of our static model, perhaps the most obvious way to test Proposition 1 would be to simply regress the corporate level share on the analogous construct for government bonds. While this is where we begin, two considerations lead us to also examine the maturity of

[11] BGW (2003), Faulkender (2005), Faulkender and Chernenko (2007), and Butler, Grullon and Weston (2006) study the debt maturity policy of nonfinancial firms. Using the Compustat data, we do find that financial firms engage in some gap filling, albeit less than nonfinancials.

corporate *issues*. First, in a more realistic dynamic setting, where adjustment costs prevent firms from recasting their balance sheets overnight, equilibrium involves a partial-adjustment mechanism, whereby it is corporate *issuance* that responds at the margin to the expected-return differentials induced by the relative stocks of long and short-term government debt.[12] Second, looking at issuance helps to resolve some of the econometric concerns associated with the high degree of persistence in the levels variable.

Accordingly, we construct long-term debt *issues* ($d_{L,t}^{C}$) as the change in the level of long-term corporate debt outstanding ($D_{L,t}^{C}$), plus one-tenth the level of long-term debt in the previous year. That is, we have:

$$d_{L,t}^{C} = \left(D_{L,t}^{C} - D_{L,t-1}^{C}\right) + 0.1 \times D_{L,t-1}^{C}. \tag{7}$$

This amounts to assuming that one-tenth of long-term debt matures each year. The 10-year maturity of long-term debt roughly corresponds to the median maturity of long-term debt issues in Guedes and Opler (1996). Our results are not sensitive to this assumption.

Total corporate debt issues, d_t^C, is the sum of long- and short-term issues. Our second corporate maturity measure, the *long-term corporate issue share*, is the ratio of long-term issues to total issues ($d_{L,t}^{C} / d_t^{C}$). Not surprisingly, the issue share closely tracks the level share, with a time-series correlation of 0.75. Nevertheless, the issue share is substantially less persistent, with a first-order autocorrelation of 0.58, compared to 0.85 for the level share.

[12] Several recent papers emphasize the importance of adjustment costs for firms' capital structure decisions. See, e.g., Leary and Roberts (2005) and Strebulaev (2007).

B. Compustat data on corporate debt maturity

Compustat is a second source of data for corporate debt maturity. The advantage of the Compustat data is that it can be disaggregated; this makes it indispensable for our cross-sectional tests of Proposition 3. However, it also has an important limitation. Because it focuses only on public firms, time-variation in a Compustat-based measure of aggregate debt maturity will be influenced by compositional effects.[13]

Since this compositional effect is likely to be especially problematic for higher-frequency movements, when working with Compustat we restrict attention to a levels measure of debt maturity, and do not attempt to construct an issues measure. For the sake of comparability, we construct our Compustat levels measure to correspond as closely as possible to the *Flow of Funds* long-term level share. Aggregating across all nonfinancial firms, we define long-term debt as the sum of all long-term borrowings (item 9), plus debt that was originally issued long-term but that is about to retire (item 44). We define short-term debt as total debt (item 9 plus item 34), minus long-term debt. Our convention of counting the current portion of long-term debt as long-term is meant to replicate the procedure used in the *Flow of Funds*, whereby corporate bonds are classified as long-term instruments, even though some portion of these bonds may, at any point in time, have a short remaining duration.[14]

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[13] For example, suppose that in year t there are 100 private firms with zero long-term debt, and 100 public firms (of the same size) with 50% long-term debt. Suppose further that no firm alters its capital structure in year $t+1$ (so that a *Flow of Funds* type measure remains constant) but that 10 of the private firms go public. The measured long-term debt share based on public-firm data would drop from 50% to 50/110 = 45%. According to Fama and French (2004), between 1980 and 2001, an average of 10% of public firms were new lists in a given year. So compositional effects of this sort have the potential to be quantitatively significant.

[14] As noted by BGW (2003), one would ideally like data on floating rate features and callability. Call provisions, for example, reduce the effective maturity of long-term issues. BGW show that corporate debt maturity measures adjusted for callability and floating rate exposure are generally stronger forecasters of bond returns than the unadjusted measures. Thus the *Flow of Funds* long-term share and the Compustat long-term share should be thought of as somewhat coarse measures of corporate debt maturity.

Over the 1963-2005 period, the Compustat long-term level share is generally higher than the corresponding *Flow of Funds* series; the means of the two series are 83.4% and 61.5% respectively. We suspect that this is because Compustat firms, which are public, have better access to longer-term financing instruments—an observation which reinforces the above concern about compositional effects. At an annual frequency, the two variables have a correlation of 0.41. This correlation is generally higher later in the sample period, and higher still if one nets out a time trend in the Compustat measure.

C. CRSP data on government debt maturity

The available data on government bonds allows for a much finer characterization of debt maturity structure than we are able to obtain for firms. Nevertheless, we stick with a simple measure that matches our corporate maturity variable: the fraction of government debt with a maturity of one year or more, hereafter the *long-term government level share*.

To construct the long-term government share, we follow Greenwood and Vayanos (2008). The CRSP U.S. Treasury Database reports detailed information on every Treasury security that was outstanding between 1925 and 2006. For each security, CRSP reports a number of characteristics, including the issue date, final maturity, and callability features. CRSP also provides monthly readings of the dollar face value of each instrument. Changes in face value reflect repurchases, as well as follow-on offerings (a.k.a. "re-openings") of an existing issue.

We decompose the payment stream of each outstanding issue into a series of principal and coupon repayments. In each month, these series are adjusted for variation in the face value outstanding. Every month, we aggregate payments due in the subsequent n periods, across all issues that are still outstanding. The government long-term share ($D^G_{L,t} / D^G_t$) is then defined as total payments due in more than one year, divided by total payments in all future periods.[15]

To ensure robustness, we also rerun some of our basic specifications with a second measure of government debt maturity: the dollar-weighted average maturity of principal payments, which we denote by *M*. As can be seen in Table 1, both of these variables are highly persistent, with first-order autocorrelations on the order of 0.95.

D. Other variables

Our tests below use several other variables, also summarized in Table 1: the short-term (one-year) Treasury yield y_{St}; the spread between the long-term (20-year) Treasury yield and the short-term yield, $(y_{Lt} - y_{St})$; the one-year excess log return on long-term Treasuries, $(R_{Lt+1} - y_{St})$; the credit spread, defined as the Moody's Baa yield minus the yield on long-term Treasuries; the ratio of government debt to GDP; the ratio of government debt to total credit market liabilities; annual GDP growth, (ΔLog(GDP)); and a recession dummy based on NBER dating conventions.

IV. Proposition 1: Gap Filling

A. Univariate tests

The primary prediction of our theory, Proposition 1, is that when the government lengthens the maturity profile of its debt, firms respond by doing the opposite. Panels A-C of Figure 1 present a first look at this prediction. In Panel A, we plot the *Flow of Funds* long-term corporate level share against one minus the government long-term share; given this transform of the government share variable, our hypothesis is that the two series in the figure should be

[15] This series has a correlation of 0.91 with the variable used by Greenwood and Vayanos (2008), namely the share of government payments due in more than 10 years. The one-year share also has a correlation of 0.95 with a simpler measure of government maturity which just counts the fraction of outstanding principal due in more than one year.

positively correlated. In Panels B and C, we replace the *Flow of Funds* level share with the *Flow of Funds* issue share and the Compustat level share, respectively. In all three cases, the correlation between corporate and government debt maturity is readily apparent.

Table 2 presents a set of univariate OLS regressions corresponding to Figure 1. We regress each of our three measures of corporate debt maturity one at a time against either: i) the government long-term share; or ii) the weighted maturity M of government debt. In these regressions, we do not invert the government variables, so we expect to see negative correlations. Since all of the underlying series are persistent, we report Newey-West (1987) standard errors which are robust to serial correlation at up to two lags.

In all six regressions, we obtain the predicted negative coefficients. The results for both the *Flow of Funds* level share and the *Flow of Funds* issue share are strongly statistically significant, with t-statistics ranging from 2.64 to 4.21. The results for the Compustat level share are statistically marginal, with t-stats of 1.83 and 1.67.

