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"Interdependent Capital Structure Choices and the Macroeconomy"

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Abstract

This study shows that capital structure choices of US corporations are interdependent across time. We follow a two-step estimation approach. First, using a large cross-section of firms we estimate year-by-year average capital structure choices, i.e., the average firm's percentage of new funding that is secured through debt, its term composition, and the percentage of new equity represented by retained earnings. Second, these time series are included in a Factor Augmented Vector Autoregressive model in which three factors representing real economic activity, expected future funding conditions, and prices, are included. We test for the interdependence between optimal capital structure decisions and for the influence exerted by macroeconomic conditions on these decisions. Results show there is a hierarchical order in which firms make capital structure decisions. They first decide on the share of debt out of total new funding they will hire. Conditional on this they decide on the term of their debt and on their earnings retention policy. Of outmost importance, macroeconomic factors are key for making capital structure decisions.

JEL classification: D25, G30, L16.

Keywords: Firms' capital structure, Financing hierarchy, Macroeconomic factors, FAVAR model.

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1. Introduction

Capital structure refers to the proportion of debt and equity employed by a firm to fund its operations and finance its assets. There are tradeoffs firms must make when they decide whether to use debt or equity to finance operations, and managers will balance the two to find the optimal capital structure, i.e., the capital structure that results in the lowest weighted average cost of capital for the firm.

Understanding how firms fund their operations is a major topic in modern corporate finance. In practice, corporations raise funds from a variety of sources, e.g., issuing shares, contracting long- or short-term debt, and retaining earnings. An important question that has not been given sufficient attention in the literature is whether a firm's capital structure decisions are interdependent and whether they are significantly influenced by the macroeconomic environment. In fact, empirical studies in corporate finance routinely examine firms' financial policy decisions in isolation. For instance, decisions on how much short-term debt to issue as a proportion of total debt are assumed to be independent of the decision on the firm's debt-to-capital ratio. This assumption that is frequently made in the literature, however, contrasts with the fact that in practice firms' financing decisions are related by accounting identities. Changes in one control variable imply the adjustment of other control variables. Additionally, optimal capital structure decisions may depend on macroeconomic conditions. Access to banking credit, for instance, depends on the monetary policy stance and on the willingness of banks to extend loans to firms.

This paper studies the interdependence of firms' capital structure decisions and their relationship with the macroeconomic environment. By integrating a structural macroeconometric approach and a classical (microeconometric) regression framework supported on cash flow restrictions, causal relations between the three most important decisions about the funding mix are studied: i) issuing shares versus acquiring new debt, ii) increasing the relative size of short- versus long term debt and, iii) retaining earnings versus raising new equity. The interdependence between these three relevant decisions is studied within a dynamic framework in which the state of the economy and uncertainty about the future matter.

Concretely, our empirical strategy consists of a two-step approach. First, using a large cross-section of firms we estimate year-by-year average capital structure choices, i.e., the average firm's percentage of new funding that is secured through debt, its term composition of debt, and its percentage of new equity represented by retained earnings. Three time series are obtained. In the second step, these time series are included in a Factor Augmented Vector Autoregressive (FAVAR) model in which three factors representing real economic activity, expected future funding conditions, and prices, are included. For identifying causal relationships among our variables, we take advantage of a big-data approach in which almost natural contemporaneous exogeneity restrictions are imposed on the data generating process. This modeling approach, which is novel in this strand of the literature, allows studying both the interdependence between optimal capital structure decisions and the influence exerted by macroeconomic conditions on these decisions.

Results show there is a hierarchical order in which firms make capital structure decisions, i.e., firms' capital structure decisions are interdependent. They first decide on the share of debt out of total new funding they will hire. Importantly, this decision is considerably affected by the prevailing macroeconomic conditions. In turn, this decision significantly affects decisions on the term of the debt selection and on their earnings retention policy. Moreover, macroeconomic conditions also directly affect these two latter decisions. Notably, the decision on the term of the debt and the decision regarding dividends retention are independent of each other.

Findings indicate the existence of a 'pecking order' effect or a hierarchy in the process of the optimal capital structure decision, reflected in the aggregate ratios that we estimate. However, as in the market timing theory, this hierarchy depends heavily on prevailing market and macroeconomic conditions. The existence of this hierarchy suggests that firms' capital structure decisions must be considered jointly. Papers studying separately these three important decisions may obtain biased and inconsistent parameter estimates, as debt maturity decisions and earning retention policies depend on the debt-to-equity ratio decided by the firm, which in turn varies over time depending on the overall macroeconomic conditions.

Besides identifying causal relations between firms' capital structure decisions, our approach allows estimation of shock persistence between them and macroeconomic factors. We show the system's dynamic responses to a variety of shocks, including perturbations to the macroeconomic conditions and to aggregate capital structure decisions. The FAVAR approach permits including a limited number of factors accounting for many macroeconomic variables which can influence firms' capital structure choices. We use a big-data set of more than 200 series of macro-variables and identify three orthogonal factors capable of explaining a high percentage of their variance. Within this setup we impose plausible contemporaneous restrictions on the data generating process, which do not directly interfere with the hypotheses under study. In other words, our set of restrictions does not imply a particular hierarchy of capital structure decisions. Instead, we let the data speak as freely as possible. But, at the same time, we consider some identification problems that have been overlooked by the past literature attempting to assemble micro-leverage levels and macroeconomic factors (e.g., the possibility of reverse causality, omitted factors due to data sparsity, etc.).

The remaining of the paper is structured as follows. Section 2 provides a brief literature review highlighting results produced by the main papers in the related literature. The third section describes the empirical methodology and explains the two-step estimation procedure implemented in this study. The fourth section presents the data and the construction of the factors and the FAVAR model. Section 5 shows the estimation results, and the last section concludes.

2. Literature review and contribution

The starting point in the optimal capital structure literature is the work by Modigliani and Miller (1958) who show that in an ideal world without transaction costs, free of taxes and with perfectly efficient capital markets, the firm's capital structure does not affect its value. This financial irrelevance theorem produced a heated debate in the corporate finance literature, focused on analyzing the implications of market frictions on firms' capital structure. Indeed, when taxes, transaction costs, and information asymmetries are considered, the choice of financing sources gains relevance as it affects firms' value, as shown by Fazzari et al. (1988). Different theories, namely the trade-off theory, the pecking order theory, and the market timing theory, explain the implications of such frictions on the firm's capital structure and provide insights regarding its empirical determinants and the mechanisms through which they influence the choice of leverage levels and the earnings retention policy.

According to the trade-off theory, capital structure is determined by a trade-off between the benefits and costs of debt. The tax-bankruptcy trade-off perspective, for instance, is that firms balance the tax benefits of debt against the deadweight costs of bankruptcy. The agency perspective focuses on the shareholder-manager versus shareholder-debtholder trade-off of debt. While increasing debt disciplines managers mitigating the former, at the same time it exacerbates the latter.

The pecking-order model (Myers and Majluf, 1984) proposes that asymmetric information increases the cost of firms' external sources of finance inducing a financial hierarchy. Firms prefer internal financing, the least costly alternative. Debt is the second preferred source and equity becomes their "last resort" source of financing. Equity is the least preferred source because when managers, who know better the firm's condition that investors, issue new equity, investors believe that managers think the firm is overvalued and managers are taking advantage of this situation. In consequence, investors will place a lower value to the new equity.

Finally, the market timing theory proposes that firms choose the form of financing which, at each point in time, seems to be more valued by financial markets. Hence, the capital structure depends on financial market conditions which, in turn, depend on the more general macroeconomic conditions.

Empirically, the capital structure literature has explored both the cross-sectional and time series determinants of firms' capital structure. However, most effort has been devoted to identifying its main microeconomic determinants. In the presence of market frictions, the choice of financing sources is not trivial and involves relevant trade-offs. For instance, while debt-financing offers tax advantages, as interests are tax deductible, it also entails considerable disadvantages such as liquidation rights that can lead to financial costs in a default scenario. Various papers on this trade-off have shown that the balance between advantages and disadvantages depends on firms' characteristics such as their asset tangibility, size, liquidity, age of the firm, cash flow volatility, and the industry to which they belong.

