

Minsky and Tobin Cycles: Bridging Macroeconomic and Firm-Level Evidence

Luis Felipe Eick*

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Abstract

This paper examines real-financial cycles in the U.S. nonfinancial corporate sector, focusing on the interaction between investment and distinct dimensions of corporate finance. Building on post-Keynesian and structuralist approaches, it develops stylized dynamic models linking investment to equity valuation, loans, and debt securities. The models generate cyclical predictions, which are evaluated using aggregate Financial Accounts and firm-level data, combining cyclical phase trajectories and vector autoregressions. The results reveal substantial heterogeneity across financial variables. Tobin's q displays a robust clockwise relationship with investment, leading it over the cycle in both aggregate and firm-level data. Aggregate leverage shows much weaker cyclical structure, but disaggregation reveals distinct patterns. Loan leverage tends to lag investment, consistent with a counterclockwise Minskyan debt cycle, whereas debt securities tend to lead investment and display clockwise dynamics. Firm-level evidence further shows that counterclockwise investment-leverage dynamics are concentrated among smaller firms and weaken toward the upper tail of the size distribution. The findings suggest that the composition of corporate finance and firm heterogeneity are central to understanding real-financial cycles.

Keywords: Financial Cycle, Business Cycle, Minsky, Tobin.

JEL Classification: E32, E44, E22, G32, E12.

*Ph.D. candidate, Department of Economics, The University of Utah. Email: luis.eick@utah.edu.

1 Introduction

In Keynes’s General Theory, fluctuations in investment occupy a central place in driving the business cycle, with important consequences for aggregate income, output, and employment. Hyman Minsky extended this investment theory of the cycle with a financial theory of investment: because investment must be financed externally, the evolution of financial conditions and firms’ financial positions becomes part of the cyclical process itself. Also building on Keynes, James Tobin’s q -theory formalized a complementary link between finance and investment by connecting the market valuation of existing capital to real accumulation. Taken together, these contributions place finance within the investment cycle and motivate a view of the modern business cycle as inherently financial.

Financial conditions and corporate investment therefore interact in ways that can shape the amplitude, persistence, and evolution of recurrent fluctuations in economic activity. Changes in asset valuations, indebtedness, and access to external finance affect investment and accumulation, while developments in investment and economic activity feed back into firms’ financial positions and balance sheets. These reciprocal interactions form the basis of the real-financial cycles studied here. Drawing on post-Keynesian and structuralist theories of real-financial cycles, this paper examines how distinct dimensions of corporate finance (equity valuation, bank loans, and debt securities) interact dynamically with investment in the U.S. nonfinancial corporate sector. Rather than estimating a complete theory of investment, the central question is whether these different financial mechanisms occupy different positions in the investment cycle and exhibit distinct patterns of cyclical feedback with investment.

Empirical work in this tradition has provided evidence for a number of individual links between finance and real activity, but comparatively little is known about how these mechanisms interact over the cycle. A smaller literature examines the cyclical cross-feedbacks directly and relates them to the dynamic systems underlying post-Keynesian theories of real-financial cycles. Stockhammer et al. (2019) develop a VAR-based framework to study the interaction of economic activity with interest rates and corporate debt across a group of selected countries. Stockhammer and Gouzoulis (2023) apply a similar approach to corporate debt and economic activity using historical U.S. data. Barrales-Ruiz et al. (2022) extend a neo-Goodwinian framework and examine the cyclical interaction between Tobin’s q and measures of economic activity.

These studies leave several related questions open. First, they employ different measures of real activity, making it difficult to compare financial mechanisms within a common framework. Second, corporate debt is typically treated in aggregate, obscuring potentially distinct cyclical roles for different sources of debt finance. Third, evidence on cross-feedback dynamics remains predominantly aggregate, leaving open whether these patterns are robust to firm-level disaggregation. This paper therefore asks whether investment and finance exhibit systematic cyclical interactions in the U.S. nonfinancial corporate sector, with a focus on three main aspects: (i) providing a

common framework centered on investment as a real-side variable, (ii) distinguishing between different forms of debt, and (iii) exploring whether the resulting patterns vary across firm size.

The results reveal distinct cyclical patterns across financial variables. The interaction between investment and equity valuation is the most robust: Tobin’s q tends to lead investment, and the two variables display the clockwise dynamics predicted by the valuation model in both aggregate and firm-level data. By contrast, aggregate leverage exhibits much weaker cyclical structure. Disaggregating debt reveals substantial differences across financing instruments. Loan leverage tends to follow investment and subsequently restrain it, generating a predominantly counterclockwise pattern consistent with a Minskyan debt cycle. Debt securities occupy a different position in the cycle, tending to lead investment and exhibiting dynamics more consistent with a clockwise relationship.

The firm-level evidence reinforces this distinction. While aggregate firm-level leverage displays weak cross-feedbacks, counterclockwise investment–leverage dynamics emerge much more clearly among firms outside the upper tail of the size distribution. These dynamics weaken as progressively larger firms are incorporated into the sample, suggesting that aggregate leverage can conceal substantial heterogeneity across firms. Taken together, these findings suggest that there is no single corporate debt cycle: the cyclical relationship between investment and finance depends on the source of external finance considered, and aggregation across instruments and firms can obscure these differences.

The remainder of the paper is organized as follows. Section 2 reviews the theoretical and empirical literature on Minskyan and Tobinian real-financial cycles. Section 3 develops the three dynamic models linking investment to equity valuation, bank loans, and debt securities. Section 4 examines these relationships using aggregate data for the U.S. nonfinancial corporate sector, while Section 5 turns to firm-level evidence and explores heterogeneity across firm size. Section 6 concludes.

2 Minsky, Tobin, and Real-Financial Cycles

This section reviews the theoretical and empirical literature on real-financial cycles that motivates the analysis. The literature is vast and touches on virtually all areas of monetary macroeconomics, so the discussion is necessarily selective. It first reviews real-financial cycle models, focusing on Minskyan debt cycles and Tobin’s q asset-price models. It then reviews the empirical evidence on these interactions, with particular attention to studies that examine the two-way feedbacks required for cyclical propagation.

2.1 Real-Financial Cycle Models

A broad theoretical literature studies the interaction between financial conditions and real economic activity over the business cycle. One influential strand is the New Keyne-

sian financial-accelerator tradition (Bernanke et al., 1999; Kiyotaki and Moore, 1997), in which credit-market frictions, borrowers' net worth, and collateral values amplify and propagate disturbances to investment and output. In these models, financial conditions evolve endogenously with economic activity, while the analysis is typically embedded in an optimizing general-equilibrium framework and organized around the transmission of exogenous shocks. A distinct approach, typically associated with post-Keynesian and structuralist traditions, integrates financial dynamics in behavioral, demand-driven models of accumulation. These dynamic systems emphasize reciprocal real-financial feedbacks that can generate damped oscillations, instability, or self-sustaining cycles. This paper builds on the latter tradition, with particular emphasis on Minskyan Financial Instability Hypothesis models and Tobin's q models of asset-price dynamics.

The theoretical literature on Minskyan financial cycles is extensive and encompasses a variety of formalizations of the financial instability hypothesis (FIH). Minsky's FIH emphasizes the endogenous development of financial fragility over the course of an expansion (Minsky, 1975, 1986, 1992). As investment and economic activity expand, the validation of existing financial commitments encourages borrowers and lenders to accept increasingly fragile financial positions. Over prolonged periods of prosperity, the financial structure therefore tends to shift from hedge toward speculative and Ponzi finance, increasing the vulnerability of the economy to a downturn.

There is no canonical model of the Minsky cycle. Nikolaidi and Stockhammer (2017) provide a structured survey of the different ways in which Minsky's financial instability hypothesis has been formalized. They distinguish broadly between models in which debt or interest-rate dynamics are central and models in which asset-price dynamics play the key role. Within the former, they identify Kalecki–Minsky, Kaldor–Minsky, Goodwin–Minsky, credit-rationing, endogenous-target-debt, and Minsky–Veblen models. These approaches differ in the source of instability, the role assigned to banks and interest rates, the relevant financial variable, and the dynamic mechanisms under consideration. The discussion here is necessarily selective and focuses on a small subset of models of corporate debt and financial fragility.

Within this debt-centered literature, Asada (2001) develops a two-dimensional system in the output–capital ratio and the debt–capital ratio in which leverage is procyclical and higher indebtedness depresses investment and output. Lima and Meirelles (2007) develop a post-Keynesian model in which investment is financed by bank credit and the interaction between firms' debt ratios and endogenous interest rates determines financial fragility and macroeconomic stability. Charles (2008) develops a tractable nonlinear model in the accumulation rate and the debt–capital ratio, with a stable equilibrium associated with hedge finance and an unstable high-debt equilibrium associated with speculative or Ponzi finance. Fazzari et al. (2008), in turn, develop a dynamic Keynes–Minsky model in which investment, firms' cash flows, debt-service commitments, and nominal interest rates interact to generate persistent endogenous fluctuations.

A related strand combines Minskyan financial dynamics with Goodwinian growth-cycle

models. Keen (1995, 2013) extend the classical growth cycle of Goodwin (1967) by allowing firms to borrow in order to finance accumulation, while Sordi and Vercelli (2014) introduce Keynesian aggregate-demand dynamics into this class of models. More recently, Keen (2020) revisits the Minskyan mechanism from a complex-systems perspective, while Stockhammer and Michell (2017) provide a particularly transparent predator–prey representation of the interaction between economic activity and financial fragility.

The predator–prey representation can be generalized beyond the Goodwin–Minsky models. Calvert Jump and Stockhammer (2023) formulate a representative Minskyan debt cycle as a two-dimensional system in economic activity and the corporate debt ratio. Drawing on Asada (2001), they show that under standard Minskyan assumptions the off-diagonal effects have opposite signs: stronger economic activity increases corporate indebtedness, while higher indebtedness subsequently reduces activity. They emphasize that this sign structure is common across Minskyan debt-cycle models, even though the own-dynamics of activity and debt differ across particular formulations.

The debt-centered Minskyan mechanism therefore provides one way in which corporate financing conditions can interact endogenously with investment and economic activity. A complementary line of research shifts attention from firms’ liabilities to the valuation of their equity. Rather than emphasizing the burden created by accumulated debt, these models focus on how financial market valuations affect investment incentives and how those valuations, in turn, respond to real-side conditions. This provides the bridge from Minskyan debt cycles to models centered on valuation ratios.

Tobin’s q , defined as the market valuation of firms relative to the replacement cost of their capital stock, provides a natural link between financial-market valuations and investment. The origins of this argument can be traced to Keynes (1936) and were subsequently formalized by Brainard and Tobin (1968) and Tobin (1969). When the market valuation of installed capital is higher than its replacement cost ($q > 1$), investment in new capital goods becomes more attractive. When it is lower ($q < 1$), investment is discouraged.

Post-Keynesian and structuralist approaches typically emphasize average rather than marginal q and do not generally require the valuation ratio to converge to unity in the long run (Kaldor, 1966; Crotty, 1990).¹ More importantly for the present analysis, these approaches allow valuation and real activity to interact dynamically. Foley and Taylor (2006) present an Stock-Flow Consistent (SFC) model which can be reduced to a two-dimensional system in the rate of capacity utilization and q . The short run model features upward-sloping equilibrium schedules in goods and financial market. More recently, Michl (2017) develops a SFC model directly in the accumulation rate

¹Foley et al. (2019, Ch. 14) distinguish among “rentier capitalist,” “managerial capitalist,” and “hybrid capitalist” regimes. In the first, accumulation is highly responsive to stock-market valuation and q converges to unity; in the second, accumulation is driven primarily by managers’ investment decisions and need not imply $q = 1$; in the hybrid case, valuation and accumulation interact systematically without requiring the long-run valuation ratio to equal unity.

and q , featuring a positively sloped growth schedule and a negatively sloped q -schedule. Neither contribution, however, focuses directly on the cyclical dynamics.

A related strand of the literature examines cyclical interactions in which financial variables lead macroeconomic activity. Taylor and O’Connell (1985) develop Minskyan theory in a portfolio-balance framework. In the basic model, the profit rate provides goods-market closure and interacts with the interest rate in an IS/LM-type setup. The dynamic version is framed in the expected profit rate and the ratio of money to fiscal debt and implies a clockwise cycle in economic activity (on the horizontal axis) and money. Similarly, Foley (1987, Sec. 4) models an aggregate economy in which the profit rate interacts with firms’ balance sheets. The model also implies a clockwise cycle between activity and a monetary aggregate, or, equivalently, that money leads activity.

More directly for the present analysis, Taylor (2012, Sec. 6) formulates a model in the accumulation rate g and valuation ratio q . The model features positively sloped growth and finance schedules and generates a clockwise cycle in (g, q) space, or, equivalently, one in which q leads accumulation. A similar clockwise real–financial pattern is obtained by von Arnim and Eick (2026), who introduce Tobin’s q into a Keynesian Distributive Cycle framework. In a four-dimensional model, valuation interacts with the income-capital ratio and the employment rate generating cycles in which valuation leads activity.

2.2 Overview of the Empirical Evidence

The empirical literature considered here is narrow and focuses on work associated with the post-Keynesian and structuralist approaches reviewed above. On the Minskyan side, empirical studies have typically examined particular channels linking financial conditions to investment and activity, including the effects of internal finance, debt-service commitments, leverage, and financial fragility (e.g. Fazzari and Mott, 1986; Ndikumana, 1999; Orhangazi, 2008), while other contributions have examined the build-up of financial fragility over the course of expansions (e.g. Mulligan, 2013; Davis et al., 2019). A related strand examines the role of equity valuation in investment, including the sensitivity of accumulation to Tobin’s q (e.g. Ndikumana, 1999; Tori and Onaran, 2018; Sündal, 2023). Taken together, this literature provides substantial evidence on individual real-financial mechanisms, but has generally focused on one side of the interaction at a time rather than on the reciprocal feedbacks between financial conditions and real activity.