In terms of economic magnitudes, the regression coefficients in the first and third columns of Table 2 (-0.262 and -0.249) imply that when the fraction of U.S. Treasury debt longer than one year rises by 10%, the long-term corporate share based on *Flow of Funds* falls by about 2.5%; this holds in both levels and issues. To understand what this means for total gap filling, we can multiply this by the average ratio of corporate debt to government debt during the sample period of 1.09, yielding 2.7% percent. This suggests that, on a dollar-for-dollar basis, firms fill 27% of the gap created by variation in government debt maturity.

B. Multivariate tests

In Table 3, we take the univariate regressions from Table 2, and add a set of further controls: i) the short-term Treasury yield y_{St}; ii) the term spread $(y_{Lt} - y_{St})$; and iii) a linear time trend. As noted in the Introduction, several studies have documented a link between corporate debt maturity and "market conditions" proxies like y_{St} and $(y_{Lt} - y_{St})$, and we want to make sure that our univariate inferences are not distorted by the omission of these variables.

As can be seen in the table, the addition of these controls makes the coefficient on government debt maturity stronger and more statistically significant in all cases. For example, in the regression of the *Flow of Funds* level share against the government level share, the coefficient is -0.387 (t-stat of 5.45) with the full set of controls—implying that firms fill 42% of any government-induced supply gaps in dollar terms—as compared to its value of -0.262 (t-stat of 3.64) in the univariate specification. In the regression of the Compustat level share against the government share, the coefficient is -0.228 (t-stat of 2.33) with the full set of controls, as compared to its value of -0.147 (t-stat of 1.83) in the univariate case.

This pattern should not be too surprising. It seems plausible that both firms and the government might respond to certain market conditions in the same manner. For example, one might expect both to tilt their borrowing to the short end of the maturity spectrum when the term spread is high, in an effort to reduce reported interest expenses. This would tend to induce an element of positive correlation between the corporate share and the government share, dampening the negative relationship created by the mechanism in our model. In this scenario, controlling for the term spread makes the predicted negative correlation emerge more clearly.

C. Robustness

Table 4 presents a number of robustness checks on the multivariate results of Table 3. There are three columns, corresponding to our three measures of corporate debt maturity. In the first row, we reproduce our baseline estimates from Table 3, using the government level share as the key explanatory variable, and including the full set of controls. (These baseline estimates correspond to columns (2), (6) and (10) of Table 3.) In the second and third rows, we display subsample estimates. As can be seen, the results are generally stronger, both economically and statistically, in the second half of the sample, which runs from 1984-2005. The differences across sample periods are relatively modest with the two *Flow of Funds* measures of corporate debt maturity, but are striking with the Compustat measure; in this case the point estimate is very large and significant in the post-1984 period, (-0.787, with a t-stat of 11.68) but actually goes the wrong way in the first half of the sample. We suspect that this divergence may have something to do with the fact that Compustat offers less complete coverage of the entire (public plus private) universe during the earlier period.

In the fourth row of Table 4, we extend the sample for the *Flow of Funds* measures further back in time, so that it covers 1953-2005. (Again, we are unable to go back further than 1963 with the Compustat data.) The results are qualitatively similar to those from our baseline sample period of 1963-2005, albeit a bit smaller in absolute magnitude.

In the fifth through ninth rows of Table 4, we add a number of further controls for general economic and credit-market conditions. The motivation is that some firms may find it difficult to issue long-term debt during periods of weak economic growth, or when credit spreads are high. In the fifth row, we add an NBER recession dummy to our baseline specification. In the sixth row, we add two leads and two lags of this recession dummy to the previous regression. In the seventh row, we control for leads and lags of GDP growth. In the eighth row, we control for the credit spread, defined as the Moody's Baa yield minus the average yield on long-term Treasuries.[16] In all cases, our results are either similar to those from the baseline specification, or somewhat stronger.

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[16] Estrella and Mishkin (1998), Harvey (1989), and Stock and Watson (1989) discuss the role of yield spreads and credit spreads in forecasting economic growth.

In the ninth row, we replace the government share with an alternative proxy, namely the fraction of government debt due in more than 10 years. This too leads to similar results, though in this case the point estimates cannot be compared directly to those in previous specifications because we are now working with a different explanatory variable.

D. What drives government debt maturity?

A general concern for our results thus far is that we have been taking government debt maturity to be exogenous, without a clearly articulated theory of what causes it to move around. This leaves open the possibility that both government and corporate maturity are simply responding (albeit in opposite directions) to some unspecified factor that we have failed to include in our list of controls. If we had a good theory of government debt maturity, this might suggest an instrument that would allow us to address this possibility head on.

Empirically, a powerful determinant of the government long-term debt share is the ratio of government debt to GDP: in our sample period, a univariate regression of the former on the latter yields an R-squared of 0.74. In other words, when the government's financing needs are greater, it tends to extend its offerings out to longer maturities. This relationship has led Greenwood and Vayanos (2008) to use the debt-to-GDP ratio as an instrument for government maturity in a setting similar to ours, and we follow this approach below. Before doing so, however, it is useful to pause and ask *why* one might expect to see such a strong empirical connection between government debt maturity and the debt-to-GDP ratio; as far as we know, this connection is not clearly predicted by any existing formal theory.[17]

[17] For theories of optimal government debt maturity see, e.g., Roley (1979), Barro (1995), Angeletos (2002), and Guibaud, Nosbusch, and Vayanos (2007).

One informal hypothesis goes as follows. On the one hand, there is a perceived cost advantage to the government in financing short-term; this allows it to economize on the historically positive term premium. On the other hand, short-term financing requires more frequent rollovers. As the size of the government's debt increases, so too do the risks associated with larger and more frequent refinancings—e.g., the possibility that a temporary dislocation in markets causes unexpectedly low investor turnout at an auction. An aversion to such risks would lead the government to extend its maturities as the stock of its debt goes up.

Former Treasury secretary Lawrence Summers describes government financing behavior along just these lines: "I think the right theory is that one tries to [borrow] short to save money but not [so much as] to be imprudent with respect to rollover risk. Hence there is certain tolerance for [short term] debt but marginal debt once [total] debt goes up has to be more long term."[18] If this account is on target, using the debt-to-GDP ratio as an instrument for government debt maturity would appear to be a well-motivated exercise, grounded in a specific model of government financing policy.

Accordingly, in the tenth row of Table 4, we return to the baseline specification of the first row, but estimate the regression by instrumental variables (IV), instead of by OLS. As can be seen, this produces estimates that are very close to those from the corresponding OLS specifications. For example, with the *Flow of Funds* level share as the dependent variable, IV yields a point estimate of -0.395 (t-stat of 4.89), as compared to the OLS estimate of -0.387.

One remaining question for the IV approach is whether our instrument, the debt-to-GDP ratio, satisfies the exclusion restriction. For example, one might worry that high values of the

[18] Private email correspondence, April 28, 2008. Also relevant is Garbade (2007), who emphasizes the Treasury's desire to minimize the uncertainties associated with the auction process. He notes that after 1975, Treasury officials explicitly renounced the concept of "tactical issuance" and replaced it with a policy of "regular and predictable" note and bond offerings. According to Garbade, "the move to regular and predictable issuance was widely credited with reducing market uncertainty, facilitating investor planning and lowering the Treasury's borrowing costs."

debt-to-GDP ratio are associated with adverse credit-market conditions, and hence influence corporate debt maturity through another channel.[19] In an effort to address this issue, we run an augmented version of the IV specification that adds a control for the credit spread. The results, shown in the eleventh row of Table 4, are actually somewhat stronger than those without the credit-spread control.

E. Differenced and GLS specifications

As emphasized above, our measures of corporate and government debt maturity are highly persistent. One way to address this persistence is to simply compute adjusted standard errors that take it into account, as we have been doing throughout. Alternatively, the classic prescriptions for persistence are either to estimate the regression in first differences, or to use a generalized-least-squares (GLS) estimator. We try both of these techniques below. In each case, however, we have to be mindful of the risk of over-differencing. Specifically, in a world where issuance costs and other frictions create lags in the adjustment process, it might be unrealistic to expect an innovation in government debt maturity in year t to be met with the full response of corporate debt maturity in the same year t—rather, it might take a few years for the adjustment process to play itself all the way out.

