
This paper formulates and tests a model of asset and financing adjustments of nonfinancial enterprises over the twentieth century. Asset adjustments change the expected income and operating risk of firms while financing adjustments change financial risk. To protect debt and equity investors from a conflict of interest problem, an up-front contract develops an “assignment” rule for managing the firm’s balance sheet whereby managers make investment decisions that conform to the risk aversion of stockholders and financing decisions that offset changes in operating risk resulting from investment decisions. Empirical evidence gathered in this paper fails to reject the predictions of the model.

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The world economic crisis that started in 2007 was a jolting reminder of the interaction between the financial side and real side of an economy. What the exact nature of that interaction might be is subject to considerable debate. At one end of the spectrum (but before the crisis) is the view that finance is just about little pieces of paper that merely reflect the real economy and have almost no independent influence.

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nothing to do with initiating or propagating something very real like the business cycle. The foundation for this view is the efficient market hypothesis with rational expectations where the market prices of financial securities reflect all the publicly available information on the real returns of the firm. At the other end of the spectrum is the view that nothing seems to happen on the real side of the economy without something first happening on the financial side. Just what that something on the financial side might be is also the subject of debate. There have been a number of time series and panel studies of the relationship between the stock and bond markets (and $Q$-ratios) and corporate investment. A small sample of this empirical work includes but is not restricted to Fama (1981), Fischer and Merton (1984), Barro (1990), Blanchard, Rhee, and Summers (1990), Morck, Vishny, and Shleifer (1990), Chirinko (1993), Gilchrist and Himmelberg (1995), Erickson and Whited (2000), Baker, Stein, and Wurgler (2003), Kau, Linck, and Rubin (2004), Polk and Sapienza (2004), Gilchrist, Himmelberg, and Huberman (2005), Panageas (2005), Chirinko and Schaller (2011, 2012), Philippon (2009), and Gala and Gomes (2012) among many others. Some of these studies find that stock valuations and $Q$-ratios measured in various ways have a relatively small effect on corporate investment while others find the effect to be substantial. Some of these studies find that investment only responds to changes in fundamental earnings; others find that investment also responds to bubbles in stock prices. Still another view that “finance matters” is based on various perceived frictions in the financial system. One such view is that moral hazard and asymmetric information problems between inside and outside investors drive a wedge between the cost of internal and external financing of real corporate investment, something that could not happen in the world of Modigliani and Miller with perfect financial markets. Calomaris and Hubbard (1995, p. 443) summarize this view in the following way: “Lemons premia in equity markets (e.g., Myers and Majluf 1984) and credit rationing and loan mispricing (e.g., Jaffee and Russell 1976, Stiglitz and Weiss 1981, Gale and Hellwig 1985, Williamson 1986, Bernanke and Gertler 1989, Calomaris and Hubbard 1990, and Kiyotaki and Moore 1997) imply that external finance will be more costly than internal finance.” The end result is that the real investments of firms (especially small firms) are finance constrained.

In Sections 1 and 2 of this paper, I present an alternative view of the $Q$-theory of investment and the financial links to the real economy. Instead of following Tobin and much of the literature in thinking of $Q$ as the expected discounted marginal product of capital, I follow Keynes (1936, p. 151) and think of $Q$ as reflecting arbitrage opportunities between the market for securities and the product/factor market. If the productive resources that comprise a firm can be purchased in the product/factor market at economic book value (say $1$) and then paid for by floating bonds and stocks at market prices greater than economic book value (say $1.15$), the investment will be made. Section 1 presents the model underlying this view. In this model, differentially risk-averse investors separate into bondholders and stockholders, thereby creating a well-known agency problem for the future management of a representative firm. This agency problem in our model is resolved with an up-front financial contract that develops what might be called an “assignment rule” (in the sense of Mundell 1962) for
managing the firm’s balance sheet. This assignment rule has the manager of the firm formulating and implementing investment decisions that conform to the risk assessments and preferences of their stockholders. These investment decisions sometimes cause business cycles. This information on the risk assessments and preferences of stockholders is communicated to the manager by the changing market valuations of their firm’s equity shares. The contract-constrained manager then makes an offsetting financing decision that insulates the bondholders from changes in the operating risk resulting from their real investment decision. In effect, the stockholders manage the asset side of the firm’s balance sheet while bondholders (through covenants) manage the liability and equity side of the balance sheet. This shared management of the firm is one way to resolve the conflict of interest problem between bondholders and stockholders so that no investor is exploited over the business cycle. These covenants are described in Section 2.

It might be asked why this conflict of interest problem is not resolved by the simple expedient of investors matching their investments in debt and levered equity securities in the same company as they would in the capital asset pricing model with simple separation. One answer is that the costs of advanced contracting in the form of covenants that resolve the conflict in the model presented below are less than the costs (including regulatory costs) of holding both debt and equity securities in the same company. Moreover, there is empirical evidence that investors do not match their investments in debt and equity securities in the same company to solve the conflict of interest problem. Lehn and Paulsen (1991) study the conflict of interest problem in the context of leveraged buyouts in the 1980s that generally were associated with bondholder losses. They examine the portfolio holdings of 24 mutual funds that held both bonds and stocks over the period 1979/80–1987/88 when leveraged buyouts were popular. The hypothesis they test is whether these mutual funds increased their matched holdings of bonds and stocks in the same companies over this time period. They found in the beginning of their sample that only 7.3% of their holdings of bonds were in companies in which they also owned stock. That percentage only rose to 13.4 by the end of their sample period, a change they found to be statistically insignificant. On the basis of this empirical test, they concluded that matched ownership of bonds and stocks in the same companies did not resolve the bondholder–stockholder conflict of interest problem over their sample time period.

In Section 3, I empirically document the financial relationships that are implied by the model described in Sections 1 and 2 for U.S. nonfinancial enterprises over the long sample period of 1900–2002 and 1946–2002. My main findings are the following. To begin with, in contrast to Philippon (2009) who finds that only bond Qs

1. Regulatory costs for some U.S. institutional investors are very high. For example, life insurance companies are the largest investors in corporate bonds. State regulation allows them to value investment grade bonds at face value or acquisition cost. On the other hand, these states require life insurance companies to value equities at market prices. In stock market, downturns declining equity values erode the surplus of life insurance companies, which, in turn, can impair their ability to sell insurance and other financial products in those states. For this reason, it is practically impossible for insurance companies to resolve the conflict of interest problem with matched holdings of bonds and stocks, but instead they seemingly rely on financial contracting.
determine corporate investment, I find that changes in both the stock and bond market \( Q \)-ratios of firms signal future changes in real corporate investments and the amount of operating risk and return these investments generate. My second finding based on rational financial contracting is that financing decisions of firms are then matched to changes in their investment decisions so as to preserve the market valuations of their long-term liabilities. Thus, the risky investments that generate operating risk and return are procyclical, while long-term financial leverage that generates financial risk is countercyclical. In a perfectly rational and efficient financial contract system, managers of debt and equity financed firms will adjust their operating decisions and financing decisions so that these two risks will exactly offset one another over the business cycle. Finally, a summary of the main results of this paper is presented in the concluding Section 4.

1. THEORETICAL FRAMEWORK

In this section, I present a comparative static and partial equilibrium model that motivates the empirical work in Section 3. Toward this end, consider a representative firm with two different investors: a relatively more risk-averse investor \((D)\) who holds the debt claims \((d)\) on this firm, and a relatively less risk-averse investor \((S)\) who holds the levered stock \((s)\).\(^2\) As we will see below, one implication of this difference in risk aversion is that \((D)\) and \((S)\) will disagree on the firm’s future business strategy in that \((D)\) would vote for the firm to pursue a safe and conservative business strategy because their income is capped from above by the promised payment on the debt claim, while \((S)\) would vote for a speculative business strategy because of the call option feature embedded in levered equity.

To see this, consider the Edgeworth–Bowley box diagram in Figure 1 that describes the firm from the perspective of investors \((D)\) and \((S)\). The box diagram presents the firm’s initial and given replacement cost productive capital investment, \(K\), along the horizontal axis and the expected cash payoff, \(\bar{X}\), generated on that investment along the vertical axis. The amount of financing of this capital provided by bondholders and stockholders is given by \(K(d)\) and \(K(s)\). Note that at point \(Z\) in the figure the expected yield on debt, \(R(d) = \bar{X}(d)/K(d)\), is less than the expected yield on levered stock, \(R(s) = \bar{X}(s)/K(s)\), indicating a positive risk premium. Suppose next that investors perceive themselves as price takers in the capital market so that \(R(d)\) and \(R(s)\) are constant in the small neighborhood around \(Z\) in Figure 1. For small variations in \(K(d)\) around \(Z\) the required income on debt is

\[
\bar{X}(d) = R(d)K(d). \tag{1}
\]

\(^2\) For a stylized numerical example of how an all equity company gets transformed into a debt and levered equity company when investors are heterogeneous in their risk aversion, see Krainer (1992, pp. 71–72).
The expected cash payoff $\bar{X}$ generated on the fixed amount of productive investment $K = [K(d) + K(s)]$ of the firm is

$$\bar{X} = R[K(d) + K(s)],$$

(2)

where $R$ is the internal rate of return earned on $K$.

Finally from the perspective of bondholders, the residual expected cash returns going to levered equity are

$$\bar{X}(s) = \bar{X} - \bar{X}(d).$$

(3)

Putting (2) into (3) and then dividing into (1) results in

$$\frac{\bar{X}(d)}{\bar{X}(s)} = \frac{K(d)/K(s)}{R/R(d) + [(R - R(d))/R(d)]K(d)/K(s)} > 0,$$

(4)

a positive concave relationship between $\bar{X}(d)/\bar{X}(s)$ and $K(d)/K(s)$ in which $R(d)$ is a constant. The linear approximation to (4) is given by the $dd$ schedule in Figure 2. Every point along the $dd$ schedule represents varying combinations of financial leverage, $K(d)/K(s)$, and the distribution of corporate income, $\bar{X}(d)/\bar{X}(s)$, for which $R(d)$ is a constant. There are many hypothetical $dd$ schedules (not shown) in Figure 2, each with a different rate of return $R(d)$. Equation (4) indicates that $dd$ schedules with a higher (or lower) embedded constant $R(d)$ lie above (or below) the reference $dd$ schedule on some $d'd'$ schedule (or a $d''d''$ schedule) and are indicated by a plus (or minus) in the figure. Similarly, for small variations in $K(s)$ around $Z$ for a fixed $R(s)$ in Figure 1, we have the required money income for equity investors:

$$\bar{X}(s) = R(s)K(s).$$

(5)
As before
\[ \bar{X} = R[K(d) + K(s)]. \quad (2) \]

The expected cash payoff going to bondholders from the perspective of levered stockholders is
\[ \bar{X}(d) = \bar{X} - \bar{X}(s). \quad (6) \]