Over the last forty years a vast number of studies has analyzed the relationship between different firm characteristics and their funding sources, typically proxied by their debt ratios. Variables which have appeared to matter in most studies are cash flow volatility, size, asset tangibility, the market-to-book ratio, profitability, stock returns, and industrial sector. For instance, a firm with highly volatile cash flows faces a higher probability of bankruptcy for a given level of debt. Then, the costs associated with debt-financing for these firms surpass their benefits, implying they tend to choose low debt-to-equity ratios. Hence, a negative relationship between cash flow volatility and leverage has been encountered by various papers in the literature (see, for instance, Bradley, 1984, Wald, 1999, and Bold et al., 2001). However, the opposite effect of cash flow volatility on debt-financing has been found by Lary and Malitz (1985), Titmand and Wessels (1988), and Kale et al. (1992), among others. Recent papers have reconciled these opposing results by suggesting the existence of a non-monotonic relationship between cash flow volatility and the debt-to-equity ratio (Hovakimian, 2009). Size has also been widely identified as a relevant microeconomic determinant of a firm's capital structure. Different channels explain this relationship. First, larger firms face lower refinancing costs and, therefore, exhibit higher leverage levels. Second, larger firms tend to be more diversified and exhibit less volatile cash flows, hence facing lower bankruptcy costs (Rajan and Zingales, 1995).

A firm's profitability has also been found to be a relevant predictor of its capital structure. As shown by Titman and Wessels (1988) and Rajan and Zingales (1995), more profitable firms tend to have lower debt-to-capital ratios. However, opposite results have been reported by papers emphasizing on the fact that more profitable firms are subject to higher tax exposures, which may motivate the use of more debt to benefit from interest deductibility.

The market-to-book ratio has a negative relation with a firm's debt ratio, as shown by Smith and Watts (1992), Rajan and Zingales (1995), Jung et al. (1996), Baker and Wurgler (2002), Frank and Goyal (2004), and Barclay et al. (2006). Different reasons have appeared explaining this result. First, firms facing important growth opportunities usually undergo higher long-term investment. Optimally, they tend to maintain a low leverage level in the present to use this financial slack for future investment. Second, as proposed by Baker and Wurgler (2002), firms with high market-to-book ratios are overvalued, incentivizing the use of equity financing over debt. This intuition is the foundation of the market timing theory, which in addition to the trade-off and pecking order provides a theoretical benchmark to analyze optimal capital structure decisions.

Stock market effects on firms' capital structure have also been documented. Welch (2004) documents a negative and long-lasting relationship between a firm's stock price and its debt ratio. Furthermore, the author finds that stock returns can explain about 40% of debt ratio dynamics and suggests that stock price effects are considerably more relevant in explaining debt-ratios than previously identified proxies (firms' characteristics).

Within the capital structure determinants, the literature has also considered the effect of the industrial sector of the firm on its funding decisions. Simerly and Li (2000) and Mackay and Phillips (2005) indicate that firms belonging to more dynamic and less predictable industries tend to issue less debt. Recent studies have explored other microeconomic determinants such as the age of the firm (Kieschnick and Moussawi, 2018), its family ownership structure (Diaz-Diaz et al., 2016), its geographical location and its executive compensation policies (Freund et al., 2018).

However, Lemmon et al. (2008) challenges the widely accepted view that microeconomic characteristics are the main determinants of firms' capital structure. This study shows that leverage ratios present two outstanding features which cannot be explained by the well-established capital structure determinants mentioned above. The first feature is that leverage ratios tend to converge over time. Specifically, firms initially exhibiting high leverage rations tend to move toward lower leverage ratios over time. The second feature is related to the stable nature of leverage ratios in the long run. In consequence, leverage ratio dynamics are represented in this study by a transitory and a permanent component. Findings suggest that the permanent component accounts for most of the observed capital structure variation (60%), while traditional determinants explain a modest proportion of this variation (between 18% and 29%, depending on the model specification). The presence of a statistically significant unobserved and permanent component highlights the necessity of considering dynamic specifications and more creative identification strategies within capital structure analysis.

Country-level determinants have also been considered (Booth 2001, Bancel and Mittoo, 2004, and Antoniou et al., 2008). These studies compare funding decisions of firms from different countries including macro-variables such as the gross domestic product, the stock market development, and the level of investor protection. They highlight the relevance of the external environment on firms' funding decisions (Kayo and Kimura, 2011).

One channel through which the external environment plays a prominent role in firms' funding decisions is by the dependence of firms' cash flows on macroeconomic conditions. During good times in which the economy is rapidly expanding firms obtain higher cash flows reducing their dependence on external financing and reducing the costs of financing through higher access to debt markets. On the contrary, in times of output contraction firms' cash flows are reduced, increasing their dependence on external funding sources. During contractions external sources of funding are more costly for firms as their access to debt markets is reduced (Shleifer and Vishny, 1992). This interaction has been analyzed in the literature through the inclusion of macroeconomic variables in empirical specifications as in Korajczyk and Levy (2003), who consider three aggregate variables in addition to firm-specific determinants: the excess returns of commercial paper, the growth rate of corporate profits, and equity market returns. Their findings suggest that firms align their funding choices to coincide with favorable macroeconomic conditions and that leverage is counter-cyclical. The relationship between firms' financing decisions and macroeconomic conditions is also theoretically analyzed by Hackbarth et al. (2006) through a contingent claims model of a levered firm. The leverage ratios generated by the model are like those observed in empirical studies. Additionally, the model predicts that firms' leverage is counter-cyclical, as empirically reported by Korajczyk and Levy (2003).

Frank and Goyal (2009) evaluate the relative importance of many factors in the capital structure of American firms. They include firm characteristics such as tangibility, profits, market-to-book ratio, and profits, and inflation as a macroeconomic indicator. Their results indicate that inflation increases leverage.

The relationship between the capital structure and the macroeconomic context arises not only due to firms' cash flow dynamics, but also due to more general debt market and macroeconomic dynamics. Uncertainty matters, and the willingness of borrowers and lenders to issue new debt are of utmost importance for the capital structure determination. In fact, Graham et al. (2015) show that the leverage ratios of American firms over the last 100 years cannot be explained solely by cross-sectional differences in firm characteristics. Macroeconomic variables play a predominant role in explaining observed capital structure differences over time. Similar results have been reported by Lemmon et al. (2008) and Kayo and Kimura (2011). These studies have augmented the set of regressors into traditional microeconometric setups, including distinct macroeconomic variables such as GDP, government debt, exports, income tax rates, money supply, inflation, among others.

A recent study by Chang et al. (2019) analyzes the influence of the business cycle on the capital structure by decomposing a set of macroeconomic variables using a principal components framework. Their empirical specifications also consider firms characteristics and firms' fixed effects to control for time invariant factors that may influence firm financing decisions as in Lemmon et al. (2008). Their findings point out that macroeconomic principal components are responsible for a significant part of the time-series variation in the dependent variable (debt versus equity). Macroeconomic variables are especially relevant for financially constrained firms, indicating that macroeconomic factors interact with firm characteristics in determining the optimal capital structure over time. In a recent contribution Crouzet and Mehrotra (2020) show that the 1% of largest firms are less cyclically sensitive than the rest. Their findings indicate that differences in cyclicality do not derive from a differential access to financing but mainly from differences in the industry scope of the firms.

While a handful of recent papers have shown that macroeconomic factors matter for capital structure decisions, the question remains on which macro-variables are to be included. Different papers propose different macroeconomic covariates. While one possible direction consists in including different sets of regressors and testing which of these sets provides more information, an alternative and more efficient way consists of using factor analysis to reduce many variables into fewer numbers of factors. This technique extracts maximum common variance from all variables and puts them into a common score. We follow this approach and use a big-data set of almost 250 series of macro- and financial variables for the US economy identifying three orthogonal factors explaining a high percentage of their variance.

Our methodological approach consists of two stages. In the first stage we use a large cross-section of firms for estimating year-by-year average capital structure choices obtaining three time series, one for the proportion of debt out of total financing, other for the proportion of short-term debt out of total debt, and one for the proportion of earnings retention out of total new equity, following the cash flow paired-regression framework put forward by Fama and French (2012) to aggregate capital structure decisions made by firms. In the second step, these time series are included in a FAVAR model in which factors representing real economic activity, expected future funding conditions, and prices, are included. This modeling approach, which is novel in this strand of the literature, allows studying both the interdependence between optimal capital structure decisions and the influence exerted by macroeconomic conditions on these decisions.