In the left-most panel of Table 5, we use the *Flow of Funds* issue share to estimate specifications of the form:

$$d_{L,t}^{C} / d_{t}^{C} = a + b \cdot \Delta_{k} \left(D_{L,t}^{G} / D_{t}^{G} \right) + u_{t}, \tag{8}$$

[19] Our baseline IV specification already controls for the level of short-term interest rates and the yield spread, which might plausibly be related to the debt to GDP ratio. We only require that our instrument be orthogonal to any *omitted* factors that affect corporate debt maturities.

where $\Delta_k\left(D_{L,t}^G / D_t^G\right)$ represents the *cumulative* change in the government long-term debt share variable over the past k years, for k=1,2,3,4, and 5. Thus these specifications explore how corporate issues respond not to the *level* of the government share, but instead to *recent changes* in the government share. This is one simple approach to differencing. When the differencing window is only one year, the results are statistically weaker than when the government share is entered in levels form. However, as we broaden the differencing window out to two years and beyond, the results again become strongly significant. By the time the window reaches five years, the estimated value of b is -0.289, with a t-statistic of 4.63. Thus while the response of corporate issues to changes in government debt maturity is not entirely contemporaneous, it appears that our earlier results reflect something more than the juxtaposition of very low-frequency trends in the two series.

In the second and third panels of Table 5, we alternately use the *Flow of Funds* and Compustat level shares to estimate specifications of the form:

$$\Delta_k\left(D_{L,t}^C / D_t\right) = a + b \cdot \Delta_k\left(D_{L,t}^G / D_t^G\right) + u_t\,. \tag{9}$$

This is just a differenced version of our baseline levels specification, with the differencing window again varying from one to five years. For the *Flow of Funds* level share the results are statistically weak when using a one-year window, but grow progressively stronger as the window is widened. With a five-year window, the estimate of b is -0.325, with a t-statistic of 2.18. By contrast, the results for the Compustat level share are of roughly similar significance for all values of k.

In untabulated regressions, we have also explored the lead-lag properties of the relationship between government and corporate maturities. Specifically, in bivariate vector autoregressions we find a negative and significant relationship between the current corporate issue share (or changes in the corporate level share) and lagged changes in the government level share. However, there is no significant relationship between current changes in the government level share and the lagged corporate issue share. That is, changes in government maturities appear to Granger-cause changes in corporate maturities. This lead-lag asymmetry further alleviates possible concerns about reverse causation.

In Table 6 we report GLS estimates of the univariate and multivariate specifications from Tables 2 and 3.[20] The middle panel presents results for the *Flow of Funds* issue share. These results are almost identical to those obtained using OLS. For example, with the full set of controls, we obtain a GLS estimate of -0.316 for the coefficient on the government share, with a t-statistic of 6.16; this compares with an OLS estimate of -0.318 (t-stat of 5.77) for the corresponding regression in Table 3. Thus for the *Flow of Funds* issue variable, our results are entirely robust to using GLS.

The GLS procedure makes less sense when using the *Flow of Funds* level share. This is illustrated in the left-hand panel of Table 6. As can be seen, the high persistence of the levels variable leads to an estimated value of ρ on the order of 0.96 in the GLS procedure. Hence in this case, GLS is essentially identical to first-differencing the data. And as seen in Table 5, running the *Flow of Funds* levels regressions in first differences leads to insignificant results, for the reasons developed above. Given that ρ is estimated to be almost one, the GLS results for *Flow of Funds* levels in Table 6 amount to no more than a restatement of this prior finding. Note that GLS is *not* redundant in the same way when the dependent variable is the *Flow of Funds*

[20] The GLS regressions are estimated using the iterated Prais-Winsten (1954) procedure. Relative to Cochrane-Orcutt (1949), the Prais-Winsten procedure does not throw out the first observation in the sample and is therefore the true MLE estimator under the assumption that the residuals follow an AR(1) process. However, we obtain virtually identical results if we do throw out the first observation and use the Cochrane-Orcutt instead.

issue share; in this case, the estimated value of ρ ranges from 0.05 to 0.43, so GLS is quite distinct from first differences.

Finally, the GLS results for the Compustat level share, shown in the right-hand panel of Table 6, represent an intermediate case between those for the two *Flow of Funds* variables. In this specification, we estimate ρ to be 0.80, so that while there is a good deal of persistence, GLS is not literally the same thing as first-differencing the data. And as can be seen, the GLS results for the Compustat level share look very similar, in both magnitude and statistical significance, to their OLS counterparts in Tables 2 and 3.

V. Proposition 2: Time-Variation in Gap Filling

Our model predicts that when government debt supply is large, gap filling by firms will be quantitatively stronger. To test this hypothesis, we consider two proxies for the size of the government bond market. The first is the ratio of government debt to GDP, and the second is the ratio of government debt to total credit market debt; these two variables are plotted in Figure 2.[21] In each case, we use the *Flow of Funds* long-term corporate issue share as our dependent variable, and run the following regression:

$$\begin{aligned} d_{L,t}^{C}/d_{t}^{C} = a + b\cdot\left(D_{L,t}^{G}/D_{t}^{G}\right) + c\cdot Scale_{t} + d\cdot\left(Scale_{t}\times D_{L,t}^{G}/D_{t}^{G}\right) + \\ e\cdot time + f\cdot\left(time\times D_{L,t}^{G}/D_{t}^{G}\right) + \boldsymbol{\theta}'\mathbf{x}_{t} + u_{t} \end{aligned} \tag{10}$$

where $Scale_t$ denotes one of our two measures of the size of the government bond market, *time* is a linear trend, and $\mathbf{x}_t$ is a set of controls for debt market conditions (yield spread and the short-term bond yield). The coefficient of interest, *d*, is that on the interaction between $Scale_t$ and

[21] In addition to Treasury securities, total credit market debt includes open market paper, GSE debt and GSE-backed securities (mortgage backed securities), municipal securities, corporate and foreign bonds, bank loans, other loans and advances, and consumer credit.

government debt maturity. If, as predicted in Proposition 2, gap filling is stronger when $Scale_t$ is high, then we should find $d < 0$.

Note that this specification also allows for an interaction between a time trend and government debt maturity. Thus we are asking whether there is an independent effect of $Scale_t$ on gap filling behavior, above and beyond the existence of a simple time trend in the intensity of gap filling. This relatively stringent test is motivated by an earlier observation from Table 4, namely that gap filling appears to be more pronounced in the latter half of our sample period.

The results of these regressions are shown in Table 7. There are four columns, corresponding to the two measures of the size of the government bond market, and to versions of (10) with and without the further controls y_{St} and $(y_{Lt} - y_{St})$. In each of the four cases, the key coefficient d is estimated to be negative, as predicted. The results are statistically significant in the first, third, and fourth columns, and marginally significant (t-stat of 1.77) in the second. Thus the evidence is generally supportive of Proposition 2.[22]

VI. Proposition 3: The Cross-Section of Gap Filling

The model also predicts that gap-filling behavior should be more pronounced among those firms for whom the costs of deviating from the optimal debt maturity structure is smaller. To test this proposition, we use the Compustat data to create disaggregated versions of the long-term corporate level share for various subsamples of firms. We can then ask whether this share responds more sensitively to the long-term government share among firms that appear to have more financial flexibility.

[22] The full effect of a one percentage-point increase in the government long-term share is given by $b + d \cdot Scale_t + f \cdot time$, which explains why $b > 0$ in Table 7.

We use six proxies for financial flexibility. The first is simply a firm's market capitalization. The other five are motivated by the work of Kaplan and Zingales (1997), who show that the following firm-level characteristics are associated with a lessening of financial constraints: high dividends; high cashflow to assets; high cash balances to assets; low Tobin's Q; and low book leverage. For all of the variables except dividends, we assign each year those nonfinancial firms below the 30th percentile to the "low" category, and those above the 70th percentile to the "high" category. For dividends, we simply separate the payers and the non-payers. Again, our predictions are that the coefficient on the government share should be more strongly negative—i.e., there should be more gap filling—for firms that rank "high" in terms of market cap, cashflow and cash balances, for firms that rank "low" in terms of Q and leverage, and for firms that are dividend payers.