Evidence on only one side of the interaction, however, is not sufficient to establish a real–financial cycle. Consider a generic two-dimensional system in a real variable x and a financial variable z . Around a steady state, its Jacobian can be written as

$$J^* = \begin{bmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{bmatrix}, \quad (2.1)$$

where the off-diagonal elements capture the reciprocal effects between the real and financial variables. A necessary condition for locally oscillatory dynamics is that these cross-effects have opposite signs, $J_{12}J_{21} < 0$.² The signs and timing of these reciprocal effects are therefore central to the empirical identification of real–financial cycles. A smaller empirical literature has examined these interactions directly.

Stockhammer et al. (2019) develop a VAR-based framework to examine financial–real interactions across seven OECD countries over the period 1970–2015. Their analysis distinguishes among different cycle frequencies and considers the interaction of output with interest rates, business debt, and household debt. They find evidence of interest–rate–GDP interactions at higher frequencies in Australia and the United States, and of business–debt–GDP interactions at medium frequencies in Canada and Great Britain. In both cases, the estimated cross-effects have the Minskyan sign structure: real activity raises the financial variable, while the financial variable feeds back negatively onto activity. These dynamics are consistent with a counterclockwise cycle in activity–finance space. They further find that the effects of interest rates and debt appear to operate primarily through investment rather than consumption.

Building on this approach, Stockhammer and Gouzoulis (2023) examine Minskyan debt cycles using historical U.S. data from 1889 to 2014. They estimate VARMA models linking corporate debt to both GDP growth and real investment growth, and find evidence of the same cross-effects as Stockhammer et al. (2019): increases in real activity raise the corporate debt-to-income ratio, while higher indebtedness depresses investment and GDP growth. The implied cycles are relatively long, at roughly 11–12 years, and the results are driven primarily by the pre-World War II and post-1973 periods. By contrast, they find no comparable evidence of cyclical propagation between mortgage debt and GDP.

On the valuation side, Barrales-Ruiz et al. (2022) examine the interaction between macroeconomic activity and Tobin’s q as a financial extension of their empirical analysis of the Goodwin distributive cycle. Using post-war data for the United States, they estimate a three-variable VAR including the labor share, the output gap, and q . Their impulse responses indicate that higher q raises economic activity, while stronger activity reduces q . These opposite-signed cross-effects are consistent with a clockwise cycle in which valuation leads activity.

These studies provide evidence that real–financial interactions can generate the cyclical patterns predicted by the theoretical literature. Important gaps nevertheless remain. Existing studies typically consider different measures of real activity, making comparisons across financial mechanisms difficult. On the debt side, corporate indebtedness is generally treated in the aggregate, without distinguishing between different sources of debt finance. Moreover, evidence on these cross-feedbacks is predominantly based on aggregate macroeconomic data, leaving open whether similar dynamics are present

²For a two-dimensional system, the discriminant of the characteristic equation can be written as $(J_{11} - J_{22})^2 + 4J_{12}J_{21}$. Complex roots therefore require $J_{12}J_{21} < 0$.

at the firm level and whether they vary systematically across firms. The present paper addresses these issues in an investment-centered framework, disaggregating debt, and complementing the aggregate evidence with firm-level analysis.

3 Real–Financial Cycle Models

This section develops three partial dynamic models of real–financial interactions. The framework is deliberately investment-centered, anchored in the Minskyan view of “an investment theory of the cycle and a financial theory of investment” (Wray, 2016). The objective is to isolate the mechanisms linking capital accumulation to external finance, and examine the direction and timing of their cyclical interactions. The models are intended to provide a theoretical motivation for the empirical patterns examined in Sections 4 and 5, rather than a complete representation of corporate financing or business-cycle dynamics.

All three models are derived from a common flow-of-funds identity for the corporate sector.³

$$P_k I + \dot{A} = \Pi - i(L + B) - Div + \dot{L} + \dot{B} + P_e \dot{E}. \quad (3.1)$$

Here, I denotes fixed investment, K the non-depreciating capital stock, P_k the price of capital goods, A firms’ holdings of liquid financial assets, Π profits, L loans, B bonds, i the interest rate on debt, Div dividend payments, P_e the price of equity, and E the quantity of shares outstanding. The left-hand side represents firms’ uses of funds, while the right-hand side represents the corresponding sources of funds.

Assuming that dividends are a constant share of profits, $Div = \delta\Pi$, and normalizing by the value of the capital stock gives

$$g + g_A = (1 - \delta)r - i(\lambda_L + \lambda_B) + \hat{L}\lambda_L + \hat{B}\lambda_B + \hat{E}q, \quad (3.2)$$

where $g = I/K$ is the investment rate, $g_A = \dot{A}/(P_k K)$ is the rate of accumulation of liquid financial assets, $r = \Pi/(P_k K)$ is the profit rate, $\lambda_L = L/(P_k K)$ is the loan-to-capital ratio, $\lambda_B = B/(P_k K)$ is the bond-to-capital ratio, and $q = P_e E/(P_k K)$ is a measure of Tobin’s q .⁴

The following subsections develop three alternative partial models from this common accounting framework, focusing respectively on equity valuation, loans, and bond finance. Steady-state derivations and local stability conditions for the three systems are provided in Appendix A.1.

³Throughout, $\dot{x} \equiv dx/dt$ and $\hat{x} \equiv \dot{x}/x$ for any variable x . A superscript x^* denotes a steady-state value.

⁴Tobin (1969) defined q as the ratio of a firm’s market value to the replacement cost of its capital. Following Taylor and Rada (2008) and Taylor (2012), we use the ratio of outstanding corporate equity, $P_e E$, to the current value of the capital stock, $P_k K$, where P_e is an equity price index and E the corresponding volume of equity outstanding.

3.1 Equity-Financed Investment: the (g, q) System

The first model isolates the interaction between capital accumulation and equity valuation by abstracting from debt finance. Setting loans and bonds equal to zero, the corporate flow-of-funds identity becomes

$$g + g_A = (1 - \delta)r + \hat{E}q. \quad (3.3)$$

Fixed investment and the accumulation of liquid financial assets are therefore financed by retained earnings and net equity issuance. Net equity issuance may be negative when firms repurchase shares, while g_A adjusts residually to satisfy the flow-of-funds identity.

To derive a law of motion for the valuation ratio, we follow Taylor and Rada (2008). Using the Gordon equation (Gordon, 1962), the required return on outstanding equity, $\rho P_e E$, is equal to the sum of capital gains and dividends, $\rho P_e E = \dot{P}_e E + Div$. Assuming that dividends are a fixed proportion of profits, $Div = \delta \Pi$, gives

$$\hat{P}_e = \rho - \frac{\delta r}{q}. \quad (3.4)$$

Following Taylor and Rada (2008), net equity issuance is assumed to be proportional to investment expenditure, $P_e \dot{E} / P_k K = \hat{E}q = \chi g$, so that $\hat{E} = \chi g / q$. We then differentiate the definition of q . Assuming $\hat{P}_k = 0$ ⁵ gives

$$\dot{q} = q \left(\hat{P}_e + \hat{E} - g \right) = q(\rho - g) + \chi g - \delta r. \quad (3.5)$$

Following Foley et al. (2019), we adopt a modified q -theory specification for desired accumulation:

$$g^d = \alpha + \beta(q - 1), \quad \beta > 0, \quad (3.6)$$

where α captures autonomous investment and β measures the sensitivity of desired accumulation to the valuation ratio⁶. The specification captures the idea that a higher market valuation of existing capital relative to its replacement cost increases the incentive to undertake new investment. Actual accumulation adjusts toward its desired rate at speed $\gamma > 0$, so that

$$\dot{g} = \gamma(g^d - g) = \gamma[\alpha + \beta(q - 1) - g]. \quad (3.7)$$

⁵Throughout the three models, the price of capital goods is held constant and depreciation is abstracted from, so that $\hat{P}_k = 0$ and $\hat{K} = g$.

⁶Following the terminology of Foley et al. (2019), β can be interpreted as capturing the responsiveness of managers' investment decisions to stock-market valuation. The limiting case $\beta = 0$ corresponds to a managerial regime in which investment is independent of q , while values approaching infinity correspond to a rentier regime. The model considered here corresponds to a hybrid regime.

Equations (3.5) and (3.7) define a two-dimensional dynamic system in the accumulation rate and the valuation ratio. Evaluated at the non-trivial steady state, its Jacobian matrix is

$$J_{g,q}^* = \begin{bmatrix} -\gamma & \gamma\beta \\ \chi - q^* & \rho - g^* \end{bmatrix}. \quad (3.8)$$

The signs of the Jacobian can be motivated using economically plausible restrictions. The accumulation equation implies $\partial \dot{g}/\partial g = -\gamma < 0$ and $\partial \dot{g}/\partial q = \gamma\beta > 0$. For the valuation ratio, $\partial \dot{q}/\partial g = \chi - q^* < 0$ provided that $q^* > \chi$. This condition is readily satisfied if net equity issuance is negative, as has frequently been the case for the U.S. corporate sector.⁷ Finally, $\partial \dot{q}/\partial q = \rho - g^* > 0$ if the required return on equity exceeds the rate of capital-stock growth, a plausible restriction for the U.S. economy.⁸ Under these restrictions, the Jacobian has the sign structure

$$J_{g,q}^* = \begin{bmatrix} - & + \\ - & + \end{bmatrix}. \quad (3.9)$$

The opposite signs of the off-diagonal entries provide the mechanism for cyclical propagation. An increase in the valuation ratio raises desired accumulation. As accumulation rises, it reduces $\dot{q}$, as growth of the capital stock in the denominator more than offsets the effect of new equity issuance. As a result, the valuation ratio begins to decline before accumulation reaches its peak. The subsequent fall in q weakens desired investment and eventually causes g to decline. As accumulation slows, the downward pressure on q is relaxed and the valuation ratio begins to recover, completing the feedback mechanism. These cross-effects generate clockwise propagation in the (g, q) plane, with q leading g , as illustrated in Figure 1(a).

3.2 Loan-Financed Investment: the (g, λ_L) System

The second model isolates the interaction between capital accumulation and loan finance by abstracting from bond and equity finance. We additionally set the accumulation of liquid financial assets equal to zero, so that loans constitute the only source of external finance. The corporate flow-of-funds identity therefore becomes

$$g = r - i\lambda_L + \hat{L}\lambda_L. \quad (3.10)$$

⁷Taylor (2012) already noted that net share repurchases implied a negative value of χ for the U.S. business sector, and our earlier model similarly treats $q^* > \chi$ as an economically plausible restriction (von Arnim and Eick, 2026). More recent Federal Reserve evidence confirms the importance of negative net equity issuance. Kuchinski et al. (2017) show that equity retirements through share repurchases and mergers and acquisitions have generally exceeded gross issuance. Consistently, the Federal Reserve's Financial Accounts series NCBCBEA027N reports negative net equity issuance in most years since the mid-1980s and continuously since 1994.

⁸Taylor (2012) motivates the same restriction. Updated estimates by Dimson et al. (2026) place the annualized real return on U.S. equities at 6.6 percent over 1900–2025. This is well above typical growth rates of the real net U.S. nonresidential capital stock reported in the Bureau of Economic Analysis Fixed Assets Accounts.

Investment is financed by retained earnings net of interest payments and by new borrowing. Loan issuance therefore adjusts residually to accommodate the difference between investment expenditure and internally available funds. This closure is consistent with an endogenous credit creation mechanism, in which lending responds to financing needs rather than being constrained by a predetermined pool of saving.⁹

Differentiating λ_L and substituting the residual loan growth rate $\hat{L}$ from Equation 3.10 yields the law of motion for the loan-to-capital ratio:

$$\dot{\lambda}_L = \lambda_L(\hat{L} - g) = (i - g)\lambda_L + g - r. \quad (3.11)$$

A common mechanism in Minskyan models is that debt-service commitments reduce the internal funds available to finance accumulation.¹⁰ Following this literature, desired accumulation is specified as

$$g^d = \alpha + \beta(r - i\lambda_L), \quad \beta > 0, \quad (3.12)$$

where α captures autonomous investment and β measures the sensitivity of desired accumulation to profits net of interest payments. Actual accumulation adjusts toward its desired rate so that

$$\dot{g} = \gamma(g^d - g) = \gamma[\alpha + \beta(r - i\lambda_L) - g]. \quad (3.13)$$

Equations (3.13) and (3.11) define the two-dimensional system in the accumulation rate and the loan-to-capital ratio. The steady-state Jacobian is

$$J_{g,\lambda_L}^* = \begin{bmatrix} -\gamma & -\gamma\beta i \\ 1 - \lambda_L^* & i - g^* \end{bmatrix}. \quad (3.14)$$

The accumulation function implies $\partial\dot{g}/\partial g = -\gamma < 0$ and $\partial\dot{g}/\partial\lambda_L = -\gamma\beta i < 0$. For the loan-to-capital ratio, $\partial\dot{\lambda}_L/\partial g = 1 - \lambda_L^* > 0$ provided that $\lambda_L^* < 1$. This condition is consistent with the U.S. macroeconomic series used in the empirical analysis in Section 4, for which the loan-to-capital ratio remains well below unity throughout the sample. Finally, $\partial\dot{\lambda}_L/\partial\lambda_L = i - g^* < 0$ assuming a solvency condition $g^* > i$. Under these conditions, the steady-state Jacobian has the sign structure

$$J_{g,\lambda_L}^* = \begin{bmatrix} - & - \\ + & - \end{bmatrix}. \quad (3.15)$$

The opposite-signed cross-effects provide the mechanism for cyclical propagation. Leverage behaves procyclically, as an increase in accumulation raises the loan-to-capital ratio.

⁹See, among others, Moore (1988), McLeay et al. (2014), and Keen (2020). When loans are supplied by banks, new lending simultaneously creates a corresponding deposit liability, so that credit creation expands both sides of the banking system balance sheet.