Putting (2) into (6) and dividing the result by (5) yields
\[ \frac{\bar{X}(d)}{\bar{X}(s)} = \frac{R - R(s)}{R(s)} + \frac{R}{R(s)} \left[ \frac{K(d)}{K(s)} \right] > 0, \quad (7) \]

or the equation for the linear ss schedule in Figure 2. The ss schedule represents the combinations of \( \bar{X}(d)/\bar{X}(s) \) and \( K(d)/K(s) \) for which the rate of return on stock, \( R(s) \), is a constant. Like the dd schedule, there are many hypothetical ss schedules (not shown) in Figure 2. Equation (7) indicates that ss schedules with a higher (or lower) constant \( R(s) \) lie to the right (or to the left) of the reference ss schedule on some \( s's' \) (or \( s''s'' \)) schedule and are indicated by a plus (or minus) in Figure 2. Moreover, since equation (4) has a zero intercept and is concave downward while (7) is linear with a negative intercept, the ss schedule must intersect the dd schedule from below in the
In order to get market signals for managers to act on, it will be useful to cast the relationships in equations (4) and (7) into observable market prices on bonds and stocks. To do this, I think of yields in two different but related senses: (i) an expected yield or internal rate of return (IRR) delivered by managers to investors through the firm’s operating and financing decisions, and (ii) a cost of capital or yield required by investors based on their time preference, risk assessments, and aversion toward risk. For bonds, the expected yield will be designated by $\bar{X}(d, ER)$ and the required yield by $\bar{X}(d, RR)$. The price per bond $P(d)$ is then given by

$$P(d) = \frac{\bar{X}(d)}{R(d, RR) N(d)},$$

(8)

where $N(d)$ represents the number of bonds. Multiplying the numerator of the right-hand side of (8) by $K(d)/K(d)$ and defining $\bar{X}(d)/\bar{X}(s)$ to be the expected yield $R(d, ER)$ on bonds results in the following expression for the price of a bond:

$$P(d) = \frac{R(d, ER) K(d)}{R(d, RR) N(d)}.$$

(9)

Equation (9) says that the market price of one bond equals the book value (or contracted redemption value) of one bond scaled by the $Q$ factor for bonds, $R(d, ER)/R(d, RR)$. The equilibrium condition for the bond market is when bonds are zero net present value (NPV) investments, or, $R(d, ER)/R(d, RR) = 1.0$. The equilibrium $dd$ schedule in Figure 2 presents the combinations of $K(d)/K(s)$ and $\bar{X}(d)/\bar{X}(s)$ for which $R(d, ER) = R(d, RR) = R(d)$ in equation (4) and $P(d) = K(d)/N(d)$ in equation (9). Now suppose there is a negative shock so that $R(d, RR)$ rises to lie on some hypothetical $d'd'$ schedules (not shown in the figure) for which $R(d, ER) < R'(d, RR)$. In this case, $P(d) < K(d)/N(d)$ by equation (9), and is indicated by a (−) in the figure. This is on the assumption that shocks are evaluated immediately in financial markets but managerial investment and financing decisions are delayed and spread out over time. Alternatively, a positive shock that reduces $R(d, RR)$ implies that it lies on some $d''d''$ schedule for which $R(d, ER) > R''(d, RR)$ so that $P(d) > K(d)/N(d)$ and is indicated by a (+) in Figure 2.

A similar equilibrium condition for the stock market is presented as the $ss$ schedule in the figure. In this connection, let $R(s, ER)$ be the expected rate of return (or IRR on stock) delivered to stockholders by the operating and financing decisions of firm managers. Next, let $R(s, RR)$ be the rate of return required by stockholders (or cost of equity capital), which in turn depends on their time preference, perceptions of risk, and risk aversion. The market price of one share of stock, $P(s)$, can then be written as

$$P(s) = \frac{\bar{X}(s)}{R(s, RR) N(s)}.$$

(10)
where $N(s)$ represents the number of shares of stock outstanding. Multiplying the numerator of the right-hand side of (10) by $K(s)/K(s)$ and defining $R(s, \ ER) = \bar{X}(s)/K(s)$, we get

$$P(s) = \frac{\bar{X}(s)/K(s)}{R(s, \ RR)} \frac{K(s)}{N(s)}$$

(11)

or

$$P(s) = \frac{R(s, \ ER)}{R(s, \ RR)} \frac{K(s)}{N(s)}.$$

Equation (11) says that the market price of one share of stock equals the economic book value of one share of stock, $K(s)/N(s)$, multiplied by the $Q$ factor on stock, $R(s, \ ER)/R(s, \ RR)$. When this $Q$ factor is unity, the market price of stock equals the economic book value of stock, and this is the equilibrium condition for the stock market. This equilibrium condition is plotted as the ss schedule in Figure 2. Everywhere along the equilibrium ss schedule, we have the combinations of $K(d)/K(s)$ and $\bar{X}(d)/\bar{X}(s)$ for which $P(s) = K(s)/N(s)$. Now suppose there is a negative shock causing investors to increase $R(s, \ RR)$ to $R'(s, \ RR)$ so that it lies on some hypothetical $s's'$ schedule (not shown in the figure) for which $R(s, \ ER) < R'(s, \ RR)$. From equation (11), we then have $P(s) < K(s)/N(s)$, which is indicated by a (-) in the figure. Again, this assumes that shocks are first evaluated and immediately reflected in the stock market. Then, after observing $P(s) < K(s)/N(s)$ managers adjust $R(s, \ ER)$ with investment and financing decisions that take time to implement. A positive shock that reduces $R(s, \ RR)$ to $R''(s, \ RR)$ that now lies on some $s''s''$ schedule implies by equation (11) that $P(s) > K(s)/N(s)$. This is indicated by a (+) in the figure.

Consider next the asset adjustments and financing adjustments managers implement in response to changes in the required rates of return of investors that are reflected in market prices. The asset or investment decision generates the probability distribution of the representative firm’s future cash flows. We make two assumptions regarding the return-generating process embedded in the company’s capital investments, $K$. The first is that expected cash returns, $\bar{X}$, are diminishing in the level of capital investments.

$$\bar{X} = f(K) \ f'(K) > 0 \ f''(K) \leq 0.$$  

(12)

Research by Titman, Wei, and Xie (2004) reveals a negative relationship between abnormally high levels of capital investments of firms and future stock returns, which is consistent with this assumption. In addition, older evidence (reviewed by Rotemberg and Woodford 1999) on the countercyclical movement of price markups over marginal costs of firms is also consistent with this assumption when corporate investment is procyclical. The second assumption, first used by Stiglitz (1972, p. 39), is that operating risk (i.e., the volatility of the firm’s cash flows), $\sigma(X)$, is increasing
in the level of capital investment.

\[ \sigma(X) = g(K) g'(K) > 0 \text{ } g''(K) = 0. \] (13)

There are several arguments that support this assumption. One argument is that larger firms and new start-up firms require additional managerial input. If experienced and skilled managerial talent is fully employed and fixed in supply, the expansion in real investment will require old firms and new firms to use less experienced managers. Will these less experienced managers turn out to be less skilled, or, will they turn out to be skilled managers? This uncertainty adds to the risk of the profitability of the new real investment. Another argument is that a differential expansion in real investments across firms today creates differential increases in supply tomorrow. This differential supply will increase the volatility of future relative prices, thereby making it more difficult for managers to estimate future costs and revenues. On the other hand, if prices are downward rigid for whatever reason, relative price volatility will fall with a reduction in real investment, thereby decreasing operating risk. Evidence supporting this view can be found in Parks (1978), Anderson (1994, 2000), Ball and Mankiw (1995), Parsley (1996), Debelle and Lamont (1997), and Balke and Wynne (2000), among others. Parsley and Popper (2004) extend this research to stock prices. They find that positive changes in the level of stock prices are associated with high volatility in the cross-section of relative stock prices. If relative stock price volatility reflects volatility in the marginal product of capital of different firms, then expansions in real investment induced by increases in the level of stock prices will be associated with increases in the operating risk of firms. Finally, Brandt and Kang (2003) find that in and around the NBER troughs of recession, mean excess stock returns are rising while the volatility of excess returns is falling, whereas in and around the peaks of an expansion, mean excess stock returns are falling while the volatility of returns is rising over their sample period 1946–98. Again if stock returns track the real returns of the firm, then this evidence is consistent with the return-generating process in equations (12) and (13). Together, (12) and (13) imply that the ratio, \( \bar{X} / \sigma(X) \), diminishes with the level of capital investment. What this means is that cyclical expansions (or contractions) in capital investment are associated with increases (or decreases) in operating risk and a decrease (or increase) in the expected-return-to-risk ratio. The second part of a company’s business strategy is its financing strategy. This strategy is implemented by purposely varying the debt/equity ratio, \( K(d)/K(s) \), which changes the financial risk of the company.

With this description of financial risk and the risk and return generating process of the firm, we can now describe the four zones in Figure 2 starting with the conflict of interest problem between bondholders and stockholders in zones IV and II over the future business strategy of the firm. Toward this end, suppose the representative firm is initially created at the no arbitrage equilibrium point \( z \) in Figure 2 where the market value of both debt and equity securities equals the economic book value of its productive assets. Now suppose there is a favorable taste shock for equity investors and their required yield falls to \( R^*(s, RR) < R(s, RR) \), driving stock prices above
economic book value, \( P(s) > K(s)/N(s) \). The response of the firm to this arbitrage opportunity of market value greater than book value is to announce an expansion of its risky investments. Suppose at the same time the firm announces its decision to invest in risky assets, it also announces that it will finance the investments with debt. The reaction of bondholders to both of these announcements will be to raise their required yield to \( R'(d, RR) > R(d, RR) \) since the investment decision increases operating risk via equation (13) while the decision to finance with debt increases financial leverage and financial risk. The end result is that \( P(d) < K(d)/N(d) \). The combination of \( P(d) < K(d)/N(d) \) and \( P(s) > K(s)/N(s) \) is described by zone IV in Figure 2, a zone where the capital gains of stockholders are matched with the capital losses of bondholders. Similarly, zone II describes the reverse redistribution of wealth with \( P(d) > K(d)/N(d) \) and \( P(s) < K(s)/N(s) \). How can these conflicts of interest and redistributions of wealth among bondholders and stockholders be prevented in this economy? One way for avoiding zone IV is through an up-front bond contract with covenants that assigns the decision making rights over the operating and financing decisions of the firm. These covenants will be described in Section 2. For zone II, management change is achieved by internal and external takeovers. What about zones I and III? In zone I, we have \( P(d) > K(d)/N(d) \) and \( P(s) > K(s)/N(s) \). The arbitrage here is to buy productive resources at economic book value in the product/factor market and finance the purchases with equity thereby creating a cyclical expansion. In zone III, \( P(d) < K(d)/N(d) \) and \( P(s) < K(s)/N(s) \). The arbitrage here is to sell the productive resources back to the factor market at book value and use the proceeds to retire equity. This downsizing causes a recession.

To summarize, I have two different investors in a representative firm that in turn formulate and implement two different business decisions (investment and financing) over time with two equilibrium conditions (market values for equity and debt equal to their book values). In this \( 2 \times 2 \times 2 \) setup, a stable equilibrium for the firm/economy can be attained by matching the firm’s financing decisions to its investment decisions. One matching rule is for the managers to make investment decisions that conform to the risk perceptions and/or aversion of their shareholders as reflected in their share valuations, and then make financing decisions (guided by bond covenants) that preserve the value of the firm’s debt. In this way, the manager can always offset any changes in operating risk initiated by their investment decision with an appropriately matched financing decision. Thus, an increase in the real investments of firms that causes a business cycle expansion but via equation (13) increases operating risk would then be accompanied by a reduction in financial leverage and financial risk. The end result is that rational bond contracts require firms to financially restructure themselves whenever they change their real investments and operating risk over the business cycle.

What triggers a change in the real investments of firms in this economy? In this model, exogenous shocks to perceptions of risk and/or risk aversion that change the required yield, \( R(s, RR) \), of shareholders and share prices cause managers to change the real investments of their firms. Theory and evidence consistent with the hypothesis that changes in required yields of investors are an important cause of
changes in the aggregate level of stock prices can be found in Campbell and Ammer (1993), Campbell and Cochrane (1999), Chan and Kogan (2002), Vuolteenaho (2002), Froot and O’Connell (2003), Gai and Vause (2006), Bekaert, Hoerova, and Scheicher (2009), Cochrane (2011), and many others. Thus, changes in stock prices trigger changes in the real investments of firms and general economic activity.