Table 8 reports the results of these tests. The baseline specification is, but for the disaggregation, identical to that in column (10) of Table 3, including as additional controls y_{St}, $(y_{Lt} - y_{St})$, and a time trend. The first row of Table 8 just repeats the coefficient estimate on the government long-term share from the full Compustat nonfinancial sample: -0.228, with a t-statistic of 2.33.

In the second row, we see that the coefficient for large firms is -0.286, while that for small firms is 0.024; the t-stat on the difference between these two coefficients is 2.18. These findings with respect to market cap echo the survey results of Graham and Harvey (2001): managers of larger firms are more likely to say that they attempt to time movements in Treasury rates. Similarly, the third row shows that the coefficient for dividend payers is -0.263, while that for non-payers is -0.043, with a t-stat on the difference of 1.91. These two sample splits are illustrated in Panels A and B of Figure 3.

The fourth and fifth rows document that firms with high cashflows and cash balances also have more negative coefficients on the government long-term share, though only the former comparison is statistically significant (t-stats of 1.94 and 1.07 respectively). The sixth row shows that low-Q firms have a coefficient of -0.318, while high-Q firms have a coefficient of -0.063, with a t-stat on the difference of 1.97. Thus for five characteristics—size, dividends, cashflow, cash balances, and Q—each of the subsample comparisons go in the direction predicted by the theory, albeit not significantly in the case of cash balances.

The one sample split that yields no meaningful differential is book leverage: the coefficients for high and low leverage firms are almost the same, at -0.367 and -0.375 respectively. One possible explanation for this non-result is that, by definition, high-leverage firms enjoy greater dollar benefits from timing the debt market. Hence if there are any fixed costs associated with having an activist debt-management policy, high-leverage firms will be more inclined to bear this fixed cost, and thus to engage in gap filling. This would create an effect that runs counter to the financial-flexibility effect envisioned in our model.

Nevertheless, the overall picture that emerges from Table 8 is that, according to most measures, it does appear that increased flexibility is associated with more aggressive gap filling. Thus the evidence is largely—though not entirely—consistent with Proposition 3.[23]

VII. Proposition 4: Gap Filling and Excess Bond Returns

Our final analysis, in Table 9, examines the predictability of excess returns in the Treasury bond market. Here we use a longer sample period of 1953-2005 to allow for comparison with the bond market predictability results in BGW (2003), Butler, Grullon and

[23] While we have interpreted our results as reflecting differences in debt supply elasticities across firms, these findings would also be consistent with the idea that investors view the debt of corporations with strong balance sheets as a closer substitute for government debt than that of financially constrained firms.

Weston (2006), and Greenwood and Vayanos (2008). There are three blocks in the table, corresponding to one-year-ahead, two-year-ahead, and three-year-ahead excess returns. The first column in each block reproduces the baseline findings of Greenwood and Vayanos (2008), using the long-term government share to forecast returns. In these univariate regressions, the government share emerges as a statistically significant predictor at all three horizons. In particular, when government debt maturity is high, subsequent returns on long-term bonds are high as well—hence the motive for firms to fill the gap by using relatively cheaper short-term debt. The magnitudes are also economically interesting: when the government share goes up by one percentage point, excess bond returns rise by 22.5 basis points, 52.3 basis points, and 82.4 basis points at the one, two and three-year horizons respectively.

The second and fourth columns of each block present univariate regressions similar to those in BGW (2003). The long-term corporate level share and the long-term corporate issue share (both based on *Flow of Funds* data) are used one at a time to forecast excess returns. Both variables have significant predictive power at the two and three-year horizons, though with the opposite sign as the government long-term share. It should be noted that while the qualitative picture is similar to that in BGW, the statistical significance of our results is somewhat weaker than those reported by BGW for the 1953-2000 period; this divergence is caused by the year 2001, when both corporate debt maturity and excess bond returns were high.

The above results are not new. However, our theory does make the following novel prediction, embodied in Proposition 4: to the extent that corporate debt maturity predicts bond returns, some of this predictability arises simply because corporate debt maturity serves as a mirror of government debt maturity, and hence of the supply shocks that are the ultimate driver of returns. Thus once government maturity is included in the regression, the predictive power of corporate maturity—measured in either levels or in issues—should be diminished. These bivariate horse races are shown in the third and fifth columns of each block. And as can be seen, they provide consistent support for this aspect of our theory. Consider for example the case where the long-term corporate issue share is used to forecast three-year ahead excess returns. When used as a univariate predictor, this variable attracts a coefficient of -1.588, with a t-statistic of 2.64. However, when it is entered with the long-term government share, the coefficient falls to -1.045, with a t-stat of -1.52—i.e., it shrinks by about one-third of its original value.

VIII. Conclusions

The survey evidence in Graham and Harvey (2001) suggests that at least some of the time-series variation in corporate debt maturity reflects an active effort by managers to time the debt market, i.e., to issue at the cheapest point on the yield curve. Such attempts at market timing are difficult to understand if one thinks in terms of access to information, or forecasting capabilities: it is hard to see why the managers of nonfinancial firms should have any comparative advantage—relative to say, hedge-fund managers—at predicting future bond-market excess returns.

This paper has argued that debt-market timing by firms makes more sense when viewed through the lens of liquidity provision. Even if operating firms have access to the same information as hedge funds, and hence make the same forecasts of excess returns, they do bring to the table significant additional risk absorption capacity. This extra capacity is of particular value when movements in excess returns are driven by quantitatively large and undiversifiable supply shocks, as is the case in the Treasury bond market.

A similar logic can be used to think about other forms of market timing. For example, it has been documented that firms exhibit timing behavior with respect to both the firm-specific and aggregate components of stock prices, issuing more equity when prices are high and expected returns are low on either of these dimensions.[24] While a theory based on private information may shed light on how individual firms manage to issue equity in advance of low idiosyncratic returns, this approach is less well-suited to explaining why high values of aggregate equity issuance forecast low market-wide returns, as in Baker and Wurgler (2000). We suspect that here too, thinking about firms as macro liquidity providers, rather than as especially well-informed stock-market forecasters, is likely to be fruitful. A clean illustration of this point comes from the stock-market crash of 1987. In the wake of the crash, many firms announced repurchase programs. Given that they were responding to an event about which there was common knowledge, it is hard to believe that these firms had any kind of informational edge over other market participants. However, given the stresses on arbitrage capital caused by the crash, it seems likely that operating firms, especially those with strong balance sheets, were advantaged in terms of risk absorption capacity.

The hypothesis that firms behave as activist macro arbitrageurs may strike many as being far from the dictates of textbook corporate-finance theory, which is often interpreted as saying that, absent adjustment costs, firms should stick close to an optimally-chosen target capital structure. However, it should be emphasized that our theory is based on the single most fundamental concept in corporate finance, namely the Modigliani-Miller (1958) irrelevance proposition. To the extent that M-M provides an accurate description of reality—i.e., to the extent that firms are otherwise approximately indifferent to variations in capital structure in the neighborhood of their target optima—their comparative advantage over other capital-market players in the realm of macro arbitrage is all the more pronounced.

[24] See e.g., Loughran and Ritter (1995), and Ikenberry, Lakonishok and Vermaelen (1995) for evidence at the firm level, and Baker and Wurgler (2000) and Lamont and Stein (2006) for evidence at the market level.