3. Methodology

Our methodological approach consists of two steps. In the first step, firms' capital structure decisions are analyzed using the analytical framework provided by Fama and French (2012). These authors put forward paired regressions that describe three different types of a firm's financing decisions: i) the division of new outside financing between shares issued and debt, ii) the division of new debt obligations between short- and long-term, and iii) the division of new equity funding between shares issued and retained earnings. The regressions above are based on cash flow constraints that describe sources and uses of funds. Unlike Fama and French (2012) results here are reported, year-by-year instead of averaging them across time. In this way, time dynamics are considered for the aggregate of firms, and we end up with three time series representing the three aggregate decisions regarding capital structure of firms in the economy. In continuation, these time series of funding decisions serve as input, alongside three macroeconomic factors, to our multivariate time-series analysis, which is conducted via a Factor-Augmented Vector Autoregression (FAVAR) model and associated Impulse-Response Functions (IRF) and Forecast Error Variance Decomposition (FEVD) statistics.

3.1. Cash flow regressions: Cross-sectional analysis

i) Shares issued against debt

Following Fama and French (2012) we start from the following cash flow constraint:

$$dS_t + dL_t = dA_t + D_t - Y_t \,. \tag{1}$$

Equation 1 is used to construct pairs of regressions that describe the division of new outside financing. In Equation 1 dS_t is the change in the book-value of common stocks issued during fiscal year *t*; dL_t is the change in liabilities, including preferred stocks, also on a yearly basis; dA_t is new total investment, defined as the yearly change in assets; D_t stands for paid dividends and Y_t for earnings in year *t*. d denotes a yearly change, which emphasizes that we are analyzing decisions made within a year, instead of cumulated effects of decisions made during several years. The pair-regressions that we fit to the data in this case are:

$$dS_t = a + b_1 dA_t + b_2 D_t + b_3 Y_t + e_t, \tag{2}$$

$$dL_t = a^* + b_1^* dA_t + b_2^* D_t + b_3^* Y_t + e_t^* \,. \tag{3}$$

The coefficients of the second regression are restricted by the cash flow identity, so that $a^* = -a$, $b_1^* = (1 - b_1)$, $b_2^* = (1 - b_2)$, and $b_3^* = (1 + b_3)$. In particular, the coefficient before the change in assets (investment) represents the division between the two funding options: shares or debt.

ii) Division of new debt financing between short- and long-term obligations

In this case, we use the following cash flow constraint:

$$dSTD_t + dLTD_t = dA_t + D_t - Y_t - dS_t, \tag{4}$$

where $dSTD_t$ is the change in short-term debt obligations, which consists of the variation in current liabilities during year *t*. $dLTD_t$ is the change in long-term debt for year *t*, constructed as the residual of total minus current liabilities. dS_t is the change in outstanding shares in year *t*. According to (4), we can fit the following paired-regressions to the data:

$$dSTD_t = a + b_1 dA_t + b_2 D_t + b_3 Y_t + b_4 S_t + e_t, \tag{5}$$

$$dLTD_t = a^* + b_1^* dA_t + b_2^* D_t + b_3^* Y_t + b_4^* dS_t + e_t^*, \tag{6}$$

where the coefficients associated to variables dA_t, D_t, Y_t, and dS_t in equations (5) and (6) indicate how, on average for the population of firms, these variables are divided between short- and long-term financing. Again we have that $a^* = -a$, $b_1^* = (1 - b_1)$, $b_2^* = (1 - b_2)$, and $b_3^* = (1 + b_3)$, $b_4^* = (1 + b_4)$.

iii) Shares issued and retained earnings

A third pair of complementary regressions is presented in what follows. In this case, given that a firm cannot freely choose earnings, the analysis of retained earnings is conducted through the analysis of dividends:

$$dS_t - D_t = dA_t - Y_t - dL_t \quad . \tag{7}$$

The third cash flow constraint in 7 states that the part of investment that is not financed by earnings or new debt must be financed through net share issuance, which corresponds to shares issued minus dividends. In this case the pair regressions fitted to the data are:

$$D_t = a + b_1 dA_t + b_2 dL_t + b_3 Y_t + e_t, \tag{8}$$

$$dS_t = a^* + b_1^* dA_t + b_2^* dL_t + b_3^* Y_t + e_t^*. \tag{9}$$

We have that $a^* = a$, $b_1^* = (b_1 - 1)$, $b_2^* = (b_2 + 1)$, and $b_3^* = (b_3 + 1)$ and the interpretation of the associated coefficients remain as before.

3.2. Factor augmented vector autoregression: Time series analysis

We follow Bernanke et al. (2005) who proposed FAVAR models, seeking to overcome two important drawbacks of the original VAR framework. Namely, traditional VARs are unable to consider large sets of information due to the curse of dimensionality, and the indicators included in the model are always arbitrarily selected from a potentially large pool of candidates. These two reasons make traditional VARs prone to biases emerging from omitting confounded variations and measurement error. A traditional VAR is given by:

$$Y_t = A(L)Y_{t-1} + e_t, \tag{10}$$

Y_t is a $(M \times 1)$ vector of M variables, $A(L)$ is a polynomial in the lag-operator of order *d,* e_t is a vector of multivariate white noise perturbations. Y_t consists of three cash flow variables describing firms' aggregate financing decisions for the US economy, constructed as described in subsection 3.1. To this specification we add F_t, which is a $K \times 1$ vector of 'factors' that contains unobservable shocks that comprehensively describe the macroeconomic environment in which firms' make their funding decisions. Hence, the joint dynamics of (Y_t, F_t) can be described as:

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = A(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + V_t, \tag{11}$$

where V_t is a vector of errors with zero-mean and variance-covariance matrix Q.

The model presented in equation (11) corresponds to a factor-augmented VAR, but unlike FAVARs in the previous literature, our factors do not come from data on capital structure decisions, but from an external big-data set that consists of 248 series describing the US economy, which are provided by McCracken and Ng (2020). This big-data set includes information on production, employment, interest rates, prices, housing, earnings, stock markets, money and credit, among others. We estimated F_t by Principal Components Analysis (PCA) and include only the first 3 components in Equation 11. The cardinality of the factors, K, is set according to the criterion proposed by Bai and Ng (2007) to determine the number of dynamic or primitive factors in large panels.

The reduced-form VAR in equation (11) can be rewritten in terms of white noise innovations, V_t, as follows:

$$\begin{bmatrix} \hat{F}_t \\ Y_t \end{bmatrix} = \begin{bmatrix} \bar{F}_t \\ \bar{Y}_t \end{bmatrix} + R(L)V_t, \tag{12}$$

$\bar{F}_t$ and $\bar{Y}_t$ are unconditional means and $R(L)$ is a polynomial in the lag operator of infinite lag order. Structural innovations can be recovered from the system in equation (12) imposing theoretical restrictions on the VAR representation. In particular if $\tilde{B}$ contains as many theoretical restrictions as needed to identify the system, then $\tilde{B}^{-1}V_t = \varepsilon_t$, and therefore, $R(L)\,\tilde{B} = \Phi(L)$, where ε_t is a $(M+K)\times 1$ vector of structural innovations and $\Phi(L)$ are structural IRFs of the system, in accordance to the following equation:

$$\begin{bmatrix} \hat{F}_t \\ Y_t \end{bmatrix} = \begin{bmatrix} \bar{F}_t \\ \bar{Y}_t \end{bmatrix} + \Phi(L)\varepsilon_t \,. \tag{13}$$

Sims (1980) proposes to fully identify the system by assuming a triangular matrix $\tilde{B}$. However, in practice, $\tilde{B}$ is not required to be triangular, as far as the number of restrictions on it, which describe the contemporaneous relations between the variables in the system, is high enough (i.e. the number of zeros is the same as in the corresponding triangular matrix). In our particular case we use the following $\tilde{B}$ matrix:

	$\boldsymbol{S_t}$	$\boldsymbol{STD_t}$	$\boldsymbol{D_t}$	$\boldsymbol{f_1}$	$\boldsymbol{f_2}$	$\boldsymbol{f_3}$
$\boldsymbol{S_t}$	1	b_{12}	b_{13}	b_{14}	b_{15}	b_{16}
$\boldsymbol{STD_t}$	b_{21}	1	b_{23}	b_{24}	b_{25}	b_{26}
$\boldsymbol{D_t}$	b_{31}	b_{32}	1	b_{34}	b_{35}	b_{36}
$\boldsymbol{f_1}$	0	0	0	1	0	0
$\boldsymbol{f_2}$	0	0	0	0	1	0
$\boldsymbol{f_3}$	0	0	0	0	0	1

Where $\mathrm{S_t}$ stands for the proportion of shares issued (versus debt), $\mathrm{STD_t}$ is the participation of short-term debt in the total, and $\mathrm{D_t}$ are retained earnings. $\tilde{B}$ exploits that macroeconomic conditions exert a contemporaneous impact on funding decisions of firms, but the latter are only allowed to affect the macroeconomy with a lag (which accounts for the zeros in the first three columns of $\tilde{B}$). Also we have that by construction (i.e. PCA estimation), the three macroeconomic factors are contemporaneously exogenous with respect to each other (which explains the zeros in the last three columns of $\tilde{B}$). The system representation in Equation 13 and the matrix $\tilde{B}$ allows constructing FEVD just as in traditional VAR analysis.