How then does a business cycle and associated financial adjustment evolve in this model? It all begins with a shock that changes the required yield of shareholders and share prices. A positive shock that reduces risk perceptions/risk aversion and the required yield of shareholders increases the market price of equity shares relative to book value. The increase in share prices is the stock market signal for managers to implement an expansionary but risky investment strategy that more closely conforms to the shock-induced change in risk perceptions and the risk aversion of equity investors. This speculative expansion in investment will increase the operating risk of firms via the return generating process in equation (13) for real investments. Any increase in the operating risk of firms will not be in the best interest of relatively more risk-averse bondholders, and for that reason bond valuations will begin to fall relative to book value. However, these covenant-protected bondholders offset this increase in the operating risk of firms that comes with a cyclical expansion in real investments with an appropriately matched financial strategy that reduces financial leverage.\(^3\) In other words, an optimal covenant in the debt contract would have the representative firm financing these increasingly risky real investments with equity, thereby reducing financial leverage and financial risk and restoring the market valuations of bonds to their pre-expansion valuation. In the end, a cyclical expansion is characterized by a larger and riskier stock of productive capital, a reduction in the Sharpe ratio of expected returns to risk from the return-generating process in equations (12) and (13), a lower risk premium, and a lower debt-to-equity ratio. While firms have more operating risk they also have less financial risk. The up-front contract that in effect assigned the investment decisions to shareholders and financing decisions to bondholders has succeeded in coalescing the welfare of both groups of investors

\(^3\) Does the representative firm really need a financial strategy? A Modigliani–Miller (MM) type argument suggests that equity investors could obtain the same pattern of levered income even when the company’s capital structure was all equity. In this case, there is a replicating way an equity investor \((s)\) could issue personal debt to \((d)\) and invest the proceeds in the equity of an unlevered firm and duplicate the income pattern obtained from directly investing in the equity of a levered company. When the real investments of the company are fixed and personal debt is a perfect substitute for company debt, the MM argument seems compelling even from the perspective of bondholders. However, in the intertemporal setting of the business cycle when company investments and financing are not fixed, it is hard to think that company debt and personal debt are perfect substitutes. In this intertemporal setting, it is rational for company debt to have control rights (which in practice are contained in bond covenants) in order to avoid a moral hazard problem. These bond covenants are designed in principle to preclude the firm from implementing future investment and financing decisions that redistribute risk and return in a way that adversely affects the market valuations of bonds. It is difficult to see how the replicating personal debt could have covenants that constrain the investment and financing decisions of the firm. In other words, there seems to be no direct way personal debt can affect the investment and financing decisions of the firm over time. For this reason, firm debt and personal debt are not perfect substitutes and the company must have a financial strategy. Finally, the MM partial equilibrium capital structure proposition holds when the firm is in a given risk class. Our analysis has the firm changing risk classes in different stages of the business cycle.
during a cyclical expansion, and in attaining an economy-wide product market and financial market equilibrium.

A cyclical expansion for this two agents, two decisions, and two equilibrium conditions economy is illustrated in Figure 3. The starting position is point \( z \) in the figure. Point \( z \) represents an intersection of an equilibrium debt market schedule \( dd \) and a stock market schedule \( ss \) in which the market value of both debt and equity securities equals the economic book value of the firm/economy’s productive assets. From this initial product market and financial market equilibrium position, suppose there is now an external shock that reduces the required yield \( R(s, RR) \) to \( R''(s, RR) \), thereby shifting the stock market schedule to \( s'' \) in the figure. For convenience, we assume the required yield on debt remains unchanged. A new equilibrium now emerges at \( z'' \). However, in terms of expected yields on stock, \( R(s, ER) \), the firm/economy is still at point \( z \) since real investment at this point is unchanged. The end result is that immediately after the shock the \( Q \) factor on stock is \( R(s, ER)/R''(s, RR) > 1 \), and hence the market value of stock and the firm is now greater than the economic book value of its productive assets. In this model, market value greater than book value signals the existence of an arbitrage opportunity, namely, buy productive assets in the product and factor market at economic book value, and then sell stock to finance the acquisition of these assets at market prices greater than book value. The resulting expansion in real investment causes a cyclical upturn in the economy. However, according to the return-generating process described in equations (12) and (13), an expansion in real investment increases the operating risk of the firm/economy and reduces the

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**Fig. 3. A Business Cycle Expansion in a Debt- and Equity-Financed Economy.**
expected return to risk trade-off. An increase in operating risk increases the possible losses for bondholders. The up-front contract now requires the firm to offset this increase in operating risk with a reduction in financial risk so as to keep the market valuation of bonds equal to their book value at $z''$. The reduction in financial risk is achieved when firms finance the real investment with equity. At the new product market and financial market equilibrium given by point $z''$, the expected yield on stock, $R'(s, ER) = \bar{X}''(s)/K''(s)$, is driven down by the expansionary diminishing returns investment financed with equity to equal the new and lower shock-induced required yield $R'(s, RR)$ on stock so that the $Q$ factor on stock is once again unity and $P(s) = K(s)/N(s)$. In the end, the economy produces more operating risk but with the reduction in leverage it produces less financial risk. Consequently, less risk-averse equity investors finance the decreasing returns and increasing risk real investments, which is the way the financial side of the economy coordinates the real side of the economy when investors differ in terms of their perceptions of and aversion toward risk. A negative shock that raises the required yield on equity, $R(s, RR)$, would generate the reverse sequence of events, producing a recession and an increase in financial leverage.

2. FINANCIAL CONTRACTS

In this section, I describe an up-front financial contract based on real-world covenants that would coordinate the investment and financing decisions of debt- and equity-financed firms in the way predicted by the model above. I also provide a stylized numerical example illustrating how the contract shapes the investment and financing decisions over the expansion phase of the business cycle presented in Figure 3. The protective covenants of this contract are well known in practice and described by the American Bar Foundation study entitled Commentaries on Model Debenture Provisions (1971). The Commentaries provide a best practices template for practicing lawyers writing covenants for real-world bond contracts.4

4. To what extent do covenants exist in real-world debt contracts? In this connection, it is important to distinguish between implicit and explicit covenants on the one hand, and public and privately placed debt to banks and nonbank financial institutions on the other hand. Public bond issues are typically larger and carry a higher quality rating than debt issued directly to banks and nonbank financial institutions. For this reason, publicly issued bonds have lower interest rates and carry fewer explicit restrictive covenants and rely more heavily on implicit covenants since they often return to the bond market for subsequent financing. Research by Nash, Netter, and Paulson (2003) on 763 public bond issues in 1989 and 1996 finds that 30% and 33%, respectively, contained restrictions on cash distributions to shareholders and/or a restriction on future debt financing. Reisel (2004) working with a sample of 7,871 public bond issues for both financial and nonfinancial enterprises finds that 59% of the issues contained a debt restriction covenant and 19% had a dividend restriction covenant. On the other hand, in a study of 12,425 bank loans Bradley and Roberts (2004) find that over 80% of the loans contained both covenants. In addition, they find that on average 88% of bank loans contained two or more covenants. This and other evidence indicates that debt covenants are important control mechanisms in real-world debt contracts. Finally, Dichev and Skinner (2002) and Garleanu and Zwiebel (2008) analyze the renegotiation of tightly set covenants and how these renegotiations shape the investment and financing decisions of firms. This is yet another way creditors participate in the management of the firm over time.
The covenants described by the Commentaries include the following restrictions on company policy: (i) restrictions on cash distributions to shareholders, (ii) restrictions on the financial structure of the company, (iii) working capital requirements, (iv) pledgeable collateral, (v) asset sales, (vi) investment restrictions, and others. In practice, these covenants are typically written to stand alone. In our model, these covenants are linked together in the following way:

\[ WC \geq \gamma \text{LTDebt} \quad \gamma > 0 \quad (14) \]

and

when \( WC > \gamma \text{LT Debt} \), \( \text{Div} \leq X(E) - [\gamma \text{LTDebt} - WC] \)
when \( WC = \gamma \text{LTDebt} \), \( \text{Div} \leq X(E) \)
when \( WC < \gamma \text{LTDebt} \), \( \text{Div} \leq X(E) - [\gamma \text{LTDebt} - WC] \) \quad (15)

and \( 0 < \gamma < 1 \),

where \( WC \) is actual net working capital or the difference between short-term assets and short-term liabilities. In the numerical example presented below, I ignore short-term liabilities so that net working capital equals short-term (and safe) assets. This variable represents an investment decision. \( \text{LTDebt} \) is long-term funded debt and this variable represents a financing decision. \( \gamma \) is a positive negotiated parameter between the firm and lender reflecting the risk of the firm. Div is the sum of cash dividends and share repurchases and this variable represents a financing decision. \( X(E) \) is the sum of annual earnings to equity investors and new equity issues net of debt issues. In the numerical example below, I ignore new issues so that \( X(E) = X(s) \).

The first part of the covenant in equation (14) is a collateral requirement that links the investment in net working capital to long-term debt. The parameter \( \gamma \) reflects the operating risk of the company. For relatively safe and stable industries, \( \gamma \) will be relatively small, and the amount of collateral required in the form of net working capital will be small. The riskier the company, the higher will be the value of the negotiated \( \gamma \). When \( \gamma \geq 1.0 \), the firm must invest in working capital an amount greater than or equal to the amount of debt outstanding.

The second part of the covenant in equation (15) says that the amount of dividends (including share repurchases) the firm can pay to stockholders depends on whether the collateral requirement in equation (14) is met. If the firm has sufficient investments in net working capital to meet the negotiated amount required by (14), then it is free to distribute a cash dividend at least equal to its earnings and new equity issues net of new debt issues. In this case, dividend policy is relatively unconstrained. However, if the collateral requirement in (14) is breached, then a remedy is automatically put in place in the form of a restriction on cash distributions to shareholders. The purpose of the remedy is to use the contractually created retained earnings of \( X(E) - [\gamma \text{LTDebt} - WC] \) to rebuild the deficiency in net working capital, or, in some cases (e.g., when \( \gamma > 1.0 \)) to reduce the amount of long-term debt outstanding.
To illustrate how this set of covenants and the model economy described in Section 1 would work in practice consider the following stylized numerical example. In this connection, let the initial time $t = 0$ balance sheet for some hypothetical representative firm/economy at point $z$ in Figure 3 be:

<table>
<thead>
<tr>
<th></th>
<th>ST assets</th>
<th>Risky assets</th>
<th>Total $K$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm $(m)$</td>
<td>300</td>
<td>700</td>
<td>1,000</td>
</tr>
<tr>
<td>LTDebt $K(d)$</td>
<td>400</td>
<td>Equity $K(s)$</td>
<td>600</td>
</tr>
<tr>
<td>Total $K$</td>
<td>1,000</td>
<td>Total $K$</td>
<td>1,000</td>
</tr>
</tbody>
</table>

It is assumed that there are $N(d) = 4$ bonds outstanding each valued at 100 per bond, and $N(s) = 60$ shares of stock each valued at $P(s) = 10$ per share. The specific concave return-generating process from equation (11) is assumed to be

$$X = 5(300)^{1/2} + 15(700)^{1/2} = 483.5.$$  

The gross return of $X = 483.5$ is assumed to be divided among bondholders and stockholders in the following way:

$$X(d) = 183.5,$$
$$X(s) = 300.$$

Financial leverage and the distribution of corporate income between bondholders and stockholders are then $\frac{LTDebt}{Equity} = \frac{400}{600} = 0.67$ and $\frac{X(d)}{X(s)} = \frac{183.5}{300} = 0.61$. In this initial $t = 0$ equilibrium, the expected and required rates of return on bonds and stocks are assumed to be, respectively, $R(d, ER) = R(d, RR) = 0.459$, and $R(s, ER) = R(s, RR) = 0.50$. The negotiated covenant from equations (13) and (14) is assumed to be

$$WC = \gamma LTDebt \quad \gamma = 0.75$$

and

$$\begin{align*}
\text{when } WC > \gamma LTDebt \quad & \text{Div} \leq X(E) - [\gamma LTDebt - WC] \\
\text{when } WC = \gamma LTDebt \quad & \text{Div} \leq X(E) \\
\text{when } WC < \gamma LTDebt \quad & \text{Div} \leq X(E) - [\gamma LTDebt - WC] \\
\text{and } 0 < \gamma < 1.
\end{align*}$$