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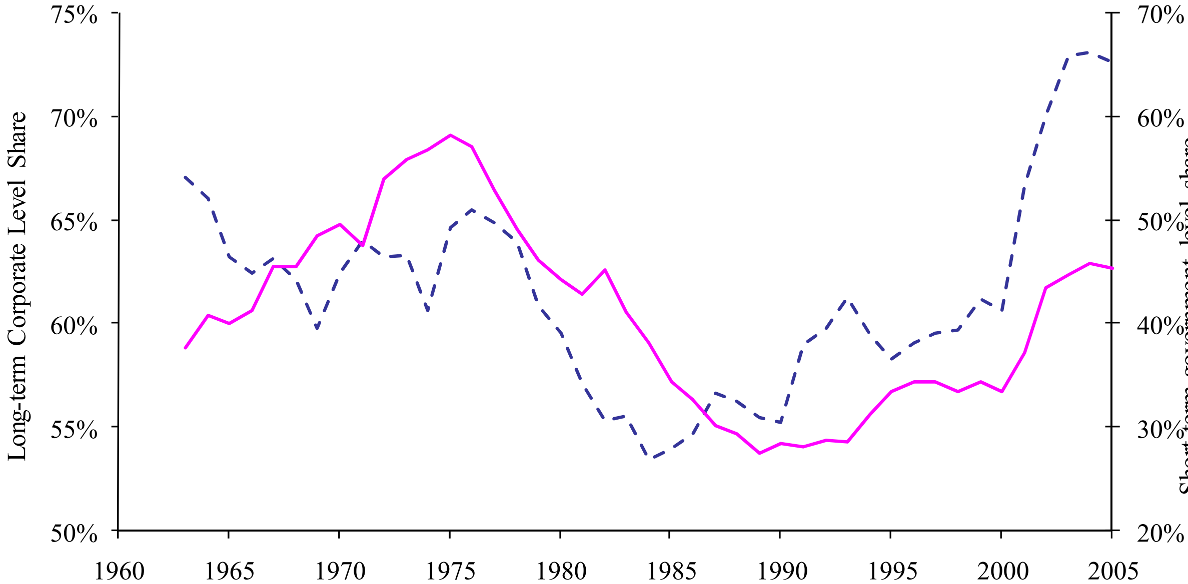
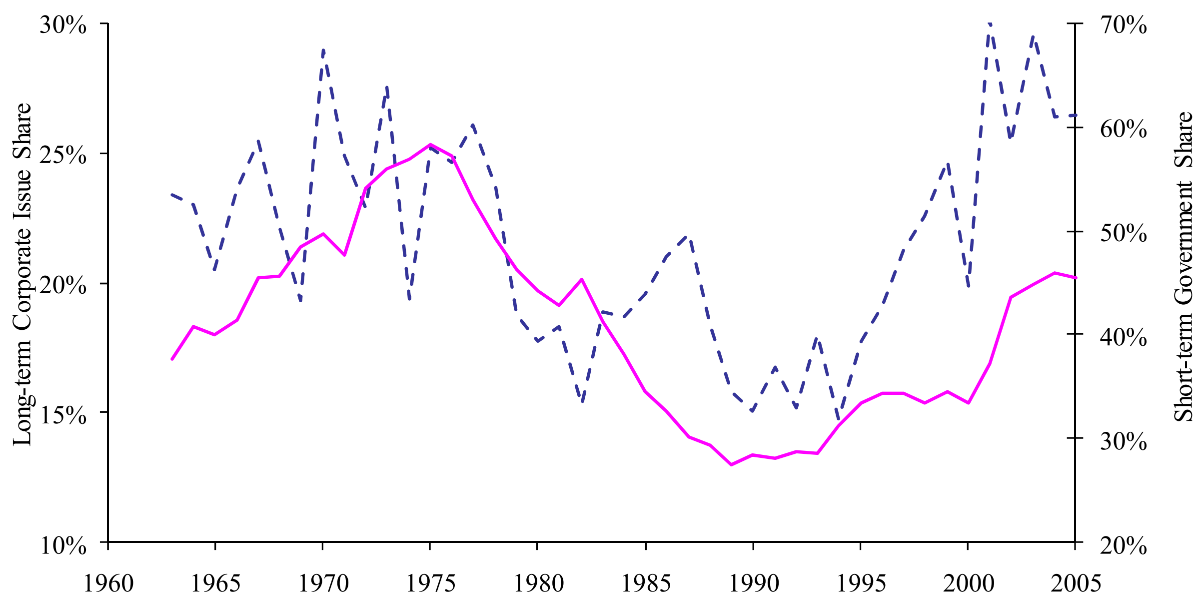
Figure 1. Corporate and government debt maturity, 1963-2005. The dashed line, plotted on the left axis, is the share of long-term corporate debt as a fraction of total debt. The solid line, plotted on the right axis, is the share of government debt with maturity of one year or less. Panel A shows the corporate long-term level share based on *Flow of Funds* data. Panel B shows the corporate long-term issue share based on *Flow of Funds* data. Panel C shows the corporate long-term level share based on Compustat data.

Panel A. *Flow of Funds* Levels: Long-term corporate debt (dashed) and short-term government debt share (solid)



Panel B. *Flow of Funds* Issues: Long-term corporate issues (dashed) and short-term government debt share (solid)



Panel C. *Compustat* Levels: Long-term corporate debt (dashed) and short-term government debt share (solid)

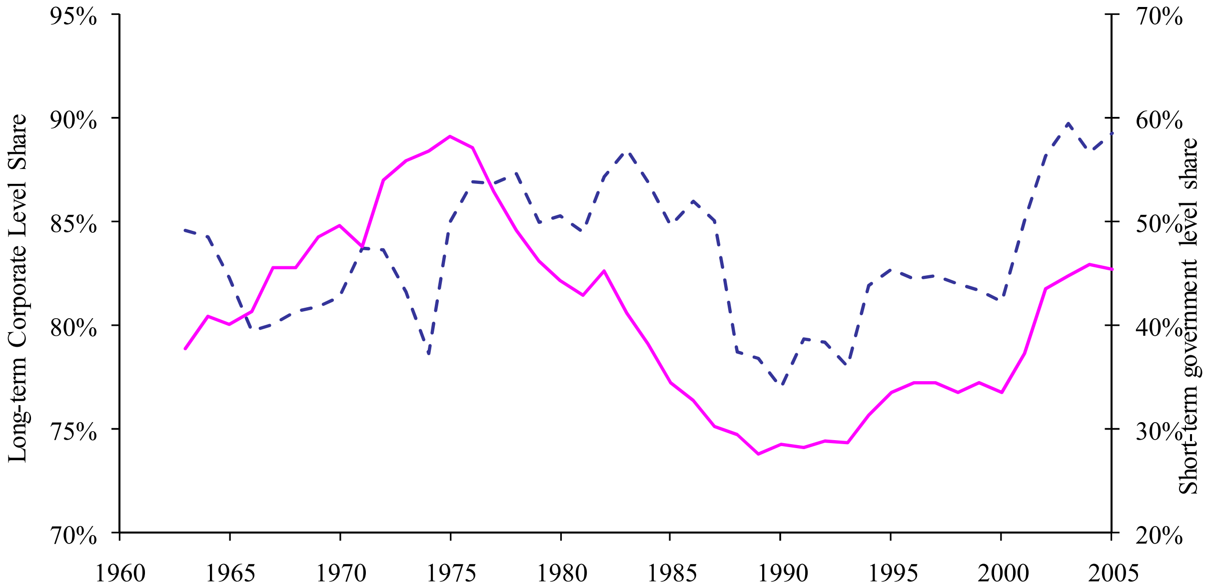


Figure 2. Debt market size, 1963-2005. The dashed line shows the ratio of government debt to GDP. The solid line shows the ratio of government debt to total credit market debt. Total outstanding Treasury securities and total credit market debt are from Table L.4 of the *Flow of Funds*. In addition to Treasury securities, credit market debt includes open market paper, GSE debt and GSE-backed securities, municipal securities, corporate and foreign bonds, bank loans (n.e.c.), other loans and advances, mortgages, and consumer credit. Data on nominal GDP is from the Bureau of Economic Analysis.