¹⁰This mechanism appears, for example, in Keen (1995) and Charles (2008). More broadly, Nikolaidi and Stockhammer (2017) identify the negative effect of debt service on investment as a recurring feature of Kalecki–Minsky and Goodwin–Minsky models.

As leverage rises, higher debt-service payments reduce desired accumulation, causing g to peak and begin to decline before λ_L . The slowdown in accumulation eventually causes the loan-to-capital ratio to fall, easing the debt-service burden and allowing accumulation to recover. These interactions generate counterclockwise propagation in the (g, λ_L) plane, with accumulation leading the loan-to-capital ratio, as illustrated in Figure 1(b).

3.3 Bond-Financed Investment: the (g, λ_B) System

The third model isolates the interaction between capital accumulation and bond finance. Abstracting from loan and equity finance, as well as dividend payments, the corporate flow-of-funds identity becomes

$$g + g_A = r - i\lambda_B + \hat{B}\lambda_B. \quad (3.16)$$

As in the equity model, g_A is determined residually from the flow-of-funds identity. As a result, firms may raise funds in advance of fixed investment and temporarily hold the proceeds in liquid financial assets. In contrast to the loans model, this allows bond issuance to precede investment expenditure.

The bond-to-capital ratio evolves according to the difference between the growth rate of outstanding bonds and the accumulation rate.

$$\dot{\lambda}_B = \lambda_B(\hat{B} - g). \quad (3.17)$$

To capture this pre-financing channel, desired accumulation is assumed to respond positively to the accumulation of liquid financial assets,

$$g^d = \alpha + \beta g_A, \quad \beta > 0. \quad (3.18)$$

After substituting for g_A from the flow of funds identity, actual accumulation adjusts toward its desired rate so that

$$\dot{g} = \gamma \left\{ \alpha + \beta \left[r - i\lambda_B + \hat{B}\lambda_B - g \right] - g \right\}. \quad (3.19)$$

Equations (3.17) and (3.19) define the two-dimensional system in the accumulation rate and the bond-to-capital ratio. At an interior steady state, $\lambda_B^* > 0$ implies $\hat{B} = g^*$. The steady-state Jacobian is therefore

$$J_{g, \lambda_B}^* = \begin{bmatrix} -\gamma(1 + \beta) & \gamma\beta(g^* - i) \\ -\lambda_B^* & 0 \end{bmatrix}. \quad (3.20)$$

Three entries of the Jacobian are signed directly: $\partial \dot{g} / \partial g = -\gamma(1 + \beta) < 0$, $\partial \dot{\lambda}_B / \partial g = -\lambda_B^* < 0$, and $\partial \dot{\lambda}_B / \partial \lambda_B = 0$ at the interior steady state. The remaining cross-effect is $\partial \dot{g} / \partial \lambda_B = \gamma\beta(g^* - i)$, which is positive under the same solvency condition $g^* > i$ used above. Under this condition, the steady-state Jacobian has the sign structure

$$J_{g, \lambda_B}^* = \begin{bmatrix} - & + \\ - & 0 \end{bmatrix}. \quad (3.21)$$

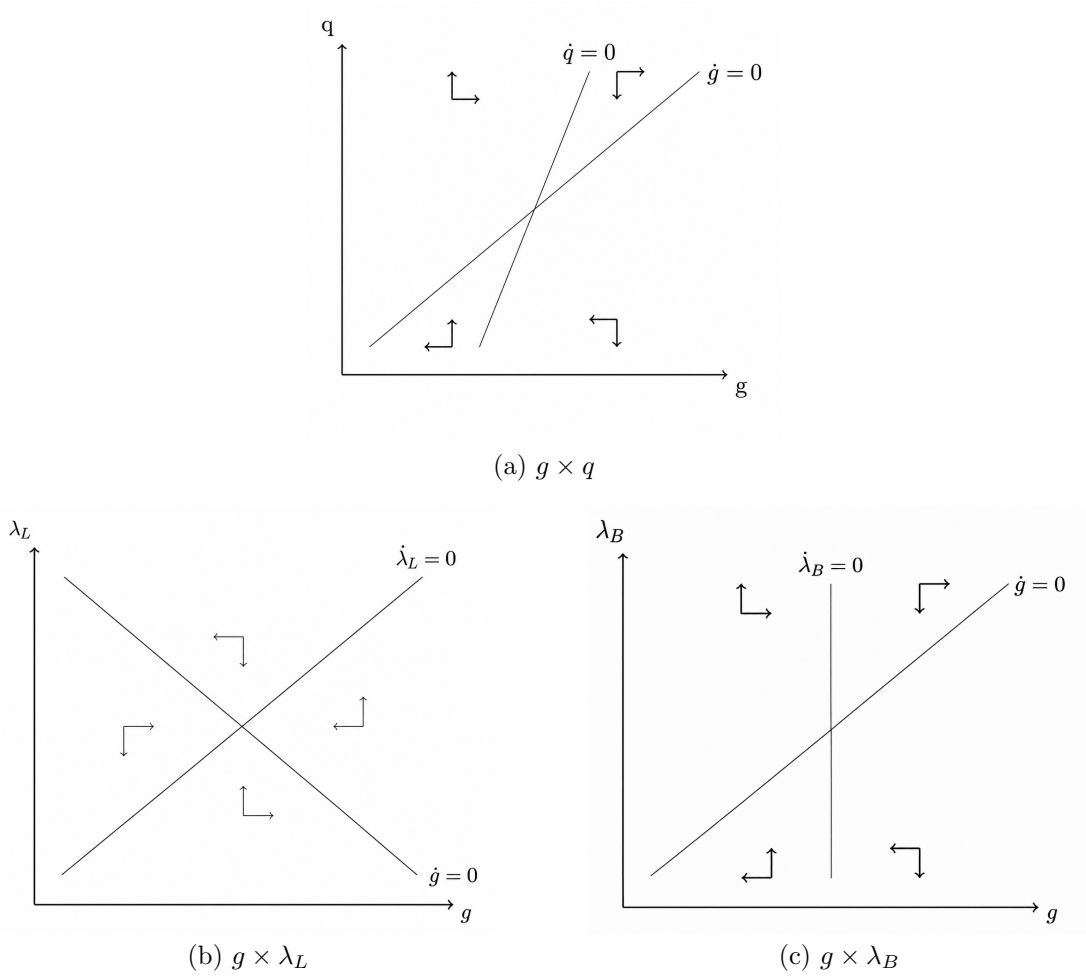


Figure 1: Phase diagrams for the three real-financial systems. The g - q and g - λ_B systems generate clockwise dynamics, while the g - λ_L system generates counterclockwise dynamics.

The opposite-signed cross-effects provide once again the mechanism for cyclical propagation. An increase in the bond-to-capital ratio raises the flow of liquid financial assets available and therefore stimulates accumulation. As g rises, however, the bond-to-capital ratio mechanically declines as the capital-stock denominator expands faster than outstanding bonds, causing λ_B to peak before g . The decline in λ_B weakens the pre-financing channel and eventually causes accumulation to fall. As accumulation slows, the downward pressure on the bond-to-capital ratio is relaxed and λ_B begins to recover. These interactions generate clockwise propagation in the (g, λ_B) plane, with the bond-to-capital ratio leading accumulation, as illustrated in Figure 1(c).

4 Macroeconomic Evidence

4.1 Data and variable construction

This section describes the macroeconomic data used to examine the real–financial interactions developed in Section 3. The analysis focuses on the U.S. nonfinancial corporate business sector and uses quarterly data. Unless otherwise noted, all series are obtained from the Z.1 Financial Accounts of the United States and are identified below by their FRED series codes. The main variables provide empirical counterparts to the state variables in the theoretical models and are described below.

- Investment rate, g_t : calculated as the ratio between gross fixed investment and the lagged capital stock. Gross fixed investment corresponds to nonfinancial corporate business expenditures on nonresidential structures, equipment, and intellectual property products (BOGZ1FA105013005Q). The capital stock is measured using the corresponding series for nonfinancial corporate business nonresidential structures, equipment, and intellectual property products at current cost (BOGZ1FL105013865Q), reported quarterly at the end of the period.¹¹
- Valuation ratio, q_t : measured as the market value of corporate equities relative to net worth for the nonfinancial corporate business sector. The series (NCBCEPNW) is converted from percentage terms to a ratio.¹²
- Leverage ratio, λ_t : calculated as the ratio between total debt liabilities (TCMILB-SNNCB) and the capital stock.
- Loans-to-capital ratio, λ_L : calculated as the ratio between loan liabilities (NCBLL) and the capital stock.
- Debt-securities-to-capital ratio, λ_B : calculated as the ratio between debt securities liabilities (NCBDBIQ027S) and the capital stock.

The baseline sample uses quarterly data from 1952Q1 to 2025Q2. The models are also estimated over a reduced sample beginning in 1984Q1 to preserve comparability with the firm-level sample outlined in Section 5. Since the analysis focuses on medium-run cyclical fluctuations, all variables are expressed in terms of their cyclical components, which are extracted using the Hamilton filter (Hamilton, 2018).¹³ The Hamilton-filtered cyclical components are shown in Appendix A.2. Results from the reduced sample are

¹¹As a robustness measure, an alternative capital stock series is constructed from BEA Fixed Assets Accounts Table 6.1, which reports the current-cost net stock of private fixed assets for nonfinancial corporations at year-end. The annual series is converted to quarterly frequency by linear interpolation.

¹²This measure follows the empirical literature on real–financial and distributive cycles (Barrales-Ruiz et al., 2022; Santetti, 2026). As a robustness exercise, market valuation is alternatively measured as the ratio of corporate equity liabilities to the capital stock, using series NCBEILQ027S.

¹³The Hamilton filter is specified with an eight-quarter horizon and four lags ($h = 8$, $p = 4$), which reduces the effective baseline sample to 1954Q4–2025Q2. As an additional robustness exercise, cyclical components are also constructed using a one-sided Hodrick–Prescott filter with a smoothing parameter of $\lambda = 1600$.

used as a robustness check and are generally consistent with those obtained from the full sample.

4.2 Cyclical patterns

To examine the cyclical relationships between investment and financial variables, we present two-dimensional phase plots constructed from the cyclical components. The data are divided into ten business-cycle windows based on the National Bureau of Economic Research (NBER) classification, with each cycle defined from peak to peak. Following a common procedure in the literature (Zipperer and Skott, 2011; Santetti, 2026), each window is extended by four quarters beyond its last peak to allow the trajectory to develop beyond the dated cycle. Within each window, observations are connected chronologically, and the trajectories provide a descriptive representation of cyclical associations between investment, valuation, and leverage over the business cycle.

Figure 2 plots the cyclical component of the valuation ratio q (y-axis) against the cyclical component of the investment rate g (x-axis). With a few local exceptions, the phase trajectories display a clear clockwise pattern across the majority of business-cycle windows. This pattern is consistent with the mechanism discussed in Section 3.1, which predicts a clockwise cycle between the two variables.

Figure 3 plots the cyclical component of the aggregate leverage ratio λ (y-axis) against the cyclical component of the investment rate, g (x-axis). In contrast to the valuation-investment relationship, no common cyclical pattern emerges across business-cycle windows. This lack of a systematic relationship at the aggregate level motivates the following decomposition of leverage into loans and debt securities.

Figures 4 and 5 show that disaggregation. The loan-to-capital ratio (λ_L) exhibits more recognizable cyclical structure than aggregate leverage. This includes visible counterclockwise trajectories for 1969Q4–1974Q4, 1990Q3–2002Q1, and 2007Q4–2020Q4, as well as locally across different windows. The pattern is nevertheless heterogeneous, with a number of windows displaying changes in orientation over the cycle. The debt securities-to-capital ratio (λ_B), on the other hand, displays a somewhat stronger tendency toward clockwise movement, with identifiable clockwise trajectories across several windows (1969Q4–1974Q4, 1973Q4–1982Q3, 2007Q4–2020Q4, and 2019Q4–2026Q1). We can also observe clockwise movements locally, although other episodes are either difficult to classify or contain limited movements in the opposite direction. The decomposition suggests that the absence of a clear aggregate leverage cycle may conceal differences in the cyclical behavior of the two main forms of debt finance.

The phase diagrams provide a convenient representation of cyclical patterns, but the relative timing of the variables is not always apparent from the trajectories alone. To examine this more systematically, we compute standard sample cross-correlation func-

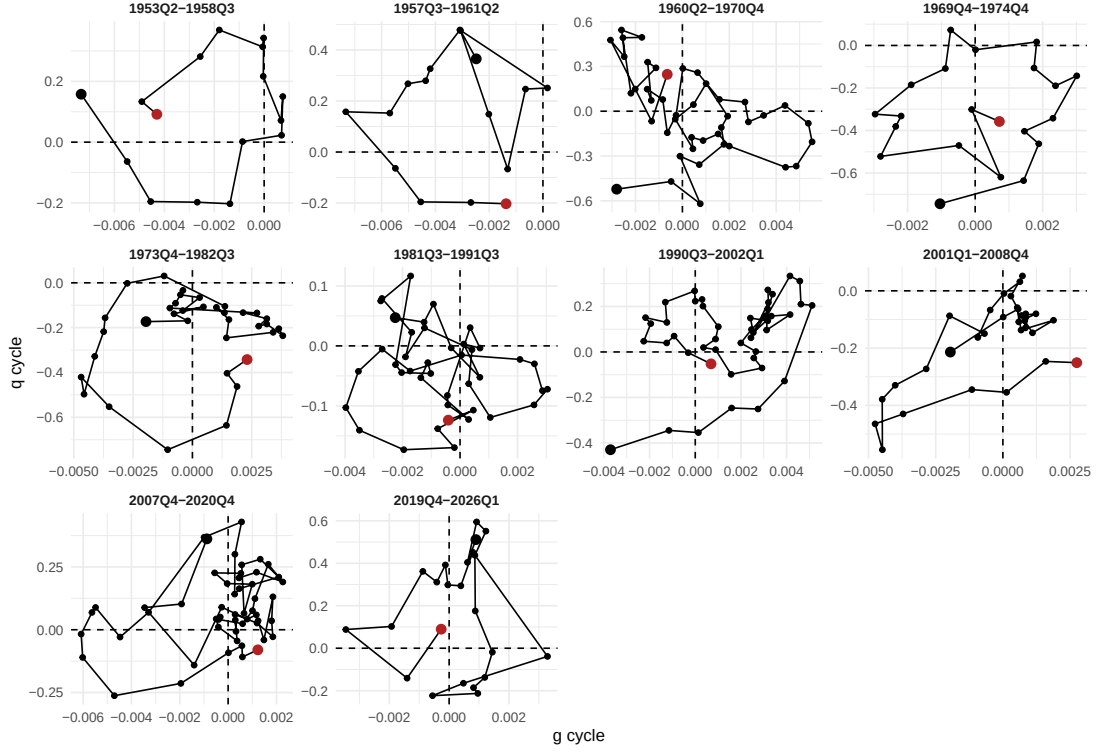


Figure 2: Investment and valuation over the business cycle. Hamilton-filtered phase trajectories for the investment rate, g , and valuation ratio, q . Red circles denote the first observation and black circles the last observation in each business-cycle window.

tions over a range of leads and lags¹⁴. Investment is kept as the common reference variable throughout. Negative lags indicate that the financial variable precedes investment, whereas positive lags indicate that it follows investment. Figure 6 shows the resulting correlations, which can be interpreted as descriptive measures of cyclical timing.