4. Data

The cash flow data used in our regressions were retrieved from Compustat. Our sample runs from 1963 to 2018 and it has a yearly frequency. Table 1 shows the summary statistics for the cash flow variables included in our regressions from 1963 to 2018. All variables in the table are divided by assets at the end of fiscal year t, and multiplied by 100. We exclude firms lacking information about any of the variables in a given year. To construct the table we first estimate yearly means, standard deviations (s.d.) and skewness (skew.) and then we average across time. The number of firms for which we have complete information in each year varies considerably, from 502 in 1963 to 3653 in 2018, with a minimum of 502 and a maximum of 6294 (observed in 1996). We trimmed our annual samples, deleting 0.5% left-tail observations of the variable dA_t to avoid the influence of outliers in our OLS regressions as recommended by Fama and French (2012).

Table 1. Variable Description: Capital Structure Choices

	dAt	**dSt**	**dLt**	**dSTDt**	**dLTDt**	**Yt**	**Dt**
Average	8.48	5.11	3.77	2.19	1.58	0.89	1.29
Average s.d.	23.14	20.08	20.75	14.40	17.18	17.58	4.41
Average skew.	-0.14	5.98	-1.94	-1.40	-2.03	-1.92	16.28

Note: Data retrieved from Conpustat from 1963 to 2018.

In Table 1 dS_t is the change in the book value of common stocks issued during fiscal year *t*; dL_t is the change in liabilities, including preferred stocks, also on a yearly basis; dA_t is new total investment, defined as the yearly change in assets; D_t stands for paid dividends, Y_t is earnings in a year, $dSTD_t$ is the change in short-term debt obligations, which consists of the variation in current liabilities during year *t*, $dLTD_t$ is the change in long-term debt for year *t*, constructed as the residual of total minus current liabilities and $dCST_t$ is the change in common equity. A more detailed description of each variable is provided in the Appendix.

The information to construct the factors is publicly available on the website of the Federal Reserve of Bank of St. Louis, it consists of 248 series for 14 groups of variables regarding production, employment, inventories, housing, sales, orders, earnings, interest rates, prices, balance sheets of households and non-households, exchange rates and stock markets, among others, from 1963:Q1 to 2020:Q1. The detailed description of the variables can be found in McCracken and Ng (2020) alongside the transformations applied to the series to achieve stationarity. We follow the advice of these authors to deal with missing observations and outliers before estimation of the factors. Thus, our factors correspond with those reported by McCracken and Ng (2020).

5. Empirical Results

As stated in the methodology, to evaluate the interdependence between the firm's capital structure decisions and to test for the effect of the macroeconomic environment on these decisions we follow a two-step approach. The first step consists of year-by-year cross-sectional regressions using firm-level data. Capital structure decisions for the average firm are obtained from these regressions. We find per-year values for the percentage of new funding that is secured through debt, the percentage of short-term debt out of total debt, and the percentage of newly issued equity represented by retained earnings. In the second step these time series are standardized (to allow comparisons of the effects) and included in a FAVAR model in which our three estimated factors standing for real economic activity, expected future funding conditions, and prices, are included.

Figure 1 shows first step results. The top left panel shows the average firm's percentage of new debt (shares) with respect to total new financing. Notably, as financial markets have evolved over time, firms have increased their financing with share issuance. While the average debt-to-equity ratio for the period 1963 – 1982 was 5.5, its average from 1983 to 2018 was only 1.1. High time-variation in this ratio is observed, however, especially during the last two decades, with lowest values registered in times of financial turmoil.

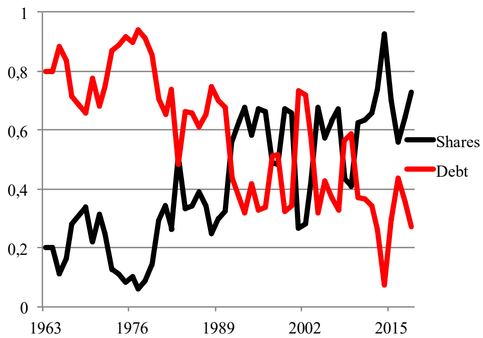
The proportion of short-term debt out of total debt (top right panel in Figure 1) shows an upward trend. This result coincides with those of Custódio et al. (2013) who show that corporate use of long-term debt has decreased in the US over the past three decades, especially for small firms. The decrease in debt maturity was generated mainly by firms with higher information asymmetry and new firms issuing public equity in the 1980s and 1990s.

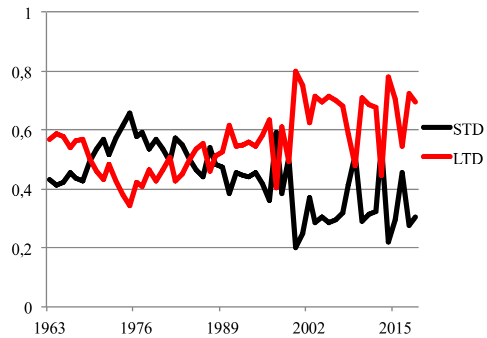
Regarding new equity issuance (bottom panel of Figure 1), most is attained through new shares (over 80% in every tear from 1963 to 2018), and an increasing trend is observed during the sample period. Hence, property in US firms has diluted over the last fifty years.

Figure 1 Capital Structure Choices

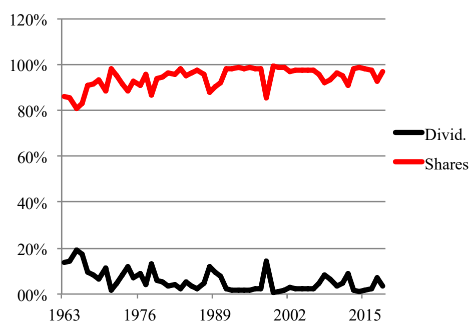
Panel A: New Shares vs. New Debt

Panel B. Short- vs. Long- Term Debt





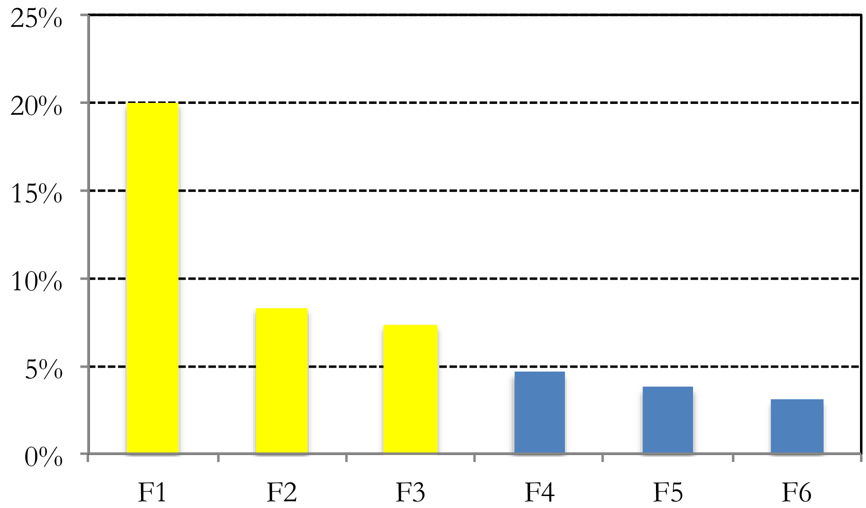
Panel C. Dividends vs. New Shares



Note: Panel A presents results of complementary regressions for dS_t and dL_t. It shows the proportion of yearly new investment (dAt) financed through issues of new shares (black line) and new outside financing (red line). Panel B presents results of complementary regressions for $dSTD_t$ and $dLDT_t$. The panel shows the proportion of new yearly investment financed through short-term-debt (black line) and long-term-debt (red line). Panel C presents results of complementary regressions for dD_t and dS_t. This panel shows the proportion of new yearly investment (financed through retained earnings (black line) and new share issues (red line). The sample runs from 1963 to 2018. We trimmed our annual samples, deleting 0.5% left-tail observations of the variable dA_t to avoid the influence of outliers.