5. It is assumed that the initial $t = 0$ balance sheet for point $z$ is measured after the previous-period earnings were distributed to stockholders in the form of cash dividends and/or stock repurchases.
The balance sheet indicates that firm \((m)\) is exactly in compliance with the covenants in its bond contract since \(WC = \gamma \text{LTDebt}\), or 300 = 0.75(400). Therefore, this firm can pay cash dividends or repurchase stock up to a maximum given by the dividend covenant in (15), or,

\[ X(s) = \text{Div} = 300. \]

Now suppose in some interim period \(0 < t < 1\) there is a positive external shock that reduces the required yield of equity investors from \(R(s, RR) = 0.50\) in \(t = 0\) to \(R(s, RR) = 0.468\). Suppose also for ease of presentation that bond yields do not change. Share prices from equation (11) then go to

\[ P(s) = \frac{R(s, ER) K(s)}{R(s, RR) N(s)} = \frac{0.50}{0.468}(10) = 10.68. \]

In response to the observable increase in share valuations relative to economic book values, the managers of firm \((m)\) implement a relatively risky operating strategy that takes the form of reducing their investment in safe ST Assets by 100 and increasing their investments in Risky Assets by the same amount so that their balance sheet is now:

\[
\begin{align*}
\text{Firm (m)} & \\
\text{ST assets} & 200 & \text{LTDebt } K(d) & 400 \\
\text{Risky assets} & 800 & \text{Equity } K(s) & 600 \\
\text{Total } K & 1,000 & \text{Total } K & 1,000
\end{align*}
\]

The returns to the firm, bondholders, and stockholders are now (by the assumed concave return-generating process) the following:

\[ X = 5(200)^{1/2} + 15(800)^{1/2} = 495 \]
\[ X(d) = 183.5 \]
\[ X(s) = 311.5. \]

The end result of this asset adjustment decision is that the covenant in the long-term debt contract is now breached since

\[ WC < \gamma \text{LTDebt} \]
\[ 200 < 0.75(400). \]

In other words, the firm is now contractually required to retain an amount of its earnings equal to the shortfall in net working capital of 100 in this case. To get back into compliance with the first part of the covenant, firm \((m)\) will have to reinvest the 100 of retained earnings in ST Assets and can only pay a dividend of \(\text{Div} = 211.5\).
The attempt to comply with the covenant by retiring LTDebt would be inefficient in that it would require a reduction in dividends of 133.33 versus 100. When the firm invests the 100 in ST Assets and finances the investment with equity in the form of a stock dividend, the period $t = 1$ balance sheet in the expansion becomes

\begin{center}
\begin{tabular}{|l|c|c|}
\hline
 & Firm ($m$) & \\
\hline
ST assets & 300 & LTDebt $K(d)$ & 400 \\
Risky assets & 800 & Equity $K(s)$ & 700 \\
Total $K$ & 1,100 & Total $K$ & 1,100 \\
\hline
\end{tabular}
\end{center}

The firm is now back in compliance with the covenants in the bond contract since

\[ WC = \gamma \text{LTDebt} \]

or

\[ 300 = 0.75(400). \]

The returns to the firm, bondholders, and stockholders in the expansion equilibrium are now

\[ X = 5(300)^{1/2} + 15(800)^{1/2} = 510.9 \]

\[ X(d) = 183.5 \]

\[ X(s) = 327.4. \]

Moreover, the firm can now pay a maximum dividend of

\[ \text{Div} = X(s) = 327.4. \]

In the new $t = 1$ equilibrium at $z''$ in Figure 3, stockholders now earn their new required rate of return of 0.468; financial leverage is lower, LTDebt/Equity = 400/700 = 0.57, compared to 0.67 in $t = 0$, while the distribution of corporate income is now \[ X(d)/X(s) = 183.5/327.4 = 0.56, \] compared to 0.61 in $t = 0$. Stockholders share in corporate income increased when firm ($m$) implemented the speculative investment strategy while bondholders share in financing the firm is now smaller. The end result is that in the period $t = 1$ expansion equilibrium, firm ($m$)/economy generates more operating risk as a result of the investment decision. However, this increase in operating risk has been offset with a reduction in financial leverage and financial risk. When the contracting is perfect, this linked covenant would take the firm/economy to point $z''$ in Figure 3. At point $z''$, the market value of bonds and stocks, \[ N(d)P(d) + N(s)P(s) = 1,100, \] equals the economic book value of these securities, \[ K(d) + K(s) = 1,100, \] and the economic book value of the productive
assets. All arbitrage opportunities between the capital market and factor market are exhausted. The covenants in the bond contract have coalesced the welfare of both bondholders and stockholders and shaped the expansion equilibrium. The contraction case is symmetric to the expansion case but is omitted here to conserve space.

In summary, this section has described the role of covenants in both protecting the investment quality of bonds and shaping the intertemporal business decisions of debt and equity financed firms. Covenants are the mechanism by which bondholders participate in the management of the firm. Their participation is different from stockholders. Business decisions made in the interest of stockholders occur sequentially as the state of nature and preferences of equity investors evolve over time. On the other hand, the bondholder’s voice in the management of the firm through covenants is fixed at the time when the bonds are issued, and remain fixed until the bonds are retired. That is why trust indentures are such long and complicated documents. Bondholders through their covenants must anticipate at the outset every potential decision and state of nature that will adversely impact the investment quality of their bonds. What makes bond contracts lengthy and complicated legal documents is the fact that the covenants contained therein are mostly static. In this section, it was proposed to exchange the complexity of stand-alone covenants for the lesser complexity of linking several covenants together. This objective was achieved when the managers of the firm made investment decisions that conform to the risk perceptions and risk aversion of their stockholders, and then make financing decisions that preserve the market valuations of their bonds. Covenants that succeed in achieving this objective enhance the efficiency of the financial system.

The testable implications from this model are as follows. The first is that stock price changes precede changes in company investments. The second, third, and fourth predictions are that the return-to-risk ratio, the risk premium, and financial leverage are all countercyclical. In the next section, we empirically test the first and fourth predictions with U.S. data for nonfinancial enterprises over the long sample periods 1900–2002 and 1946–2002. The second and third predictions are well documented in the work of Ferson and Merrick (1987), Fama (1990), Hardouvelis and Wizman (1992), Harrison and Zhang (1999), Harvey (2001), and Brandt and Kang (2003) among others.

3. INVESTMENT DECISIONS AND FINANCING DECISIONS OF U.S. NONFINANCIAL (AND NONFARM) ENTERPRISES: SOME EMPIRICAL EVIDENCE

The model in Section 1 has managers of firms: (i) adjusting their assets and operating risk in response to shock-induced changes in the pricing of risk and the required rate of return of their stockholders, and then (ii) through covenants adjusting their financing to offset any effects of a change in operating risk on the market value of their bonds. While it is clear that covenants exist and there is much evidence they
are priced in the market (see Bradley and Roberts 2004, Reisel 2004), is there any statistical evidence that covenants shape the investment and financing decisions of firms in the way predicted by the contracting model in Section 1 and illustrated in the numerical example in Section 2? To test this theory, I must find suitable proxies for the initiating capital market signal, the asset adjustments (and operating risk), and the offsetting financing adjustments (and financial risk) of firms. Toward this end, I study the intertemporal adjustments of the aggregate balance sheets for the U.S. nonfarm and nonfinancial corporate business sector over the long sample period 1900–2002. Like Philippon (2009), I use aggregate time-series data from the Federal Reserve balance sheets for the nonfinancial corporate sector rather than panel data for individual firms to test the model in Section 1 for several reasons. To begin with, business cycles are aggregate intertemporal economic phenomena, and for that reason policymakers are interested in the behavior of economic aggregates. Every year some firms expand while others contract due to changes in taste and technology. This is normal in a dynamic market economy. However, in some years more firms contract (or expand) than expand (or contract), thus producing a recession (or an expansion). This is less normal. The goal of this paper is to understand the aggregate balance sheet adjustments of all firms during these abnormal periods of recession and expansion. The second reason aggregate time-series data are used is that the Federal Reserve and Bureau of Economic Analysis (BEA) generate current replacement cost data for tangible assets (inventories, plant, and equipment) for the entire nonfinancial corporate sector. Current replacement cost tangible assets go to the heart of the $Q$-theory I described in Section 1. Most panel data on firm balance sheets are measured in terms of historical cost book values, which has a more tenuous link to $Q$-theory. For these reasons, I look for these proxies in the aggregate financial statements of U.S. nonfinancial enterprises.

The financial statement data underlying the empirical work presented below was obtained from Wright (2004). Wright extends the Federal Reserve Flow of Funds Statistics on aggregate balance sheets (table B102) and changes in net worth (table R102) for nonfinancial and nonfarm corporations from 1945 back to 1900. His useful contribution was to link earlier published data from the BEA, the National Income and Product Accounts, Historical Statistics, Goldsmith (1955), Kuznets (1941), and others to the Federal Reserve data set (1945–present) to obtain a consistent time series for various financial statement variables and other economic variables for the entire twentieth century. For a description of the data, see the Appendix.

The first set of empirical tests is directed toward the business cycle relationships among certain economic variables that are predicted by the model in Section 1. In this connection, Table 1 presents the means and standard deviations of changes in certain financial statement and capital market variables for recession years and expansion years over the long sample time period 1900–2002. To obtain the recession years and the expansion years in Panel A of the table, the sample time period was split into two

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6. The data can be downloaded from Wright’s website at www.econ.bbk.ac.uk/faculty/Wright.
TABLE 1
The Cyclical Pattern of Investment and Financing for U.S. Nonfinancial Corporations

Panel A. 1900–2002

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2) Means (std. dev.)</th>
<th>(3) Means (std. dev.)</th>
<th>(4) t-scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Recession years&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Expansion years&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>ΔSP&lt;sub&gt;0.5&lt;/sub&gt;</td>
<td>−137.55(402.17)</td>
<td>284.90 (596.87)</td>
<td>3.38&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>ΔQ&lt;sub&gt;0.5&lt;/sub&gt;&lt;sup&gt;Inv&lt;/sup&gt;</td>
<td>−0.08 (0.16)</td>
<td>0.05 (0.11)</td>
<td>4.00&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Δ(Inv)</td>
<td>−8.41 (35.82)</td>
<td>25.97 (22.20)</td>
<td>4.78&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Δ(Inv + P&amp;E)</td>
<td>29.43(114.23)</td>
<td>105.87 (94.46)</td>
<td>2.98&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Δ(ΔLT Liab × 100)</td>
<td>0.941 (2.98)</td>
<td>−1.16 (2.26)</td>
<td>3.18&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Δ(ΔLT Liab&lt;sub&gt;0.5&lt;/sub&gt; × 100)</td>
<td>0.315 (1.388)</td>
<td>−0.588 (1.097)</td>
<td>2.96&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Panel B. 1900–2002