Government Debt / GDP (dashed), Government Debt/All Credit Market Debt (solid)

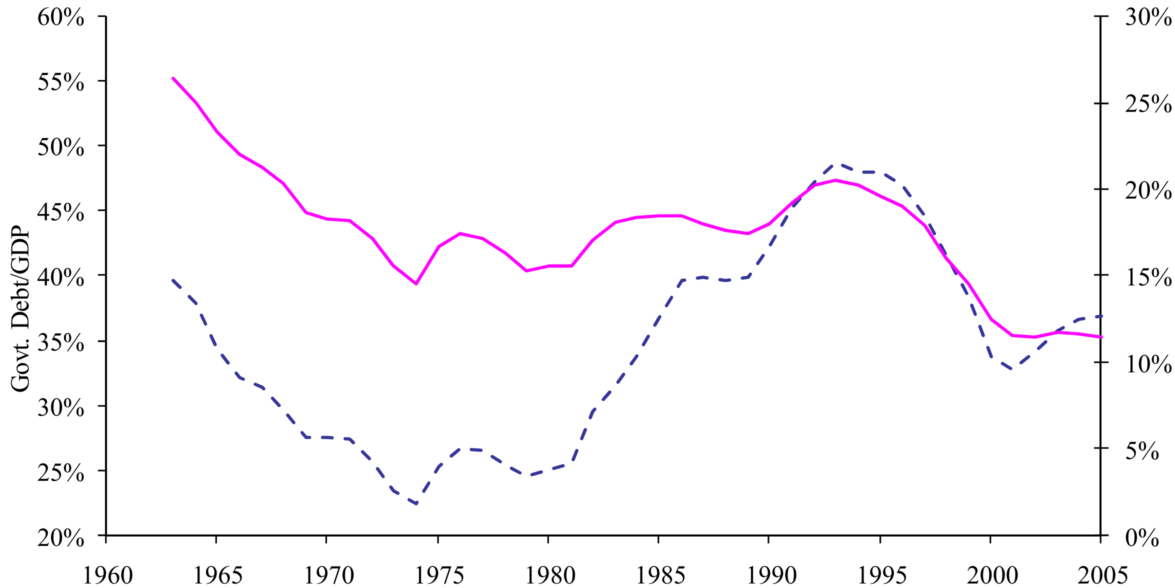
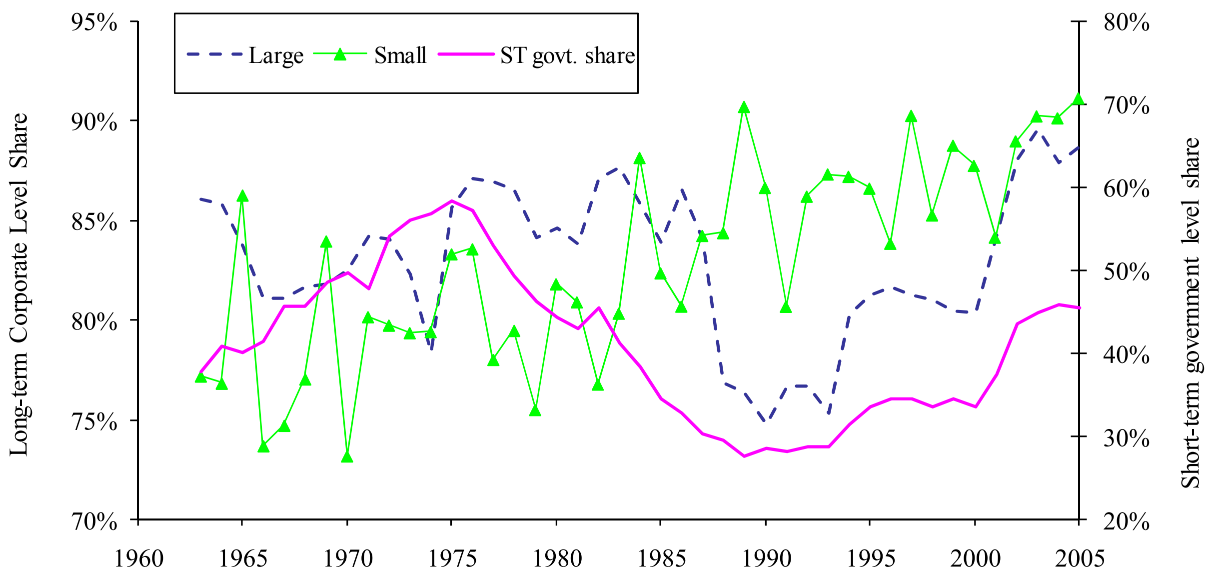


Figure 3. Long-term debt share, Compustat splits, 1963-2005. The solid line, plotted on the right axis, is the share of government debt with maturity of one year or less. In Panel A, the dashed and hatched lines plot the long-term corporate share for large capitalization and small capitalization firms, respectively. In Panel B, the dashed and hatched lines plot the long-term corporate share for dividend payers and non-payers, respectively.

Panel A. Small and large firms



Panel B. Payers and non-payers

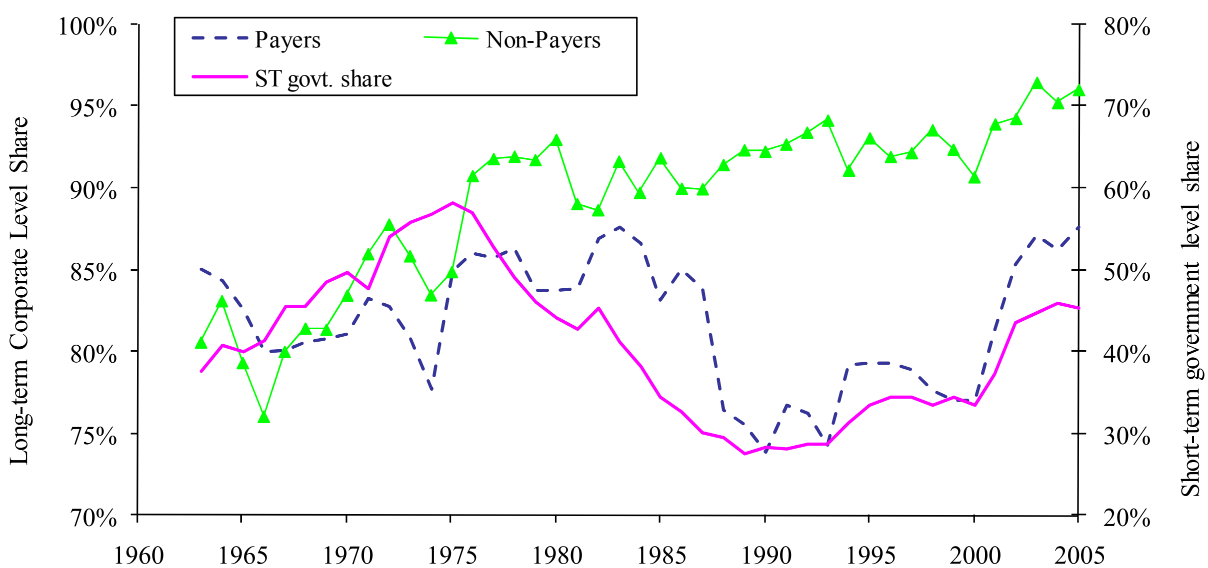


Table 1. Summary statistics. Means, medians, standard deviations, extreme values, and autocorrelations of variables between 1963 and 2005. Panel A shows the corporate long-term level share, and the corporate long-term issue share, based on *Flow of Funds* (FOF) data. FOF long-term debt includes industrial revenue bonds, corporate bonds, and mortgages. FOF total debt also includes commercial paper, bank loans not elsewhere classified, and other short-term loans and advances. All FOF short-term debt is assumed to be new short-term issues. FOF long-term issues are defined as the change in FOF long-term debt plus one-tenth of lagged FOF long-term debt. Panel B shows the corresponding levels measure from Compustat. Compustat debt is the sum of long-term debt (Item 9) and debt in current liabilities (Item 34). Long-term debt is the sum of all long-term borrowings (item 9), plus debt that was originally issued long-term but that is about to retire (item 44). Panel C summarizes measures of public debt maturity, estimated using the CRSP government bond database. The first measure, D_L^G / D^G, denotes the fraction of principal and coupon payments that are due in more than one year. The second measure, M, denotes the face-value weighted maturity of government bonds. Panel D summarizes interest rate conditions: y_{St} is the log yield on one-year Treasuries, $y_{Lt} - y_{St}$ is the spread between the log yields of the 20-year Treasury bond and the one-year Treasury bond, $R_{Lt+1} - y_{St}$ is the log one-year forward excess bond return, and *Credit Spread* is the Moody's Baa yield minus the average yield on long-term Treasuries. Panel E summarizes the ratio of government debt to GDP, the ratio of government debt to total credit market debt, annual GDP growth, as well as a recession dummy based on NBER dating conventions. All variables, except for M and the Recession Dummy, are expressed in percentage terms.