Figure 6a shows the cross-correlation between the valuation ratio and investment. The correlation is positive at negative lags and peaks four quarters before investment. It declines around zero contemporaneously and becomes negative at positive lags, reaching the strongest negative correlation around four quarters after investment. This pattern is consistent with the clockwise phase plots documented above: high valuation tends to precede higher investment and later declines as investment picks up.

Figure 6b reveals substantial differences across forms of debt finance. The loan-to-capital ratio displays the strongest positive correlation with investment, reaching its peak around one quarter afterward. This is consistent with a counterclockwise cyclical

¹⁴Cross-correlation functions are computed using the `ccf()` function in R's `stats` package, following the convention described by Venables and Ripley (2002).

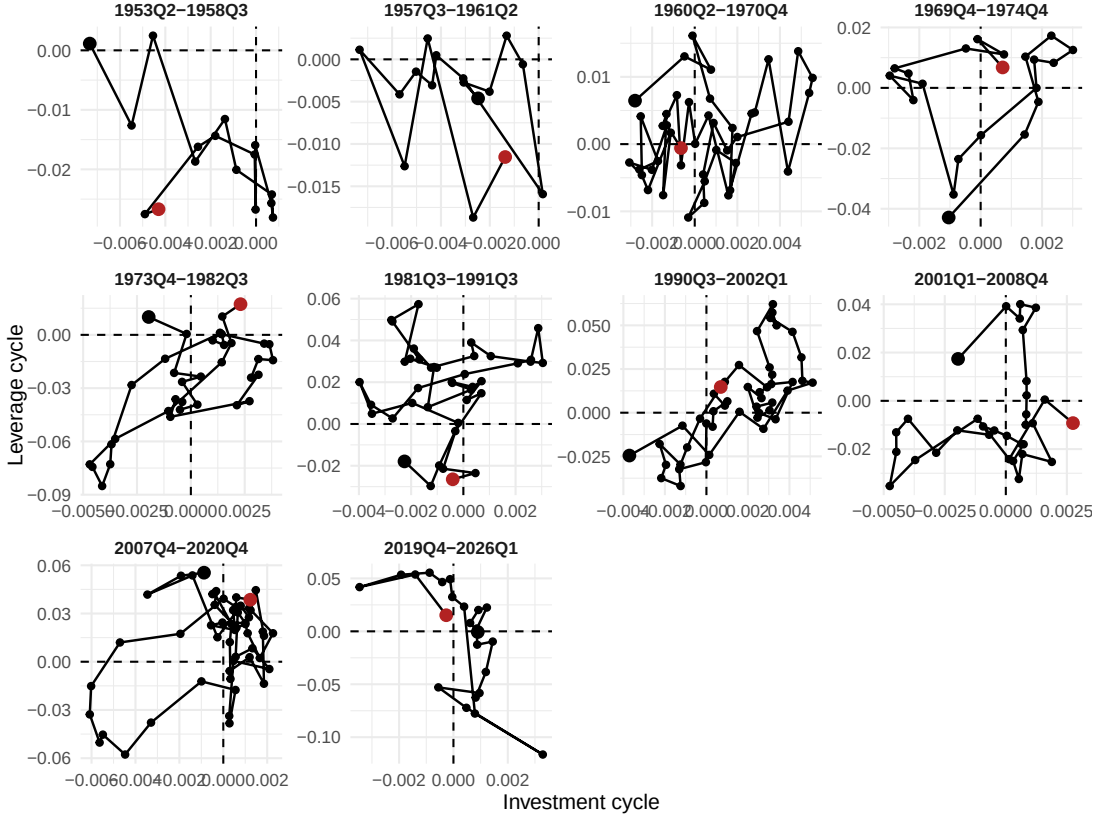


Figure 3: Investment and aggregate leverage over the business cycle. Hamilton-filtered phase trajectories for the investment rate, g , and aggregate leverage ratio, λ . Red circles denote the first observation and black circles the last observation in each business-cycle window.

pattern in which the investment rate leads leverage. Aggregate leverage exhibits a similar but weaker profile, with its strongest correlation centered around the contemporaneous period. Debt securities, on the other hand, show an opposite pattern. Their correlation with investment is positive at longer negative lags, becoming negative contemporaneously and reaching its strongest negative value immediately afterward. This is consistent with a clockwise pattern where debt securities tend to lead investment. The contrast suggests that the weak cyclical structure observed for aggregate leverage hides different timing patterns across its components.

Taken together, the descriptive evidence points to different cyclical relationships between investment and the financial variables. Valuation tends to precede investment in a pattern consistent with clockwise dynamics, while the timing of leverage differs substantially across forms of debt finance. Loans tend to lag investment, while debt securities display a timing profile that is more consistent with a leading role. These patterns, however, do not account for the dynamic feedback between these variables.

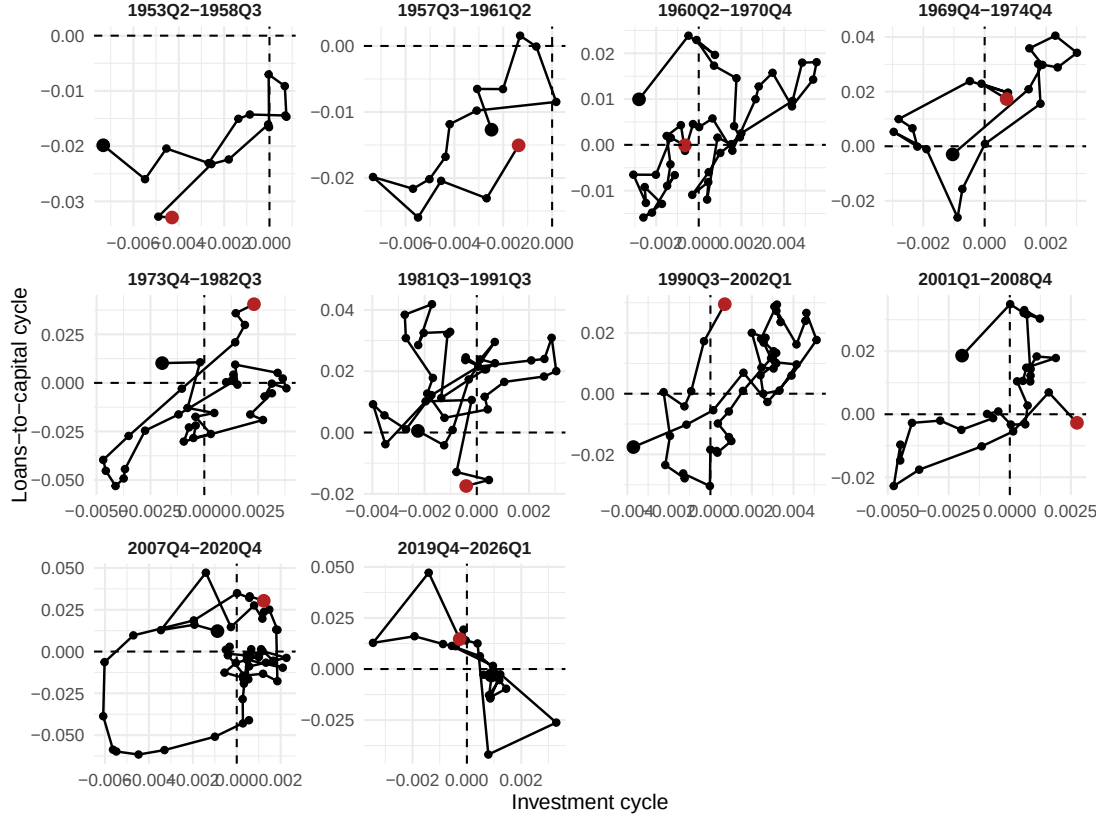


Figure 4: Investment and loans over the business cycle. Hamilton-filtered phase trajectories for the investment rate, g , and loan-to-capital ratio, λ_L . Red circles denote the first observation and black circles the last observation in each business-cycle window.

The next section therefore examines these relationships in a bivariate VAR framework.

4.3 VAR methodology

The VAR analysis outlined in this section examines whether the dynamic interactions implied by the models in Section 3 are also present in the data. In each dynamic system, oppositely signed cross-effects constitute a necessary condition for cyclical propagation. This provides a natural link to the empirical strategy adopted in the literature, where VAR-based methods are used to assess whether the interaction mechanisms implied by dynamic systems are supported by the data (Stockhammer et al., 2019; Stockhammer and Gouzoulis, 2023; Barrales-Ruiz et al., 2022). The resulting dynamic responses are used as empirical counterparts to the cross-variable feedbacks predicted by the models. We therefore estimate separate bivariate systems pairing the investment rate, g , with the valuation ratio, q , aggregate leverage, λ , the loan-to-capital ratio, λ_L , and the debt-securities-to-capital ratio, λ_B .

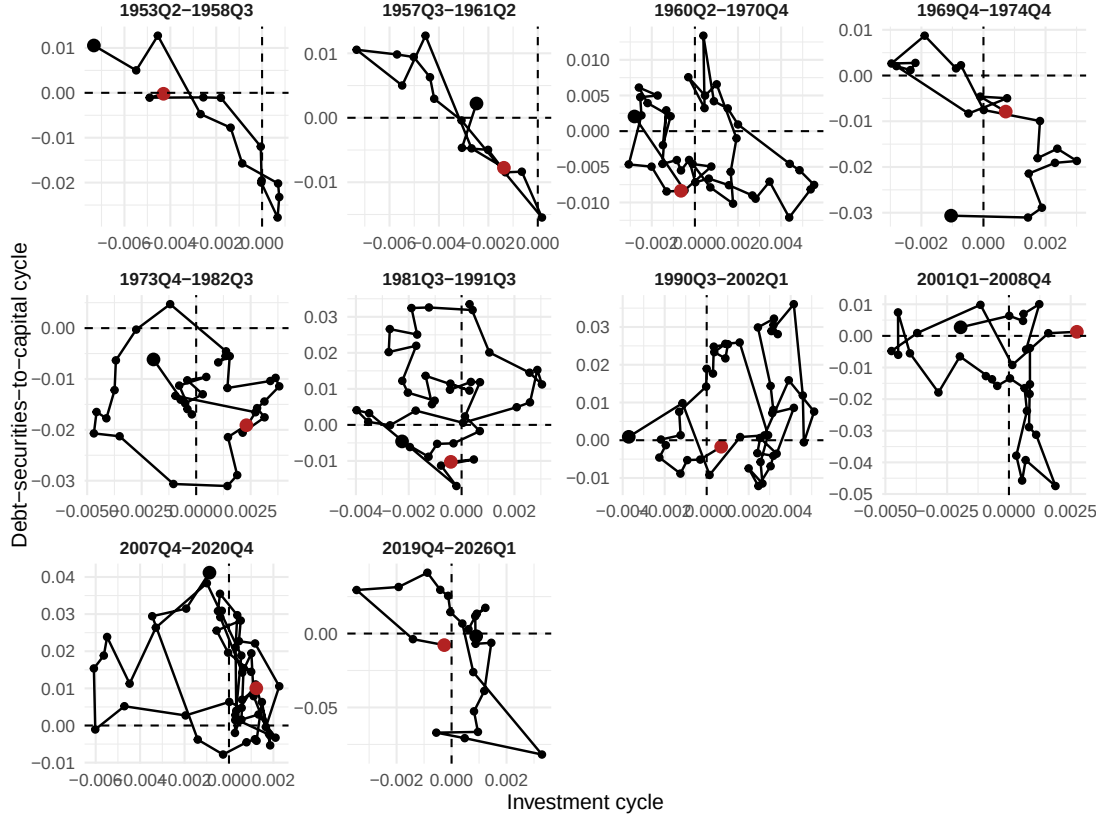


Figure 5: Investment and debt securities over the business cycle. Hamilton-filtered phase trajectories for the investment rate, g , and debt-securities-to-capital ratio, λ_B . Red circles denote the first observation and black circles the last observation in each business-cycle window.