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2) Means (std. dev.)</th>
<th>(3) Means (std. dev.)</th>
<th>(4) t-scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Recession years&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Expansion years&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>ΔSP&lt;sub&gt;0.5&lt;/sub&gt;</td>
<td>−291.0 (661.5)</td>
<td>275.6 (552.5)</td>
<td>4.33&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>ΔQ&lt;sub&gt;0.5&lt;/sub&gt;&lt;sup&gt;Inv&lt;/sup&gt;</td>
<td>−0.10 (0.17)</td>
<td>0.05 (0.10)</td>
<td>5.56&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Δ(Inv)</td>
<td>−12.44 (40.0)</td>
<td>20.24 (23.92)</td>
<td>4.95&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Δ(Inv + P&amp;E)</td>
<td>16.66 (171.0)</td>
<td>101.0 (87.8)</td>
<td>3.87&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Δ(ΔLT Liab&lt;sub&gt;0.5&lt;/sub&gt; × 100)</td>
<td>1.428 (2.93)</td>
<td>−0.65 (2.52)</td>
<td>3.52&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Δ(ΔLT Liab&lt;sub&gt;0.5&lt;/sub&gt; × 100)</td>
<td>0.46 (1.34)</td>
<td>−0.33 (1.17)</td>
<td>2.93&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Recession years and expansion years were obtained in the following way. The sample time period 1900–2002 was split in half: 1900–51 and 1952–2002. For each half, a mean and standard deviation of the growth rate in gross domestic product, GDP, generated in the nonfinancial corporate sector was calculated. Recession (or expansion) years were then defined as those years in which actual GDP was less (or more) than or equal to mean GDP minus (or plus) one-half the standard deviation of GDP. For 1900–51, mean GDP = 0.0385 and the standard deviation of GDP was 0.08. Recession years were those years in which actual GDP was less than or equal to: mean GDP − ½ standard deviation of GDP or 0.0385 − ½ 0.08 = −0.0015 or lower. Expansion years are those years in which mean GDP growth is 0.0385 + ½ 0.08 or 0.0785 or larger. For 1952–2002, mean GDP growth was 0.0407 and the standard deviation was 0.036. Recession years are then calculated as 0.0407 − ½ 0.036 = −0.0227 or lower and expansion years as 0.0407 + ½ 0.036 = 0.0587 or larger. Using this criterion, we obtained 30 recession years and 33 expansion years. The recession years were: 1904, 1908, 1914–15, 1919–21, 1924, 1930–33, 1938, 1945–46, 1949, 1954, 1957–58, 1961, 1970, 1974–75, 1980, 1982, 1986, 1989–91, and 2001. The expansion years are: 1901, 1906, 1909, 1918, 1922–23, 1925, 1934–37, 1939–43, 1950, 1953, 1955, 1959, 1962, 1964–66, 1968, 1972, 1976–78, 1984, 1994, 1997, and 2000. Expansion years were: 1901–02, 1905–06, 1909, 1912, 1915–18, 1922–23, 1925–26, 1928–29, 1934–37, 1939–44, 1946–47, 1950–53, 1955–58, 1962–69, 1971–73, 1976–79, 1981, 1983–89, 1992–2000.


<sup>**</sup>Indicates that the difference in means between recession years and expansion years is significantly different than zero at the 1% level on a one-tail t-test.
According to the NBER, recessions start at the peak of a business cycle and end at the trough, while expansions start at the trough and end at the peak. Peaks and troughs in turn are dated by quarters within a year while the balance sheet and income statement data for the nonfinancial corporate sector is on an annual basis. The question is how to treat the year in which a peak (or trough) occurs. My arbitrary strategy is as follows. If the peak (or trough) occurs in the third or fourth quarter of a given year, that year is counted as an expansion (or recession) year. If the peak (or trough) occurs in the first or second quarter of a given year, I then assign it to a recession or expansion or normal year using the criteria in Panel A. Once the recession years and expansion years were identified, the means and standard deviations for each of the financial statement and market variables for the nonfinancial corporate sector in column 1 of Table 1 were calculated and presented in columns 2 and 3.

I begin by comparing the asset adjustments and financing adjustments of U.S. nonfinancial enterprises for the 30 recession years and 33 expansion years in Panel A of the table, and the 27 recession years and 66 expansion years in Panel B of Table 1 for the period 1900–2002. The model in Section 1 argues that the asset adjustments of firms represent a response to changes in the lagged market valuations of their equity securities. These asset adjustments cause business cycles. The empirical prediction from the theory is that lagged changes in the market valuation of equity shares (or Keynes–Tobin $Q$-ratios) and risky asset adjustments of nonfinancial firms are procyclical. In column 1 of Panels A and B of Table 1, the lagged change in both of these capital market variables in the nonfinancial corporate sector is represented by $\Delta SP_{-1}$ and $\Delta Q_{-1}^{bea}$. The next two variables in column 1 represent the risky asset adjustments of firms. The first is the change in the real value of inventories, $\Delta(Inv)$, and the second is the sum of the changes in the real value of inventories, plant, and equipment represented by $\Delta(Inv + P&E)$. As expected, the average values in the recession years (in column 2) and the expansion years (in column 3) for the two lagged capital market signals and the two risky investment variables indicate that all four are procyclical. Moreover, it can be seen in column 4 in both Panels A and B of Table 1 that the differences in the means over all recession years and all expansion years for these four variables over the 102-year sample time period are significantly different from zero at the 1% level on a one-tail $t$-test. On the other side of the balance sheet is the financing adjustment. According to the model, managers constrained by covenants in the bond contract make financing decisions to protect bondholders. This protection takes the form of adjusting financial leverage—measured as $\Delta(LTLiab/A)$ and $\Delta(LTLiab/Net Worth)$—and financial risk to offset the changes in the operating risk associated with the asset adjustments of firms. When firms are increasing (or decreasing) $\Delta(Inv)$ and $\Delta(Inv + P&E)$ in the expansion years (or recession years) and by equation (12) increasing (or decreasing) operating risk, a rational contract between bondholders and stockholders will require firms to reduce (or increase) the two measures of financial leverage and financial risk. In other words, the theory predicts $\Delta(LTLiab/A)$ and $\Delta(LTLiab/Net Worth)$ rise during recessions and fall in expansions. This prediction is not rejected by the data in both panels of Table 1 for the recession years and the expansion years in the nonfinancial corporate sector over the twentieth century.
Furthermore, the differences between the means for the two stages of the business cycle for both $\Delta(LTLiab/A)$ and $\Delta(LTLiab/Net\ Worth)$ are statistically significant at the 1% level. These balance sheet adjustments in cyclical troughs and peaks over the 102-year period do not reject the view that the nonfinancial corporate sector uses financing adjustments to offset operating risks associated with their asset adjustments.

The next set of empirical tests measures the response of risky tangible corporate investments to four different capital market signals for all years (not just recession and expansion years) over the two sample time periods: 1900–2002, and the post-WWII period 1946–2002. The measure of reproducible tangible investments used in the regression tests in Table 2 is the change in inventories plus the change in the real replacement value of the stock of plant and equipment held by these companies, $\Delta(\text{Inv} + \text{P&E})$. Four capital market variables are used in the regressions to represent the cost of capital signal. The first two are used together and are an integral part of the theory described in Section 1 and illustrated in Figures 2 and 3. One is an equity $Q$-ratio, which in principle is equal to $R(s, ER)/R(s, RR)$ as described in equation (11). From the Federal Reserve balance sheets, it is measured as the ratio of the market value of net worth to the economic book value of net worth. The latter is measured as the real replacement cost of total assets minus the book value of debt. The variable used in the regressions in Table 2 is the change in this $Q$ factor, namely, $\Delta(NWQ)$. The other capital market variable is a debt $Q$-ratio. The variable used in the regressions is the change in this debt $Q$-ratio, $\Delta(LT LiabQ)$. In equation (8) in Section 1, this debt $Q$-ratio equaled $R(d, ER)/R(d, RR)$. In practice, this debt $Q$ factor is measured as the ratio of the market value of bonds and mortgages to the book value of bonds and mortgages. The third capital market signal used in Table 2 is the change in the more traditional $Q$-ratio labeled $\Delta Q^{\text{bea}}$. This $Q$-ratio is measured as the ratio of the market value of nonfinancial corporate equity and net liabilities (total liabilities minus financial assets) to the replacement cost of tangible assets. The final capital market variable used in this study is the change in the real market value of the total equity in the nonfinancial corporate sector, $\Delta(\text{SP})$.

Many empirical studies that use $Q$-ratios as a market signal that summarizes the future profitability of new corporate investment opportunities often include cash flow as an additional explanatory variable reflecting fundamentals. Early empirical research found that $Q$ had a relatively small effect on corporate investment (particularly for small firms) while cash flow had a much larger effect. Some (e.g., Hubbard 1998)

7. I obtained essentially the same results for $\Delta(\text{Inv})$ and $\Delta(\text{P&E})$ separately, but do not report them here in the interest of conserving space.

8. Tobin (1969) suggests that the $Q$-ratio relevant for corporate investment decisions is marginal $Q$ defined as the ratio of the capital market value of new additional capital goods to their current replacement cost. Many empirical studies of corporate investment using the $Q$ approach proxy marginal $Q$ with average $Q$. Hayashi (1982) shows that marginal $Q$ and average $Q$ are equivalent when the firm is a price taker in factor and product markets, and the production and installation (of capital) functions are both linear homogeneous. In Table 2, I proxy marginal $Q$ with the change in measured $Q$.

9. More recent research finds that cash flow sensitivities have declined over time. A partial listing of empirical work on both sides of this issue include: Fazzari, Hubbard, and Petersen (1988), Lorenzoni and Walentin (2007), Brown and Petersen (2009), and Gatchev, Pulvino, and Tarhan (2010).
TABLE 2
NONFINANCIAL CORPORATE INVESTMENTS, MARKET SIGNALS, AND CASH FLOWS

Panel A. 1900–2002

<table>
<thead>
<tr>
<th>Regression:</th>
<th>2I1</th>
<th>2I2</th>
<th>2I3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔNWQ_{-1}</td>
<td>3,174.60</td>
<td>(8.74/0.00)</td>
<td>3,174.60</td>
</tr>
<tr>
<td>ΔLTLQ_{-1}</td>
<td>1,243.28</td>
<td>(7.08/0.00)</td>
<td>1,243.28</td>
</tr>
<tr>
<td>ΔQ^{bea}_{-1}</td>
<td>193.24</td>
<td>(1.99/0.05)</td>
<td>193.24</td>
</tr>
<tr>
<td>ΔSP_{-1}</td>
<td>0.547</td>
<td>(3.76/0.00)</td>
<td>0.547</td>
</tr>
<tr>
<td>ΔCF_{-1}</td>
<td>0.579</td>
<td>(1.53/0.13)</td>
<td>0.579</td>
</tr>
<tr>
<td>Δ(Inv + P&amp;E)_{-1}</td>
<td>0.589</td>
<td>(6.65/0.00)</td>
<td>0.589</td>
</tr>
<tr>
<td>ΔDV</td>
<td>DV41 DV45 DV50</td>
<td>DV41 DV45 DV50</td>
<td>DV41 DV45 DV50</td>
</tr>
<tr>
<td></td>
<td>DV53 DV73 DV74</td>
<td>DV53 DV73 DV74</td>
<td>DV53 DV73 DV74</td>
</tr>
<tr>
<td>R^2</td>
<td>0.58</td>
<td>0.48</td>
<td>0.53</td>
</tr>
<tr>
<td>Breusch–Godfrey LM test</td>
<td>0.49 (0.78)</td>
<td>2.11 (0.07)</td>
<td>2.25 (0.06)</td>
</tr>
</tbody>
</table>

Panel B. 1946–2002

<table>
<thead>
<tr>
<th>Regression:</th>
<th>2I1</th>
<th>2I2</th>
<th>2I3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔNWQ_{-1}</td>
<td>3,046.29</td>
<td>(5.81/0.00)</td>
<td>3,046.29</td>
</tr>
<tr>
<td>ΔLTLQ_{-1}</td>
<td>1,268.42</td>
<td>(5.51/0.00)</td>
<td>1,268.42</td>
</tr>
<tr>
<td>ΔQ^{bea}_{-1}</td>
<td>491.18</td>
<td>(5.21/0.00)</td>
<td>491.18</td>
</tr>
<tr>
<td>ΔSP_{-1}</td>
<td>0.599</td>
<td>(1.34/0.18)</td>
<td>0.599</td>
</tr>
<tr>
<td>ΔCF_{-1}</td>
<td>0.757</td>
<td>(2.10/0.04)</td>
<td>0.757</td>
</tr>
<tr>
<td>Δ(Inv + P&amp;E)_{-1}</td>
<td>0.417</td>
<td>(3.28/0.00)</td>
<td>0.417</td>
</tr>
<tr>
<td>ΔDV</td>
<td>DV50 DV53</td>
<td>DV50 DV53</td>
<td>DV50 DV53</td>
</tr>
<tr>
<td></td>
<td>DV73 DV74</td>
<td>DV73 DV74</td>
<td>DV73 DV74</td>
</tr>
<tr>
<td>R^2</td>
<td>0.58</td>
<td>0.48</td>
<td>0.53</td>
</tr>
<tr>
<td>Breusch–Godfrey LM test</td>
<td>0.49 (0.94)</td>
<td>1.31 (0.28)</td>
<td>1.94 (0.11)</td>
</tr>
</tbody>
</table>

Note: The table reports the estimated coefficients on lagged market variables and cash flows in a tangible investment regression. The Newey-West t-scores/p-values (in parentheses) and the Breusch–Godfrey LM test for serial correlation up to five lags are reported in the table.