The time series on capital structure decisions constructed in the first step of our empirical procedure are included in a FAVAR model in the second step. Besides these three variables, the FAVAR model includes three factors that determine the dynamics of the US economy from 1959 to 2019. These three factors explain roughly 35% of total variability in the set of 248 macro-variables, as shown in Figure 2.

Figure 2: Factor selection



Note: The figure shows the first main factors that determine the dynamics of the US economy from 1959 to 2019. The factors were estimated as the six first principal components of a large data set provided by McCracken and Ng (2020). The set consists of 248 quarterly series from 1959:Q2 to 2020:Q1, is comprehensive, and includes subcategories like production, employment, interest rates, prices, housing, earnings, stock markets, money and credit, etc. for the US economy. The first factor explains 20% of the total variability in the macroeconomic big-data set, the second factor explains 8.3%, and the third factor 7.3%.

These three factors can be intuitively associated with distinct aspects of the macroeconomic environment, as shown in Table 2. Particularly, the first factor corresponds to real economic activity, the second to forward looking funding conditions, and the third factor to prices. Figure 3 graphically presents time series for these three factors. Note, for instance, that the real economic activity factor shows minimum values around episodes of economic depression like the recessions of 1973-1975 and the Great Recession of 2008-2010.

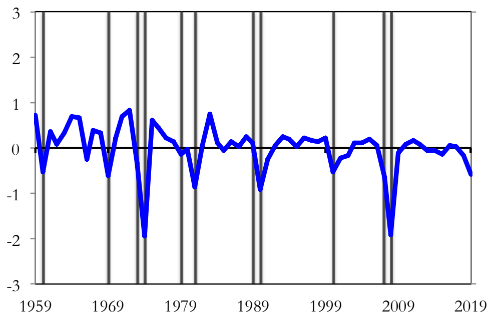
Table 2 Most heavily loading series and explanatory power of factors

Factor 1: Real Economic Activity		
All Employees: Total Private Industries	USPRIV	83.5%
Manufacturing Sector: Real Output	OUTMS	80.9%
All Employees: Goods-Producing Industries	USGOOD	80.9%
All Employees: Total nonfarm	PAYEMS	80.8%
Industrial Production: Manufacturing (SIC)	IPMANSICS	79.8%
Industrial Production Index	INDPRO	78.5%
Nonfarm Business Sector: Hours of All Persons	HOANBS	77.3%
All Employees: Manufacturing	MANEMP	76.7%
Civilian Unemployment Rate	UNRATE	76.5%
All Employees: Durable goods	DMANEMP	75.6%
Factor 2: Forward Looking Funding Conditions		
Moody's Aaa Corporate Bond Minus Federal Funds Rate	AAAFFM	49.8%
5-Year Treasury Constant Maturity Minus Federal Funds Rate	T5YFFM	46.4%
New Private Housing Units Authorized by Building Permits	PERMIT	46.2%
Total Business Inventories	BUSINVx	43.0%
Total: New Privately Owned Housing Units Started	HOUST	42.0%
New Private Housing Units Authorized by Building Permits	PERMITS	40.5%
Capacity Utilization: Total Industry	TCU	39.8%
S&P's Composite Common Stock: Dividend Yield	S&P div yield	39.4%
10-Year Treasury Minus 3-Month Treasury Bill	GS10TB3Mx	36.3%
3-Month Commercial Paper Minus 3-Month Treasury Bill	CPF3MTB3Mx	36.0%
Factor 3: Prices		
Consumer Price Index Less Shelter	CUSR0000SA0L2	75.3%
Consumer Price Index: Commodities	CUSR0000SAC	73.8%
Personal consumption expenditures: Goods	DGDSRG3Q086SBEA	73.4%
Personal Consumption Expenditures: Chain-type Price Index	PCECTPI	71.9%
Consumer Price Index: Transportation	CPITRNSL	70.4%
Personal consumption expenditures: Nondurable good	DNDGRG3Q086SBEA	69.4%
Consumer Price Index Less Medical	CUSR0000SA0L5	67.5%
Consumer Price Index for All Urban Consumers: All Items	CPIAUCSL	66.8%
Producer Price Index by Commodity Intermediate Materials	WPSID61	64.6%
Consumer Price Index Less Food	CPIULFSL	63.3%

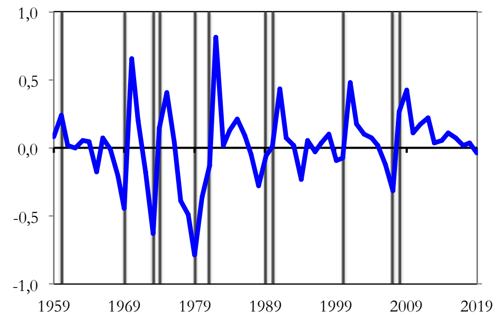
Note: The table shows the series with the larger factor loads at each of the three factors joint with the marginal R-squared of each factor on each series. The first factor captures the dynamics of production and unemployment so is regarded as economic activity; the second factor is related to several forward-looking variables, mainly interest rates, yields and housing activity, so we interpret it as a broadly defined funding or liquidity factor. Finally, the third factor is clearly related with prices.

Figure 3 Big-Data Macro-Factors

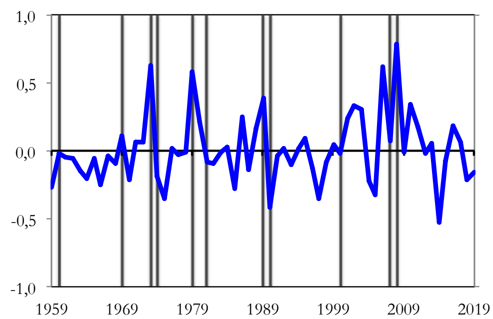
Panel A: Factor 1



Panel B. Factor 2



Panel C. Factor 3



Note: The figure shows the three main factors that determine the dynamics of the US economy from 1959 to 2019. The factors were estimated as the three first principal components of a large data set provided by McCracken and Ng (2020). The set consists of quarterly series from 1959: Q2 to 2020: Q1, is comprehensive, and includes subcategories like production, employment, interest rates, prices, housing, earnings, stock markets, money and credit, etc. for the US economy. We took the value of the factors recorded in the fourth quarter as our annual estimate (plotted then on the figure). The shadowed areas in each subplot correspond to recessions as indicated by a probability of recession greater than 0.5 at a given quarter, also extracted from the web page of the St. Louis Fed.