Each system is estimated as a reduced-form VAR of order p ,

$$\mathbf{z}_t = \mathbf{c} + \sum_{i=1}^p \mathbf{A}_i \mathbf{z}_{t-i} + \mathbf{u}_t, \quad (4.1)$$

where

$$\mathbf{z}_t = \begin{pmatrix} g_t \\ x_t \end{pmatrix}, \quad x_t \in \{q_t, \lambda_t, \lambda_{L,t}, \lambda_{B,t}\}.$$

The vector $\mathbf{c}$ contains the intercepts, $\mathbf{A}_i$ denotes the matrix of coefficients associated with lag i , and $\mathbf{u}_t$ is the vector of reduced-form innovations. In this framework, both variables are endogenous, allowing the VAR to capture the two-way feedback mechanisms highlighted by the theoretical models. All variables enter the VARs as Hamilton-filtered cyclical components.

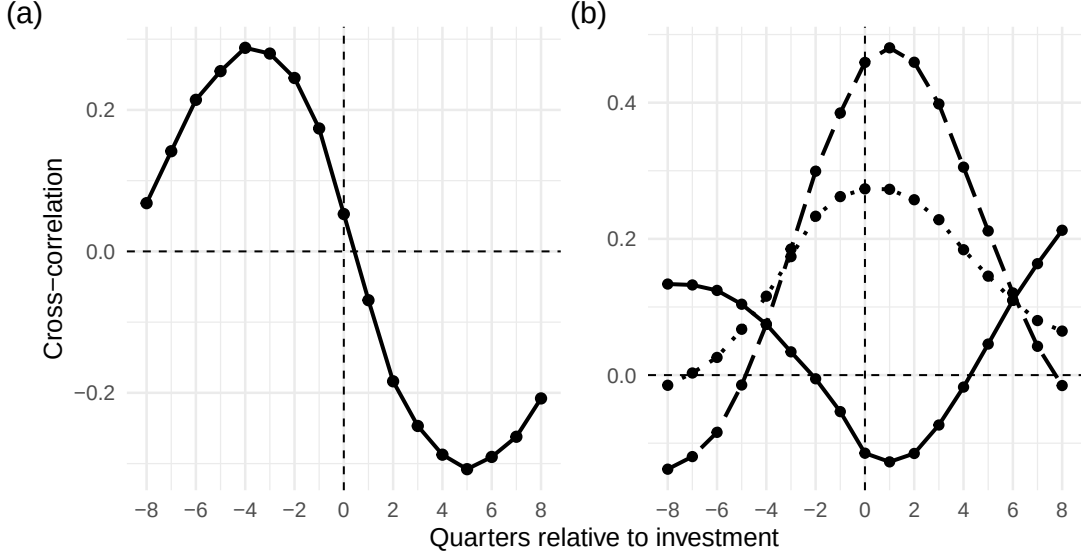


Figure 6: Cyclical timing relative to investment. Cross-correlation functions between the cyclical component of the investment rate and the corresponding financial variables. Panel (a) reports the valuation ratio. In panel (b), the solid line denotes debt securities, the long-dashed line denotes loans, and the dotted line denotes total leverage. Points indicate the estimated cross-correlations at each lag, while lines connect adjacent estimates for visual guidance. Negative lags indicate that the financial variable precedes investment; positive lags indicate that it follows investment.

Before estimating the dynamic responses, the time-series properties and lag structure of each system are assessed. Information criteria are used to determine initial lag-length candidates. The resulting specifications are then evaluated using Breusch–Godfrey tests for residual serial correlation, with the lag order increased where necessary until residual autocorrelation is adequately removed. This procedure yields VAR orders of four lags for the $g-q$ system, five for $g-\lambda$, three for $g-\lambda_L$, and ten for $g-\lambda_B$ in the baseline sample.¹⁵ All estimated systems are dynamically stable, with the roots of their companion matrices lying inside the unit circle.

We examine the dynamic interactions between investment and the financial variables using impulse-response functions (IRFs) based on shocks orthogonalized through a Cholesky decomposition (Sims, 1980). The Cholesky decomposition requires a recursive ordering of the variables, which determines their contemporaneous responses to the identified shocks. In each bivariate system, the investment rate is ordered before the financial variable, (g, x) . Therefore, the financial variable may respond contemporaneously to an innovation in investment, but not the other way around. For the $g-q$ system, this ordering follows the same logic as Barrales-Ruiz et al. (2022), who

¹⁵Although the debt-securities specification requires a relatively large number of lags, ten quarters correspond to two and a half years of dynamics, which remains within a conventional business-cycle horizon.

Table 1: Granger-causality and instantaneous-dependence tests

System	Granger causality		Instantaneous dependence
	Financial variable $\rightarrow g$	$g \rightarrow$ financial variable	
$g-q$	< 0.001	< 0.001	0.896
$g-\lambda$	0.102	0.608	0.770
$g-\lambda_L$	0.004	< 0.001	0.031
$g-\lambda_B$	0.178	0.254	< 0.001

Notes: Reported values are p -values. Granger-causality tests assess whether lagged values of one variable provide predictive information for the other, conditional on its own history. Instantaneous-dependence tests assess whether the reduced-form innovations of the two equations are contemporaneously uncorrelated after accounting for the lagged dynamics of the VAR. Granger causality is interpreted as predictive content rather than structural causality. Tests follow Granger (1969) and Lütkepohl (2005).

place Tobin’s q after the activity variable on the grounds that financial-market valuation adjusts more rapidly than real-side activity. The same ordering is retained in the leverage specifications to maintain a common identification scheme across the four bivariate systems. Figure 7 presents the cross-feedback IRFs for each system. As complementary evidence, Table 1 reports Granger-causality and instantaneous-dependence tests (Granger, 1969; Lütkepohl, 2005).

4.4 Results

The $g-q$ system provides the clearest evidence of the cyclical interactions predicted by the models.¹⁶ As shown in Figure 7, a positive shock to the valuation ratio raises the investment rate, with the response remaining statistically significant for about seven quarters. In the opposite direction, a positive investment shock reduces the valuation ratio, with a statistically significant response that extends for about ten quarters. The estimated responses are therefore consistent with the clockwise cycle predicted by $g-q$ system in Section 3.1. This result is also consistent with the descriptive evidence in Section 4.2, which indicates that movements in valuation tend to precede movements in investment, and with the results of Barrales-Ruiz et al. (2022) for a clockwise interaction between economic activity and Tobin’s q . The Granger-causality tests in Table 1 provide complementary evidence of significant predictive relationships in both directions.¹⁷

¹⁶Using the alternative valuation measure based on corporate equity liabilities relative to the capital stock preserves the qualitative response pattern. The positive response of investment to valuation remains statistically significant, while the negative response of valuation to investment is no longer statistically significant at the 5% level.

¹⁷The VARs are also re-estimated over the reduced sample beginning in 1984Q1 to preserve comparability with the firm-level analysis. The main qualitative results are preserved. In the $g-q$ system, the positive response of investment to valuation and the negative response of valuation to investment both remain statistically significant. The debt-securities system likewise retains the oppositely signed

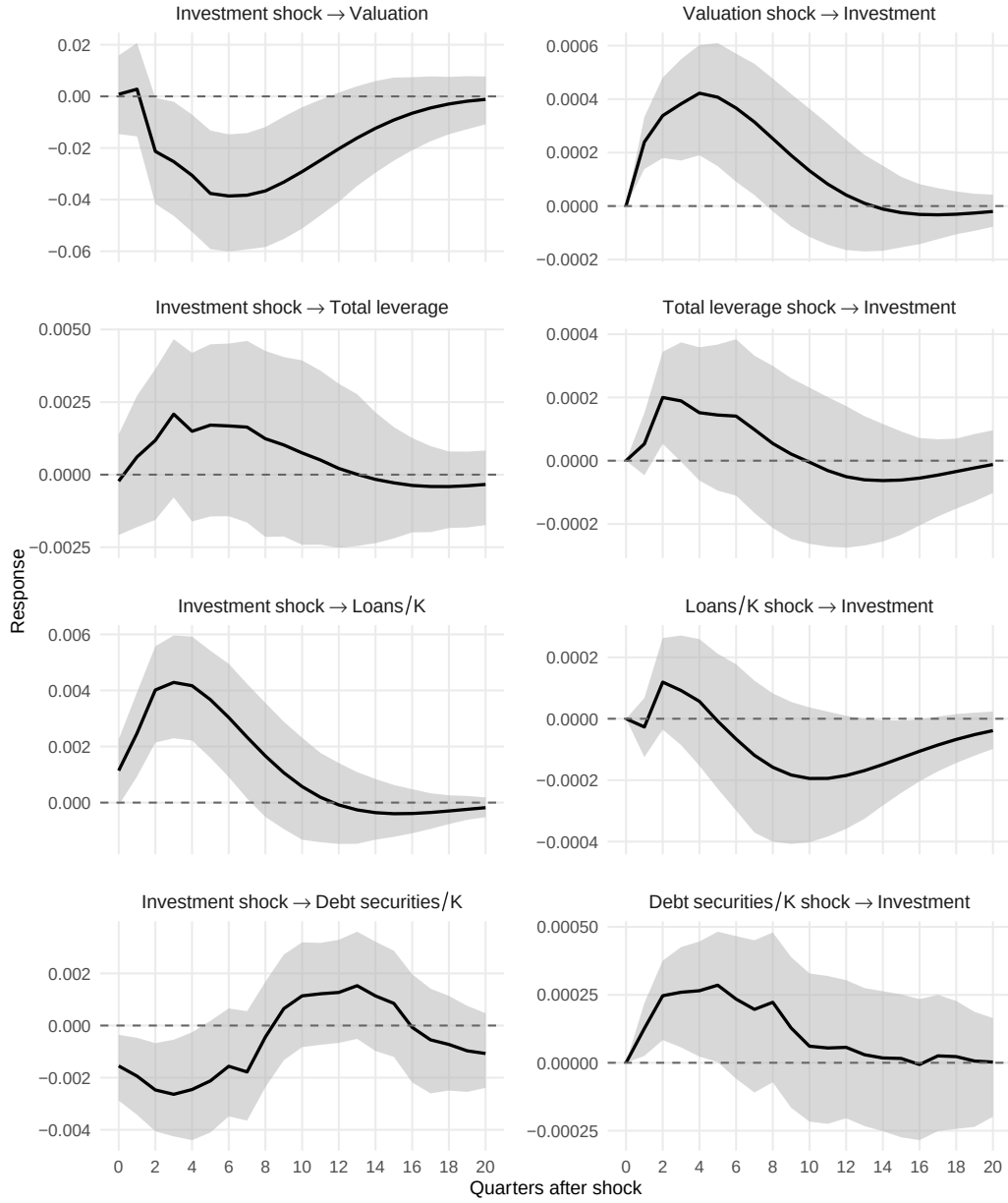


Figure 7: Impulse-response functions for the baseline macroeconomic VARs. The figure reports orthogonalized impulse responses over a 20-quarter horizon for the bivariate systems relating the investment rate to the valuation ratio, aggregate leverage, loans, and debt securities. Shaded areas denote 95% bootstrap confidence intervals based on 1,000 replications. All variables are Hamilton-filtered cyclical components. Shocks are orthogonalized using a Cholesky decomposition with the investment rate ordered first in each system.

The aggregate leverage system provides much weaker evidence of a cyclical interaction. A positive shock to λ produces only a short-lived statistically significant increase in the investment rate, while an investment shock does not generate a statistically significant response in λ . The Granger-causality tests provide no significant evidence of predictive relationships in either direction. Taken together with the evidence in Section 4.2, these results do not support a clear cyclical cross-feedback mechanism between investment and aggregate leverage.

The disaggregation of leverage into loans and debt securities reveals much clearer cyclical interactions with investment. A positive investment shock significantly raises λ_L , while a positive shock to λ_L eventually reduces the investment rate, with the negative response becoming statistically significant only at longer horizons. These responses are consistent with the counterclockwise cycle predicted by the g - λ_L system in Section 3.2, in which higher investment is followed by rising leverage and the subsequent increase in leverage ends up restraining investment. Debt securities display the opposite pattern. A positive shock to λ_B raises the investment rate over the following quarters, while a positive investment shock reduces λ_B . This is consistent with the clockwise cycle predicted by the system in Section 3.3. These results reinforce the idea that the weak relationship observed for aggregate leverage masks distinct cyclical dynamics across different forms of debt finance. The Granger-causality tests provide complementary evidence of significant predictive relationships in both directions for loans. For debt securities, no significant lagged predictive relationships are detected, although the innovations exhibit significant contemporaneous dependence.¹⁸

Taken together, the macroeconomic evidence points to systematic cyclical interactions between investment and financial variables, while also highlighting important differences in timing and across forms of external finance. Aggregate data, however, cannot reveal whether these relationships characterize firms broadly or are driven by particular segments of the nonfinancial corporate sector. The following section therefore turns to firm-level data to examine whether similar cyclical interactions persist after disaggregation and whether their strength varies systematically across firm size.

5 Firm-level Evidence

5.1 Data and Variable Construction

The firm-level analysis uses quarterly data from Compustat North America for publicly traded U.S. nonfinancial corporations. Financial firms and utilities are excluded

and statistically significant cross-responses associated with a clockwise cycle, while aggregate leverage continues to display weak dynamics. For loans, an investment shock continues to raise the loan-to-capital ratio, while the negative response of investment to a loan shock is preserved but does not reach statistical significance at the 5% level over the shorter sample.

¹⁸The null of no instantaneous dependence is rejected for the g - λ_B system ($p < 0.001$), and the contemporaneous correlation between the reduced-form residuals is approximately -0.21 . This test establishes contemporaneous dependence but does not identify its direction.

from the sample.¹⁹ The analysis covers 1984Q1 through 2026Q1, with the starting date determined by the availability and coverage of the variables required to construct the investment and financial ratios. The firm-level variables are constructed to correspond as closely as possible to their aggregate counterparts and are identified by their Compustat item codes:

- Capital stock, K : measured using gross property, plant, and equipment (`ppegtq`) in the baseline specification. Net property, plant, and equipment (`ppentq`) is used as an alternative measure for robustness²⁰.
- Investment rate, g_t : calculated as the ratio between capital expenditures (`capxy`) and the lagged capital stock.²¹
- Valuation ratio, q_t : defined as market equity relative to the capital stock, with market equity calculated as the quarter-end share price (`prccq`) multiplied by common shares outstanding (`cshoq`).
- Leverage, λ_t : defined as total debt relative to the capital stock, where total debt is the sum of short-term debt (`d1cq`) and long-term debt (`d1ttq`).