The Breusch–Godfrey LM test is a test for serial correlation in the regression residuals up to a prespecified lag. The first number reported is the F-statistic and the second is the p-value. The null is that there is no serial correlation in the residuals up to the prespecified lag, 5 in this table. Low probabilities indicate a rejection of the null.

interpret these results as evidence of the importance of financing constraints arising from asymmetric information between inside and outside investors, while others (e.g., Abel and Eberly 2004) interpret these results as consistent with the existence of growth options associated with exogenous changes in the technology frontier of firms. It would therefore seem useful to include the change in real cash flows, ΔCF
(defined as nominal earnings retention plus depreciation charges deflated by the consumer price index), as an additional explanatory variable alongside the four capital market variables.

The long sample period for the regression tests in Panel A of Table 2 covers 1900–2002. Much in the way of outside disturbances occurred over this sample time period. There were two world wars, radical changes in tax regimes, three medium to small wars, price controls, and an oil boycott of the U.S. To accommodate these major outside disturbances, I include dummy variables in the regressions at the beginning and end of each disturbance with the exception of World War I. Including a dummy variable for 1917 (and/or 1918/19) had a statistically insignificant effect on the investment regressions so one was not used. The dummy variables used in the regression tests of Table 2 are the following: DV41 and DV45 for World War II, DV50 and DV53 for the Korean War, and DV73, DV74 for the oil shock and price controls in the early and mid 1970s. All dummy variables take on the value of unity in the year of the external disturbance and zero elsewhere. Slope dummy variables were not empirically successful and hence were not included in the regressions.

Table 2 presents the estimated coefficients on the explanatory variables, the Newey–West t-statistics and p-values, the coefficient of determination, and the Breusch–Godfrey LM test for serial correlation in the regression residuals for the three corporate investment regressions run over the two sample time periods, 1900–2002 and the post-WWII period 1946–2002. I calculate and report (but do not show) the 5% bands for the cumulative sum of the recursive residuals (CUSUM) as an approximate test for parameter stability. The measure of corporate investment is the change in tangible reproducible assets, \( \Delta(\text{Inv} + \text{P&E}) \). The regressors are the changes in the four lagged capital market variables, the change in real cash flow, the dummy variables included where appropriate over the two sample time periods, and, finally, the lagged value of the dependent variable to account for any frictions (as in Eberly, Rebelo, and Vincent 2011) associated with the adjustment lag. The regression results for the entire sample period of 1900–2002 are presented in Panel A of Table 2. The regressions in (2I1)–(2I3) indicate that the estimated coefficients on all lagged capital market variables are positive and statistically significant. These results fail to reject the predictions of the theory outlined in Section 1. Firms adjust their assets in response to lagged changes in the market value of their securities. The estimated coefficients on the change in cash flow are all positive but never statistically significant with t-scores/p-values in the neighborhood of 1.3–1.5/0.13–0.2. For aggregate tangible investment, changes in cash flow do not seem to be a particularly important variable over the long sample time period. It can also be seen in the table that the estimated coefficients on the lagged changes in tangible assets are all positive and statistically significant indicating that the investment response of the nonfinancial corporate sector is distributed over time. In time-series regressions when the lagged dependent variable is a regressor, serial correlation in the residuals can bias both the t-statistics and the estimated coefficients. One test that can detect the presence of higher order serial correlation in the regression residuals is the Breusch–Godfrey test. For the regressions in Panel A of Table 2, the Breusch–Godfrey test indicates that we cannot reject at the 5% significance level the hypothesis of no serial correlation in the residuals up to a lag of
5 years for regressions 2I1 and 2I2. For regression 2I3 where $\Delta SP_{-1}$ is the stock market variable there is some evidence at the 6% significance level of higher order serial correlation in the regression residuals. Finally, the CUSUM plots of the recursive residuals (not shown here) all lie within the critical 5% significance boundary lines for all three regressions in Panel A of Table 2, indicating that we cannot reject the hypothesis that the estimated coefficients are stable over the sample period. For the long sample period, the corporate investment specification using both $\Delta (NWQ)$ and $\Delta (LTLiabQ)$ as the capital market signals seems to outperform the traditional $Q$ specification given by $\Delta Q^{new}$ and the stock market variable $\Delta (SP)$ in terms of the statistical significance of the estimated coefficients, parameter stability, and the overall explanatory power. This specification of the market signal is more directly related to the theoretical model in Section 1 compared to the other two market signals. It is also worth noting that the estimated coefficient on $\Delta (NWQ)$ is roughly two and a half times larger than the coefficient on $\Delta (LTLiabQ)$, indicating that the equity market signal is relatively stronger in shaping the asset adjustments of nonfinancial firms than the debt market signal. Finally, the fact that the estimated coefficients on $\Delta (NWQ)$ and $\Delta (LTLiabQ)$ are both positive indicates that the balance sheet adjustments of nonfinancial firms on average occur in zones I and III in Figures 2 and 3.10

In Panel B of Table 2, the sample period covers the more recent time period from the end of WWII to 2002. I use this sample time period as a basis for comparison with more recent studies of the nexus between corporate investment, $Q$-ratios, and cash flow. The regression results are presented in 2II1–2II3. Again, it is the case that the

10. A referee of this paper suggested that it would be useful to compare our measure of risky investment, $\Delta (Inv + P&E)$, used in Table 2 to alternative measures of a risky investments. One measure suggested would be to scale the level of investment by the total assets of nonfinancial enterprises, namely, $\Delta (Inv + P&E)/A$. A second and more cyclically sensitive measure of a risky investment strategy of nonfinancial enterprises would be the change in the deviation of real investment in inventories, plant, and equipment from their Hodrick–Prescott computed trend. I label this measure of a risky investment strategy $\Delta (Inv + P&E)^{\text{Cyc}}$. Using the same regression specification (including the same dummy variables) as in 2II1 in Table 2, I obtain the following results for the period 1900–2002:

(i) $\Delta [\text{Inv} + \text{P&E}]/A$

$$= -0.001 + 0.373 \Delta NWQ_{-1} + 0.118 \Delta LTLiabQ_{-1} + 2.346 - 0.572 \Delta [(\text{Inv} + \text{P&E})/A]_{-1}$$

$$(-1.32/0.19) \quad (3.56/0.00) \quad (2.57/0.01) \quad (0.67/0.50) \quad (5.40/0.00)$$

$R^2 = 0.27$ Breusch–Godfrey LM Test 1.14(0.35)

(ii) $\Delta (\text{Inv} + \text{P&E})^{\text{Cyc}}$

$$= -9.756 + 2.439.55 \Delta NWQ_{-1} + 1.043.81 \Delta LTLiabQ_{-1} + 0.662 \Delta CF_{-1} + 0.311 \Delta [(\text{Inv} + \text{P&E})_{-1}^{\text{Cyc}}$$

$$(-1.54/0.13) \quad (5.28/0.00) \quad (6.53/0.00) \quad (2.21/0.03) \quad (3.28/0.00)$$

$R^2 = 0.38$ Breusch–Godfrey LM Test 2.14(0.07)

The Newey–West $t$-scores/$p$-values are reported below the estimated coefficients. The statistical fits in 10(i) and 10(ii) are not as good as the fits in 2I1 in Table 2. Nevertheless the estimated coefficients on the equity $Q$ and debt $Q$ in both regressions have the correct theoretical signs, and both are statistically significant at the 1% level. In both cases, the estimated coefficient on the equity $Q$ are two to three times larger than the estimated coefficient on the debt $Q$ as they were in Table 2. Lagged cash flows are not statistically significant in the specification where $\Delta [(\text{Inv} + \text{P&E})/A]$ is the dependent variable but are statistically significant when $\Delta (\text{Inv} + \text{P&E})^{\text{Cyc}}$ is the dependent variable. Finally, the CUSUM plots of the recursive residuals (again not shown) all lie within the 5% boundary lines indicating parameter stability over the sample period.
estimated coefficients on the capital market variables are all positive and all are statistically significant at the 1% significance level, indicating that the balance sheet adjustments take place on average in zones I and III in Figures 2 and 3. With the exception of the estimated coefficient on $\Delta(Q^{bea})$, all the coefficients on the other capital market variables are fairly close to those estimated over the longer time period 1900–2002. The estimated coefficients on the cash flow variable are also positive. When the capital market variables are $\Delta(NWQ)$, $\Delta(LTLiabQ)$, and $\Delta(SP)$, the positive estimated coefficient on the cash flow variable is not significantly different from zero at the 5% significance level. This result is similar to the investment regressions of Philippon (2009) who develops a bond $Q$ measure based on relative bond prices between Baa bonds and T-bonds conditioned on leverage, the risk-free rate, and idiosyncratic risk. On the other hand, when the capital market variable is $\Delta(Q^{bea})$ as in regression 2II2, the positive estimated coefficient on the cash flow variable is statistically significant at the 5% level. The result in this regression is somewhat closer to the results reported in many previous studies of corporate investment, $Q$-ratios, and cash flows over roughly comparable time periods. Even so the cash flow variable in this regression does not reduce the size or statistical significance of the estimated coefficient on the capital market variable $\Delta(Q^{bea})$. In fact, the estimated coefficient and $t$-score on $\Delta Q^{bea}$ are both more than 2.5 times their respective values compared to the longer time period when the cash flow variable was not statistically significant. The Breusch–Godfrey LM test indicates that serial correlation up to order 5 is absent in the regression residuals in all three regressions, and all dummy variables in Panel B of Table 2 were statistically significant at the 1% level. As in Panel A of the table, the CUSUM plots of the recursive residuals (again, not shown here) for the 1946–2002 time period regressions all lie within the 5% boundary lines, indicating parameter stability over this sample period. Finally, it is again the case that the estimated coefficient on the equity $Q$-ratio, $\Delta(NWQ)$, is more than twice as large as the coefficient on the debt $Q$-ratio, $\Delta(LTLiabQ)$.

Capital market signaling of investor preferences over real investment strategies for their firms is one function of an efficient financial system. The other function emphasized in Sections 1 and 2 of this paper is the role of rational financial contracts in matching the financing decisions of firms to their investment decisions. I now present some evidence on the financing decisions of nonfinancial corporations over the twentieth century.