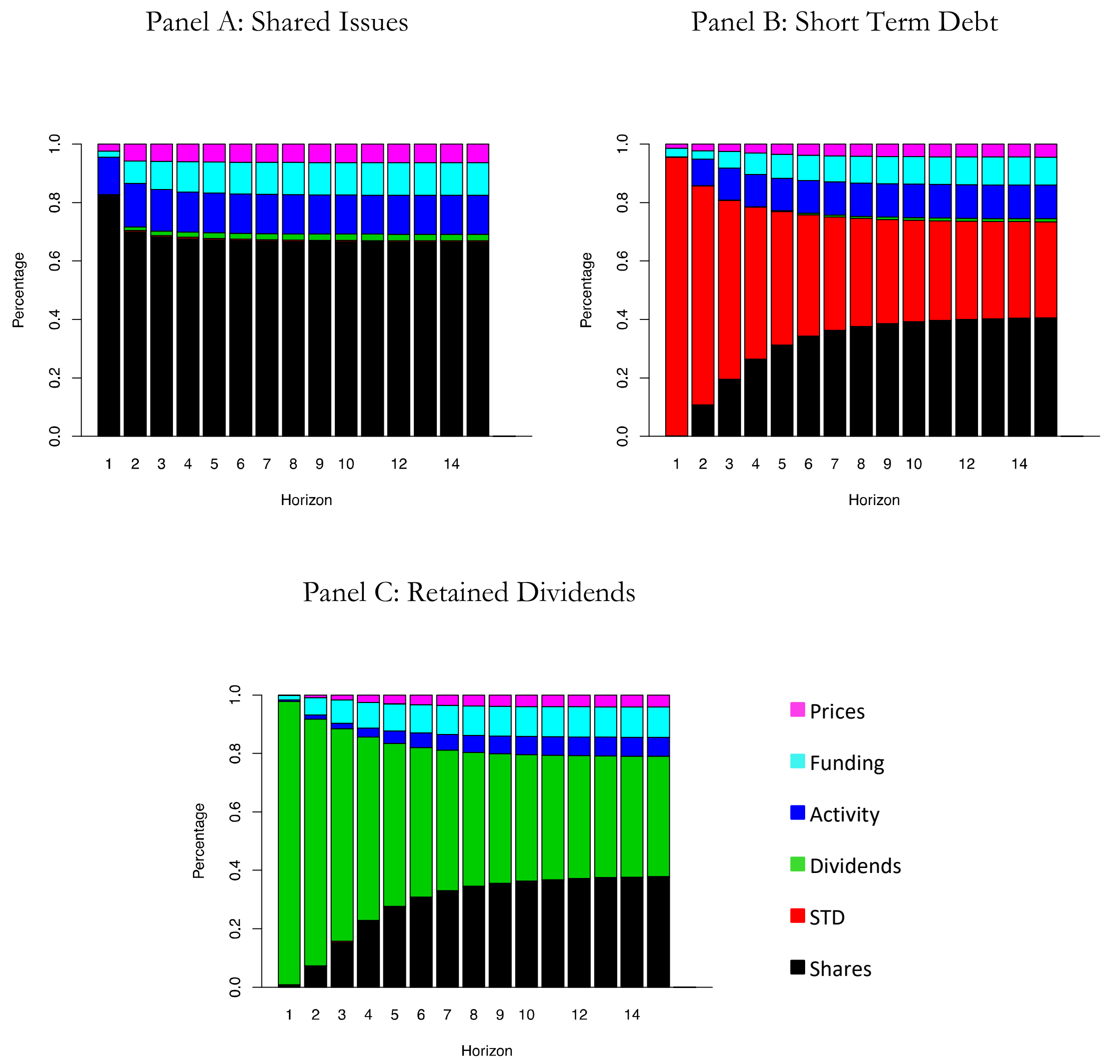
Figure 4 presents FEVD results for the three capital structure decisions. The variance decomposition indicates the amount of information each variable contributes to the other variables in the FAVAR model. In other words, it determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. As expected, autoregressive components are very important. Panel A shows that over 60% of the forecast error variance of the proportion of shares out of total new financing is explained by its autoregressive component. The remaining 40% is explained by macroeconomic factors. This is an important result, highlighting the relevance of macroeconomic conditions, especially real economic activity and expected funding conditions, on firms' main capital structure decision, namely the decision on how much equity to issue and how much new debt to contract. This result is like those obtained by Kayo and Kimura (2011), who show that time-determinants, i.e., those associated with the macroeconomic environment, are more important than firm-, industry-, and country-level determinants of firm leverage. Capital structure composition depends on various aspects of the macroeconomic environment, including the level of economic activity, the willingness of creditors to extend credit, and creditors' and debtors' expectations about future economic and financial conditions. Notably, the decisions on term composition of new debt and on earnings retention do not affect the decision on the proportion of equity.

Panels B and C show a different story for the term-composition of debt and the earnings retention policy, respectively. These two decisions are also influenced by the macroeconomic environment. In fact, the effect of real economic activity and expected funding conditions increases on the forecast horizon. However, the debt-to-equity ratio decided by the firm affects these two decisions considerably. In fact, approximately ten quarters ahead, around 40% of the forecast error variance of these two variables is explained by the debt-to-equity ratio decision.

This important result illustrates there is a hierarchical interdependence between a firm's capital structure decisions. Our results go in line with the predictions of the theoretical model developed by Gatchev et al. (2010), showing that static models of financial decisions produce inconsistent coefficient estimates, and that models ignoring the interdependence between decision variables lead to misleading conclusions regarding optimal capital structure choices made by firms. The proportion of short-term debt issued and the decision to retain earnings significantly depend on the decision of how much new debt to issue. It also suggests that papers ignoring this hierarchical decision process obtain biased and inconsistent estimates of the effects of distinct firm-specific variables on their capital structure composition.

Our results confirm the findings reported by Graham et al. (2015), who show that changes in government borrowing, macroeconomic uncertainty, and financial sector development play the major role in explaining differences in firm leverage and capital structure decisions during the twentieth century. Cross-sectional differences among firms and changing firm characteristics are unable to account for the change in firm leverage patterns observed over the last 100 years.

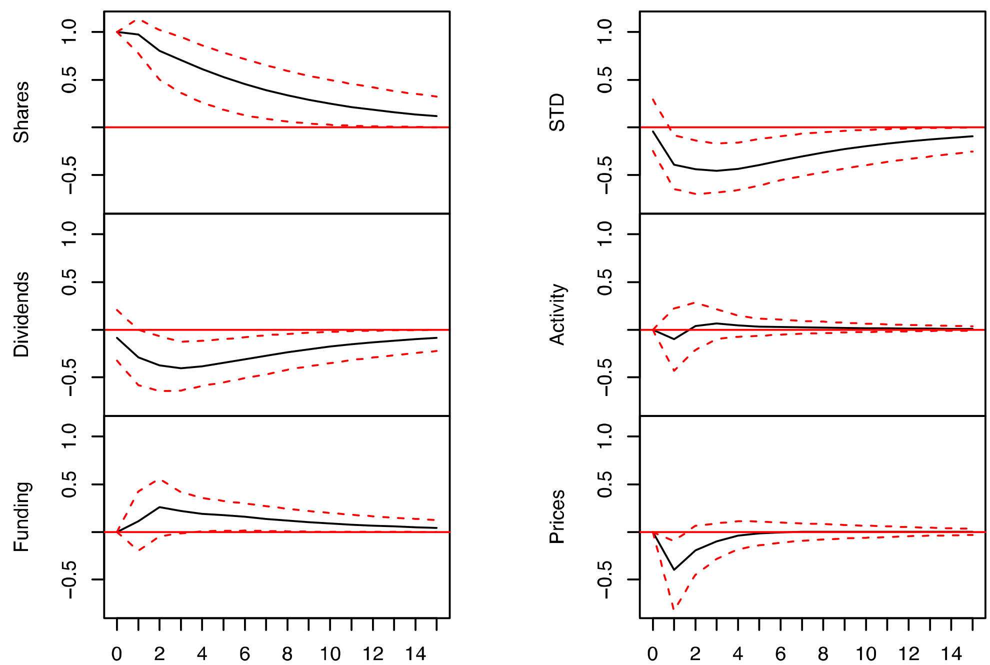
Figure 4. Forecast Error Variance Decomposition



Note: The figure shows the forecast error variance decomposition for the FAVAR (1) system estimated using the three capital structure choices by US firms and the three main factors for the US economy. The FEVD for the factors is presented in the online Appendix.

Figures 5, 6 and 7 present impulse response functions showing the response of the six variables included in the system to shocks in each of the three capital structure variables included in the FAVAR model. The behavior of these dynamic multipliers confirms the main results described above. As shown in Figure 5, the share of short-term debt is significantly reduced from the first to the sixth quarter after a shock to the proportion of equity occurs. In other words, increases in the proportion of debt lead to increases in the proportion of short-term debt hired by firms. This result, which goes in line with those of Custódio et al. (2013), shows that increases in the debt-to-equity ratio imply firms are bearing higher risk as the shortening of debt maturity implies an increased exposure of firms to credit and liquidity shocks. As expected, the three macroeconomic factors are unaffected by corporate capital structure decisions.