	Mean	**Median**	**SD**	**Min**	**Max**	**P**
	Panel A: *Flow of Funds* Corporate Debt maturity					
Levels: D_L^C / D^C	61.51	60.93	4.97	53.46	73.12	0.85
Issues: d_L^C / d^C	21.57	21.28	4.14	14.75	30.13	0.58
	Panel B: Compustat Corporate Debt maturity					
Levels: D_L^C / D^C	83.41	83.69	3.36	77.00	89.75	0.76
	Panel C: Government Debt maturity					
D_L^G / D^G	59.09	58.78	8.94	41.74	72.48	0.95
M (years)	4.51	4.57	0.90	2.82	5.75	0.96
	Panel D: short rate, term spread, subsequent bond returns, and credit spread (%)					
y_{St}	6.01	5.41	2.99	0.96	16.86	0.74
$y_{Lt} - y_{St}$	0.87	0.73	1.41	-1.60	3.75	0.63
$R_{Lt+1} - y_{St}$	0.98	0.22	9.81	-15.21	21.01	-0.10
Credit Spread	2.01	1.84	0.80	0.59	3.85	0.69
	Panel E: Other controls					
D^G/GDP	34.63	34.08	7.73	22.46	48.67	0.96
D^G/D	17.47	17.86	3.42	11.39	26.33	0.84
$\Delta Log(GDP)$	3.25	3.48	1.99	-1.95	6.94	0.25
Recession Dummy	0.26	0.00	0.44	0.00	1.00	0.38

Table 2. The maturity of corporate and government debt, 1963-2005: Univariate Regressions. OLS regressions of the maturity of corporate debt on the maturity of government debt. The dependent variable is alternately the *Flow of Funds* corporate long-term level share, the *Flow of Funds* corporate long-term issue share, or the Compustat corporate long-term level share. The maturity of government debt is defined as either the share of government debt and coupon payments with maturity of one year or more (D_L^G / D^G), or the dollar weighted maturity of principal payments (*M*). The constant term is not reported. t-statistics, in brackets, are based on Newey-West (1987) standard errors allowing for two years of lags.

	FOF: Levels		FOF: Issues		Compustat: Levels	
D_L^G / D^G	-0.262		-0.249		-0.147	
	[-3.64]		[-4.21]		[-1.83]	
M		-1.804		-1.949		-1.272
		[-2.64]		[-2.85]		[-1.67]
R^2	0.22	0.11	0.29	0.18	0.15	0.12

Table 3. The maturity of corporate and government debt, 1963-2005: Multivariate regressions. OLS regressions of the maturity of corporate debt on the maturity of government debt, controlling for the short-term rate, the term spread, and a time trend. The dependent variable is alternately the *Flow of Funds* corporate long-term level share, the *Flow of Funds* corporate long-term issue share, or the Compustat long-term level share. The maturity of government debt is defined as either the share of government debt and coupon payments with maturity of one year or more (D_L^G / D^G), or the dollar weighted maturity of principal payments (*M*). The constant term is not reported. t-statistics, in brackets, are based on Newey-West (1987) standard errors allowing for two years of lags.

	FOF: Levels				FOF: Issues				Compustat: Levels			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
D_L^G / D^G	-0.296	-0.387			-0.278	-0.318			-0.169	-0.228		
	[-5.14]	[-5.45]			[-5.00]	[-5.77]			[-1.96]	[-2.33]		
M			-2.540	-3.488			-2.526	-2.939			-1.474	-2.094
			[-4.31]	[-4.03]			[-4.68]	[-5.64]			[-1.80]	[-2.05]
y_{St}	-1.214	-1.263	-1.317	-1.404	-0.815	-0.836	-0.919	-0.957	0.155	0.123	0.095	0.038
	[-2.93]	[-3.55]	[-2.87]	[-3.43]	[-5.02]	[-5.81]	[-4.97]	[-5.45]	[0.60]	[0.48]	[0.35]	[0.14]
$y_{Lt} - y_{St}$	-0.613	-1.257	-0.781	-1.436	-0.207	-0.486	-0.355	-0.641	0.919	0.504	0.824	0.395
	[-1.11]	[-2.72]	[-1.30]	[-2.94]	[-0.48]	[-1.08]	[-0.74]	[-1.31]	[1.77]	[0.88]	[1.48]	[0.66]
Trend		0.160		0.154		0.069		0.067		0.103		0.101
		[2.26]		[1.78]		[2.07]		[1.71]		[1.62]		[1.38]
R^2	0.63	0.73	0.55	0.64	0.59	0.61	0.52	0.54	0.25	0.34	0.20	0.29

Table 4. Robustness checks. Regressions of the maturity of corporate debt on the maturity of government debt. We vary the basic specification in row (1) by: (2) using only the first half of the sample period; (3) using only the second half of the sample period; (4) extending the FOF data back to 1953; (5) controlling for a dummy that takes a value of one when the NBER has designated any quarter of that year to be a recession; (6) controlling for two leads and two lags of the NBER recession dummy; (7) controlling for two leads and two lags of changes in log GDP; (8) controlling for the credit spread, defined as the Moody's Baa yield minus the average yield on long-term Treasuries; (9) using a longer-dated proxy for the maturity of government debt (the fraction of debt due in more than 10 years). In the last two rows, we instrument for government debt maturity using the ratio of government debt to GDP: (10) presents IV estimates for our baseline specification; (11) adds the credit spread as a control. All t-statistics are based on Newey-West (1987) standard errors allowing for two years of lags. All regressions include a constant term and controls for the short-term rate, the term spread, and a time trend, none of which are reported.

	FOF: Levels			FOF: Issues			Compustat: Levels		
	b	**[t]**	**R^2**	**b**	**[t]**	**R^2**	**b**	**[t]**	**R^2**
OLS:									
(1) Baseline	-0.387	[-5.45]	0.73	-0.318	[-5.77]	0.61	-0.228	[-2.33]	0.34
(2) First half (1963-1983)	-0.203	[-1.84]	0.58	-0.266	[-3.34]	0.52	0.163	[1.88]	0.58
(3) Second half (1984-2005)	-0.371	[-3.63]	0.95	-0.477	[-2.97]	0.71	-0.787	[-11.68]	0.92
(4) Long sample (1953-2005)	-0.303	[-3.99]	0.70	-0.269	[-4.72]	0.60	-	-	-
(5) Control for Business Cycle	-0.385	[-5.42]	0.73	-0.316	[-5.62]	0.61	-0.267	[-3.53]	0.49
(6) Business Cycle leads and lags	-0.383	[-4.64]	0.74	-0.381	[-8.13]	0.77	-0.305	[-4.02]	0.62
(7) ΔLog(GDP) leads and lags	-0.373	[-5.20]	0.74	-0.383	[-6.30]	0.73	-0.280	[-3.37]	0.57
(8) Control for credit spread	-0.466	[-7.52]	0.76	-0.328	[-5.80]	0.61	-0.308	[-3.34]	0.41
(9) Long-dated proxy for gov debt	-0.729	[-4.66]	0.66	-0.581	[-5.50]	0.54	-0.382	[-1.85]	0.25
Instrumental Variables:									
(10) Baseline	-0.395	[-4.89]	0.73	-0.402	[-5.33]	0.59	-0.242	[-2.59]	0.34
(11) Control for credit spread	-0.539	[-6.41]	0.75	-0.488	[-4.87]	0.55	-0.392	[-4.35]	0.39

Table 5. Differenced regressions. This table presents regressions of the following form:

$$d^{C}_{L,t} / d^{C}_{t} = a + b \cdot \Delta_k \left(D^{G}_{L,t} / D^{G}_{t} \right) + u_t$$

$$\Delta_k \left(D^{C}_{L,t} / D^{C}_{t} \right) = a + b \cdot \Delta_k \left(D^{G}_{L,t} / D^{G}_{t} \right) + u_t$$

The dependent variable is alternately $d^{C}_{L,t} / d_t$, the *Flow of Funds* long-term corporate issue share, or $\Delta_k \left(D^{C}_{L,t} / D^{C}_{t} \right)$, the change in either the *Flow of Funds* or the Compustat long-term corporate level share over a k-year window. The independent variable is $\Delta_k \left(D^{G}_{L,t} / D^{G}_{t} \right)$, the change in the long-term government share over a *k*-year window. The constant term is not reported. t-statistics are based on Newey-West (1987) standard errors allowing for two years of lags.