According to the model in Sections 1 and 2, changes in tangible investment and operating risk triggered by a capital market signal must be offset with changes in financial risk in order to balance the interests of bondholders and stockholders in the representative firm over the business cycle. Operating risks as well as expected cash flows are generated by the investment decisions of firms. Financial risk in this model is the result of the firm’s covenant constrained choice of a capital structure. Table 3 tests the second of these predictions from the theory using tangible investments to proxy for changes in operating risk, and changes in capital structure to proxy for changes in financial risk.
### TABLE 3

#### Panel A. Nonfinancial corporate leverage and investments

\[
\Delta \left( \frac{LTLiab}{A} \right) = b_0 + b_1(\text{Corporate Investments}) + b_2(\text{Lagged Corporate Leverage}) + b_3(\text{Dummy Variable}) + V
\]

<table>
<thead>
<tr>
<th>Regression</th>
<th>3I1</th>
<th>3I2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta(\text{Inv}) \times 100 )</td>
<td>(-0.010)</td>
<td>(-0.003)</td>
</tr>
<tr>
<td>( \Delta(\text{Inv} + \text{P&amp;E}) \times 100 )</td>
<td>((-3.52/0.00))</td>
<td>((-3.65/0.00))</td>
</tr>
<tr>
<td>( \Delta \left( \frac{LTLiab}{A} \right)_{-1} )</td>
<td>0.594</td>
<td>0.603</td>
</tr>
<tr>
<td>( DV )</td>
<td>DV36 DV86</td>
<td>DV36 DV86</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.53</td>
<td>0.51</td>
</tr>
<tr>
<td>Breusch–Godfrey LM test</td>
<td>1.55 (0.18)</td>
<td>1.99 (0.09)</td>
</tr>
</tbody>
</table>

#### Panel B. Nonfinancial corporate leverage, investments, and taxes

\[
\Delta \left( \frac{LTLiab}{A} \right) = b_0 + b_1(\text{Corporate Investments}) + b_2(\text{Corporate Tax Rates}) + b_3(\text{Lagged Corporate Leverage}) + b_4(\text{Dummy Variables}) + V
\]

<table>
<thead>
<tr>
<th>Regression:</th>
<th>3II1</th>
<th>3II2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta(\text{Inv}) \times 100 )</td>
<td>(-0.006)</td>
<td>(-0.002)</td>
</tr>
<tr>
<td>( \Delta(\text{Inv} + \text{P&amp;E}) \times 100 )</td>
<td>((-3.60/0.00))</td>
<td>((-3.35/0.00))</td>
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<tr>
<td>( \Delta t )</td>
<td>0.014</td>
<td>0.010</td>
</tr>
<tr>
<td>( \Delta \left( \frac{LTLiab}{A} \right)_{-1} )</td>
<td>0.442</td>
<td>0.421</td>
</tr>
<tr>
<td>( DV )</td>
<td>DV86</td>
<td>DV86</td>
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<tr>
<td>( R^2 )</td>
<td>0.41</td>
<td>0.42</td>
</tr>
<tr>
<td>Breusch–Godfrey LM test</td>
<td>2.34 (0.06)</td>
<td>1.49 (0.21)</td>
</tr>
</tbody>
</table>

**Note:** The table reports the estimated coefficients on two measures of corporate investment in long-term financial leverage regressions. The Newey–West t-scores/p-values (in parentheses) and the Breusch–Godfrey LM test for serial correlation up to 5 lags are reported in the table. The Breusch–Godfrey LM test is a test for serial correlation in the regression residuals up to a prespecified lag. The first number reported is the F-statistic and the second is the p-value. The null is that there is no serial correlation in the residuals up to the prespecified lag, 5 in this table. Low probabilities indicate a rejection of the null.

Table 3 begins the empirical testing of this financing prediction from the theory in Section 1 by regressing one measure of financial leverage, \( \Delta(LT Liab/A) \), on two measures of corporate investments that proxy for changes in operating risk, namely, \( \Delta(\text{Inv}) \) and \( \Delta(\text{Inv} + \text{P&E}) \). Then with a planning, ordering, and building lag the investment expenditures are incurred and financing arrangements put in place. If the new investment strategy results in an economic expansion and increases the

11. We obtained the same results for the \( \Delta t(LTLiab/\text{Net Worth}) \) measure of financial leverage but do not report them here in the interest of conserving space.
operating risk of firms, then according to the theory in Sections 1 and 2 the new tangible investment expenditures will be financed predominately with equity reducing financial leverage and financial risk. If the new investment strategy reduces operating risk by downsizing the representative firm causing a recession, then the released financial resources will be returned to stockholders as they let their call option expire and financial leverage and financial risk will rise. The prediction from the theory is that adjustments in financial leverage will be negatively related to risky tangible investments and are countercyclical. This prediction is tested in Panels A and B of Table 3 over the two sample time periods of 1900–2002 and 1946–2002. In Panel A, the change in financial leverage, Δ(LTLiab/A), is regressed on the two measures of tangible investment—Δ(Inv) and Δ(Inv + P&E)—the lagged value of Δ(LTLiab/A) to capture financing adjustment costs, and the dummy variables for the years 1936 and 1974. The estimated coefficients, the Newey–West t-scores/p-values, the adjusted coefficient of determination, and the Breusch–Godfrey LM test for serial correlation, are reported in the body of the table. Again the 5% CUSUM bands are reported (but not shown) to test for parameter stability. As can be seen in regressions 3I1 and 3I2, the estimated coefficients on the two corporate investment variables are negative and all are statistically significant. An expansion (or reduction) in risky tangible investments is accompanied by a reduction (or expansion) in financial leverage, which in turn reflects financial risk. Firms seemingly match their financing strategy to the risks of their investment strategy. The reported Breusch–Godfrey LM test indicates an absence of serial correlation at the 5% significance level and the CUSUM plots of

12. It is surprising that the largest 1-year decline in long-term debt for the entire 102-year sample period occurred in the year 1936. The year 1936 experienced a sharp expansion in GDP, Δ(Inv), and Δ(Inv + P&E). Accordingly, the model in Section 1 predicted a decline in financial leverage. However, the actual decline was over 400 times the fitted decline for the Δ(LTLiab/A) regression without DV36. Major economic events that occurred in and around that year include the enactment of social security in 1935 and the tax on undistributed profits of corporations enacted in 1936. What is surprising is that a tax on undistributed corporate profits (ostensibly designed to capture individual tax revenues on dividend income, thus giving rise to the double taxation of corporate income) should have the exact opposite effect on long-term debt financing by forcing companies to rely less on retained earnings and more on external financing to fund their new investments. On the other hand, Treasury Decision No. 4674 (approved on August 6, 1936) allowed companies to issue taxable stock dividends, which, in turn, would enable firms to avoid the undistributed corporate profit tax and yet keep the cash in the business to acquire assets and/or retire liabilities. This way of meeting the new tax legislation would minimize the corporate tax liability while at the same time maximizing the amount of internal funds retained in the business, thus enabling firms not to issue debt to finance their investments.

13. The balance sheet adjustment model in Sections 1 and 2 was constructed to represent a recursive system. It all begins with an external shock that is first evaluated in the stock market. Managers then respond to the stock market signal of \( P(s) \neq \frac{\Delta N}{\Delta t} \) with a lag by adjusting their assets so that eventually the \( R(s, ER) \) embedded in their investment strategy more closely matches the risk perceptions and aversion of their stockholders given by \( R(s, RR) \). To compensate bondholders for any change in operating risk associated with the investment decision, managers guided by covenants then make an offsetting financing decision that in turn changes the financial risk of firms. Since the system is recursive, OLS estimates of the coefficients of the model are both consistent and efficient. Nevertheless, it might be thought that because assets and financing are two sides of the same balance sheet, their adjustments are endogenous in which case OLS parameter estimates are neither consistent nor efficient (in large samples). This line of reasoning suggests an instrumental variable approach to estimation. Hausman (1978) proposed a two-step test of endogeneity for use in single equation OLS models. We use the Davidson and Mackinnon (1993) version of the Hausman test. The first step is to run an auxiliary regression of risky investments (in our case, \( \Delta Inv \) and \( \Delta (Inv + P&E) \)) on all exogenous variables (i.e., \( \Delta NWQ_{-1}, \Delta LTLiabQ_{-1}, \Delta CF_{-1}, \text{and} \ DV41, DV45, DV50, DV53, DV73, \text{and} \ DV74 \)) and instruments (assumed to be lagged changes in: real
the recursive residuals (not shown here) all lie within the 5% significance boundaries indicating we cannot reject the hypothesis that the estimated coefficients are stable.

Up to this point attention has been focused on the fundamental nontax reasons for the capital structure choices of U.S. nonfinancial firms over time. Tax considerations as a motivation for issuing debt have been ignored. However, in the U.S. and many other countries interest payments on debt reduce the taxable income and tax payments of firms. From the corporate tax perspective debt is a more tax-efficient financing instrument than equity, and this efficiency increases with the corporate tax rate. Personal tax rates on investment income can increase or decrease the corporate tax efficiency of debt financing. For example, high personal tax rates on debt income (i.e., rates higher than the corporate income tax rates) combined with low personal tax rates on equity income reduce the corporate tax advantage of debt financing (see Miller 1977). The Tax Reform Act of 1986 reduced personal income tax rates so that they were below the corporate income tax rate and at the same time made the personal capital gains tax rate equal to the rate on dividend income. The end result is that the Tax Reform Act of 1986 provided firms with a tax inducement to finance their investments with debt. To include taxes in the financing decisions of firms, a corporate income tax rate variable (i.e., the change in the ratio of reported tax liabilities to taxable income of nonfinancial corporations indicated by \( \Delta t \)) is incorporated into the regressions presented in Panel A of Table 3. The sign of the estimated coefficient on the tax rate variable \( \Delta t \) is predicted to be positive in that the higher (or lower) corporate income tax rate the greater (or smaller) the tax incentive to issue debt, holding personal tax rates and nontax factors constant. In addition the dummy variable DV86 is included in the financial leverage regressions presented in Panel B of Table 3 to account for the tax regime changes that accompanied the Tax Reform Act of 1986.

depreciation charges, the CPI index, and real GDP). The next step is to collect the residuals from the auxiliary regression and include them as regressors in the financial leverage regressions in Table 3. If the estimated coefficients on these residuals are zero, we can reject the hypothesis that \( \Delta \text{Inv} \) and \( \Delta \text{Inv} + \text{P&E} \) are endogenous variables in the financial leverage regressions. With these exogenous variables and instruments the results of the Hausman test for endogeneity are

\[
\begin{align*}
(\text{i}) & \quad \Delta \left( \frac{\Delta \text{Inv}}{\text{A}} \right) \\
& = 0.001 - 0.008 \Delta \text{Inv} + 0.593 \Delta \left( \frac{\Delta \text{Inv}}{\text{A}} \right)_{t-1} - 0.042 \text{DV36} + 0.006 \text{DV86} - 0.006 \text{(Residuals)} \\
& \quad \text{(0.85/0.35)} \quad \text{(-3.26/0.00)} \quad \text{(6.37/0.00)} \quad \text{(-29.90/0.00)} \quad \text{(2.00/0.05)} \quad \text{(-1.03/0.30)} \\
(\text{1900 - 2002})
\end{align*}
\]

\[
\begin{align*}
(\text{ii}) & \quad \Delta \left( \frac{\Delta \text{Inv} + \text{P&E}}{\text{A}} \right) \\
& = 0.002 - 0.002 \Delta \text{Inv} + 0.605 \Delta \left( \frac{\Delta \text{Inv}}{\text{A}} \right)_{t-1} - 0.044 \text{DV36} + 0.011 \text{DV86} - 0.002 \text{(Residuals)} \\
& \quad \text{(1.36/0.18)} \quad \text{(-2.50/0.01)} \quad \text{(5.98/0.00)} \quad \text{(-37.38/0.00)} \quad \text{(10.74/0.00)} \quad \text{(-0.93/0.36)} \\
& \quad \text{1946 - 2002}
\end{align*}
\]

\[
\begin{align*}
(\text{iii}) & \quad \Delta \left( \frac{\Delta \text{Inv}}{\text{A}} \right) \\
& = 0.001 - 0.006 \Delta \text{Inv} + 0.458 \Delta \left( \frac{\Delta \text{Inv}}{\text{A}} \right)_{t-1} + 0.001 \text{DV86} - 0.001 \text{(Residuals)} \\
& \quad \text{(1.92/0.06)} \quad \text{(-2.78/0.01)} \quad \text{(4.36/0.00)} \quad \text{(7.29/0.00)} \quad \text{(-0.02/0.98)} \\
& \quad \text{1900 - 2002}
\end{align*}
\]

\[
\begin{align*}
(\text{iv}) & \quad \Delta \left( \frac{\Delta \text{Inv} + \text{P&E}}{\text{A}} \right) \\
& = 0.002 - 0.002 \Delta \text{Inv} + 0.427 \Delta \left( \frac{\Delta \text{Inv}}{\text{A}} \right)_{t-1} + 0.011 \text{DV86} + 0.010 \text{(Residuals)} \\
& \quad \text{(2.72/0.01)} \quad \text{(-2.05/0.05)} \quad \text{(4.42/0.00)} \quad \text{(18.88/0.00)} \quad \text{(0.47/0.64)} \\
\end{align*}
\]

In all four cases, over the two different sample time periods the estimated coefficient on the regressor (Residuals) is not significantly different from zero and therefore we cannot reject the hypothesis that OLS parameter estimates are consistent and efficient.
The results for these tax adjustments are presented in Panel B of Table 3 for the sample time period, 1946–2002.