To construct the firm-level series, the underlying components are first aggregated across firms within each calendar quarter and the corresponding ratios are then formed from these aggregate sums. This ratio-of-sums approach is used as the baseline because it provides the closest firm-level analogue to the sectoral aggregates used in the macro analysis. As a complementary specification, quarterly cross-sectional medians of the firm-level ratios are constructed, giving each firm equal influence in the cross-sectional statistic and reducing the dominance of the largest firms.²² The cyclical components of both specifications are then extracted using the same Hamilton filter specification employed in Section 4 and shown in Appendix A.3. Further details on the construction of the firm-level aggregates, sample restrictions, and missing-data treatment are provided in Appendix A.4.

¹⁹Financial firms are identified by SIC codes 6000–6999 and utilities by SIC codes 4900–4999. The 1984Q1–2026Q1 unrestricted panel contains 918,923 firm-quarter observations covering 20,535 firms.

²⁰Neither Compustat measure corresponds exactly to the current-cost net capital stock used in the aggregate analysis, since Compustat reports property, plant, and equipment at historical cost. In the firm-level data, however, the gross measure produces investment, valuation, and leverage ratios whose levels more closely match their aggregate counterparts, while the cyclical components are highly similar under the two capital-stock definitions. Gross capital is therefore used as the baseline measure, with the net specification serving as a robustness check.

²¹Quarterly investment flows are obtained by using first-quarter capital expenditures directly and differencing consecutive fiscal-quarter observations thereafter. For the ratio-of-sums specification, aggregate capital expenditures are seasonally adjusted using X-13ARIMA-SEATS before constructing the investment rate. For the median specification, the quarterly cross-sectional median investment-rate series is constructed first and then seasonally adjusted using X-13ARIMA-SEATS.

²²For the median specification, the medians within each bivariate system are calculated over the common set of firms with valid observations for both variables in a given quarter.

5.2 Cyclical Patterns

We now turn to the phase plots for the firm-level investment and financial ratios. As in the macroeconomic analysis, the cyclical trajectories are traced over NBER peak-to-peak business-cycle windows, with completed cycles extended four quarters beyond the final peak.²³

Figure 8 shows the phase diagrams for the cyclical components of the firm-level investment rate and Tobin's q . The trajectories display a predominantly clockwise orientation across business cycles. This result reproduces the aggregate evidence in Section 4.2 as well as the theoretical trajectories in Section 3.1.

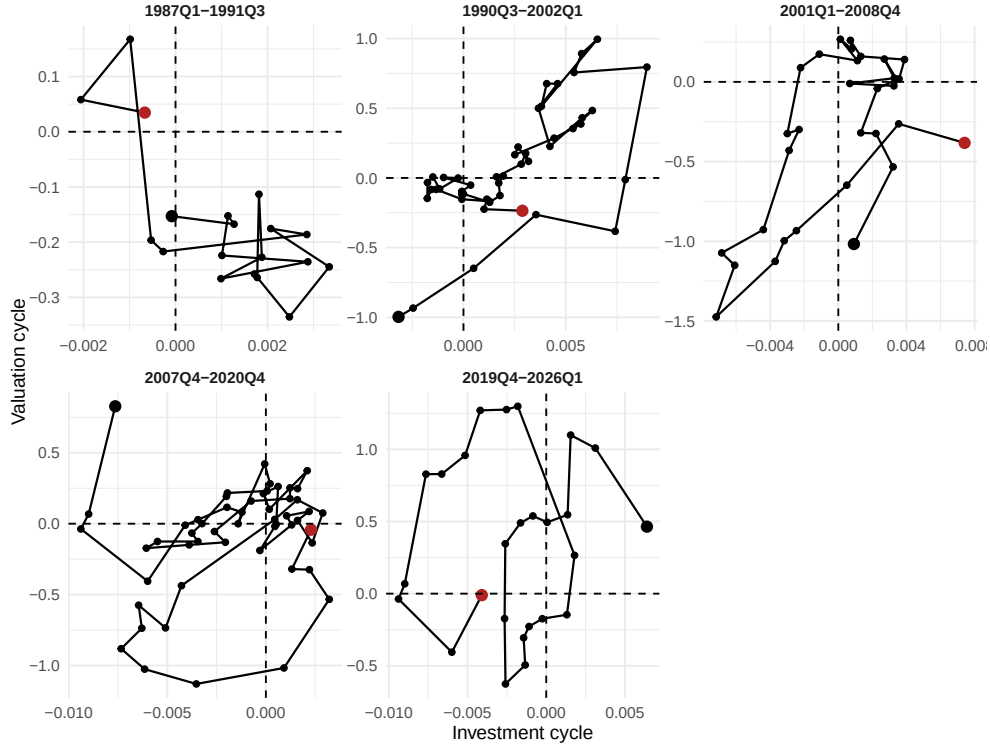


Figure 8: Phase diagrams for the Hamilton-filtered cyclical components of the firm-level investment rate and Tobin's q . The red circle indicates the first observation and the black circle the final observation in each window. The first plotted window begins in 1987Q1 and therefore covers only part of the 1981Q3–1991Q3 NBER cycle.

Figure 9 presents the corresponding phase diagrams for the investment rate and leverage. In contrast to the g – q relationship, the trajectories do not exhibit a consistent cyclical orientation across business cycles. This result closely parallels the macroeconomic evidence for aggregate leverage in Section 4.2.

²³Because the Hamilton filter removes the initial observations, the first available firm-level cycle begins in 1987Q1 and therefore covers only part of the 1981Q3–1991Q3 NBER window.

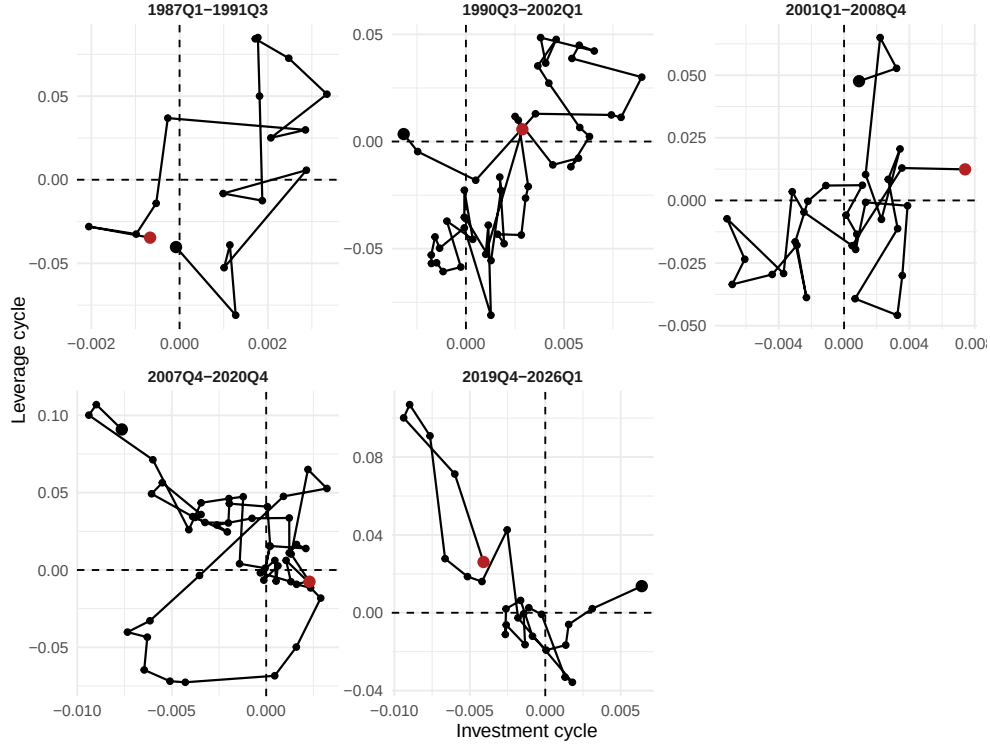


Figure 9: Phase diagrams for the Hamilton-filtered cyclical components of the firm-level investment rate and leverage. The red circle indicates the first observation and the black circle the final observation in each window. The first plotted window begins in 1987Q1 and therefore does not cover the full 1981Q3–1991Q3 NBER cycle.

Figure 10 repeats the investment-leverage phase-plot analysis using quarterly cross-sectional medians. In contrast to the ratio-of-sums specification, the median trajectories display a much clearer counterclockwise pattern. This is particularly visible in three of the business-cycle windows, 1990Q3–2002Q1, 2001Q1–2008Q4, and 2007Q4–2020Q4. This cyclical pattern is consistent with the loan-finance dynamics derived in Section 3.2 and with the cyclical behavior of the loan-to-capital ratio documented in Section 4.2. A direct comparison is limited, however, since Compustat total debt does not distinguish between loans and debt securities.

The contrast between the two aggregation methods also points to a potential role for firm-size heterogeneity. Whereas the ratio-of-sums specification gives greater influence to firms with larger balance sheets, the cross-sectional median gives firms equal weight in the quarterly statistic. The emergence of counterclockwise dynamics under median aggregation therefore raises the possibility that the investment-leverage relationship differs systematically across the firm-size distribution. This motivates the size decomposition considered in the VAR analysis below.

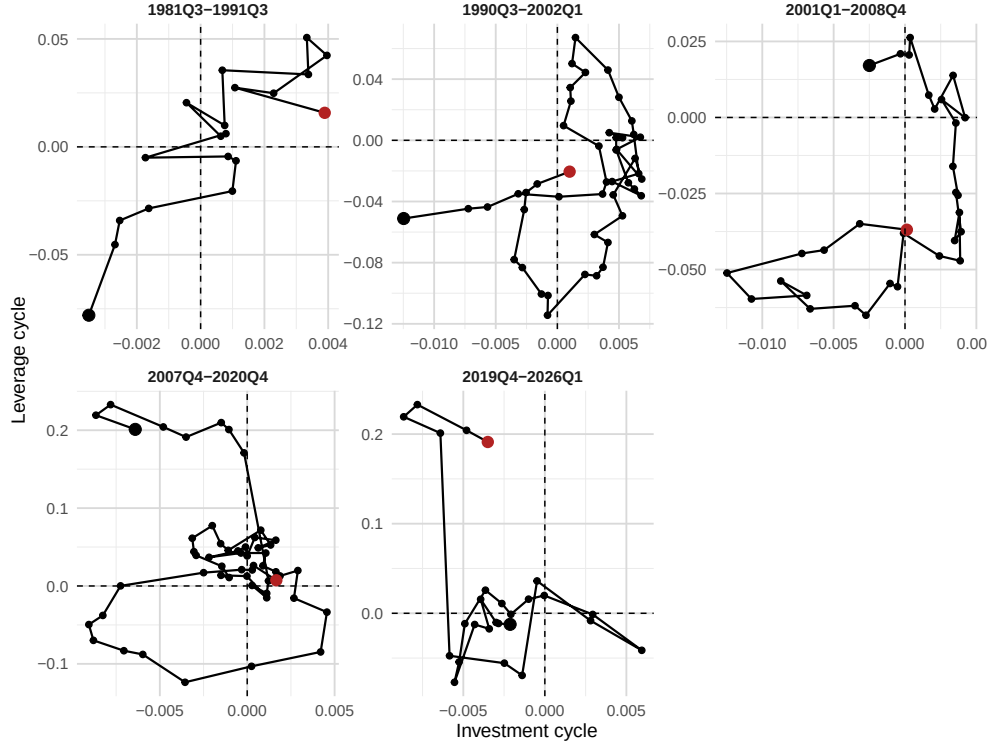


Figure 10: Phase diagrams for the Hamilton-filtered cyclical components of the quarterly median firm-level investment rate and leverage. The red circle indicates the first observation and the black circle the final observation in each window. The first plotted window begins in 1987Q1 rather than at the 1981Q3 NBER peak and therefore covers only the latter part of the 1981Q3–1991Q3 cycle.

5.3 VAR Evidence

We begin by examining the dynamic interactions among the full-sample firm-level aggregates using the same bivariate VAR methodology employed in Section 4.3. We estimate separate systems for investment and valuation ratio, (g, q) , and for investment and leverage, (g, λ) , using the ratio-of-sums series described above. As before, investment is ordered first in the Cholesky decomposition, so the financial variable may respond contemporaneously to an investment shock, whereas investment responds to innovations in the financial variable only with a lag. Results are reported using both net and gross measures of the capital stock.

All VARs are estimated using the Hamilton-filtered cyclical components of the firm-level series. Lag lengths are selected following the same procedure used in Section 4.3, with information criteria used as a guide and the final specification chosen to avoid residual serial correlation. This procedure yields a VAR(4) for the (g, q) system and a VAR(2) for the (g, λ) system under both the net- and gross-capital specifications. The

resulting models satisfy the residual serial-correlation diagnostics and are dynamically stable.

The full-sample impulse-response functions are shown in Figure 11. The results provide strong evidence of the cyclical propagation mechanism predicted by the valuation model. A positive innovation to q generates a positive and statistically significant response of investment for approximately seven quarters under both specifications. In the opposite direction, a positive investment shock is followed by a negative response of q at longer horizons, becoming statistically significant at approximately quarters 8-12. These responses are consistent with the theoretical cross-feedbacks derived in Section 3.1 and with the aggregate evidence presented in Section 4.3. Taken together, the results support clockwise dynamics in the (g, q) plane, in which valuation leads investment over the cycle.