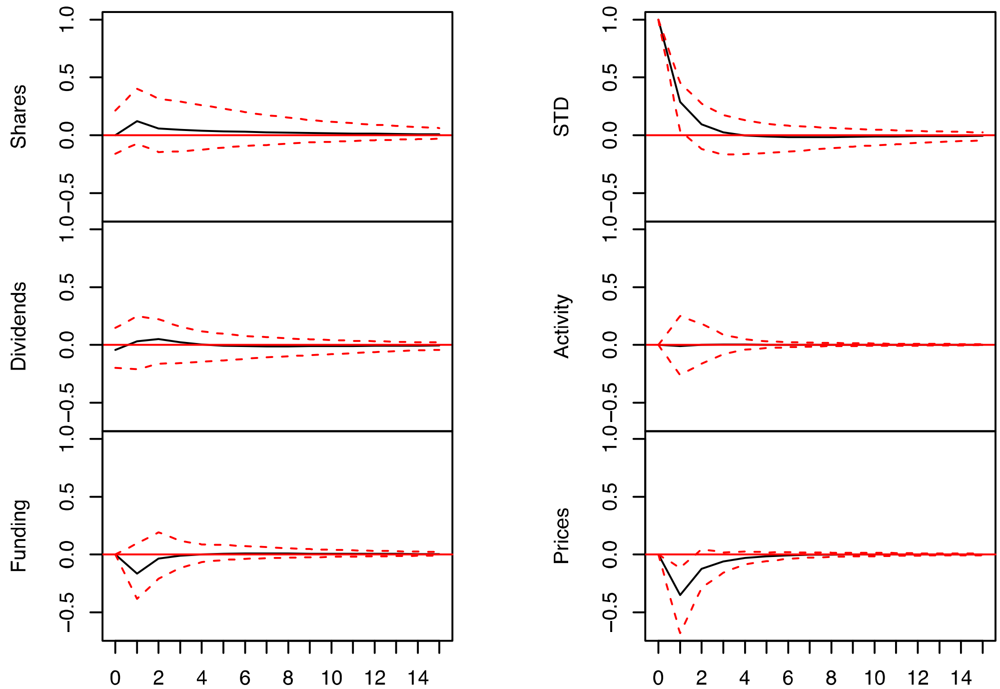
Figure 5. Impulse Response Function: Shock to Shared Issues



Note: IRF to the Structural VAR system of 6 variables, from a shock to Shared Issues with a horizon of 15 years. The axes and the shock are measured in standard deviations of the normalized variables. The estimation period runs from 1963:Q4 to 2018:Q4. Confidence bands (84%) are calculated using bootstrapping techniques as explained in Efron and Tibshirani (1993). The macroeconomic indicators: Activity, Funding and Prices are assumed as contemporaneously exogenous and the three capital structures choices by firms, namely the indicators of the proportion of: Shared Issues, Short-Term Debt and Retained Dividends are assumed as contemporaneously endogenous. All the variables become endogenous after the first year thanks to the VAR dynamics.

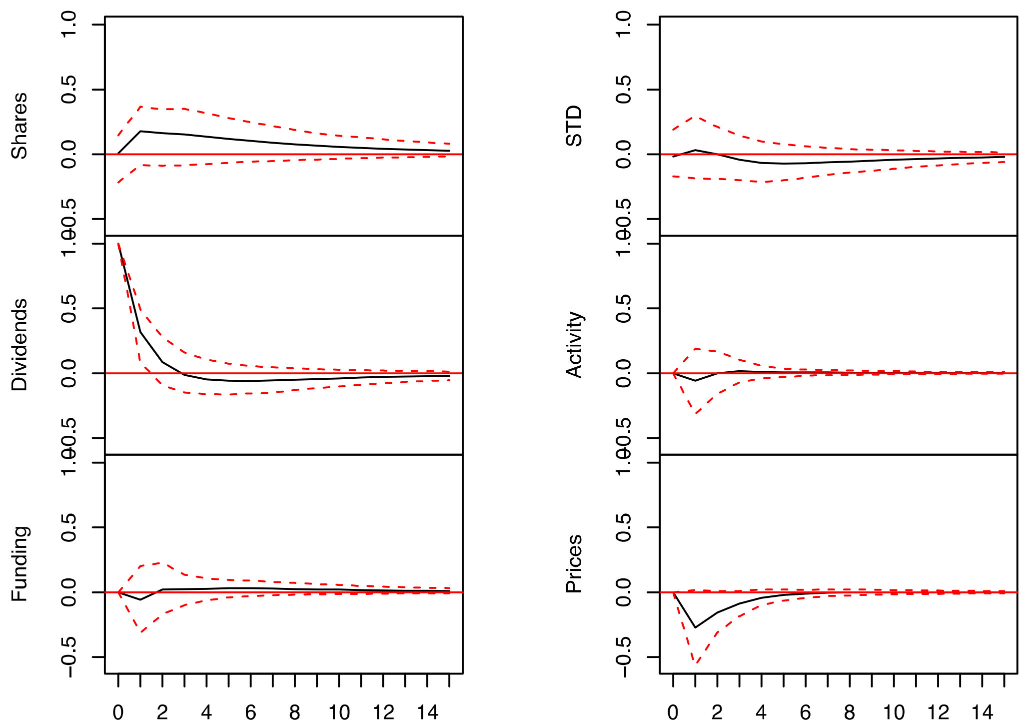
Figures 6 and 7, in contrast, show that the debt-to-equity ratio does not respond to shocks in either the proportion of short-term debt or the proportion of new equity issued by the firm. Additionally, these two decisions are independent, as neither the proportion of short-term debt responds to the proportion of new equity issued, nor vice versa. Thus, all results support the finding that there is a unique hierarchical ordering in the capital structure decision process.

Figure 6. Impulse Response Function: Shock to Short Term Debt



Note: IRF to the Structural VAR system of 6 variables, from a shock to Short Term Debt with a horizon of 15 years. The axes and the shock are measured in standard deviations of the normalized variables. The estimation period runs from 1963:Q4 to 2018:Q4. Confidence bands (84%) are calculated using bootstrapping techniques as explained in Efron and Tibshirani (1993). The macroeconomic indicators: Activity, Funding and Prices are assumed as contemporaneously exogenous and the three capital structures choices by firms, namely the indicators of the proportion of: Shared Issues, Short-Term Debt and Retained Dividends are assumed as contemporaneously endogenous. All the variables become endogenous after the first year thanks to the VAR dynamics.

Figure 7. Impulse Response Function: Shock to Retained Dividends

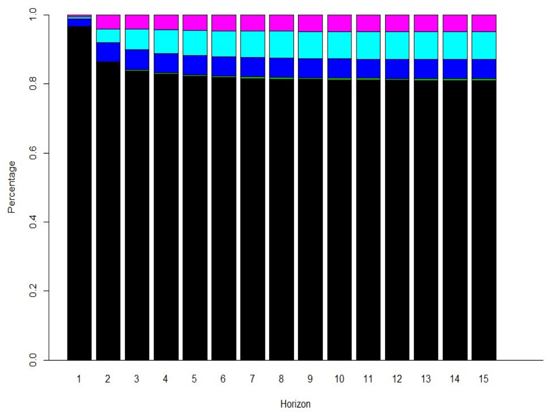


Note: IRF to the Structural VAR system of 6 variables, from a shock to retained Dividends with a horizon of 15 years. The axes and the shock are measured in standard deviations of the normalized variables. The estimation period runs from 1963:Q4 to 2018:Q4. Confidence bands (84%) are calculated using bootstrapping techniques as explained in Efron and Tibshirani (1993). The macroeconomic indicators: Activity, Funding and Prices are assumed as contemporaneously exogenous and the three capital structures choices by firms, namely the indicators of the proportion of: Shared Issues, Short-Term Debt and Retained Dividends are assumed as contemporaneously endogenous. All the variables become endogenous after the first year thanks to the VAR dynamics.

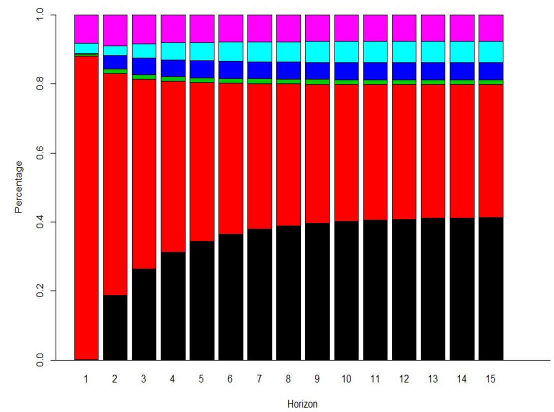
The literature on microeconomic determinants of the capital structure has insisted in some key characteristics affecting it. One important determinant of capital structure decisions is firm size. To test for the firm size effect in our setup, we performed two additional sets of estimations. In the first, the two-step procedure described above was applied to the average firm within the 25% smallest firms in the sample. In the second the same procedure was applied to the 25% largest firms in the sample. Results are qualitatively identical, as shown by forecast variance error decomposition results presented in figures 8 and 9, respectively.