In the table, $\Delta(LT \text{ Liab}/A)$ is regressed on the nontax factors of $\Delta(\text{Inv})$, $\Delta(\text{Inv} + \text{P&E})$, $\Delta(LT \text{ Liab}/A)_{-1}$, and DV74 just as they were in regressions 3I1 and 3I2 in Table 3. To these nontax operating risk factors, we now add the tax factors of $\Delta t$ (or $t$ in unreported regressions) and DV86. As can be seen the estimated coefficient on $\Delta t$ is positive in 3II1 and 3II2 although none of the estimated coefficients on $\Delta t$ are statistically significant. Moreover, the estimated coefficients on DV86 (not shown in the table) are both positive and statistically significant at the 0.01 level. The Tax Reform Act of 1986 had an effect on the financial policies of nonfinancial corporations over and above the operating risk variables emphasized in this study. Nevertheless, it is the case that the estimated coefficients on $\Delta(\text{Inv})$ and $\Delta(\text{Inv} + \text{P&E})$ in the table are roughly the same as those in 3I1 and 3I2 in Panel A of Table 3. The evidence from Table 3 suggests that including changes in time-varying effective corporate tax rates in the financial adjustment regressions for the second part of the sample time period had very little effect on the estimated coefficients of the operating risk variables. The estimated coefficients on $\Delta(\text{Inv})$ and $\Delta(\text{Inv} + \text{P&E})$ are negative and essentially the same in Panel B of Table 3 as they were in Panel A. While the estimated coefficient on the tax rate variable $\Delta t$ was positive, it was never significantly different from zero. On the other hand, the Tax Reform Act of 1986 had an impact on the financial decisions of U.S. nonfinancial enterprises in 1986. This legislation made corporate tax rates higher than personal tax rates, thereby providing a tax motivation for corporations to increase their financial leverage. Finally, unreported CUSUM plots of the recursive residuals again indicate we cannot reject the hypothesis of estimated parameter stability over the shorter sample period 1946–2002.

The regression results from Table 3 are supportive of the hypothesis advanced in Section 1, namely, U.S. nonfinancial corporations over the twentieth century used financial leverage to offset changes in operational risk resulting from changes in their production-investment decisions. Firms sell risk and return in the market place. In risky cyclical expansions, firm returns are redistributed toward stockholders. However, a rational bond contract requires stockholders to exercise their call option and reinvest these transitory high returns in the firm, thereby reducing financial leverage and financial risk. In recessions, returns are redistributed toward bondholders. In this case, a rational bond contract allows the stockholders to let their call option expire and withdraw their investment in the firm, thereby increasing financial leverage and financial risk. When risks and return are distributed in this way debt and equity securities are rational contract forms for gathering capital resources for the firm.

4. SUMMARY AND CONCLUSIONS

This paper describes the interaction of the financial side and real side of a market economy with a model of the balance sheet adjustments for debt- and equity-financed enterprises. These balance sheet adjustments are implemented with the investment
decisions and financing decisions of firm managers in a way that both causes business cycles and coalesces the welfare of bondholders and stockholders over the business cycle. Suppliers of financial capital to firms are heterogeneous in terms of their risk aversion and/or risk perceptions. The more risk wary and sensitive investors concentrate their holdings in bonds while the less risk sensitive investors focus on equity. The heterogeneity in the risk aversion and/or risk perception of the two groups of investors creates a classic conflict of interest problem over the future management of the firm. This conflict of interest problem is resolved with an up-front bond contract with covenants that constrain managers to manage the firm in the joint interest of their bondholders and stockholders. Asset adjustments are made to conform to the risk assessment and/or the risk aversion of the firm’s shareholders. Contract-induced financing adjustments are then made to insulate the market valuation of the firm’s bonds from any change in operating risk caused by the asset adjustment decisions. Under this regime of shared decision making, contract-constrained managers acting for bondholders can always offset any change in operating risk initiated by the investment decisions with an appropriately matched financing adjustment. The framework can also describe the balance sheet adjustments of banks and the underlying rationale of the Basle Accord of risk-based capital requirements (Krainer 2009). Both old and new versions of the Basle Accord require banks to adjust their financing in response to changes in the risk of their portfolio strategy. The riskier their portfolio, the more tier 1 equity capital is required. Supply adjustments of firms in this economy are linked to the investment decisions of firms via a return-generating function that is diminishing in expected returns and increasing in risk. This implies that business cycle expansions are characterized by diminishing expected returns on capital investment and relatively high operating risk, while recessions are characterized by the reverse. Empirical evidence on the cyclical movement of the Sharpe ratio and risk premium is consistent with the return-generating process assumed in this model.

There are a number of financial predictions that follow from the balance sheet adjustment model presented in Section 1. One is that changes in the capital market valuations of firms precede changes in the level and structure of firm assets. This prediction is not unique to my model but is shared by all capital-budgeting based models of corporate investment. What is unique is that from the theoretical perspective this relationship is described as a covenant constrained arbitrage between the capital market and the market for productive resources. The contribution from the statistical perspective is that the best capital market signal was obtained when \( Q \) was split into both a debt \( Q \) and an equity \( Q \) as suggested by the model in Section 1. Tables 1 and 2 provide some evidence that changing capital market valuations of firm securities signal changes in the tangible investments of U.S. nonfinancial enterprises over the twentieth century. Table 2 also indicates that including cash flow variables in these tangible investment regressions does not materially change the empirical results. These tangible investments must be financed. How they are financed in the model of Section 1 depends on the amount of operating risk (or portfolio risk in the case of banks) they generate. An expansion (or contraction) in tangible assets causes an expansion (or contraction) in economic activity but at the cost of an increase (or
decrease) in operating risk according to the return generating process in equation (12). To protect bondholders, expansions (or contractions) in tangible assets are financed with equity (or debt). This implies that marginal adjustments in financial leverage are countercyclical and negatively correlated to risky tangible investments. Tables 1 and 3 provide some suggestive evidence supporting this prediction. Over the past 100 years financial adjustments on average have seemingly been linked to the risk characteristics of the asset adjustments for nonfinancial enterprises. Taking tax considerations into account does not change the empirical support for this financing prediction. The countercyclical movement of financial leverage matched to corporate investment seems to be a stylized fact of U.S. business cycles in the twentieth century. This financing pattern along with the procyclical movement of corporate investment rationalizes the existence of debt- and equity-financed firms. Nevertheless, my first pass at the evidence cannot be regarded as definitive. More empirical work must be done. Empirical work at the level of the individual firm would be a welcome addition in testing the predictions of the model as would a finer partition of the data to capture the temporal sequencing described in the model. I hope to continue these paths in future research.

APPENDIX: DATA SOURCES

I begin with a description of the capital market variables used in this study, which according to the theory provide the market signal for a change in the operating strategy of nonfinancial enterprises.

\[ NWQ = \frac{N(s)P(s)}{K(s)} = 1.0 \]  

This was defined to be the equilibrium condition in the stock market. Data from Wright (2002).

\[ LTLiabQ = \frac{N(d)P(d)}{K(d)} = 1.0 \]  

This was defined to be the equilibrium condition in the bond market. Data from Wright (2002).

\[ Q^{bea} = \frac{N(d)P(d)}{K(d)} \]  

This was defined to be the equilibrium condition in the bond market. Data from Wright (2002).
the real stock of land remained constant and the value of land was only adjusted by changes in real estate prices. The BEA measures land as a fixed proportion of total tangible assets. For a detailed description of these differences, see Wright (2002, pp. 28–30). We use the BEA valuation in all measures of tangible assets since it is compatible with earlier measures of assets. Data from Wright (2002).

\[ SP = \text{The real market value of equity in the nonfinancial corporate sector.} \]

Nominal market valuations were deflated by the consumer price index. Data from Wright (2002).

The next set of variables represent the measures for a change in the operating strategy (which in turn is induced by the previously described capital market valuations) of nonfinancial enterprises. I proxy changes in operating strategy with changes in real inventories, and the sum of the change in real inventories and the change in real plant and equipment. Inventories are the most volatile component of total assets of nonfinancial corporations as measured by the coefficient of variation. I also use a measure of investment that includes plant and equipment since this category of assets is the vehicle by which new but risky technologies are introduced into the firm. The specific measures of corporate investments are as follows:

\[ \text{Inv} = \text{The replacement cost of inventories in the nonfinancial corporate sector, deflated by the U.S. consumer price index. For a description of the estimation procedure used for this variable, see the Survey of Current Business, October 2002, p. 27. Data from Wright (2002).} \]

\[ (\text{Inv} + \text{P&E}) = \text{The replacement cost of inventories and plant and equipment in the nonfinancial corporate sector deflated by the U.S. consumer price index. For a description of the estimation procedures used for this variable, see “Fixed Reproducible Tangible Wealth in the United States, 1925–94,” BEA, U.S. Department of Commerce, August 1999. This article is available on the BEA website, www.bea.gov under Methodologies. Data from Wright (2002).} \]

For the proxy measure of the matching financial strategy, I use the following definition of long-term financial leverage:

\[ (\text{LTLiab/NetWorth}) = \text{The ratio of long-term liabilities to the economic book value of net worth. Data from Wright (2002).} \]

\[ (\text{LTLiab}/A) = \text{The ratio of long-term liabilities to the economic book value of total assets. Data from Wright (2002).} \]

Other variables used in the empirical work presented below are:

\[ \text{GDP} = \text{The percentage rate of growth in real GDP generated by nonfinancial corporations. Data from Wright (2002).} \]

\[ t = \text{The corporate profits tax rate for nonfinancial corporations. This tax rate is computed as the ratio of reported profit tax liabilities of nonfinancial corporations (line 29), to profits before taxes (line 28) of nonfinancial} \]
corporations. These data come from table 1.16 of the National Income and Product Account Tables and were obtained from the BEA website, www.bea.gov.

\[ CF = \text{Real cash flow defined as the sum of undistributed profits and depreciation charges for nonfinancial corporations deflated by the U.S. consumer price index. The depreciation charges and undistributed profits come from lines, 20 and 32 of table 1.16 of the National Income and Product Accounts and were obtained from the BEA website, www.bea.gov} \]

**LITERATURE CITED**