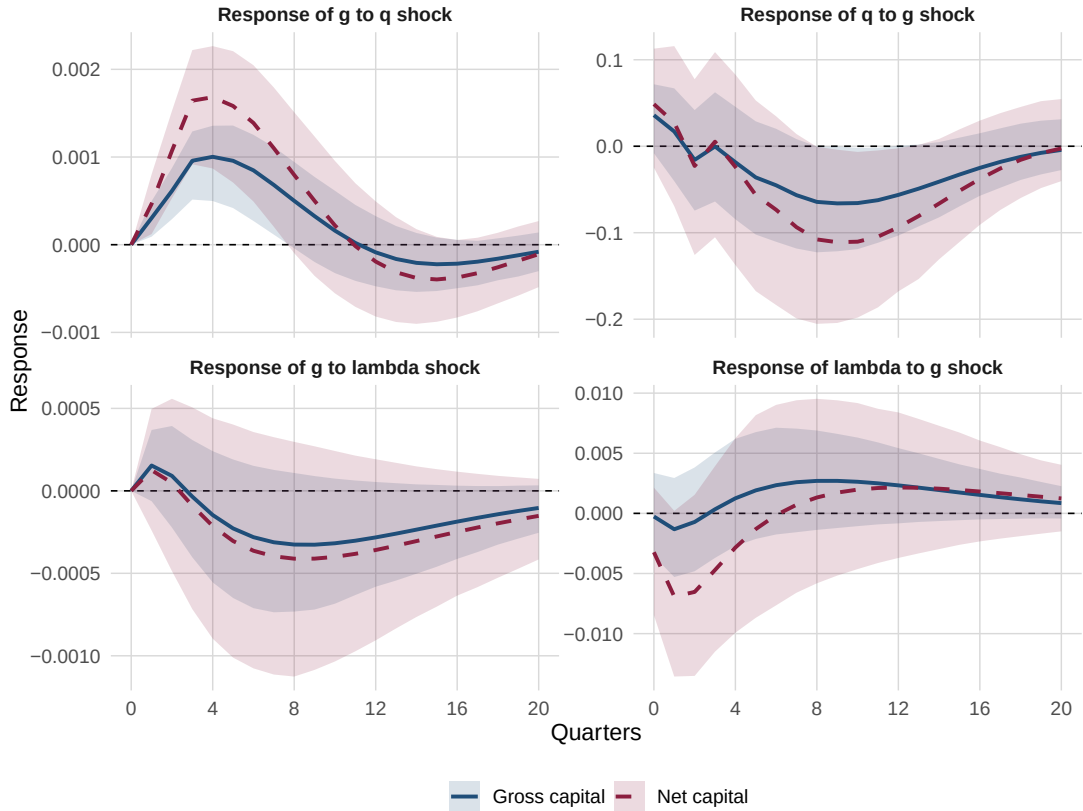


Figure 11: Full-Sample Firm-Level Impulse-Response Functions. The figure reports orthogonalized impulse-response functions from the full-sample firm-level VARs using net and gross measures of the capital stock. Shaded areas denote 95% bootstrap confidence intervals based on 2,000 replications. Responses are reported over a 20-quarter horizon.

The full-sample (g, λ) system does not recover a clear pattern of cyclical propagation.

Under both specifications, the cross-responses are generally imprecisely estimated and do not display statistically significant cross-feedbacks. These findings are also consistent with the weak (g, λ) IRFs reported in Section 4.3, suggesting that aggregate leverage may obscure underlying heterogeneity in financing dynamics. This motivates the next step of the analysis, which examines whether the investment–leverage relationship varies systematically across firm size.

To investigate this possibility, we reconstruct the (g, λ) system for subsamples defined by firm size, ranking firms within each quarter according to lagged total assets²⁴. The size-based analysis imposes a common-firm restriction, so that investment and leverage are constructed from the same set of firms within each quarter. This restriction reduces the possibility that the estimated cross-dynamics reflect differences in the composition of firms contributing to each variable rather than their underlying interaction. We first examine firms in the bottom 75 percent²⁵ of the size distribution and then compare the resulting dynamics with progressively broader and upper-tail size groups.

VARs are again estimated using the cyclical components, with the same lag-selection procedure yielding a VAR(5) under the gross-capital specification and a VAR(4) under the net-capital specification. Figure 12 presents the corresponding impulse-response functions for firms in the bottom 75 percent of the size distribution.

The estimated cross-effects reveal substantially stronger investment–leverage dynamics than in the full sample. Under the gross-capital specification, a positive investment shock generates a positive and statistically significant response of leverage through approximately the first seven quarters, while a positive leverage shock produces a negative and statistically significant response of investment from roughly quarters 2 through 9. The net-capital specification exhibits the same qualitative pattern, although the positive response of leverage to an investment shock is weaker and shorter-lived, while the negative response of investment to leverage remains statistically significant over several quarters. These opposite-signed cross-feedbacks are consistent with the counterclockwise dynamics predicted by the loan-finance model in Section 3.2 and with the empirical evidence for the (g, λ_L) model in Section 4.3.

We complement this evidence by examining how the lead–lag relationship between investment and leverage varies with firm size. Figure 13 reports the cross-correlation functions across alternative size groups. Using the baseline gross-capital specification, we calculate cross-correlations for the bottom 75, 90, and 95 percent of the size distribution.

²⁴Following Crouzet and Mehrotra (2020), firms are classified by their lagged position in the cross-sectional distribution of total assets. Using lagged rather than contemporaneous size reduces the possibility that cyclical changes in firm outcomes mechanically induce reclassification across size groups. Total assets also provide a comparatively stable measure of firm size at quarterly frequencies.

²⁵An initial decomposition by firm-size quartiles showed that the top 25 percent accounts for a disproportionate share of the aggregate balance-sheet quantities entering the ratio-of-sums series. As a result, the top-quartile series closely tracks the full-sample aggregates, while the bottom three quartiles display more distinct dynamics. The Bottom 75 percent grouping is therefore used to isolate the behavior of firms outside the upper tail of the size distribution.

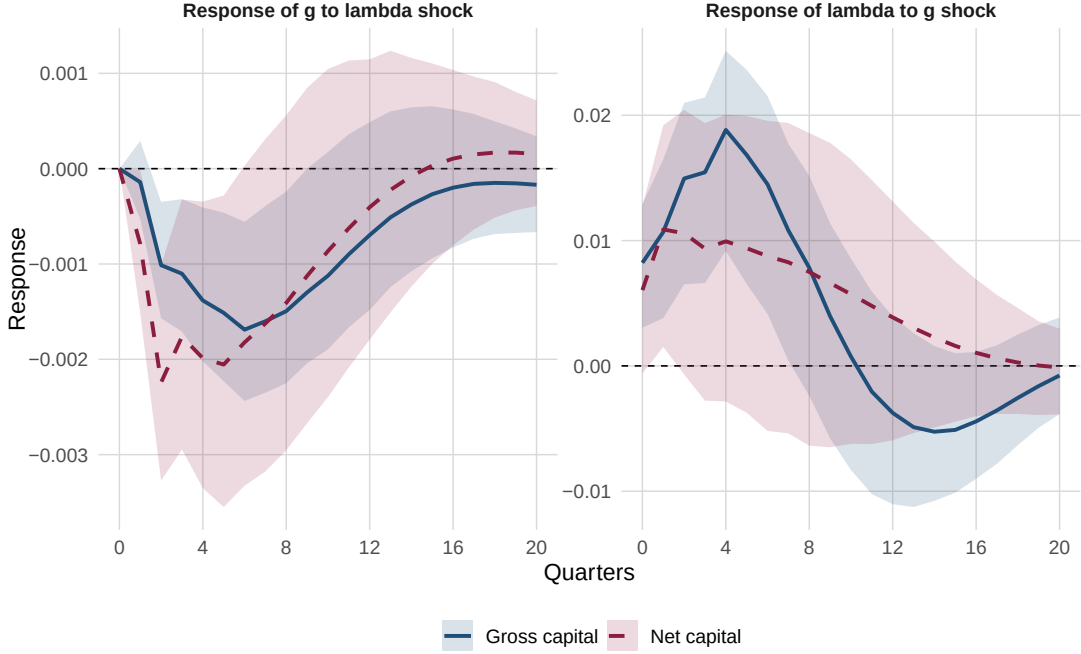


Figure 12: Firm-Level Impulse-Response Functions: Bottom 75 Percent of the Size Distribution. The figure reports orthogonalized impulse-response functions from the investment-leverage VARs for firms in the bottom 75 percent of the size distribution under net- and gross-capital specifications. Shaded areas denote 95% bootstrap confidence intervals based on 2,000 replications. Responses are shown over a 20-quarter horizon.

bution, the full size-classified sample, and the top 5 and top 1 percent of firms. Negative lags represent correlations between current leverage and preceding values of investment, whereas positive lags represent correlations between current leverage and subsequent values of investment. Positive correlations indicate same-signed comovement at the corresponding lead or lag, while negative correlations indicate opposite-signed comovement.

The cross-correlations reveal a pronounced size gradient in the investment-leverage relationship. For firms in the bottom 75 percent of the size distribution, the strongest correlations occur at negative lags and are positive, peaking at approximately 0.38 when investment precedes leverage by two quarters. At positive lags, the correlations subsequently turn negative, reaching approximately -0.25 when leverage precedes investment by four quarters. This sequence is consistent with the counterclockwise dynamics of the loan-finance model, in which higher investment is followed by rising leverage and higher leverage is subsequently associated with lower investment. The pattern becomes progressively weaker as larger firms are incorporated into the sample: the positive investment-leading correlations decline for the bottom 90 and 95 percent groups and largely disappear in the full size-classified sample, while the top 5

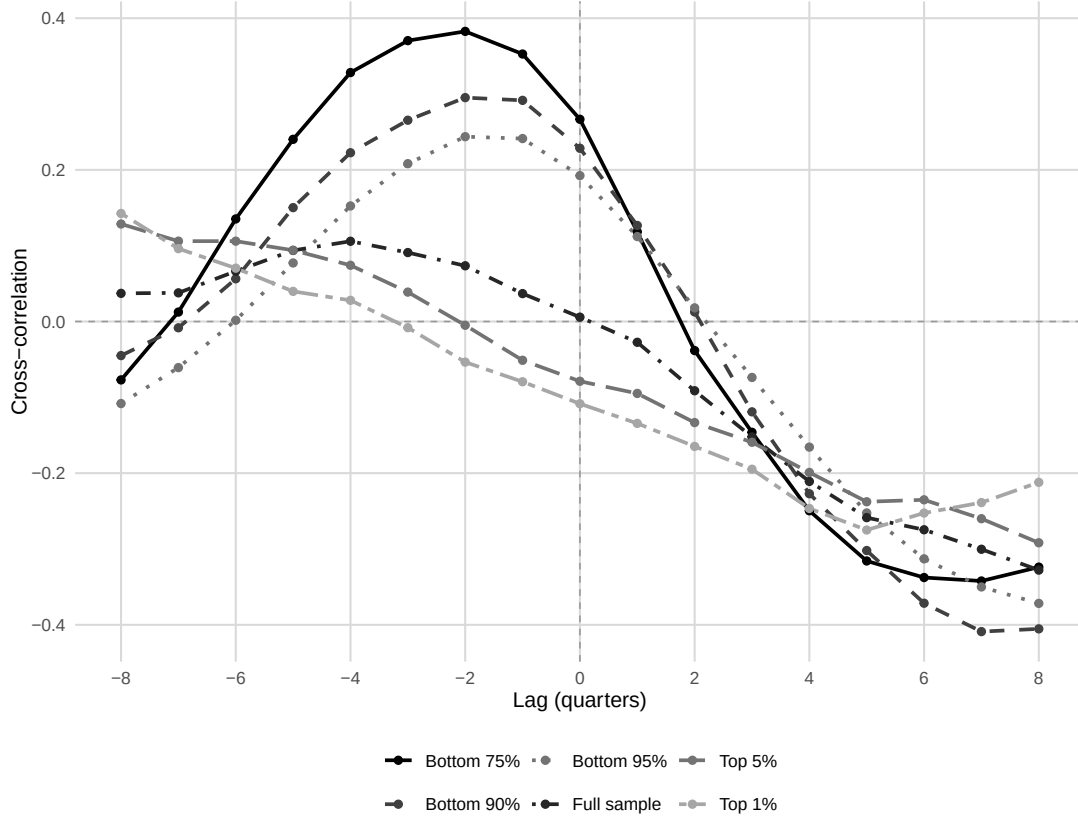


Figure 13: Cross-Correlation Functions of Investment and Leverage by Firm Size. The figure reports cross-correlations between the cyclical components of investment and leverage under the gross-capital specification for alternative firm-size groups. Negative lags relate current leverage to preceding values of investment, while positive lags relate current leverage to subsequent values of investment. The bottom 75, 90, and 95 percent groups are cumulative size cutoffs, while the top 5 and top 1 percent isolate firms in the upper tail of the size distribution.

and top 1 percent exhibit predominantly negative correlations. The weak full-sample investment–leverage dynamics therefore appear to conceal substantial heterogeneity across the firm-size distribution.

Although Compustat debt measures do not distinguish bank loans from debt securities, the size gradient is suggestive of differences in the underlying sources of external finance. Existing evidence indicates that smaller firms tend to be more dependent on bank finance, while larger firms have greater access to and make greater use of bond-market finance (Hale and Santos, 2008; Colla et al., 2013; Bräuning et al., 2021). In this context, the concentration of counterclockwise investment–leverage dynamics among firms at the lower end of the firm-size distribution is consistent with the loan-finance mechanism developed in Section 3.2 and with the loan-system evidence in Section 4.3. As progressively larger firms are incorporated into the sample, these dynamics weaken,

consistent with a financing mix that becomes less dependent on bank credit and increasingly includes market-based debt. While the Compustat data do not permit the underlying debt instruments to be identified directly, these results are consistent with the aggregate evidence that loans and debt securities occupy different positions in the investment cycle.