	FOF Issues			Changes in FOF Levels			Changes in Compustat Levels		
	b	**[t]**	**R^2**	**b**	**[t]**	**R^2**	**b**	**[t]**	**R^2**
k=1 lag	-0.309	[-1.30]	0.04	-0.179	[-1.23]	0.06	-0.211	[-1.84]	0.07
k=2 lags	-0.331	[-2.26]	0.12	-0.265	[-1.64]	0.13	-0.273	[-2.10]	0.13
k=3 lags	-0.287	[-2.72]	0.16	-0.282	[-1.71]	0.16	-0.237	[-1.86]	0.13
k=4 lags	-0.285	[-3.86]	0.25	-0.308	[-2.07]	0.21	-0.228	[-1.96]	0.16
k=5 lags	-0.289	[-4.63]	0.33	-0.325	[-2.18]	0.24	-0.230	[-2.00]	0.19

Table 6. GLS regressions. Generalized least squares regressions of the maturity of corporate debt on the maturity of government debt, controlling for the short-term rate, the term spread, and a time trend. The dependent variable is alternately the *Flow of Funds* corporate long-term level share, the *Flow of Funds* corporate long-term issue share, or the Compustat long-term level share. The maturity of government debt is defined as the share of government debt and coupon payments with maturity of one year or more (D_L^G / D^G). The constant term is not reported. t-statistics for GLS regressions, in brackets, are computed using heteroskedasticity-robust standard errors. We also report the estimated first-order autocorrelation of the residuals, denoted by ρ.

	FOF: Levels			FOF: Issues			Compustat: Levels		
D_L^G / D^G	-0.187	-0.130	-0.130	-0.238	-0.276	-0.316	-0.212	-0.194	-0.209
	[-1.44]	[-1.20]	[-1.21]	[-2.60]	[-4.70]	[-6.16]	[-1.73]	[-1.85]	[-2.05]
y_{St}		-0.290	-0.300		-0.780	-0.826		-0.274	-0.259
		[-1.14]	[-1.15]		[-3.78]	[-4.60]		[-1.14]	[-1.04]
$y_{Lt} - y_{St}$		0.299	0.284		-0.100	-0.437		0.155	0.145
		[0.79]	[0.73]		[-0.21]	[-1.02]		[0.40]	[0.36]
Trend			0.101			0.066			0.087
			[0.65]			[1.95]			[1.16]
R^2	0.62	0.66	0.73	0.25	0.53	0.59	0.87	0.88	0.90
ρ	0.96	0.97	0.96	0.43	0.16	0.05	0.80	0.82	0.77

Table 7. The effect of government-bond-market size on gap-filling intensity. This table presents regressions of the following form:

$$d^C_{L,t} / d^C_t = a + b \cdot \left(D^G_{L,t} / D^G_t \right) + c \cdot Scale_t + d \cdot \left(Scale_t \times D^G_{L,t} / D^G_t \right) + e \cdot time + f \cdot \left(time \times D^G_{L,t} / D^G_t \right) + \boldsymbol{\theta}' \mathbf{x}_t + u_t$$

The dependent variable is the *Flow of Funds* corporate issue share. $Scale_t$ is either the ratio of government debt to GDP, or the ratio of government debt to total credit market debt. The constant term is not reported. t-statistics, in brackets, are based on Newey-West (1987) standard errors allowing for two years of lags.

	Scale = gov't debt to GDP		*Scale = gov't debt to total debt*	
D^G_L / D^G	0.640	0.351	1.188	0.845
	[2.79]	[1.49]	[2.44]	[2.12]
Scale	2.906	0.957	4.795	2.442
	[4.41]	[1.32]	[2.95]	[1.69]
$\left(Scale\right) \times \left(D^G_L / D^G\right)$	-4.400	-1.941	-7.622	-4.918
	[-4.49]	[-1.77]	[-3.03]	[-2.21]
time	-0.916	-0.268	0.957	0.491
	[-1.69]	[-0.68]	[1.94]	[1.72]
$time \times \left(D^G_L / D^G\right)$	0.017	0.006	-0.013	-0.009
	[1.77]	[0.87]	[-1.58]	[-2.06]
y_{St}		-0.920		-0.889
		[-4.08]		[-5.08]
$y_{Lt} - y_{St}$		-0.293		-0.260
		[-0.58]		[-0.58]
R^2	0.52	0.71	0.45	0.71

Table 8. Disaggregated results by firm type, 1963-2005. OLS regressions of the Compustat long-term level share on the government long-term level share, disaggregated by firm type. Each year, nonfinancial firms are classified as low (below 30th percentile) or high (greater than 70th percentile) with respect to: market capitalization; cash flow over assets; cash balances over assets; Tobin's Q; and book leverage. They are also classified as either dividend payers or non-payers. All regressions include a constant term and controls for the short-term rate, the term spread, and a time trend, none of which are reported. t-statistics are based on Newey-West (1987) standard errors allowing for two years of lags. In the final column of each row, we report the difference between the coefficients for the high and low groups along with a t-test for whether this difference is significantly different from zero. The t-statistics are calculated using a seemingly unrelated regression framework with Newey-West standard errors allowing for two years of lags.

	Low		High		High – Low	
	b	**[t]**	**b**	**[t]**	**b^{High} - b^{Low}**	**[t]**
All Compustat Nonfinancial	-0.228	[-2.33]				
Market Capitalization	0.024	[0.43]	-0.286	[-2.50]	-0.310	[-2.18]
Non-payers ("low"); Payers ("high")	-0.043	[-0.83]	-0.263	[-2.30]	-0.220	[-1.91]
Cash Flow/Assets	0.073	[1.35]	-0.125	[-1.42]	-0.198	[-1.94]
Cash/Assets	-0.059	[-0.39]	-0.215	[-2.53]	-0.156	[-1.07]
Tobin's Q	-0.318	[-3.09]	-0.063	[-0.69]	0.255	[1.97]
Leverage	-0.375	[-3.19]	-0.367	[-2.88]	0.008	[0.06]

Table 9. Corporate debt maturity, government debt maturity, and excess bond returns, 1953-2005. Annual regressions of 1-year, 2-year, and 3-year log excess bond returns on combinations of the long-term government share, the *Flow of Funds* long-term corporate level share, and the *Flow of Funds* long-term corporate issue share. t-statistics, in brackets, are adjusted for up to 3 lags of autocorrelation based on Newey-West (1987).

	1-year ahead excess returns (%)					2-year ahead excess returns (%)					3-year ahead excess returns (%)				
$D^G_{L,t} / D^G_t$	0.225		0.185		0.170	0.523		0.394		0.388	0.824		0.580		0.576
	[2.10]		[1.19]		[1.39]	[2.78]		[-1.59]		[1.77]	[3.22]		[1.83]		[2.00]
$d^C_{L,t} / d^C_t$		-0.337	-0.163				-0.912	-0.542				-1.588	-1.045		
		[-1.07]	[-0.42]				[-2.24]	[-1.07]				[-2.64]	[-1.52]		
$D^C_{L,t} / D^C_t$				-0.312	-0.206				-0.778	-0.531				-1.408	-1.034
				[-1.58]	[-0.91]				[-2.26]	[1.30]				[-3.05]	[1.95]
R^2	0.04	0.02	0.05	0.03	0.05	0.12	0.09	0.15	0.11	0.17	0.19	0.17	0.25	0.20	0.28