Figure 8. Forecast Error Variance Decomposition for 25% smallest firms

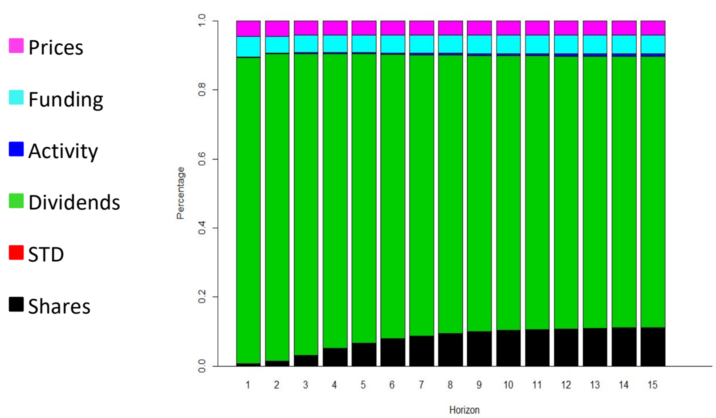
Panel A: Shared Issues



Panel B: Short Term Debt

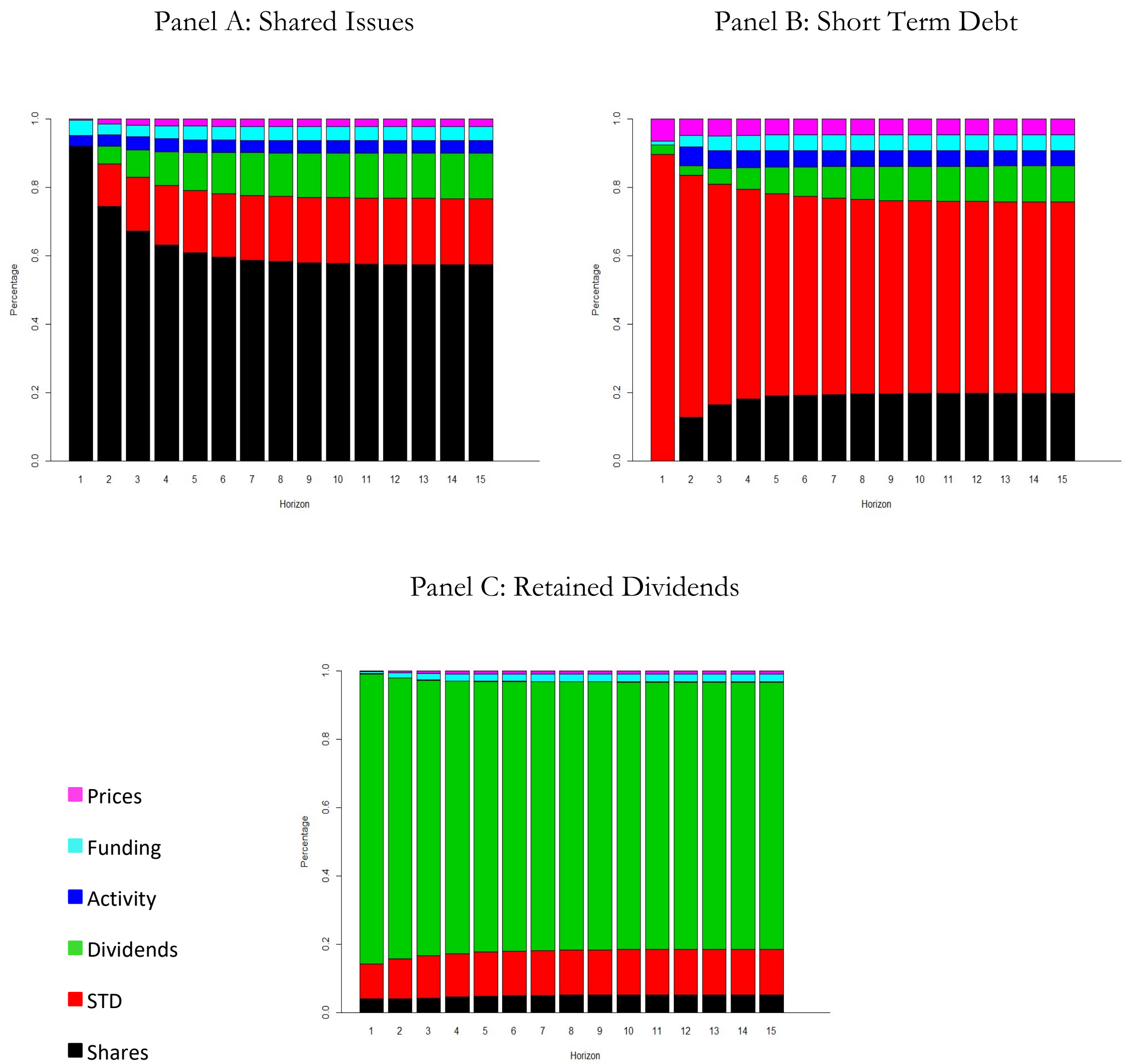


Panel C: Retained Dividends



Note: The figure shows the forecast error variance decomposition for the VAR (1) system estimated using the three capital structure choices by US firms and the three main factors for the US economy. The FEVD for the factors is presented in the online Appendix.

Figure 9. Forecast Error Variance Decomposition for 25% largest firms



Note: The figure shows the forecast error variance decomposition for the VAR (1) system estimated using the three capital structure choices by US firms and the three main factors for the US economy. The FEVD for the factors is presented in the online Appendix.

6. Conclusions

This paper studies the interdependence between aggregate firms' capital structure decisions and the influence that macroeconomic factors exert on these decisions. We design a two-step empirical strategy combining a classical microeconometric approach based on cash flow constraints with a novel macroeconometric model. In the first step year-by-year regressions are performed to estimate the debt-to-equity ratio, the proportion of short-term debt, and the percentage of new share issuance for the average US firm for the period comprising between 1963 and 2018. In the second step we include the time series obtained in the first step into a FAVAR model in which three factors representing real economic activity, expected future funding conditions, and prices, are also included. Factors are estimated using a large dataset comprising 248 macroeconomic variables. The three factors used in our empirical model can be associated with real economic activity, expected future funding conditions, and prices. By imposing natural contemporaneous exogeneity restrictions on the FAVAR model, we study both the interdependence between optimal capital structure decisions and the influence exerted by macroeconomic conditions on these decisions.

Results show that, contrary to what is conventionally assumed in the related literature, firm capital structure decisions are interdependent and follow a hierarchical order. Firms decide first the optimal share of debt out of total new funding they will hire. This decision depends heavily on macroeconomic conditions, especially on real economic activity and on future expected funding conditions. Then, depending on the debt-to-equity ratio selected by the firm, decisions on short-term debt composition and on earnings retention are taken. These two decisions, which are independent from each other, depend also directly on the macroeconomic environment.

Our findings therefore suggest the existence of a 'pecking order' effect in the process of the optimal capital structure decision. However, as in the market timing theory, this hierarchy depends on prevailing market and macroeconomic conditions. Firms' capital structure decisions are not independent from each other and must therefore be jointly modeled. Papers studying separately these three important decisions may obtain biased and inconsistent parameter estimates, as debt maturity decisions and earning retention policies depend on the debt-to-equity ratio decided by the firm, in turn varies over time depending on the overall macroeconomic conditions.

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Appendix

Variable Definitions:

Our data are from Compustat. All variables are divided by assets at the end of fiscal year t, and multiplied by 100. The variables we use in the regressions for year t (traditional Compustat item numbers in parentheses) are:

dA_t Investment: Change in assets (6) during fiscal year t.

Y_t Earnings: Income before extraordinary items available for common (237) plus extraordinary income (48) during fiscal year t.

$dCST_t$ Change in common equity (Compustat data item 60).

D_t Dividends: Dividends per share by ex-date (26) at the end of fiscal year t times shares outstanding (25) at the end of t.

dS_t Book value of shares issued: Change in common equity (Compustat data item 60) plus dividends, D_t, minus earnings, Y_t, during fiscal year t.

dL_t Change in total liabilities, including preferred: Change in assets (6) minus change in common equity (60) during fiscal year t.

$dSTD_t$ Change in short-term debt: Change in current liabilities (5) during fiscal year t.

$dLTD_t$ Change in long-term debt: Change in total liabilities, dL_t, minus change in current liabilities, $dSTD_t$.

We exclude financial firms (Standard Industrial Classification codes between 6000 and 6999). We exclude firms that lack information about any of the variables in a given year. We also exclude firms from the regressions for year t if we are missing: Compustat shares outstanding, income before extraordinary items available for common, and extraordinary income for the fiscal year ending in t; assets, common equity, and current liabilities for the fiscal yearends in calendar years t -1 and t; and book equity for the fiscal year ending in calendar year t-1. Finally, we exclude firms whose common equity at the end of year t-1 exceeds their assets at the end of t -1.

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