6 Conclusions

This paper examined whether distinct dimensions of corporate finance generate different cyclical interactions with investment in the U.S. nonfinancial corporate sector. Building on post-Keynesian and structuralist theories of real-financial cycles, it developed three stylized dynamic models linking investment to equity valuation, loans, and debt securities, each generating distinct predictions for the direction and timing of the underlying cross-feedbacks. These predictions were then examined using both aggregate and firm-level data, allowing the analysis to compare alternative financial mechanisms within a common investment-centered framework and to explore whether the resulting dynamics vary systematically across firms.

The macroeconomic analysis reveal different cyclical patterns across financial variables. Tobin's q exhibits the most robust relationship with investment: valuation tends to lead the investment cycle, and the two variables display the clockwise dynamics predicted by the q model. By contrast, aggregate leverage exhibits little systematic cyclical interaction with investment. Once debt is disaggregated, however, distinct patterns emerge. Loan leverage tends to lag investment, consistent with the counterclockwise dynamics of the Minskyan debt-cycle mechanism, whereas debt securities tend to lead investment and display a clockwise pattern.

The firm-level evidence adds an important dimension to the aggregate results by showing that the investment-leverage relationship varies systematically across the firm-size distribution. While the full-sample leverage doesn't exhibit meaningful cyclical patterns, counterclockwise dynamics become much clearer among firms outside the upper tail of the size distribution. For firms in the bottom 75 percent, investment shocks raise leverage and leverage shocks subsequently depress investment, closely matching the mechanism predicted by the loan-finance model. These patterns weaken as progressively larger firms are incorporated into the sample, indicating that aggregate leverage can conceal substantial heterogeneity in the financial dynamics faced by different firms.

These findings suggest that there is no single corporate financial cycle. The cyclical relationship between investment and finance depends on the type of financial instrument and on the firms through which that financing operates. Treating corporate debt as a single aggregate can therefore obscure qualitatively different dynamics associated with distinct debt instruments, just as firm-level data can conceal important heterogeneity across the size distribution. The size gradient is consistent with differences in firms' access to external finance, since smaller firms tend to rely more heavily on bank credit while larger firms have greater access to marketable debt. This interpretation

remains suggestive, however, since Compustat has not data on debt structure. Future research could use more detailed firm-level balance-sheet and capital-structure data to test whether the loan and bond dynamics observed in the aggregate data are also present across individual firms.

7 Bibliography

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A Appendix

A.1 Steady States and Local Stability

This appendix derives the steady states and local stability conditions for the three systems in Section 3. For a two-dimensional continuous-time system, an interior steady state is locally asymptotically stable if

$$\text{tr}(J^*) < 0 \quad \text{and} \quad \det(J^*) > 0. \quad (\text{A.1})$$

Conditional on stability, adjustment is locally oscillatory when $[\text{tr}(J^*)]^2 < 4 \det(J^*)$.

A.1.1 Equity valuation

Setting $\dot{g} = \dot{q} = 0$ gives

$$g^* = \alpha + \beta(q^* - 1), \quad q^*(\rho - g^*) + \chi g^* - \delta r = 0. \quad (\text{A.2})$$

These two equations jointly determine the interior steady state (g^*, q^*) .

Using the Jacobian in Equation (3.8), its trace and determinant are

$$\text{tr}(J_{g,q}^*) = \rho - g^* - \gamma, \quad (\text{A.3})$$

$$\det(J_{g,q}^*) = \gamma [\beta(q^* - \chi) - (\rho - g^*)]. \quad (\text{A.4})$$

The steady state is therefore locally asymptotically stable if

$$\gamma > \rho - g^*, \quad \beta(q^* - \chi) > \rho - g^*. \quad (\text{A.5})$$

A.1.2 Loan finance

Setting $\dot{g} = \dot{\lambda}_L = 0$ gives

$$g^* = \alpha + \beta(r - i\lambda_L^*), \quad \lambda_L^* = \frac{r - g^*}{i - g^*}. \quad (\text{A.6})$$

These conditions jointly determine the interior steady state (g^*, λ_L^*) .

Using the Jacobian in Equation (3.14),

$$\text{tr}(J_{g,\lambda_L}^*) = i - g^* - \gamma, \quad (\text{A.7})$$

$$\det(J_{g,\lambda_L}^*) = \gamma [(g^* - i) + \beta i(1 - \lambda_L^*)]. \quad (\text{A.8})$$

Under the restrictions imposed in the main text, $g^* > i$ and $\lambda_L^* < 1$, the trace is negative and the determinant positive. The interior steady state is therefore locally asymptotically stable.

Additionally, the parsimonious loan-finance closure implies the steady-state result for λ_L^* in A.6 so that, under $g^* > i$, a positive steady-state loan ratio requires $g^* > r$. This

restriction results from abstracting from other corporate uses and sources of funds. To illustrate, restoring dividend payments and net equity issuance, with $\hat{E}q = \chi g$, gives

$$\dot{\lambda}_L = (i - g)\lambda_L + (1 - \chi)g - (1 - \delta)r, \quad \lambda_L^* = \frac{(1 - \chi)g^* - (1 - \delta)r}{g^* - i}. \quad (\text{A.9})$$

This broader closure is consistent with the corporate financing identity in Taylor (2012), which includes retained earnings, borrowing, and equity transactions as sources of investment finance. Under $g^* > i$, positive leverage now requires only $(1 - \chi)g^* > (1 - \delta)r$. Moreover, $\partial \dot{\lambda}_L / \partial g = 1 - \chi - \lambda_L^* > 0$ provided $\lambda_L^* < 1 - \chi$, while $\partial \dot{g} / \partial \lambda_L = -\gamma \beta i < 0$. Thus, relaxing the baseline financing closure alters the steady-state restriction without changing the counterclockwise cross-dynamics emphasized in the main text.

A.1.3 Bond finance

For an interior steady state with $\lambda_B^* > 0$, $\dot{\lambda}_B = 0$ implies

$$g^* = \hat{B}. \quad (\text{A.10})$$

Setting $\dot{g} = 0$ then gives

$$\lambda_B^* = \frac{(1 + \beta)g^* - \alpha - \beta r}{\beta(g^* - i)}. \quad (\text{A.11})$$

Using the Jacobian in Equation (3.20),

$$\text{tr}(J_{g, \lambda_B}^*) = -\gamma(1 + \beta) < 0, \quad (\text{A.12})$$

$$\det(J_{g, \lambda_B}^*) = \gamma \beta \lambda_B^* (g^* - i). \quad (\text{A.13})$$

For an interior steady state with $\lambda_B^* > 0$, the condition $g^* > i$ implies a positive determinant. The interior steady state is therefore locally asymptotically stable.

For all three models, the opposite-signed off-diagonal elements identified in Section 3 determine the direction of local cyclical propagation. Oscillatory convergence additionally requires $[\text{tr}(J^*)]^2 < 4 \det(J^*)$.

A.1.4 Direction of Local Rotation

The direction of local rotation follows from the signs of the off-diagonal elements of the Jacobian. Let z denote q , λ_L , or λ_B . In the linearized system, evaluated to the right of the steady state ($g > g^*$, $z = z^*$), the vertical component of motion has the sign of $\partial \dot{z} / \partial g$. Evaluated above the steady state ($g = g^*$, $z > z^*$), the horizontal component has the sign of $\partial \dot{g} / \partial z$.

For the equity and bond systems, $\partial \dot{g} / \partial z > 0$ and $\partial \dot{z} / \partial g < 0$, implying clockwise local rotation. For the loan system, the signs are reversed, implying counterclockwise local rotation. These directions correspond to the phase diagrams shown in Figure 1. Opposite-signed cross-effects therefore determine the direction of local rotational propagation, while repeated oscillatory convergence additionally depends on the eigenvalues of the system.

A.2 Macroeconomic cyclical components

Figure 14 reports the cyclical components of the aggregate series used in the macroeconomic analysis. The figure includes the investment rate, g , the valuation ratio, q , total leverage, λ , and the decomposition of leverage into loans, λ_L , and debt securities, λ_B . Each series is filtered separately using the Hamilton filter with an eight-quarter forecast horizon and four lags, as described in Section 4. Shaded areas identify NBER recessions.

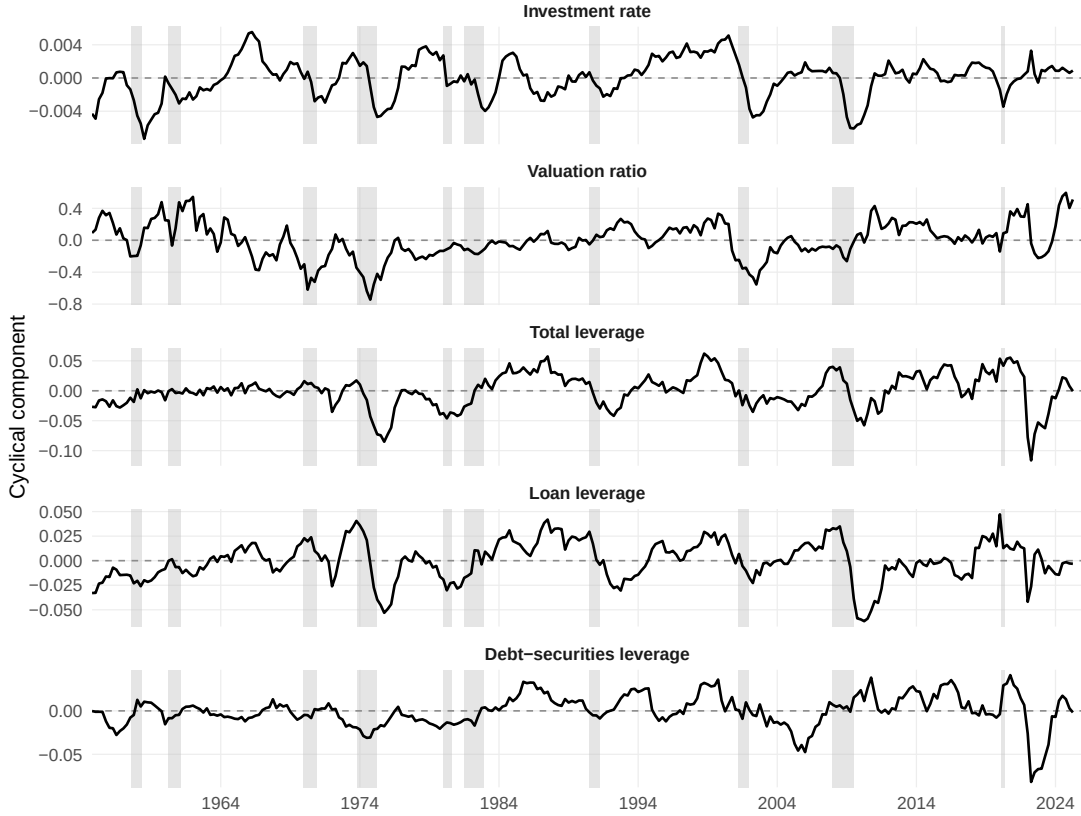


Figure 14: Cyclical Components of the Aggregate Real–Financial Series. The figure reports the Hamilton-filtered cyclical components of the investment rate, valuation ratio, total leverage, loan leverage, and debt-securities leverage. Shaded areas indicate NBER recessions.

A.3 Firm-level cyclical components

Figure 15 presents the Hamilton-filtered cyclical components of the firm-level variables used in the analysis.



Figure 15: Firm-level Hamilton-filtered cyclical components. The figure presents the cyclical components of the firm-level variables used in the analysis, obtained using the Hamilton filter with $h = 8$ and $p = 4$. NBER recessions are shaded in the background.

A.4 Firm-Level Data Construction and Aggregation

The firm-level series are constructed using two alternative aggregation procedures. The baseline specification uses a ratio-of-sums approach. Let I_{it} denote quarterly capital expenditures, K_{it} the capital stock, V_{it} market equity, and D_{it} total debt. The aggregate series are defined as

$$g_t = \frac{\sum_i I_{it}}{\sum_i K_{i,t-1}}, \quad (\text{A.14})$$

$$q_t = \frac{\sum_i V_{it}}{\sum_i K_{it}}, \quad (\text{A.15})$$

$$\lambda_t = \frac{\sum_i D_{it}}{\sum_i K_{it}}. \quad (\text{A.16})$$

Quarterly capital expenditures are constructed from Compustat's year-to-date `capxy` variable and the aggregate investment-flow series is seasonally adjusted using X-13ARIMA-SEATS before calculating g_t . For the full-sample series, each component is aggregated using all available valid observations within a quarter, maximizing sample coverage.

As an alternative, firm-level ratios are first calculated as

$$g_{it} = \frac{I_{it}}{K_{i,t-1}}, \quad q_{it} = \frac{V_{it}}{K_{it}}, \quad \lambda_{it} = \frac{D_{it}}{K_{it}}, \quad (\text{A.17})$$

and quarterly cross-sectional medians are then constructed. Within each bivariate system, medians are calculated over the common set of firms with valid observations for both variables in a given quarter. The resulting median investment-rate series is seasonally adjusted using X-13ARIMA-SEATS. This specification gives each firm equal influence in the cross-sectional statistic and reduces the dominance of the largest firms.

Missing observations in the capital-stock variables are treated at the firm level before aggregation. For gross property, plant, and equipment, missing observations are carried forward from the firm's most recently reported value (LOCF), reducing discontinuities associated with intermittent quarterly reporting. For net property, plant, and equipment, the carry-forward procedure is more conservative and is applied only to bounded internal gaps of up to three quarters; longer gaps and observations without a preceding reported value remain missing. These adjustments are performed on firm histories prior to constructing the quarterly aggregates.

For the size-based analysis, the ratio-of-sums series are likewise constructed using a common-firm sample within each bivariate system and quarter. The sample is not required to be balanced over time. Both gross and net capital-stock measures are constructed using the same procedures, and their cyclical components are extracted using the Hamilton filter described in Section 4.